Soil Testing as a Tool for Balanced Fertilizer Use

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Introduction

The process by which elements such as phosphorus, potassium, calcium, magnesium, sodium, sulphur, manganese, copper and zinc are chemically removed from the soil and measured for their available content within the sample of soil is called Soil Testing. Knowing the exact nutrient found in your farm soil and the pH is the first step of any healthy crop production program. Crops are usually grown on a very wide variety of soil types and different fertilizer requirements, depending on the soil's health and condition.

Key words: Soil testing, Soil analysis, Soil fertility evaluation, Soil nutrient assessment, Soil sampling, Soil pH.

Soil pH

Soil pH is a crucial soil indicator, and is defined as the negative log of the hydrogen ion activity. Since pH is logarithmic, the H-ion concentration in solution increases ten times when its pH is lowered by one unit. The pH range normally found in soils varies from 3 to 9. The significance of pH lies in its influence on availability of soil nutrients, solubility of toxic nutrient elements in the soil, physical breakdown of root cells, and CEC in soils whose colloids(clay/humus) are pH-dependent and biological activity. At high pH values, availability of P, and most micronutrients, except B and Mo, tends to decrease .Acid soils are rare in semi-arid, dry-land areas of the world; they tend to occur in temperate and tropical areas where rainfall is substantial; conversely, soils of drier areas are generally alkaline, i.e., above pH 7.0, as a result of the presence of $CaCO_3$, and will visibly effervesce (fizz) when 10%hydrochloric acid (HCl) is added drop wise to the soil

Table 1: Various categories of soil pH

Sl. No	Category	pH Levels
1	Strongly acid	pH < 5.0
2	Moderately to slightly acid	5.0-6.5
3	Neutral	6.5-7.5
4	Moderately alkaline	7.5-8.5
5	Strongly alkaline	> 8.5

Apparatus Required: pH meter with combined electrode, Reference Electrode, Saturated KCl, Measuring cylinder, Glass rod, Glass beaker

Reagents

pH 4.0 buffer solution,pH 7.0 buffer solution,pH 9.2 buffer solution.

Procedure for pH Measurement

Weigh 50 g air-dry soil (< 2-mm) into a 100-mL glass beaker

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Add 50 ml distilled water using a graduated cylinder or 50 ml volumetric flask.

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Mix well with a glass rod, and allow to stand for 30 minutes.

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Stir suspension every 10 minutes during this period

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Calibrate the pH meter with standard buffer Solutions (pH 4,7 and 9.2 buffer)

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Put the combined electrode in suspension (about 3-cm deep).
Take the reading after 30 seconds with one decimal.

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Remove the combined electrode from the suspension, and rinse thoroughly with distilled water in a separate beaker, and carefully dry excess water with a tissue.

Soil EC

Soil salinity refers to the concentration of soluble inorganic salts in the soil. It is normally measured by extracting the soil sample with water (1:2.5 soil: water ratio) or in an extract saturated paste. However, Soil: Solution ratios of a 1:1 or wider are more convenient where the quantity of soil is limited. Such extracts are rapid, and salinity is measured by electrical conductivity (EC) using a conductivity bridge. The total salt content of a soil can be estimated from this measurement.

Sl. No	EC Levels	Category
1	< 1	Normal
2	1-2	Critical for Germination
3	2-4	Critical for growth of sensitive crops
4	Above 4	Injuries to most crops

Apparatus Required: Conductivity Bridge

Potassium Chloride Solution (KCl), 0.01 *N*

- Dissolve 0.7456 g KCl in distilled water and transfer to 1-Litre flask, mix well, and bring to volume.
- This solution gives an electrical conductivity of 1.413 dS/m at 25 °C.

Procedure for EC Measurement

1. Weigh 50 g air-dry soil (< 2-mm) into a 100-mL glass beaker
2. Add 50 ml distilled water using a graduated cylinder or 50 ml volumetric flask.
3. Mix well with a glass rod, and allow to stand for 30 minutes.
4. Stir suspension every 10 minutes during this period
5. Calibrate the EC meter with standard buffer Solutions
6. Immerse the conductivity cell in the solution, and take the reading.
7. Remove the conductivity cell from the solution, rinse thoroughly with distilled water, and dry excess water with a tissue.

Soil Organic Matter

Soil organic matter (SOM) represents the remains of roots, plant material, and soil organisms in various stages of decomposition and synthesis, and is variable in composition. Though occurring in relatively small amounts in soils, organic matter (OM) has a major influence on soil aggregation, nutrient reserve and its availability, moisture retention, and biological activity. Soil Organic Carbon (SOC) ranges from being the dominant constituent of peat or muck soils in colder regions of the world to being virtually absent in some desert soils. However, the most common procedure involves reduction of potassium dichromate ($K_2CR_2O_7$) by Organic Compounds and subsequent determination of the unreduced dichromate by oxidation-reduction titration with ferrous ammonium sulphate. This method is referred to as the Walkley-Black method (Walkley, 1947; FAO, 1974).

Reagents required

1. Potassium Dichromate Solution ($K_2Cr_2O_7$) - 1 N
   - ✓ Dissolve 49.04 g K2Cr2O7 in distilled water, and bring to 1 litre volume.
2. Ferrous Ammonium Sulphate- 0.5 N
   - ✓ 196 grams of ferrous ammonium sulphate dissolved in 1 litre of distilled water and add 15 ml of concentrated sulphuric acid (H_2SO_4).
3. Diphenylamine indicator
   - ✓ 0.5 g of Diphenylamine + 90 ml of Conc H_2SO_4 + 10 ml distilled water.

Procedure for Organic Carbon Estimation

- ➢ Weigh 0.5 g air-dry soil (< 0.5mm) into a 500ml Conical flask (Blank Without Soil)
- ➢ Add 10 ml of 1N Potassium Dichromate ($K_2CR_2O_7$) and Mix well.
- ➢ Add 20 ml of conc H_2SO_4 and mix well for one minute (Keep on Tiles while adding).
- ➢ Allow for 20-30 mins
- ➢ Then add 200 ml of distilled water to dilute.
- ➢ Add 10 ml of orthophosphoric acid
- ➢ Add 1 ml of diphenylamine indicator (Colour changes from light orange to Blue Colour)
- ➢ Titrate against 0.5 N ferrous ammonium sulphate
- ➢ Dull green at Beginning
- ➢ Finally turns to Bright green

Conclusion

Measuring soil pH, electrical conductivity, and major nutrients using proven laboratory methods and practical field tools provides the foundation for growing healthy crops while caring for the environment. Whether you're using precise laboratory equipment or quick field kits, these measurements tell you the true story of your soil's fertility. When combined with proper sampling, good record-keeping, and locally proven interpretation guides, soil testing becomes your most important tool for deciding how much fertilizer to apply, protecting water quality, and keeping soil healthy for crops, livestock, and the future.

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