

Soil pH and Sikora Lime Requirement

1. Application

This method covers the determination of soil pH in water using a 1:1 soil:solution ratio and in a buffer solution with a 1:1:1 soil:water:buffer ratio. The lime requirement is calculated from the two pH readings.

2. Summary of Methods

Soil pH is measured in water using a pH meter with a combination reference glass electrode. For those soils with a pH below 6.6 a Sikora buffer solution with a pH of 7.70 ± 0.01 is added and the Sikora-pH is measured. Depression of buffer pH by the soil gives an indication of the soil's pH buffering capacity.

3. Safety

Each chemical compound should be treated as a potential health hazard. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material handling data sheets should be made available to all personnel involved in the chemical analysis.

4. Interferences

High salt concentrations depress soil pH by displacement of exchangeable H^+ and Al^{3+} into solution. (In states where soil salinity is a problem, pH is often measured in 0.01 M $CaCl_2$.)

5. Apparatus and Materials

- 5.1 Soil scoop calibrated to hold 10 g of light-colored silt loam soil
- 5.2 Plastic vials with caps, 13-dram (45 ml)
- 5.3 Time-controlled oscillating shaker (Eberbach) set at 180 oscillations per minute
- 5.4 Constant suction pipette apparatus
- 5.5 Pipettes (10 ml)
- 5.6 Brinkman bottle-top dispenser capable of dispensing 10 ml
- 5.7 pH meter (Fisher Scientific Accumet Model No. AR25) with combination reference-glass electrode (Orion, Ross[®] Sure-Flow[™] combination, epoxy body Model No. 8165)

6. Reagents

- 6.1 Sikora buffer solution: for every liter of solution, dissolve 149 g of potassium chloride (KCl, mw: 74.55) in approximately 750 mls of deionized water. Add 5.11 mls of glacial acetic acid (CH_3COOH , mw: 60.05). Stir thoroughly. Add 6.70 g MES (2-(N-morpholino) ethanesulfonic acid monohydrate) ($\text{C}_6\text{H}_{13}\text{NO}_4\text{S}\cdot\text{H}_2\text{O}$, mw: 213.25). Stir until dissolved. Add 0.936 g of imidazole ($\text{C}_3\text{H}_4\text{N}_2$, mw: 68.08) and stir until dissolved. Add 9.23 mls triethanolamine [$(\text{HOCH}_2\text{CH}_2)_3\text{N}$, mw: 149.19]. Stir thoroughly. Add 5 mls sodium hydroxide (40% NaOH) [w/w]. Stir thoroughly. Adjust the volume to 1 liter by adding deionized water. Allowing time for the solution pH to stabilize, add drops of 40% NaOH (w/w) or 50% HCl (v/v) to achieve a pH of 7.70 ± 0.01 . Place 50 mls of the buffer in a beaker and measure pH. The pH should be 7.70 ± 0.01 . Add 50 mls of deionized water to the buffer, stir, and measure pH. The pH should be 7.53 ± 0.03 . Add 5 mls of the 0.5 M HCl to the 1:1 dilution buffer, stir, and measure pH. The pH should be 5.68 ± 0.06 .

7. Methods

- 7.1 Place a 10 g scoop of soil into a 13-dram vial.
- 7.2 Add 10 mls of deionized water by means of constant suction pipette.
- 7.3 Let stand at least 10 minutes.
- 7.4 Read the pH with the pH meter. Stir each sample and allow electrode to sit until pH meter equilibrates. This is the water pH of the soil.
- 7.5 If the water pH of the soil is 6.6 or greater, it will not be necessary to proceed further with the Sikora buffer test. Samples with a pH below 6.6 will need further testing with the Sikora buffer.
- 7.6 Sikora buffer test: Add 10 mls of Sikora buffer solution to the sample with the Brinkman bottle-top dispenser set at 10 mls.
- 7.7 Cap the sample vial and place in a horizontal position on an oscillating shaker. It is important that the vial be placed in a horizontal position for thorough sample mixing.
- 7.8 Shake the sample for 10 minutes.
- 7.9 Read the pH with the glass electrode pH meter making sure all of the soil is in the buffer solution. This is the Sikora-pH. It is not necessary to stir the sample just before reading the pH, provided they are read within an hour after the final shaking.

8. Calculations

The lime requirement calculations use water pH of the soil, Sikora-pH, and the target pH, which is based on the most acid sensitive crop to be grown. It is calculated by computer in the soil test recommendation program. The lime requirement equations can be found in table 5.1 of UW-Extension publication A2809, "Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin."

9. Quality Control

- 9.1 Standardization of pH meter. The pH meter must be standardized with buffer solutions of known pH. For soil testing, buffers at 4.0 and 7.0 are usually used because these buffers are readily available and this pH range covers most soils that are likely to require liming. Standard buffers can be obtained from most chemical supply companies.
- 9.2 In addition to standardizing the pH meter at pH 4.0 and 7.0 with buffers, it is essential to check a standard soil of known pH.

10. Reporting

Report soil water pH and Sikora buffer pH to ± 0.1 -pH unit.

11. References

- 11.1 Laboski, C.A.M., Peters, J.B. and Bundy, L.G. 2006. Nutrient Application Guidelines for field, vegetable, and fruit crops in Wisconsin. UW-Extension Publication A2809. UW-Madison Cooperation Extension Publications, Madison, Wisconsin.
- 11.2 Sikora, F.J. 2006. A buffer that mimics the SMP buffer for determining lime requirement of soil. *In Soil Sci. Soc. Am. J.* 70:474-486. SSSA, Madison, Wisconsin.
- 11.3 Watson, M.E., and Brown, J.R. 1998. pH and lime requirement. pp 13-16. *In* J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for North Central Region, NCR Publ. No. 221 (revised). Missouri Agr. 0045p. Sta. SB 1001. Columbia, MO.