CIFOR World Agroforestry	**SOP 005**	**Date: 11.09.2023** **Author:** Robin Chacha and Lukelysia Mwangi **Authorizer:** David Lelei

STANDARD OPERATING PROCEDURE

METHOD FOR ANALYSING SOIL pH IN WATER

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Changes in this version compared to previous version:

Inclusion of principles of effects and measurement of hydronium ion in soil

Contents

1. INTRODUCTION

Soil pH is one of the most important properties of soil that affects plant growth and productivity. Soil pH influences nutrient availability, microbial activity, and soil structure. Therefore, accurate measurement of soil pH is crucial for effective soil management, plant growth, and sustainable agriculture practices.

The purpose of this SOP is to provide a standardized procedure for the measurement of soil pH in the laboratory. This SOP will outline the equipment and materials needed, the steps for soil sample preparation, and the method for pH measurement using a pH meter. This procedure is intended for use by trained laboratory technicians or researchers to ensure consistency and accuracy in soil pH measurements.

It is important to note that soil pH can vary significantly within a single field, so proper sampling techniques should be employed to ensure representative samples. Furthermore, soil pH can be influenced by various factors such as soil type, organic matter content, and soil amendments. Therefore, it is recommended to follow this SOP in conjunction with other soil analyses to better understand the factors influencing soil pH.

2. SCOPE AND APPLICATION

This is a Standard Operating Procedure developed and validated for determining pH in soil. This standard method uses a soil: water ratio of 1:2.5. The pH of buffer solutions should bracket the expected pH values of soil samples. The scope of this SOP includes the measurement of soil pH in the laboratory using a pH meter. It is applicable to a wide range of soil types and can be used for various research or analytical purposes. This SOP outlines the steps for soil sample preparation, pH measurement, pH meter calibration, quality control measures, data recording, and reporting. This SOP is intended for use by laboratory technicians, researchers, or agricultural professionals involved in soil fertility assessment, soil quality monitoring, soil amendment evaluation, plant growth and productivity studies, or environmental impact assessments. The accurate and reliable measurement of soil pH is critical for understanding soil health and nutrient availability, and this SOP provides a standardized procedure for pH measurement to ensure consistency and accuracy in results.

3. PRINCIPLE

The soil pH is a measure of the numerically equal to 7 for soil with a neutral pH, increasing with rising alkalinity and falling with increasing acidity. It is defined as the negative logarithm (base 10) of the concentration of aqueous cation of H30 ions in a solution. In water, it normally ranges from 1 to 14, with 7 being neutral. A pH below 7 is acidic and above 7 is alkaline. Soil pH is a master variable in soils because it controls many chemical processes that take place in the soil. It specifically governs the availability of nutrients to plants by controlling the chemical forms and processes of the nutrient. The optimum pH range for most plants is between 5.5 and 7.0, however many plants will adapt to pH values outside this range. Soils with a pH of less than 5.5 are considered acidic, due to the presence of exchangeable aluminum that affects root growth and the uptake of nutrients.

4. PROCEDURES

4.1 REQUIREMENTS

- **Equipment**
  a) pH meter
  b) Reciprocal Shaker (Edmund Bhuler Equipment)
- **Materials & Supplies**
  a) Combination electrode for pH meter
  b) Calibrated spoon, 10 mL (Custom Laboratory Equipment)
  c) Plastic bottles, 60 mL, with holders (Custom Laboratory Equipment)
- **Chemicals**
  a) pH 4 buffer
  b) pH 7 buffer
  c) pH 10 buffer

4.2 EXTRACTION

- Analyses are conducted in batches of 33 with 30 soil samples, 2 repeated samples and 1 standard soil sample.
- Scoop 10 mL of soil and add to 60 mL bottle.
- Add 25 mL distilled water to bottle with dispenser.
- Shake for 10 minutes on a reciprocal shaker.
- Let stand for 20 minutes then shake again for 2 minutes

4.3 CALIBRATION OF PH METER

- Immerse the electrode into pH 7 buffer.
- After the reading stabilizes (about 1 minute), adjust the buffer knob on the meter to read 7.00.
- Remove electrode, rinse with distilled water, and touch off the remaining drop of water with tissue paper. NOTE: Do not wipe the electrode tip with the tissue, as this can create static charge and cause unstable readings.
- Immerse the electrode into pH 4 buffer. After 1 minute, adjust the slope (or sensitivity) knob of the pH meter to read 4.00.
- Repeat the calibration until the values obtained for pH buffers agree within ± 0.02 pH unit of the theoretical values.

5. OCCUPATIONAL HEALTH AND SAFETY

- Laboratory dress code: clean laboratory coats and only closed low-heeled shoes should be worn while performing the procedure.
- All activities performed under this SOP comply with the recommendations of CIFOR-ICRAF Health and Safety policy.

6. MAINTENANCE

- Regular maintenance schedule and proper storage of Ph electrode will minimize performance and help to extend the life of the electrode.
- Inspect electrode for scratches, cracks salt crystals built up on membrane/liquid junction deposits.
- Use a dedicated electrode storage solution (Buffer 4.01) to keep the electrode in proper working order.
- Constant use of this solution will keep the electrode ready to use and provide a fast stable response.

7. QUALITY CONTROL

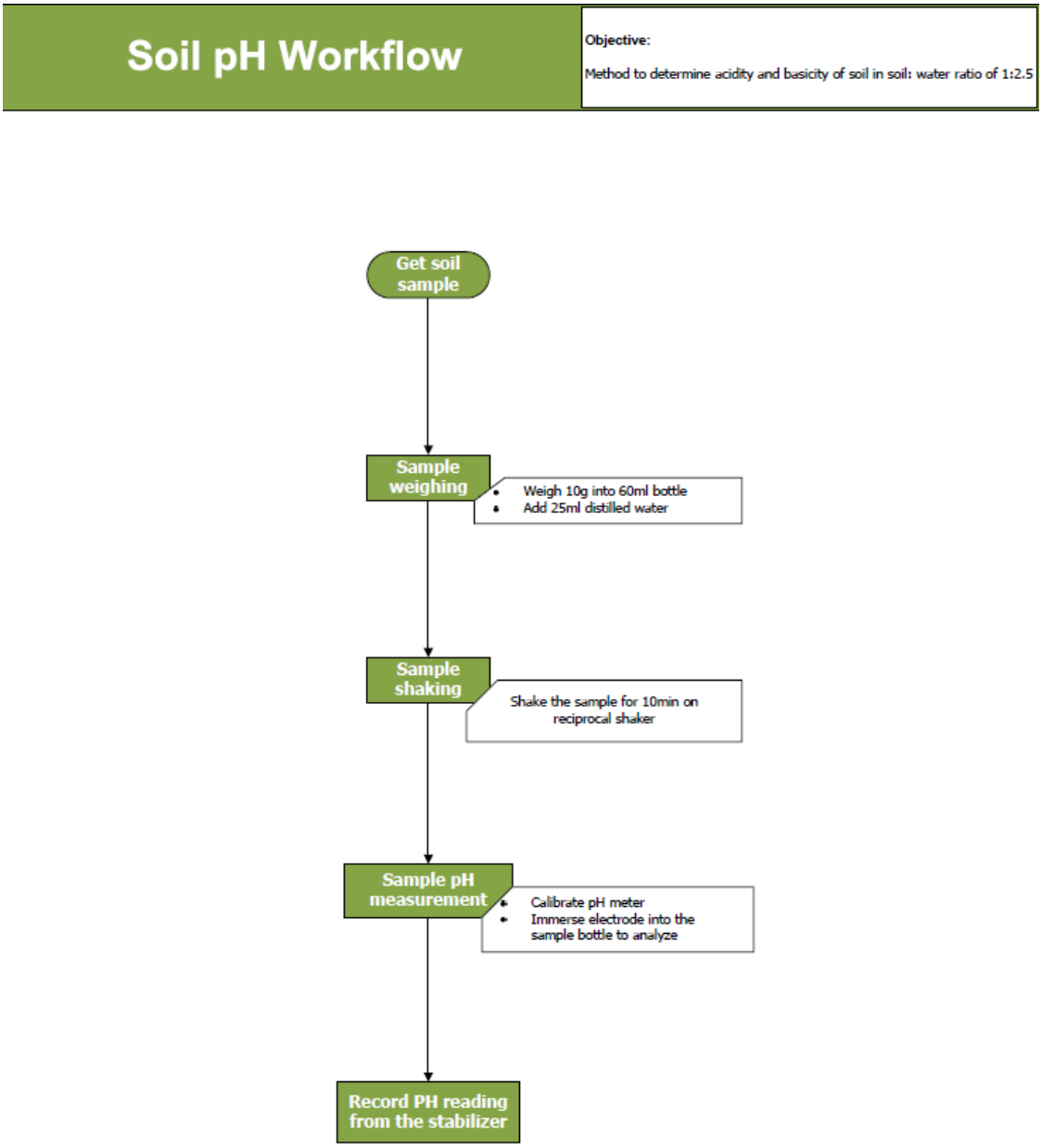
1 Volume of standard pipetted is checked by weight at time of preparation. 9.2 Blank: DI water twice each analysis batch. 9.3 Quality Control Check Sample: sample run once each analysis batch. 9.4 Method Detection Limit (MDL): Established for each analyte. Based on a one-sided 99% confidence interval (t-value) from at least seven repeated measurements of a low concentration standard. The t-distribution value is multiplied by the standard deviation of the population (n-1) to obtain the MDL. 9.5 Analytical Duplicate: Separate analysis from the same sample aliquot. Run a minimum of once each analysis set.

8. REFERENCES

1. Schofield, R. K., & Taylor, A. W. (1955). The measurement of soil pH. *Soil Science Society of America Journal*, *19*(2), 164-167.
2. Thomas, G. W. (1996). Soil pH and soil acidity. *Methods of soil analysis: part 3 chemical methods*, *5*, 475-490.
3. Thomas, G. W. (1996). Soil pH and soil acidity. *Methods of soil analysis: part 3 chemical methods*, *5*, 475-490.

8. ANNEXES

1 ANNEX 1: Workflow



8.2 ANNEX 2: Reference Standard factsheet

Reference standard	Origin	Calibration	Frequency
SOIL REFERENCE MATERIAL			
Buffer 4	Commercial standard	Instrument calibration & quality control	Every sample batch
Buffer 4	Commercial standard	Instrument calibration & quality control	Every sample batch
Buffer 4	Commercial standard	Instrument calibration & quality control	Every sample batch
Katumani soil	KALRO, research Station,	Quality control	Every sample batch