



Evaluation of Physico-Chemical Properties of Soil in Junnar for Agricultural Suitability

Dr. Sujata Modhave, Dr. Deepak Nighot

AISSMS, COE, Pune

ssmodhave@aissmscoe.com

Abstract:

Understanding soil characteristics is essential for improving agricultural productivity and sustainability. This study investigates the physical and chemical properties of soils collected from different agricultural sites in the Junnar region of Pune district, Maharashtra. Parameters including soil texture, bulk density, porosity, water holding capacity, pH, electrical conductivity, organic carbon, and macronutrients (N, P, K) were analyzed using standard laboratory techniques. The findings reveal that soils are predominantly clay-loam in texture with moderate water retention capacity. Soil reaction varied from neutral to slightly alkaline, and electrical conductivity indicated non-saline conditions. Nitrogen levels were relatively low, whereas phosphorus and potassium were within moderate ranges. These results suggest the need for improved nutrient management strategies to enhance soil fertility and crop yield.

Keywords: characteristics, management, properties, strategies

I. Introduction

Soil is a vital natural resource that underpins agricultural productivity by providing essential nutrients, water, and mechanical support for plant growth. Its effectiveness in sustaining crop production is largely governed by its physical structure and chemical composition, which influence processes such as nutrient availability, water retention, and root development. Any variation in these properties can directly impact soil fertility and, consequently, agricultural output. In intensively cultivated regions such as Junnar, spatial variability in soil characteristics is commonly observed due to differences in land use, cropping patterns, and management practices. These variations necessitate systematic evaluation to ensure optimal utilization of soil resources and to prevent long-term degradation.

The present study is therefore designed to assess the key physical and chemical properties of soils from selected sites within the study area. The findings aim to provide a scientific basis for evaluating soil fertility status and to support the development of appropriate soil management strategies for sustainable agricultural production.

II. Materials and Methods

2.1 Study Area

The study area is located in Junnar, characterized by semi-arid climate conditions and mixed cropping systems.

2.2 Soil Sampling

- Number of samples: 6
- Depth: 0–15 cm
- Method: Random sampling
- Processing: Air-dried, sieved (2 mm)

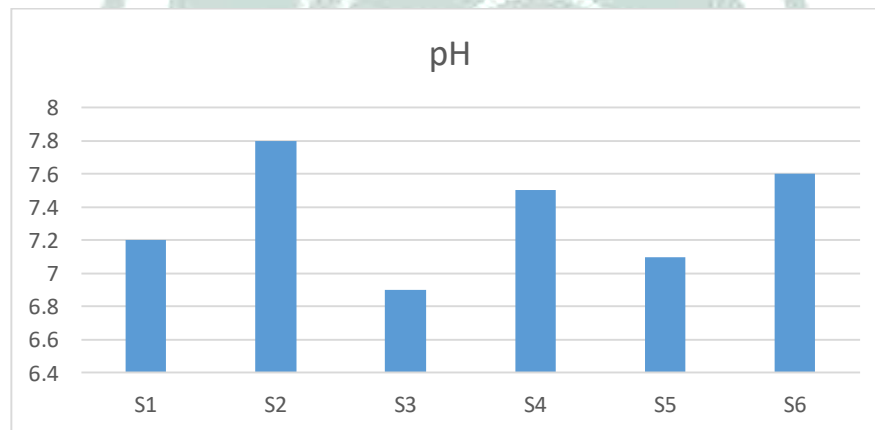
III. Results

3.1 Experimental Data Table

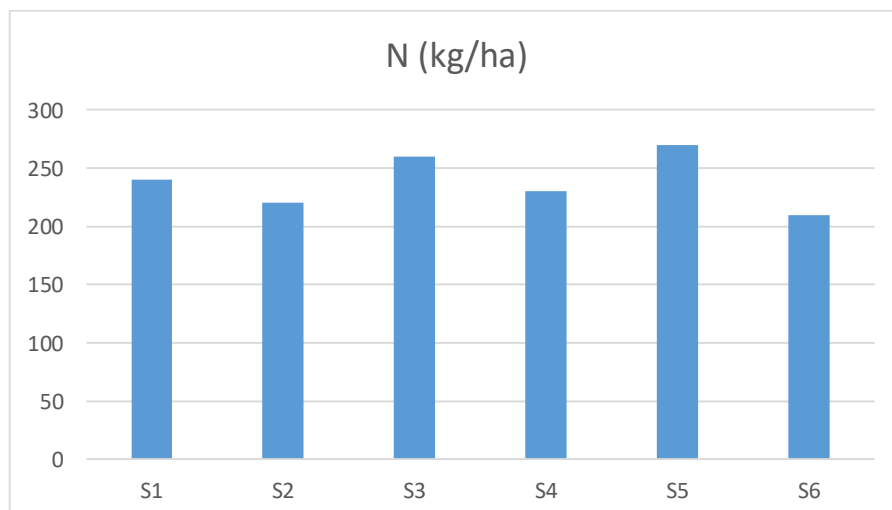
Sample	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
S1	7.2	0.35	0.52	240	18	210
S2	7.8	0.42	0.48	220	22	195
S3	6.9	0.30	0.60	260	20	205
S4	7.5	0.50	0.55	230	25	215
S5	7.1	0.28	0.62	270	19	225
S6	7.6	0.45	0.50	210	23	200

IV. Graphical Representation

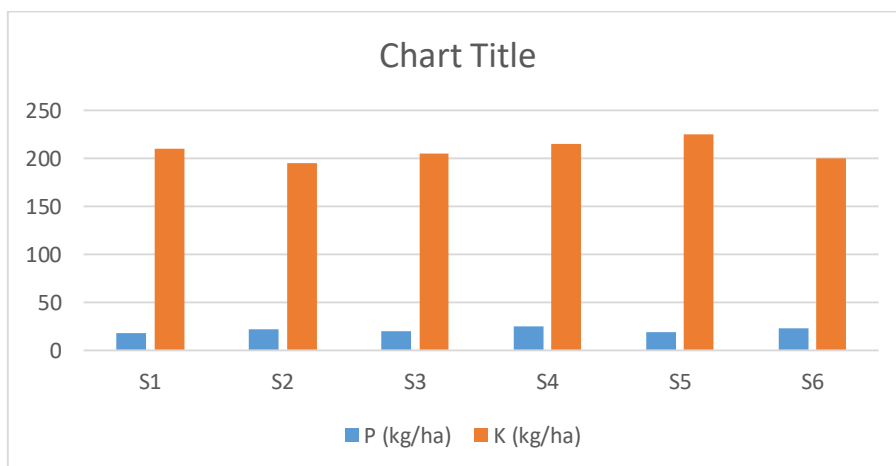
Graph 1: Soil pH Variation



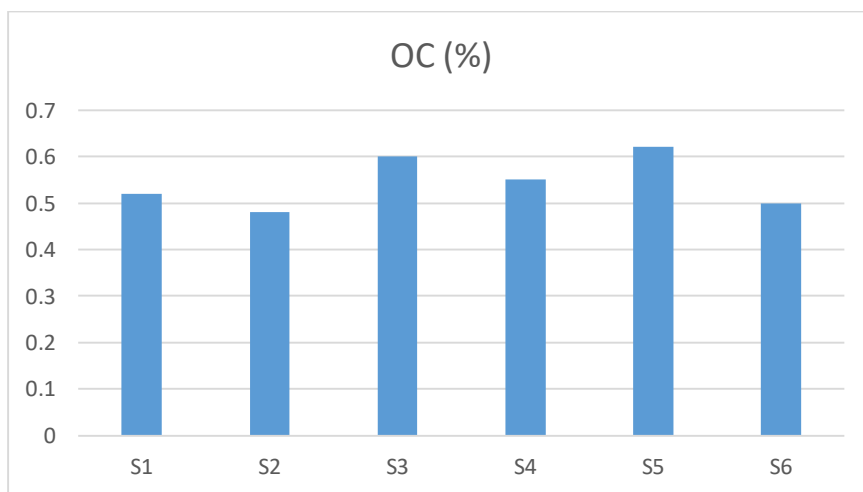
Graph 2: Nitrogen Content (kg/ha)



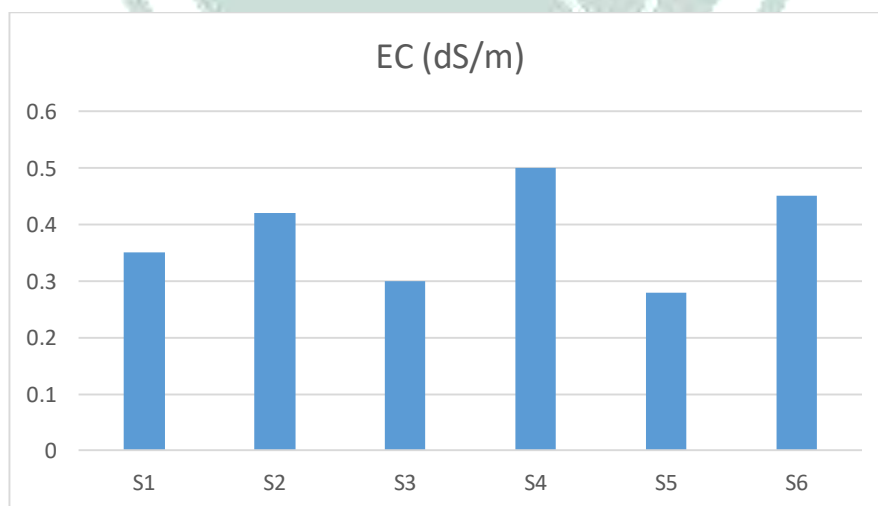
Graph 3: Phosphorus and Potassium Comparison



Graph 4: Organic Carbon (%)



Graph 4: Electrical Conductivity



V. Discussion

The results of the present investigation reveal a moderate degree of spatial variability in the physico-chemical properties of soils collected from different sampling sites within Junnar. Such variability is expected in agricultural landscapes due to differences in cropping practices, fertilizer application, irrigation methods, and micro-topographic conditions. The soil pH values ranged from near neutral to slightly alkaline. This alkaline tendency in certain locations may be attributed to the presence of basic cations such as calcium and magnesium, along with limited leaching under semi-arid climatic conditions. Soil reaction plays a crucial role in regulating nutrient availability; slightly alkaline conditions can

reduce the solubility of micronutrients such as zinc and iron, potentially leading to deficiencies in crops if not properly managed.

Electrical conductivity (EC) values across all samples were found to be within the normal range, indicating non-saline soil conditions. This suggests that there is no immediate risk of salt-induced stress on crops. The low EC values may be associated with adequate drainage and the absence of excessive accumulation of soluble salts, which is favorable for most agricultural activities.

Organic carbon (OC) content in the studied soils was observed to be in the moderate range. This reflects a reasonable level of organic matter, which contributes to improved soil structure, moisture retention, and microbial activity. However, the OC levels are not sufficiently high to ensure long-term soil sustainability. Continuous cultivation and limited incorporation of organic residues may have contributed to this condition. Therefore, the addition of organic amendments such as farmyard manure, compost, or green manure is recommended to enhance soil organic matter content.

Available nitrogen levels were generally low to medium across the sampling sites, indicating that nitrogen is a limiting nutrient in the study area. This is a common characteristic of intensively cultivated soils, where nitrogen is rapidly depleted due to crop uptake and losses through leaching and volatilization. Insufficient nitrogen availability can directly affect plant growth, chlorophyll formation, and overall yield. Hence, the application of nitrogenous fertilizers in a balanced and split manner is essential to improve nitrogen use efficiency.

In contrast, available phosphorus levels were found to be in the medium to high range. This may be attributed to the regular application of phosphatic fertilizers and the relatively lower mobility of phosphorus in soil. However, under alkaline conditions, phosphorus can become fixed in less available forms, which may reduce its uptake by plants over time. Therefore, periodic monitoring is necessary to maintain optimal phosphorus availability.

Potassium levels in the soil samples were observed to be within the medium range, indicating a satisfactory supply for crop requirements. Potassium plays a key role in enzyme activation, water regulation, and disease resistance in plants. The presence of adequate potassium suggests that the soils possess a reasonable reserve of this nutrient; however, continuous cropping without replenishment could lead to gradual depletion.

Overall, the findings indicate that while the soils of the study area possess favorable physical and chemical characteristics, certain constraints such as low nitrogen content and moderate organic carbon levels need to be addressed. Adoption of integrated nutrient management practices, including the combined use of organic and inorganic fertilizers, can help improve soil fertility and sustain agricultural productivity in the long term.

VI. Conclusion

The present study provides a comprehensive assessment of the physico-chemical characteristics of soils from Junnar and highlights their implications for agricultural productivity. The findings indicate that the soils are generally neutral to slightly alkaline, non-saline, and possess moderate levels of organic carbon, reflecting reasonably favorable conditions for crop growth. The physical properties, particularly soil texture and water retention capacity, further support their suitability for agricultural use.

However, despite these favorable attributes, certain limitations were identified that may affect long-term soil fertility and productivity. Among the macronutrients, nitrogen was found to be deficient to moderately available across most sampling sites, indicating its role as a primary limiting nutrient in the region. In contrast, phosphorus and potassium levels were within moderate to adequate ranges, suggesting that these nutrients are currently sufficient but require periodic monitoring to prevent future imbalances.

The moderate organic carbon content observed in the soils points to a need for improving soil organic matter through sustainable management practices. Continuous cultivation, coupled with insufficient organic inputs, may lead to gradual depletion of soil health if not addressed. Enhancing organic matter is critical not only for improving nutrient availability but also for maintaining soil structure, moisture retention, and microbial activity.

Based on the findings, it can be concluded that while the soils of the study area are moderately fertile and capable of supporting agricultural production, their productivity can be significantly improved through appropriate nutrient management strategies. The adoption of integrated nutrient management practices—combining organic amendments such as compost and farmyard manure with balanced chemical fertilization—will be essential for sustaining soil fertility. In particular, targeted nitrogen supplementation, along with the judicious use of micronutrients where required, is recommended to optimize crop yield.

Furthermore, regular soil testing and site-specific nutrient management should be encouraged to ensure efficient use of inputs and to prevent soil degradation. Such practices will contribute to maintaining long-term soil health and promoting sustainable agricultural development in the region.

VII. References:

1. Brady, N. C., & Weil, R. R. (2016). *The Nature and Properties of Soils*. Pearson Education.
2. Sparks, D. L. (2003). *Environmental Soil Chemistry*. Academic Press.
3. Jackson, M. L. (1973). *Soil Chemical Analysis*. Prentice Hall of India, New Delhi.
4. Walkley, A., & Black, I. A. (1934). An examination of the Degtjareff method for determining soil organic matter. *Soil Science*, 37, 29–38.
5. Gill, J. S., & Aulakh, M. S. (2013). Soil chemical properties and nutrient availability in Punjab soils. *Indian Journal of Agricultural Sciences*.
6. Sharma, P. K., & Arora, R. (2012). Assessment of soil fertility status in Punjab soils. *Journal of the Indian Society of Soil Science*.
7. Tiwari, K. N., & Sudi, R. (2013). Soil nutrient status and fertility mapping in Indo-Gangetic plains. *Agricultural Research*.
8. Wagh, G. S., Chavhan, D. M., & Sayyed, M. R. G. (2015). Physicochemical analysis of soils from eastern part of Pune city. *Universal Journal of Environmental Research and Technology*, 3(1), 93–99.
9. Deshmukh, A. M., et al. (2016). Soil quality assessment in agricultural areas of Pune district. *International Journal of Chemical Studies*.
10. Patil, S. N., & Kulkarni, D. N. (2017). Physico-chemical analysis of soils in peri-urban regions of Maharashtra. *Journal of Environmental Biology*.
11. Olsen, S. R., Cole, C. V., Watanabe, F. S., & Dean, L. A. (1954). *Estimation of available phosphorus in soils by extraction with sodium bicarbonate*. USDA Circular 939.
12. Bouyoucos, G. J. (1962). Hydrometer method improved for particle size analysis. *Soil Science Society of America Journal*.
13. Piper, C. S. (1966). *Soil and Plant Analysis*. Hans Publishers.