

ASSESSMENT OF PHYSICAL PROPERTIES OF SOILS FROM DIFFERENT VILLAGES OF OSMANABAD DISTRICT, MAHARASHTRA, INDIA

Abstract:

The study was carried out with the objective of analysing the physical properties for determining depth wise nutrient distribution and variation from three different villages of Osmanabad district, Maharashtra. The twenty-seven soil samples were collected from three different villages on different depth that is 0-15 cm, 15-30 cm and 30-45 cm of farmer's fields.

The colour of the soil sample in dry condition varies at different depths from dark yellowish brown to very dark brown and in wet condition it varies from very dark brown to black. The results revealed that the texture of soil was clay found in all the three respective depths. The Bulk density of different depths varied from 1.17 to 1.21 Mg m⁻³, Particle density from 2.46 to 2.53 Mg m⁻³, Percent Pore Space from 40.88% to 48.40 %, Water Holding Capacity from 42.02% to 45.00 %. To maintain fertility of soil, farmers have to test their soils to obtain higher crop yield.

Keywords: Physical Properties, Osmanabad District, Black cotton soil, WHC

Introduction:

“The word soil represents one of the most active and complex natural systems on the earth's surface. It is essential for the existence of many forms of life and provides medium for plant's growth and also supplies the organisms with most of their nutritional requirements” (Tewari *et al.*,2016). Soil is a natural body consisting of layers (soil horizons) of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical, and mineralogical characteristics.

“It is composed of particles of broken rock that have been altered by chemical and environmental processes that include weathering and erosion. Soil differs from its parent rock due to interactions between the lithosphere, hydrosphere, atmosphere, and the biosphere. The soil is a complex organization being made up of some six constituents namely inorganic matter, organic matter, soil organisms, soil moisture, soil solution and soil air” (Nisha *et al.*,2017).

“The physical and chemical characteristics of soil play a big role in the plant’s ability to extract water and nutrients. Soil is that the product of biochemical weathering of the parent material and its formation is influenced by the soil formation factors like climate, organism, parent material, relief, and time” (Belwal and Mehta, 2014). “The physical properties of the soil depend upon the amount, shape structure, size, pore spaces, organic matter, and mineral composition of the soil. The chemical property of soil is the interaction of different chemical constituents between soil particles and solutions”. [13]

The physical properties are Bulk Density (Mg m^{-3}), Particle Density (Mg m^{-3}), Pore space (%), Water Holding Capacity (%), Soil Colour, Soil Texture. All soil properties differ and working with them needs an understanding of these properties. The knowledge about the physical and chemical properties helps in managing the resources while working with a particular soil. This study aimed to examine the structural status of soils in the different villages of Osmanabad district, Maharashtra. The aim is to set appropriate guidelines for sustainable productivity for better utilization and management of the soil for particular land use.

Materials and Methods:

Site Details:

Osmanabad is a district of Maharashtra and is located between 18.2070°N and 76.1784°E . The district has an area of $7,569 \text{ km}^2$ (District book, 2023). The entire study area divided into three villages i.e., Upla (Village1), Alani (Village2), Javla (Village 3) of a Osmanabad District. From each village three plots were selected like Plot 1, Plot 2, Plot 3.

Soil and climate

In Maharashtra, ‘Residual’ is the status of Soil and is derived from the underlying basalts. It composes the black soil, which is present in large amount in the Maharashtra. This type of soil is clayey, retains moisture and is rich in humus. The soil is commonly known as 'black cotton soil' or 'regur'. Osmanabad district lies in the southern part of Maharashtra. Osmanabad’s weather is dry and arid during summer months followed by humid climate in the rainy season and moderate to cool in winter months.

Soil sampling and analysis

Soil samples were collected from the three different villages of Osmanabad district, Maharashtra. Three plots are selected for sampling from each village. Samples are taken from three depths i.e 0-15 cm, 15-30 cm, 30-45cm totally 27 soil samples were collected with the help of spade/garden hoe and khurpi. The sample was collected by cutting a V-shaped slice of

the proper depth of about 15-20 cm then the samples were dried in shade and large clods were broken using wooden mallet. Using 2 mm sieve the powdered soils were sieved and were collected in a polythene bag and was labelled properly for laboratory analysis.

The collected samples were analysed for physical parameters. Soils were analyzed for its textural class by Bouyoucos hydrometer method (Bouyoucos, 1927), soil colour by using Munsell soil colour chart (Albert H. Munsell, 1954), bulk density and particle density was determined by graduated measuring cylinder method (Muthuvel *et al.*, 1992) and Water Holding Capacity by keen's cup method (Muthuvel *et al.*, 1992).

Result and discussion

Physical Properties

1. Soil colour

The colour of the soil sample in dry condition varies at different depths from dark yellowish brown (10YR, 3/2) to very dark brown (10YR,2/1) and in wet conditions; it also varies different depths from very dark brown (10YR, 2/2) to black (10YR,2/1). The similar research was also done by Kumar *et al.*, (2018).

2. Soil texture

The soil texture was clay found in all the three respective depths. The sand, silt and clay percent ranges from 10% - 12%, 15% - 20%, 70% - 75% respectively. A similar result analysis was reported by Patel *et al.*, (2017).

3. Bulk Density

The bulk density increases with the increase in soil depth. The bulk density decreased due to high organic matter content or vice versa. The mean bulk density of different depths varied from 1.17 to 1.21 Mg m⁻³. The similar analysis was done by Bhuyan *et al.*, (2013).

4. Particle Density

Particle density varies according to the mineral content of soil particles. According to the farmer's field, the mean particle density of different depths of soil varied from 2.46 to 2.53 Mg m⁻³. The similar analysis was done by Kumar *et al.*, (2018).

5. Pore Space (%)

“Soil containing high organic matter possesses high porosity. The percent pore space decreases with an increase in the depth of soil. The Percent Pore Space of different soil depths varied from 40.88% to 48.40%”. [13] Similar result was reported by Choudhary *et al.*, (2020).

6. Water Holding Capacity

“The water-retaining capacity of different soil depths varied from 36.77% to 42.00 %. These variations were due to clay, silt, and organic carbon content. The WHC increased with an increase in the clay content at the sites and decreases with an increase in the depth of soil”. [13]The similar analysis was reported by Sahu *et al.*, (2014) and Sharma *et al.*, (2010).

Table 1: Bulk density and Particle density (Mg m^{-3}) of soil in different villages of Osmanabad district at 0-15 cm, 15-30 cm, 30-45 cm depths.

Villages	Bulk Density (Mg m^{-3})			Particle Density (Mg m^{-3})		
	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm
Upla (V₁)						
F1	1.15	1.19	1.19	2.41	2.47	2.50
F2	1.15	1.17	1.21	2.44	2.48	2.48
F3	1.17	1.19	1.20	2.46	2.46	2.50
Alani (V₂)						
F1	1.17	1.21	1.24	2.49	2.49	2.51
F2	1.19	1.21	1.23	2.49	2.53	2.53
F3	1.18	1.19	1.21	2.46	2.47	2.50
Javla (V₃)						
F1	1.16	1.16	1.19	2.49	2.47	2.49
F2	1.18	1.19	1.23	2.50	2.49	2.52
F3	1.17	1.17	1.21	2.47	2.49	2.50
	F-test	S.Em (\pm)	C.D@5%	F-test	S.Em (\pm)	C.D@5%
Depth(0-15cm)	NS	0.20	-	NS	0.04	-
Depth(15-30cm)	NS	0.016	-	NS	0.03	-
Depth(30-45cm)	NS	0.016	-	NS	0.03	-

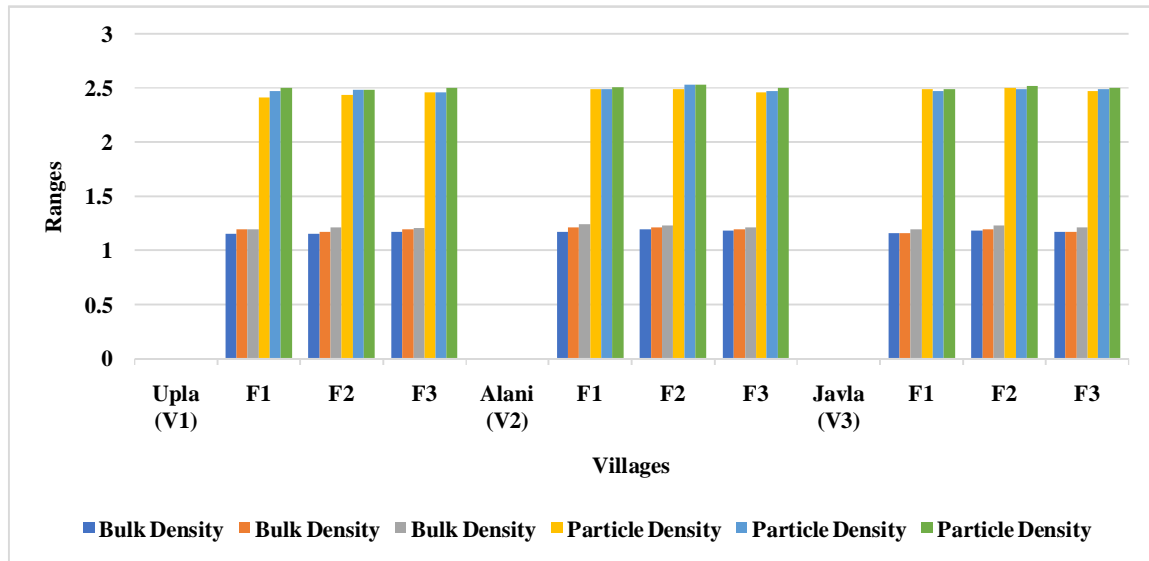


Fig 1: Bulk density and Particle density (Mg m^{-3}) of soil in different villages of Osmanabad district at 0-15 cm, 15-30 cm, 30-45 cm depths.

Table 2: Pore Space and Water Holding Capacity of soil in different villages of Osmanabad district at 0-15cm, 15-30cm, 30-45cm depths.

Villages	Pore Space (%)			Water Holding Capacity (%)		
	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm
Upla (V1)						
F1	47.40	47.05	46.80	44.10	43.89	43.56
F2	43.12	43.01	42.37	43.98	43.36	42.92
F3	47.96	46.36	45.93	43.88	43.01	42.86
Alani (V2)						
F1	48.36	47.93	46.86	43.78	42.62	42.02
F2	43.20	41.71	40.10	44.00	43.87	43.52
F3	49.36	48.98	48.36	44.89	44.07	43.96
Javla (V3)						
F1	46.13	45.27	43.26	45.00	44.84	44.10
F2	43.20	41.71	40.10	44.36	44.08	43.66
F3	42.39	40.70	40.10	43.38	43.01	42.78

	F-test	S.Em (±)	C.D@5%	F-test	S.Em (±)	C.D@5%
Depth(0-15cm)	S	0.69	2.01	NS	0.50	-
Depth(15-30cm)	S	0.78	2.32	NS	0.52	-
Depth(30-45cm)	S	0.59	1.77	NS	0.57	-

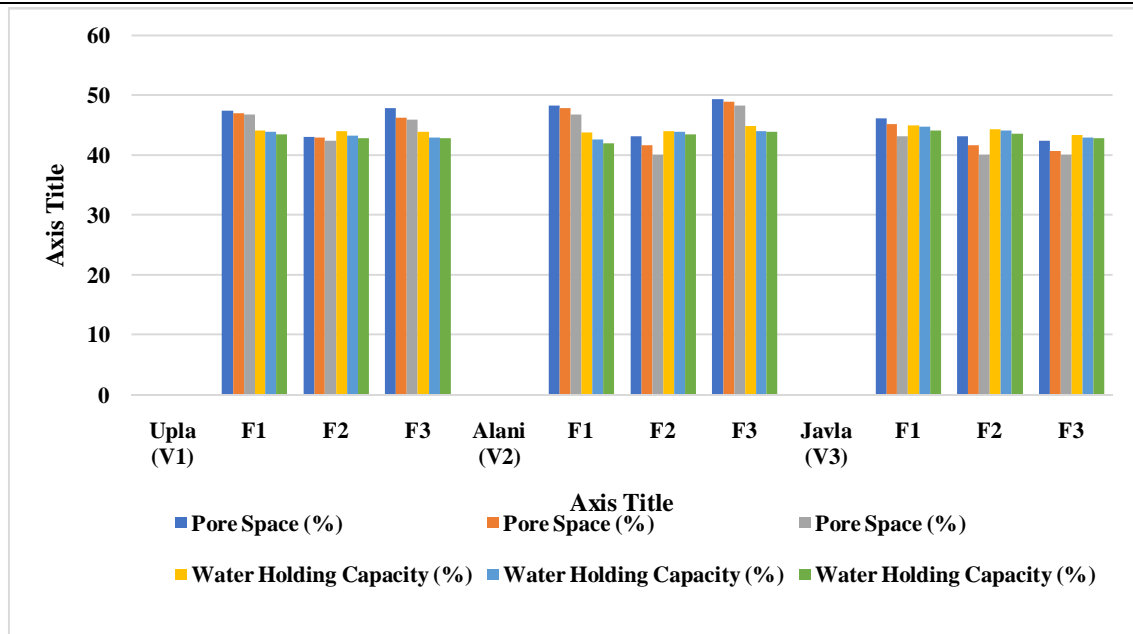


Fig 2: Pore Space and Water Holding Capacity (%) of soil in different villages of Osmanabad district at 0-15cm, 15-30cm, 30-45cm depths.

Conclusion

It can be concluded that the soils of different villages of Osmanabad district have a good physical condition which favours the cultivation of most of crops. The colour of soils slightly differs from dark brown to black. The soil texture showed high clay percentage therefore the water holding capacity of soil is also high. The bulk density of these soils was found high. Because of the high fertility, good physical properties and retentivity of moisture the black soil is widely used for producing several important crops like cotton, wheat, jowar, linseed, castor, sunflower and millets.

Acknowledgement

The authors would like to avail this opportunity to thank to the Hon'ble Vice Chancellor, HoD of the Department of Soil Science and Agricultural Chemistry, Sam Higginbottom

University of Agriculture, Technology and Sciences, Prayagraj, U.P. for providing necessary support and desired equipment's for this research work.

Conflict of Interest

As a Corresponding Author, I Padwal Snehal Sudhakar, confirm that none of the others have any conflicts of interests associated with this publication.

References

1. **Belwal, M. and Mehta, S.P.S. (2014)** Physico-Chemical Properties of the main soil types of Ranikhet region of Kumaun (Uttarakhand). *Journal of Chemical and Pharmaceutical Research*, **6**(4): 682-688.
2. **Bhuyan S.I., Tripathi, O.P. and Khan, M.L. (2013)** Soil characteristics, dynamic of microbial biomass: a study of hill agro-ecosystem, Eastern Himalaya, India. *International Journal of Current Science*, **12**: 79-86.
3. **Bouyoucos, G.J. (1927)** The Hydrometer as a new method for the mechanical analysis of soil. *Soil Science*, **23**: 343-353.
4. **Choudhary, S., Swaroop, N. and Thomas, T. (2020)** Assessment on Physico-chemical properties of soil from different blocks of Rajsamand district of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences*, **9**(9): 1718-1722.
5. **Jackson, M.L. (1958)** The pH was determined in 1:2 soil water suspension using digital pH meter. *Soil Chemical Analysis, Prentice Hall, Inc. Englewood. Cliffe. N.J.*
6. **Kumar, M., Kumar, N., Bharose, R. and Kumar, R. (2018)** Morphology, Physico-chemical properties and classification of salt-affected soils of Rudauli block, Faizabad, UttarPradesh. *Annals of Plant and Soil Research*, **20**(1): 26-30.
7. **Munsell, A.H. (1971)** Munsell Soil Color Chart. *Munsell Color Company Inc. 2441 N, Baltimore, Maryland.*
8. **Muthuvel, P., Udayasoorian, C., Natesan, R. and Ramaswami, P.R. (1992)** Introduction to Soil Analysis. Tamil Naidu Agricultural University, Coimbatore.
9. **Patel, A., Verma, S., Singh, S.K. and Singh, R.K. (2017)** Soil fertility status of Jaunpur district in Eastern Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry*, 949-952.
10. **Sahu, V.K. and David, A.A. (2014)** Soil health assessment of research farm of Allahabad School of Agriculture SHIATS-DU Allahabad, the Allahabad farmer vol. LXIX, no.2.

11. **Sharma, C.M., Gairola, S., Ghildiyal, S.K. and Suyal, S. (2010)** Physical properties of soils in relation to frost composition in Moist Temperate valley slopes of the Central WesternHimalaya. *Journal of Forest Science*. **26**(2): 117-129.
12. **Tewari, G., Khati, D., Rana, L., Yadav, P., Pande, C., Bhatt, S., Kumar, V., Joshi, V. and Joshi, P.K. (2016)** Assessment of Physicochemical properties of soils from different land usesystems in Uttarakhand, India. *Journal of Chemical Engineering and Chemistry Research*, **3**(11): 1114-1118.
13. Mohanta SR, David AA, Swaroop N, Thomas T, Hasan A. Assessment of heavy metals and Physico-chemical properties of soil near the mining areas of Mayurbhanj district, Odisha. *The Pharma Innovation Journal*. 2021;10(8):1430-6.