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PHYSICO-CHEMICAL ANALYSIS OF SOME MACRONUTRIENTS FROM SOIL IN SELECTED VILLAGES OF ANJANGAON SURJI TALUKA OF AMRAVATI DISTRICT, MAHARASHTRA STATE

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Abstract:
PUSA STFR METER KIT of Soil Test and Fertilizer Recommendation System used for determination for PH, Electrical conductivity, Organic carbon, Phosphorus, Potassium, Sulfur, Zinc, Iron, Copper, Manganese, Boron and Nitrogen. The conductometry techniques used to measure conductance of micronutrients, and pH metric analysis indicating the pH of soil. In analysis of soil, soil sampling technique, determination of texture, water content, organic matter, air content, and soil pH. We have used five type of soil samples for analysis at different places. The soil are extracted successfully from main area of farm places. In the determination of texture of soil. The water holding capacity of the farm soil has slightly decreased due to the deposition of hydrophobic organic matter in the soil. The pH of the soil has been increased may due to the presence of alkaline and alkaline earth metals in the soil. The electrical conductivity of soil in liquid medium has increased may due to containing ionic matter into the soil through fertilizer utilization. The research study may helpful in the vitality of good soil management to ensure high sustainable production for economic viability as well as to maintain or improvement in soil fertility.

KEYWORDS: *Physico-chemical techniques, Soil analysis, Micronutrients, Pusa STFR meter kit.*

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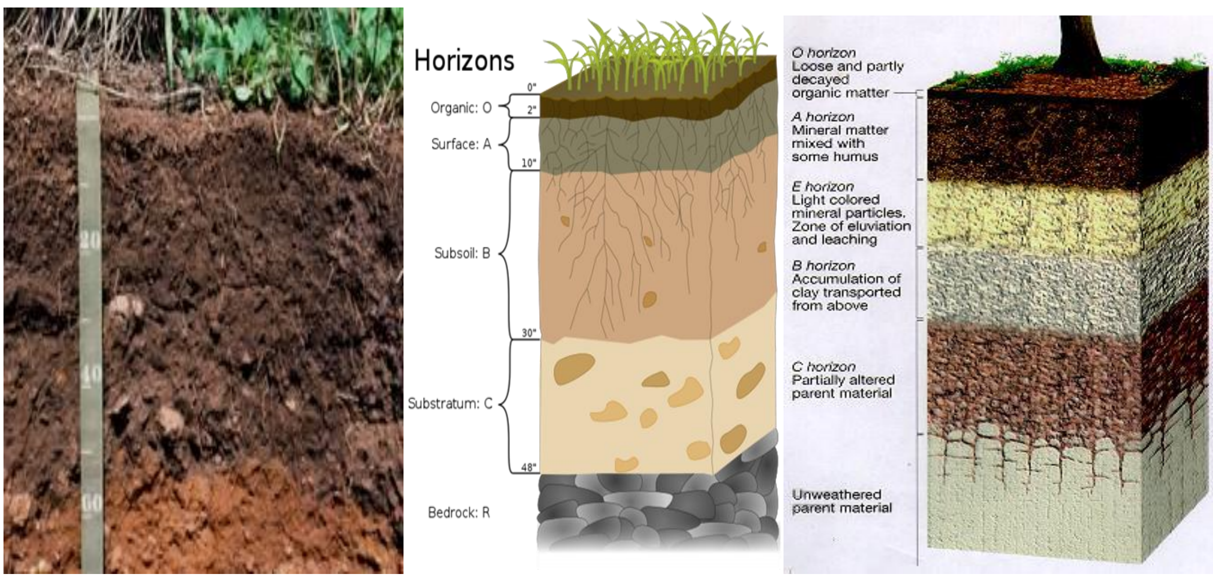
1. INTRODUCTION:

Soil is a diverse complex as a mixture of minerals and organic materials, capable of supporting to plant life [1-2]. Soil contains 13 elements as essential for plant growth out of 16 different elements [3]. However, the small amounts of nutrients are available for plants. Nutrients become available through mineral weathering and through decomposition of organic matter into inorganic mineral which are absorbed by plants in the form of ions [4-5]. In the last decades Ion exchange resin has been used to assess the availability of plant nutrients where anion and cation exchange resins are used in numerous microanalysis [7-8]. The method simulates removing ions from soil by plant roots to prevent equilibrium of ions between the solid and the solution phases [9]. Ion exchange membrane technique (IEM) was developed as an alternative to chemical extraction methods to measure nutrients for the bioavailability. IEM involves disaggregation of soil by shaking in the water medium during 15 minutes with a glass marble, the elements transfer from the soil to the AEM and CEM during a 16 hours shaking period, removing of the membrane from the soil, and finally extracting the elements from the membrane (elution). IEM extraction method allows single extraction process and a single subsequent measurement of the soil available nitrate, phosphate, sulfate by IC, calcium, magnesium, total phosphorous, and heavy metals by inductive coupled plasma (ICP), sodium and potassium by flame photometer, and ammonium by UV/ vis. Commercial anion exchange resin are generally found in the chloride (Cl^- ion form while cation resin are usually commercialized in the hydrogen (H^+) ion [10-15].



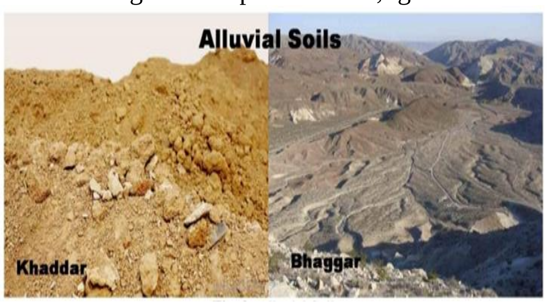
(a) (b) (c)

Fig.1(a-c). Examination of types of soil horizons within the soils

Soil classification system: General soils may be classified by the following systems 1) Alluvial soils, (2) Black soils, (3) Red Soils, (4) Laterite Soils (5) Forest and Mountain Soils, (6) Arid and Desert Soils, (7) Saline and Alkaline Soils, (8)Peaty and Marshy Soils. Fig.2(a-c).

Alluvial Soils: These are formed by the deposition of sediments by rivers and rich in humus and very fertile. They are found in Great Northern plain, lower valleys of Narmada and Tapti and fertile.The materials was deposited by rivers, and sea waves are known to be alluvium and soils formed of alluvium are refereed alluvial soils. The old alluviums are clayey and sticky have a darker color contains nodules of lime concretions and have been to lie on slightly elevated lands. The new alluviums is lighter in color found in the deltas as well as the flood plains. **Black Soils :** The black soils are also called regur (from the Telugu word Reguda) and black cotton soils because cotton is the most important crop grown on these soils. Several theories have been put forward regarding the origin of this group of soils but most pedologist believe that these soils have been formed due to the solidification of lava spread over large areas during volcanic activity in the Deccan Plateau, thousands of years ago. Geographically, black soils are spread over 5.46 lakh sq km (i.e. 16.6 per cent of the total geographical area of the country). **Red Soil:** This comprehensive term designates the largest soil group of India, comprising several minor types. Most of the red soils have come into existence due to weathering of ancient and metamorphic rocks. The red color is due more to the wide diffusion rather than and metamorphic rocks. The color of these soils is generally red, often grading into brown, and metamorphic rocks. In the north the red soil area extends in large parts of south Bihar; the Birbhum and Bankura districts of West Bengal; Mirzapur, Jhansi, Banda and Hamirpur districts of Uttar Pradesh; Aravallis and the eastern half of Rajasthan. **Laterite Soils:** The word 'laterite' was first applied by Buchanan in 1810 for a clayey rock, hardening on the exposure. **Forest and Mountain Soils**: These soils occupy about 2.85 lakh sq km which is about 8.67 per cent of the total land area of India. formation of these soils is mainly governed by the characteristic deposition of organic matter derived from forest growth these soils are heterogeneous in nature and their character changes derived from forest growth these soils are heterogeneous in nature and their character changes with parent rocks, ground-configuration and climate. In the Himalayan region, these soils are mainly found in valley basins, depressions. Generally, it is the north facing slopes which support soil cover; the southern slopes being too precipitous and exposed found in valley basins, depressions, and less steeply inclined slopes. **Desert soil:** The soils of Rajasthan, Haryana and the South Punjab are sandy. Indus and the Aravallis, covering an area of 1.42 lakh sq km (or 4.32% of total area). Some of these soils contain high percentages of soluble salts, are alkaline with varying degree of calcium carbonate and are poor organic matter[16-18].

Saline and Alkaline Soils-In the drier parts of Bihar, Uttar Pradesh, Haryana, Punjab, Rajasthan and Maharashtra, there are salt-impregnated or alkaline soils occupying 68,000 sq km of area. These soils are liable to saline and alkaline efflorescence and are known by different names such as reh, kallar, usar, thur, rakar, karl and chopan. Soil Fertility and Crop Growth: The early use of fire to flush out wild game and to clear forested land provided the first major anthropogenic influence on the environment[19-20].



(a)

(b)

(c)

Fig.2 (a-c). Types of soil

Objectives: Soil science is the study of soil as a natural resource on the surface of the Earth including soil formation, classification and mapping; physical, chemical, biological, and fertility properties of soils; and these properties in relation to the use and management of soils. The diversity of names associated with this discipline is related to the various associations concerned. Indeed, engineers, agronomists, chemists, geologists, physical geographers, ecologists, biologists, microbiologists, silviculturists, sanitarians, archaeologists, and specialists in regional planning, all contribute to further knowledge of soils. The soil scientists have been raised concerns about how to preserve soil and arable land in a world with a growing population and the possible future water crisis, increasing per capita food consumption, and land degradation.

Our interest have been grown up to study importance associated to analysis the soil for better fertility, in prediction of some parameter for further increase agricultural yield. The various parameter have been demonstrated from the physicochemical study which may help to farmer to know the microelement available in the soil for future advancement.

2. INSTRUMENTATION AND METHODOLOGY:

2.1 Instrumentation: PUSA STFR METER KIT, Conductometer equiptronics model no. EQ-661, Elico-pH meter and with three buffer solution of 9.2 pH, 4 pH and 7 pH using standard buffer in distilled water was used.

2.2 MATERIALS:

Buffer solution, Zinc sulfate, EDTA, Boric Acid Indicator, 0.02N H_2SO_4, HCl, deionized water. After initial warm up adjust the dial at 25°C with the help of sp cable (provide with instrument) connect electrode terminal and 7 pH terminal. Adjust asymmetric potential knob to read 7.00.Now remove the wire from 7 pH and connect to 4 pH adjust SLOPE to read 4.00. Then remove 4 pH and connect 9.2 pH the reading must come to 9.20. **Tools**: The tools used for soil sampling includes Auger, Spade, Khurpa, measurement tape Bags, Cloth bag, marker pen, Information Sheet.**Standardization**: We have made 1000 ppm standard stock solution for Zn^{2+}, from their salt i.e. ZnSO4.7H_2O. From 1000 ppm stock solution of Zn $^{2+}$ ion[21-23].

Result and discussion:

1. pHmetry: The sample must stand for a minimum of one hour stirring every 10 to 15 minutes. The pH metry data are recorded in table1. The soil slurry was prepared and the temperature of the sample should be normalized. Measure the temperature of the sample and adjust the temperature controller of the pH meter to that if the sample temperature. On meters with an automatic temperature control follow instruction Standardize the pH meter by means of the standard solution provided. Immediately before immersing the electrode into the sample stir the sample well with a glass rod. Place the electrode into the soil slurry solution and gently turn beaker to make good contact between the solution and the electrode. Do not place electrode into the soil only into the soil slurry solution. The electrode require immersion 30 seconds or longer in the sample before reading to allow the meter to stabilize. If the meter has an auto read system it will be automatically signals when stabilized.

Table.1 Recorded pH of soil samples at room temperature

Sr No.	Soil sample No.	Observation Sample Sol^n
1.	1	4.5
2.	2	5.0
3.	3	6.1
4.	4	7.0
5.	5	8.1

2. PUSA STFR Metry:-

PUSA STFR METER KIT (PUSA Soil Test and Fertilizer Recommendation Meter Kit) is an advanced Soil Testing Kit manufactured by W S Telematics Pvt. Ltd. under license from ICAR - IARI, New Delhi, Ministry of Agriculture, Govt. of India. The macronutrients data are recorded in table 2. This advanced Soil Testing Kit is a Soil Doctor that tests 14 parameters of soil, recommends fertilizer dose for over 100 crops. Indian soils suffer from widespread multi-nutrient deficiencies. The soil testing service is not adequate to cater the need of large number of farm holding. Farmers generally applied fertilizers without much more any scientific view of recommendation. This increase the cost of production, lower farm profits and leads to soil health deterioration. PUSA STFR Meter would increase farmer access the soil testing, and the help then to achieve higher yield owing to soil test based fertilizer application. PUSA STFR Meter is a low cost, user friendly digital embedded system instrument which can quantitatively estimate available nutrients in soil such as organic carbon, phosphorus, potassium. The available nutrients in the soil is extracted with an extracting and a color is developed in the extract with another reagent. The color intensity which is proportional to the amount of nutrients extracted measured by this STFR meter. Fertilizer doses item of the menu gives fertilizer doses for N, P and K from soil test value of organic phosphorus, potassium for a selected crop. So the STFR meter used for following test of soil pH, Electrical Conductivity, OC, Phosphorus, Potassium, Sulfur, iron, Zinc, Copper and recommendation for crop specific fertilizer and micronutrients[24-27].

Table2. Macronutrients found in soil samples

Sr. No.	Macronutrients	Reference Value	Soil Sample No.	Observation Value	
				Blank sol^{n}	Sample sol^{n}
1.	Phosphorus Kg/Ha	350-400 Kg/Ha	1	313.6	28.2
			2	312.3	24.9
			3	308.3	52.1
			4	300.9	11.3
			5	327.3	32.1
2.	Potassium Kg/Ha	300-400 Kg/Ha	1	361.5	285.7
			2	348.0	218.7
			3	370.0	83.1
			4	340.4	268.7
			5	310.5	404.5
3.	Sulfur Kg/Ha	1Kg/Ha	1	190.8	208.9
			2	181.0	201.1
			3	171.2	190.0
			4	165.0	200.1
			5	140.2	230.2

Table 3. Macronutrients found in soil samples

Sr. No.	Micronutrients	Reference Value	Soil Sample No.	Observation	
				Blank Sol^{n}	Sample Sol^{n}
1.	Iron (mg/Ha)	0.02-0.20 (mg/Ha)	1	368.1	0.95
			2	368.2	0.81
			3	368.5	4.76
			4	368.0	20.2
			5	371.5	18.2
2.	Copper (mg/Ha)	0.50 (mg/Ha)	1	362.1	0.35
			2	362.2	0.31
			3	350.4	0.25
			4	352.0	0.30
			5	358.5	0.33
3.	Zinc (mg/Ha)	30(mg/Ha)	1	61.0	10.0
			2	62.1	12.1
			3	64.4	12.2
			4	59.3	17.0
			5	57.0	19.3
4.	Manganese (mg/Ha)	300-600	1	249.0	59.0
			2	249.1	61.2

		(mg/Ha)	3	253.3	64.3
			4	259.4	67.0
			5	262.5	69.5
5.	Boron (mg/Ha)	30(mg/Ha)	1	271.0	11.0
			2	271.1	10.1
			3	274.2	12.1
			4	276.3	13.3
			5	278.5	14.4

3. **Complexometric method**: The apparatus used in complexometric titrations is burettes, pipettes, volumetric flask and weighing balance. The burette was filled with standard EDTA solution. Pipetted out 10 ml of standard zinc solution in a clean conical flask and add nearly 20 ml of distilled water 4-5 ml buffer solution (pH = 10) by measuring cylinder and add 1-2 drops of Erio-T-indicator Zn^{2+} ions forms a complex with indicator, Erio by appearance of red color. Now, run in standard EDTA solution from burette slowly and shake the flask continue the addition of EDTA solution until color changes from wine red to blue. Repeat the titration till the three concordant readings are obtained. Soil sample reading: Take a 1g of soil sample from different soil samples in five 100 ml volumetric flask with the help of funnel and make up the volume till the 100 ml mark using distilled water formation of unknown solutions of samples (solutions B,C,D,E,F).Pipette out 10 ml from unknown solution B in a clean conical flask and add nearly 20 ml of distilled water, then add 4-5 ml buffer solution by measuring cylinder and add 1-2 drops of Erio-T-indicator by appearance of wine red color. Now, run in standard EDTA solution from burette slowly shake the flask continue the addition of standard EDTA solution till the color changes from wine red to light blue [28-30].

Table 4. Estimation of Zn^{2+}ion

Sr No.	Soil sample No.	Zn^{2+} ion (mg/1kg)
1.	1	0.11
2.	2	0.55
3.	3	0.22
4.	4	0.66
5.	5	0.77

4. **Conductometry method**:

It is an electrochemical method of analysis used for the determination or measurement of the electrical conductance of an ion present soil solution with the help of conductometer. The conductivity of the solution depends on presence of type of ions (cations, anions, singly or doubly charged). The conductivity meter was standardized with 0.1 N KCl solution. Once the instrument is standardized, dip the conductivity cell in the supernatant solution/layer without disturbing the soil and take the reading. The reading observed was and represented as EC2 (dS/ m^{-1}).

Table 5. Conductance data of soil samples

Sr No.	Soil sample No.	Observation (dS/m^{-1})
		Sample Sol^n
1.	1	3.0
2.	2	3.8
3.	3	4.3
4.	4	4.4
5.	5	5.0

5.Determination of total Nitrogen (Kjeldhal method)

Chemicals and equipment's required: micro burette of 10 ml con. H_2SO_4, Catalyst/ Digestion mixture: 45 g of potassium sulphate and 5 g of $CuSO_4$ mixed together, 4% Boric acid: 30 g of Boric acid –AR dissolved in one liter of distilled water, mixed indicator: 0.35 g of bromocresol green (BCG) indicator powder and 0.2 g of methyl red mixed in 500 ml of 98% dry ethanol, 40-45 % NaOH: 400 g of sodium hydroxide dissolved in 1 liter of distilled water, for titration: 0.1N HCl.

Analysis of soil: Take 1 g of the soil sample into the digestion tube, added about 5-6 gm. of mixture and 20 ml of con. H_2SO_4, The mixture was added in the digestion block place the exhaust hood on the tubes, and switch on the exhaust unit then heat the digestion block at a temperature of 375^0C for about 2 to 3 hour till the digestion is completed. The sample turns color light green at the end of the digestion. Switch off the digester apparatus and allow them to cool to room temperature.

Distillation process: Pipetted 10 ml of the 4-5 % boric acid in 250 ml flask, and added two-three drops of mixed indicator in the distillation apparatus and dip the outlet tube in boric acid solution. Later to added 25 ml of 40-45 % NaOH in digestion tube and continued the again distillation. After the collection of the distillate of about 100 ml. the conical flask was removed from the distillation apparatus, and allowed to cool to room temperature and titrated this distillate with 0.1 N hydrochloric acid or sulphuric acid till the color changes from green to red/pinkish red. The blank sample was also analyzed without soil sample.

The following relationship was used for estimation of Nitrogen present in soil sample. % TN = Vol. of the acid used (sample titer value-blank titer value) × normality of acid × 14 × 100 sample weight (g) × 1000 [31-37].

Table 6. Blank titration

Sr. No.	Boric Acid Indicator	Distillate added	Vol. of 0.02 N concentrated H_2SO_4	Mean
1	20 ml	80 ml	5	7.5
2	20 ml	80 ml	5	

Table 7. Soil sample No. 1

Sr. No	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02N H_2SO_4	Mean
1	0.5g	20ml	80ml	2ml	3
2	0.5g	20ml	80ml	2ml	

Table 8. Soil sample No. 2

Sr. No	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02N H_2SO_4	Mean
1	0.5g	20ml	80ml	2.5ml	3.75
2	0.5g	20ml	80ml	2.5ml	

Table 9. Soil Sample No. 3

Sr. No	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02N H_2SO_4	Mean
1	0.5g	20ml	80ml	2.8	4.2
2	0.5g	20ml	80ml	2.8	

Table 10. Soil Sample No.4

Sr. No	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02N H2SO4	Mean
1	0.5g	20ml	80ml	2	3
2	0.5g	20ml	80ml	2	

Table 11. Soil Sample No. 5

Sr. No	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02N H_2SO_4	Mean
1	0.5g	20ml	80ml	2.7	4.05
2	0.5g	20ml	80ml	2.7	

CONCLUSION:

We have used some important processes for the soil analysis of determination of texture of soil, Zn^{2+}ion, conductance, determination of nitrogen, and soil pH in liquid medium. Three type of soil samples are used in soil analysis, which are farm at maximum level. The soil are extracted successfully. The soil texture has obtained moderately result for the long-term cultivation. The water holding capacity of the farm soil has slightly decreased due to the deposition of hydrophobic organic matter in the soil. The pH of the soil has been increased may due to the presence of alkaline and alkaline earth metals in the soil. The electrical conductivity of soil in liquid medium has increased may due to containing ionic matter into the soil through fertilizer utilization.

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