



Determination of Physico-chemical Properties in Soil Samples of Prayagraj (Allahabad) District, Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Physico-chemical properties of soils from different land use systems viz. agriculture, olericulture, horticulture etc in Prayagraj (Allahabad) Uttar Pradesh were analyzed in 2018-19. Samples were collected from 4 different sites of Allahabad district viz., ECC gaughat, Jhunsi, Karchhana & Subedarganj having distance between them of at least 4 kms. Some soils samples had higher water holding capacity & value of organic carbon. They have average value of pH and EC as compared to the cultivated soils. Potassium was found to be of low content in soil samples. Physical properties and parameters for all soils were average or medium whereas as variation in chemical properties were observed.

Keywords: *Physical properties; chemical properties; Allahabad district; soil; physico-chemical; prayagraj.*

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1. INTRODUCTION

Soil is a dynamic, 3-dimensional natural body of the landscape developed from the weathering of rocks through various pedogenic processes, consisting of mineral & organic constituents [1-3], processing a definite set of physical, chemical and biological properties, having a variable depth covering the surface of earth & providing a medium for growth of the terrestrial plant [4-9].

2. MATERIALS AND METHOD

Soil samples, all laboratory chemical reagents, apparatus etc. were used for physical and chemical analysis of soil samples. Soil samples were collected from four regions (Atleast 4 km Apart from each other as suggested) namely ECC Chemistry Dept. (Gaughat), Jhunsi, Karchhana & Subedarganj Allahabad. Chemicals were used from UG & PG LABS of SHUATS University. Soil samples were dried, powdered and sieved. Then these samples were taken for analysis of physical parameters viz. Bulk density, particle density, pore size, water retaining capacity, specific gravity etc. The samples were also analyzed for chemical parameters like pH, electrical conductivity, percentage organic carbon and potassium content.

2.1 Sampling and Analysis- Location & Date of Samples

Sample 1 was taken from Chemistry Department, ECC dated 09-04-2019 with Latitude-25°25'40" North & Longitude 81°50' 41"East, Sample 2 was taken from Havelia, Jhunsi dated 10-04-2019 with Latitude 25°25' 15"North & Longitude 81°54' 31"East, Sample 3 was taken from Rajrooppur Subedarganj dated 10-04-2019 with Latitude 25°26' 18"North & Longitude 81°47' 20"East, Sample 4 was taken from Rampur Karchhana dated 09-04-2019 with Latitude 25°19' 04"North & Longitude 81°55'43"East. All samples were collected from a depth of furrow slice layer. With respect to Climatic conditions of Allahabad, on 9th and 10th april 2019, all four samples were collected having dry hot weather conditions with a lit bit of temperature up to 36°C. We have worked on physical & chemical properties of the respective soil samples collected and before proceeding to experimental processes and data, we must see in general some basic properties as classified further. Physical properties of soil include Particle density, Bulk density, Percent pore space, Specific gravity, Soil color, Water

retaining capacity, etc. Whereas Chemical properties involve pH of soil, Electrical conductivity (EC), Percentage organic carbon, Potassium Estimation, etc.

3. RESULTS AND DISCUSSION

Certain number of experiments regarding physico-chemical properties of soil samples from all 4 sites of Allahabad was analyzed. (Note- Due to certain limitations and sensitivity of apparatus and methods used, some experimental values came to be same for some samples). The experiments performed had given data regarding soil properties and the following are the results about the whole experimental findings with respect to the physical and chemical properties of all four samples. Starting with physical properties, Bulk density of sample 1 & 2 was found to be 1.17 Mg m⁻³ and 1.05 Mg m⁻³ for sample 3 & 4. Particle density was 2.85 Mg m⁻³ for sample 1, 2.50 Mg m⁻³ for sample 2, 2.85 Mg m⁻³ for sample 3 & 4 as represented in Fig. 1. Percentage pore space of sample 1 was found to be 58.82%, 45% for sample 2 and 52.63% for sample 3 & 4. Whereas Percentage solid space was 41.18% for sample 1, 55% for sample 2 and 47.37% for sample 3 & 4 as represented in Fig.2. Values of Bulk density, Particle density, % pore space & % solid space was coming under average values. Water retaining capacity value was 45.71% for sample 1, 52.94% for sample 2, 57.14% was sample 3 & 66.66% for sample 4 as represented in Fig. 3. Sample 4 has the highest value of water retaining capacity among all the 4 samples. Specific gravity was found to be 2.25 for sample 1, 3.31 for sample 2, 3.10 for sample 3 & 2.43 for sample 4 as represented in Fig.4. By using Munsell color chart [10], soil color was recognized in both dry & wet conditions. Sample 1 was having 10 Yr 5/3 brown & 10 Yr 3/3 dark brown color, sample 2 was having 10 YR 6/6 Brownish Yellow & 10 YR 4/4 Dark yellowish brown color, sample 3 was having 10 YR 6/4 Light Yellowish Brown & 10 YR 5/4 Yellowish Brown color, sample 4 was having 10 YR 6/3 Pale Brown & 10 YR 4/2 Dark Greyish Brown color in dry and wet conditions respectively, as shown in Table 1. Now discussing about the chemical properties, pH (measured in pH meter by Globe Scientific Instruments Model 015-G) was 7.35 for sample 1, 7.78 for sample 2, 8.12 for sample 3 & 7.93 for sample 4 as shown in Fig. 5. Its interpretation can be drawn as sample 1 as free lime soil and sample 2, 3 & 4 as alkali soil. Electrical conductivity (EC) (measured in Conductometer by Globe Scientific Instruments

Model 061-G) was 0.484 dS m^{-1} for sample 1, 0.529 dS m^{-1} for sample 2, 0.540 dS m^{-1} for sample 3 & 0.482 dS m^{-1} for sample 4 as shown in Fig. 6. These values of Electrical conductivity fall within the Normal range. Percentage organic carbon was found to be 1.29% for sample 1, 1.14% for sample 2, 0.84% for sample 3 & 1.51% for sample 4 as shown in Fig. 7. Here sample 3 was having medium range of organic carbon value whereas sample 1, 2 & 4 were having

higher & significant values of organic carbon in soil. Value of Potassium (K) was found to be 33ppm for sample 1, 95ppm for sample 2, 28ppm for sample 3 and 160ppm for sample 4 in soil samples as shown in Fig. 8. Potassium content was low & non-significant in sample 1,2 & 3 whereas sample 4 contained significant and medium value of potassium content. These experimental data are as shown below in the form of charts and tables.

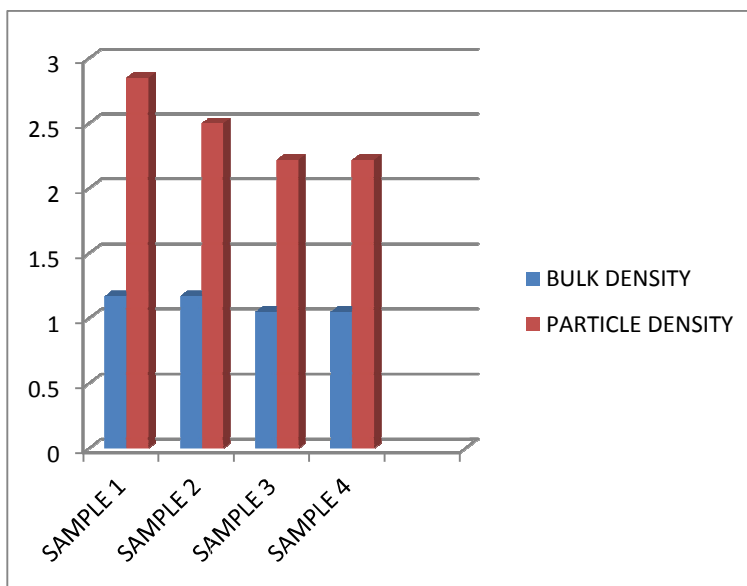


Fig. 1. Bulk density (Mg m^{-3}) & Particle density (Mg m^{-3}) of soil samples

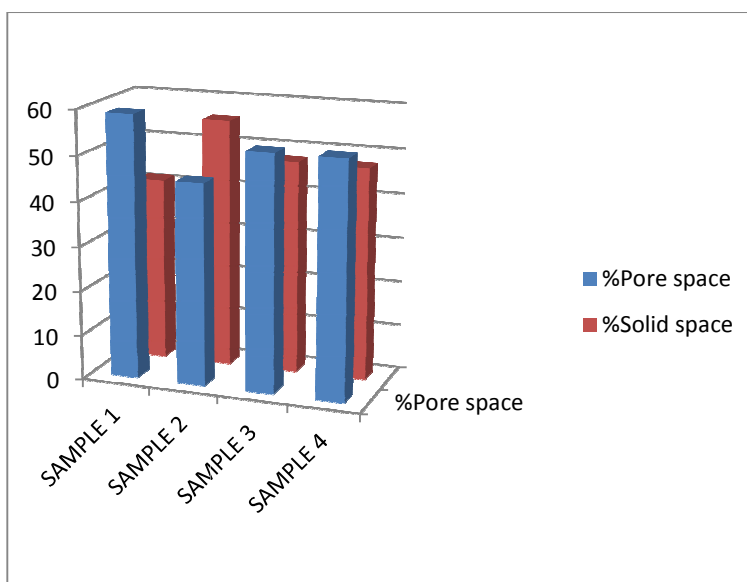


Fig. 2. % Pore space & %Solid space of soil samples

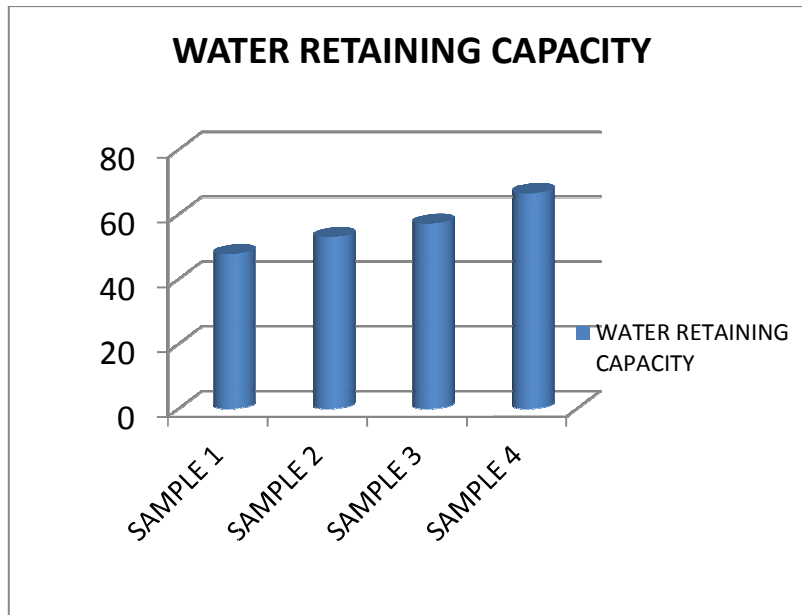


Fig. 3. Water retaining capacity (%) of soil samples

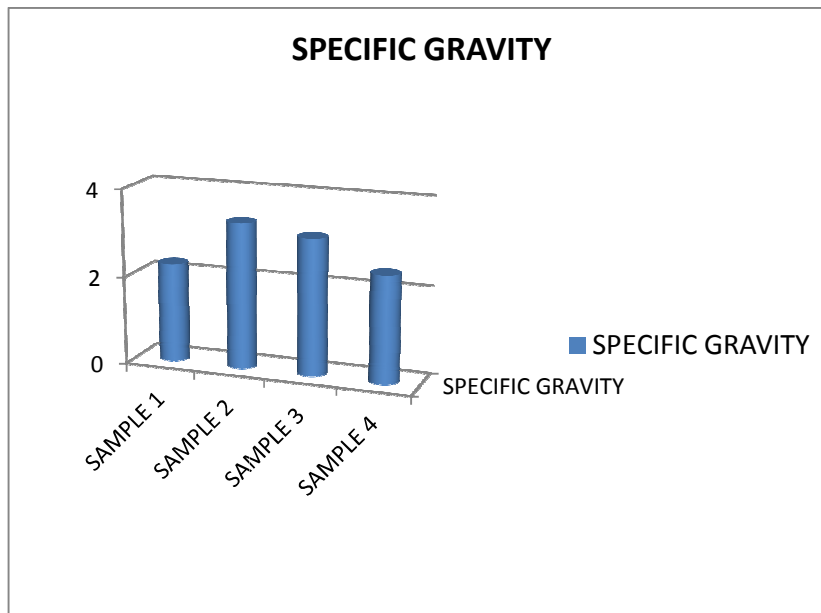


Fig. 4. Specific gravity (Unitless) of soil sample

Table 1. Soil color of soil samples (Munsell color chart)

S.No.	Soil color in dry condition	Soil color in wet condition
Sample 1	10 YR 5/3 Brown	10 YR 3/3 Dark Brown
Sample 2	10 YR 6/6 Brownish Yellow	10 YR 4/4 Dark Yellowish Brown
Sample 3	10 YR 6/4 Light Yellowish Brown	10 YR 5/4 Yellowish Brown
Sample 4	10 YR 6/3 Pale Brown	10 YR 4/2 Dark Greyish Brown

Note: 10YR 5/3 indicates the hue, value and chroma of the soil. The hue is 10YR, value is 5/ and chroma is /3

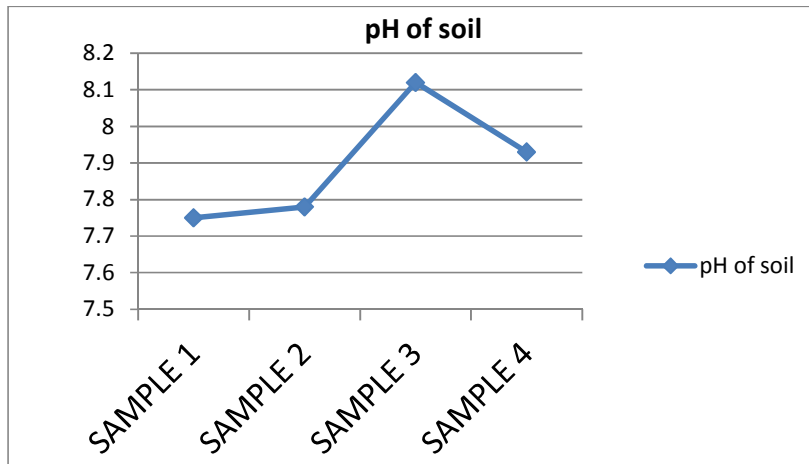


Fig. 5. pH of soil samples

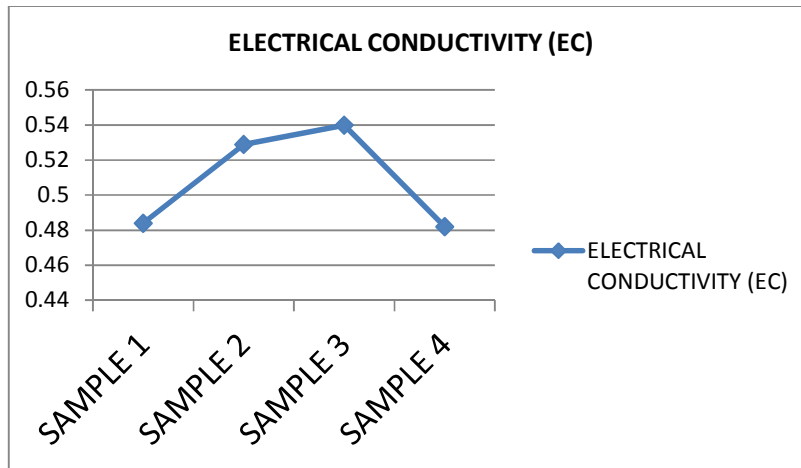


Fig. 6. Electrical conductivity ($d Sm^{-1}$) of soil samples

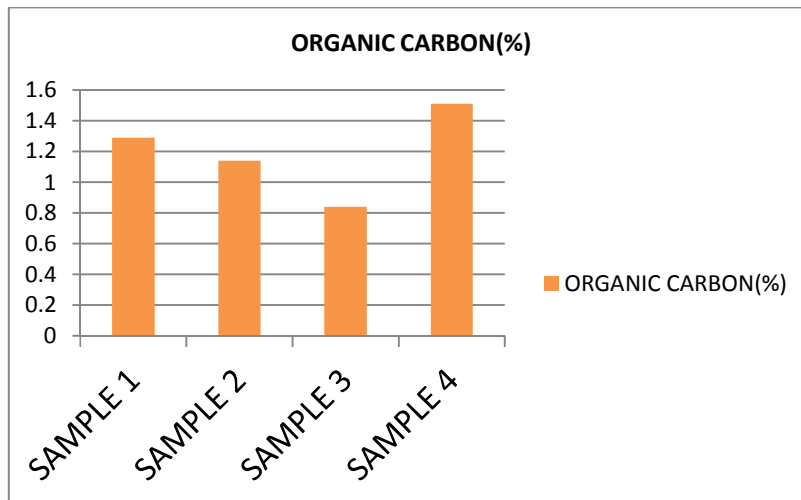


Fig. 7. Organic carbon % in soil samples

Table 2. Overall data table

S.No.	Sample 1	Sample 2	Sample 3	Sample 4
Bulk density (Mg m^{-3})	1.17 Mg m^{-3}	1.17 Mg m^{-3}	1.05 Mg m^{-3}	1.05 Mg m^{-3}
Particle density (Mg m^{-3})	2.85 Mg m^{-3}	2.50 Mg m^{-3}	2.22 Mg m^{-3}	2.22 Mg m^{-3}
% Pore space	58.82%	45.00%	52.63%	52.63%
% Solid Space	41.18%	55.00%	47.37%	47.37%
Water retaining capacity	45.71%	52.94%	57.14%	66.66%
Specific Gravity	2.25	3.31	3.10	2.43
Soil color in dry condition	10 YR 5/3 Brown	10 YR 6/6 Brownish Yellow	10 YR 6/4 Light Yellowish Brown	10 YR 6/3Pale Brown
Soil color in wet condition	10 YR 3/3 Dark Brown	10 YR 4/4 Dark Yellowish Brown	10 YR 5/4 Yellowish Brown	10 YR 4/2 Dark Greyish Brown
pH of soil	7.35	7.78	8.12	7.93
Electrical conductivity (EC) in dS m^{-1}	0.484	0.529	0.540	0.482
% Organic Carbon	1.29%	1.14%	0.84%	1.51%
Potassium (K) (ppm)	33	95	28	160

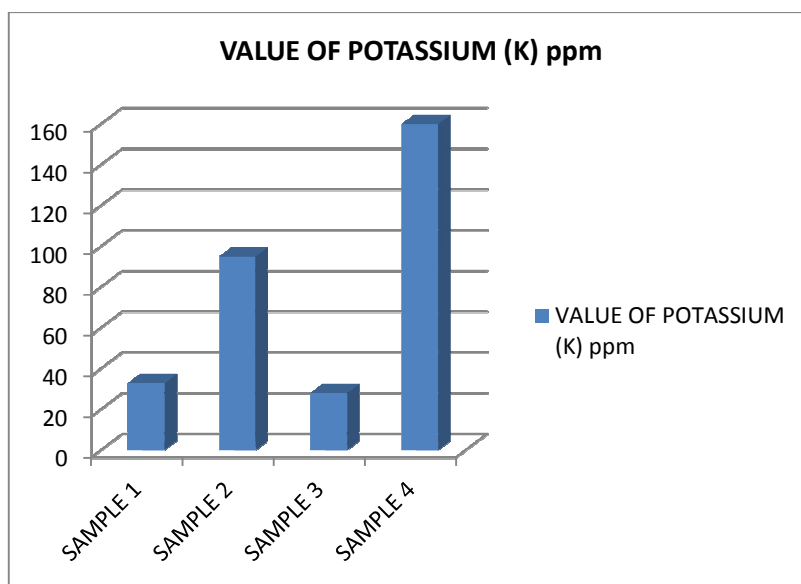


Fig. 8. Value of available Potassium (K) in soil samples

4. CONCLUSION

Above data shows that the physical properties like Bulk density, Particle density, Percentage pore space, Percent solid space, Water retaining capacity, Specific gravity & soil color fall within normal range of parameters. Whereas pH value of soil samples shows that most of them are alkali in nature. EC is of average range & percent organic carbon content is of high value than average of maximum of samples. Potassium content is found to be of low value in all samples except sample4.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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