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ASSESSMENT OF SELECTED PHYSICOCHEMICAL PROPERTIES OF AGRICULTURAL SOILS FROM MOUDA AND KALMESHWAR, NAGPUR DISTRICT

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Abstract

Soil is an essential natural resource that supports agricultural production and plays an important role in nutrient cycling, water retention, and plant growth. The physicochemical characteristics of soil directly influence nutrient availability and crop productivity. The present study was undertaken to assess selected physicochemical properties of agricultural soil samples collected from farmland areas of Mouda and Kalmeshwar in Nagpur District. Twelve soil samples were analysed for pH, electrical conductivity (EC), calcium carbonate (CaCO_3), and chloride content using standard laboratory procedures. Soil samples were collected from a depth of approximately 10–15 cm, air-dried, ground, sieved, and subjected to chemical analysis. The pH values of the analysed samples ranged from 7.29 to 8.30, indicating predominantly neutral to alkaline soil conditions. Electrical conductivity values ranged from 0.100 to 0.649, with sample 6 showing the highest EC value. Calcium carbonate content varied considerably among the samples, ranging from 3.00% to 49.75%, while chloride content ranged from 0.50% to 4.81%. The observed variation among samples indicates differences in the physicochemical characteristics of agricultural soils in the selected study areas. The study demonstrates the importance of routine soil analysis for evaluating soil conditions and supporting appropriate agricultural management practices.

Keywords: Soil analysis, pH, electrical conductivity, calcium carbonate, chloride, agricultural soil, Mouda, Kalmeshwar.

1. Introduction

Soil is a vital natural resource that supports terrestrial life and agricultural production. It provides a medium for plant growth and acts as a source of essential nutrients, water, and minerals. Soil also plays an important role in regulating the movement of water, recycling nutrients, supporting microorganisms, and maintaining environmental balance. Therefore, an understanding of the physical and chemical characteristics of soil is important for evaluating its suitability for agricultural and environmental purposes.

The chemical properties of soil influence nutrient availability, microbial activity, plant growth, and the movement of ions and other substances within the soil system. Soil is a complex mixture of inorganic materials, organic matter, water, and air. Interactions among these components determine important characteristics such as acidity or alkalinity, salinity, nutrient availability, and mineral composition.

Agricultural productivity is strongly influenced by the physicochemical condition of soil. Parameters such as pH and electrical conductivity provide important information about soil reaction and soluble salt concentration. Calcium carbonate affects soil alkalinity and calcium availability, whereas chloride concentration may contribute to soil salinity when present in excessive amounts.

Regular analysis of agricultural soil is therefore important for understanding variations in soil properties and for supporting appropriate soil management practices. The present study focuses on selected

physicochemical parameters of soil samples collected from agricultural land in Mouda and Kalmeshwar areas of Nagpur District.

1.1 Significance of Soil Analysis

Soil analysis provides important information regarding the chemical condition of agricultural land. Soil pH influences nutrient availability and microbial activity, whereas electrical conductivity provides an indication of the concentration of soluble salts. Calcium carbonate content is useful for understanding calcareous characteristics and soil reaction. Chloride is an essential plant nutrient, but excessive concentrations may contribute to salinity and adversely affect plant growth. Evaluation of these parameters can therefore provide useful information regarding variations in agricultural soil conditions and assist in the assessment of soil suitability.

1.2 Objectives of the Study

This study aims to evaluate the physicochemical condition of agricultural soil samples collected from Mouda and Kalmeshwar by determining their pH, electrical conductivity, calcium carbonate, and chloride content. These parameters were selected to assess soil reaction, soluble salt concentration, mineral composition, and variations in the overall chemical characteristics of the soil samples.

2. Methodology

2.1 Study Area

Soil samples were collected from agricultural land located in the Mouda and Kalmeshwar areas of Nagpur District, Maharashtra.

2.2 Soil Sampling

The soil sampling depth was maintained at approximately 10–15 cm. Samples were collected using a stainless-steel auger and khurpi. Surface litter, stones, and other unwanted materials were removed before collection. The agricultural fields were divided into homogeneous units based on visual observation and field conditions. Soil was collected from the selected locations at the required depth. A total of twenty subsamples were collected from each site and combined to obtain composite soil samples. The bulk soil sample was reduced by the quartering method, and approximately 500 g of composite soil was retained for laboratory analysis. The collected samples were stored in clean polyethylene bags and appropriately labelled.

2.3 Processing of Soil Samples

The collected soil samples were air-dried in shade. After drying, the samples were ground using a wooden pestle and mortar. The ground soil was passed through a 0.5 mm stainless-steel sieve. Crop residues, gravel, and other materials retained on the sieve were removed. The processed soil samples were then remixed and used for analysis.

2.4 Determination of pH

Principle: The pH of soil represents the activity of hydrogen or hydroxyl ions in the soil-water system and indicates whether the soil is acidic, neutral, or alkaline.

Instrument: pH meter

Procedure: Ten grams of soil sample were transferred into a clean beaker. Distilled water was added to the sample, and the mixture was stirred thoroughly. The suspension was allowed to stand for approximately thirty minutes. The mixture was stirred again, and the pH was measured using a calibrated pH meter.

2.5 Determination of Electrical Conductivity

Principle: Electrical conductivity depends on the concentration of ions present in the soil-water system. Higher concentrations of soluble salts increase the electrical conductivity of the soil extract.

Instrument: Conductivity meter

Reagent: 0.01 N potassium chloride solution for calibration.

Procedure: Twenty grams of soil sample were weighed into a 100 mL beaker. Forty millilitres of distilled water were added, and the mixture was shaken intermittently for approximately one hour. The suspension was allowed to stand until a clear supernatant liquid was obtained. The conductivity meter was calibrated using standard potassium chloride solution, and the electrical conductivity of the clear soil extract was measured.

2.6 Determination of Calcium Carbonate

Calcium carbonate content was determined by the rapid titration method.

Reagents: 0.5 N hydrochloric acid; 0.5 N sodium hydroxide; phenolphthalein indicator.

Procedure: Ten grams of soil sample were weighed and transferred to a 250 mL conical flask. Hydrochloric acid solution was added to the soil sample, and the contents were shaken for approximately one hour. The mixture was allowed to settle and filtered. A measured quantity of filtrate was transferred to another conical flask, phenolphthalein indicator was added, and the solution was titrated with standard sodium hydroxide until a persistent pink colour was obtained. A blank determination was also performed.

2.7 Determination of Chloride

Chloride content was determined by titration of the soil extract using silver nitrate solution. A measured volume of soil extract was transferred into a flask. Potassium chromate indicator was added, and the solution was titrated against standard silver nitrate until the first persistent faint reddish colour was observed.

3. Results

The results obtained for the twelve soil samples are presented in Table 1.

Sample No.	pH	EC	CaCO ₃ (%)	Chloride (%)
1	7.76	0.139	4.65	2.59
2	7.84	0.149	5.0	2.01
3	7.71	0.223	7.4	2.01
4	8.16	0.187	10.15	0.5
5	8.3	0.213	24.45	1.09
6	7.74	0.649	16.75	4.81
7	8.06	0.152	7.95	2.28
8	7.29	0.101	14.55	0.59
9	7.36	0.116	9.6	1.9
10	7.92	0.15	3.0	0.96
11	7.34	0.102	49.75	0.53
12	7.45	0.1	8.5	2.53

3.1 pH

The pH values of the analysed soil samples ranged from 7.29 to 8.30. Most samples showed neutral to moderately alkaline conditions. Samples 4, 5, and 7 showed pH values above 8.0, while the remaining samples had pH values between 7.29 and 7.92.

3.2 Electrical Conductivity

The electrical conductivity values ranged from 0.100 to 0.649. Sample 6 showed the highest EC value, whereas the remaining samples showed comparatively lower values ranging approximately from 0.100 to 0.223.

3.3 Calcium Carbonate

The calcium carbonate content showed considerable variation among the soil samples. The lowest value was observed in sample 10 at 3.00%, while the highest value was observed in sample 11 at 49.75%. Sample 5 also showed comparatively high calcium carbonate content at 24.45%.

3.4 Chloride

Chloride content ranged from 0.50% to 4.81%. Sample 6 showed the highest chloride content, whereas sample 4 showed the lowest value.

4. Discussion

4.1 Soil Reaction and pH

Soil pH is an important parameter because it influences nutrient availability, microbial activity, and plant growth. The analysed samples showed pH values ranging from 7.29 to 8.30, indicating that the soils were predominantly neutral to alkaline in nature. The variation in pH among samples may reflect differences in soil composition and local agricultural conditions.

4.2 Electrical Conductivity and Soluble Salts

Electrical conductivity is used as an indicator of the concentration of soluble ions and salts in soil. The analysed samples showed EC values ranging from 0.100 to 0.649. Sample 6 exhibited a substantially higher value than the other analysed samples. The observed variation in EC indicates differences in soluble salt concentrations among the agricultural soil samples.

4.3 Calcium Carbonate Content

Calcium carbonate content varied widely among the samples, ranging from 3.00% to 49.75%. Sample 11 showed the highest calcium carbonate content, while sample 10 showed the lowest value. The variation in calcium carbonate content indicates differences in mineral composition among the soil samples.

4.4 Chloride Content

Chloride is an essential nutrient for plants, but excessive concentrations can contribute to salinity-related problems. The chloride content of the analysed samples ranged from 0.50% to 4.81%. Sample 6 showed the highest chloride content and also exhibited the highest electrical conductivity value among the analysed samples, indicating comparatively higher concentrations of soluble ions.

5. Conclusion

The present study assessed physicochemical properties of agricultural soil samples collected from Mouda and Kalmeshwar areas of Nagpur District. Twelve soil samples were analysed for pH, electrical conductivity, calcium carbonate, and chloride content. The pH values ranged from 7.29 to 8.30, indicating that the analysed soils were predominantly neutral to alkaline. Electrical conductivity values varied from 0.100 to 0.649, with sample 6 showing the highest value. Calcium carbonate content showed substantial variation, ranging from 3.00% to 49.75%. Chloride content ranged from 0.50% to 4.81%, with the highest value observed in sample 6. The results demonstrate variability in physicochemical properties among the agricultural soil samples. Regular soil analysis is important for monitoring changes in soil conditions and can provide useful information for agricultural management.

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