

Phosphorus for Forest Soil

1. Application

This procedure covers the extraction and analysis of plant available phosphorus (P) in forest soil.

2. Summary of Methods

Plant available phosphorus (P) is extracted from the soil with 0.002 N sulfuric acid. The extracted P is reacted with a sulfuric-molybdate to form a blue phosphomolybdate compound in the presence of a reducing agent.

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

Color development is complete in 15 minutes but will continue at a slow rate. For this reason, samples should be read within two hours. Arsenic forms a blue molybdate complex but is usually present in very low amounts unless a special arsenical pesticide has been applied in the past.

Very high soil pH interferes with phosphorus by this extraction method.

5. Apparatus and Materials

- 5.1 Soil scoop calibrated to hold 1.5 g of forest soil.
- 5.2 Erlenmeyer flasks (500 ml)
- 5.3 Pipette banks
- 5.4 Time-controlled oscillating shaker (Eberbach) set at 160 excursions per minute.
- 5.5 Filter paper (9 cm Whatman No. 2 or equivalent).
- 5.6 Funnel tubes (15 ml).
- 5.7 Matched colorimetric tubes (10 ml).
- 5.8 UV-Vis spectrophotometer

6. Reagents

- 6.1 N/10 sulfuric acid
- 6.2 Sulfuric acid extracting solution: Dissolve 3 g of $(\text{NH}_4)_2\text{SO}_4$ in approximately 0.5 L of deionized water. Add 20 ml of N/10 sulfuric acid and dilute to 1 L with deionized water.
- 6.3 Standard phosphate solution (Weigh out 0.4394 g of KH_2PO_4 , bring to 1 liter with extracting solution. This solution contains 100 ppm of phosphorus. Prepare a second stock solution by taking 50 ml of 100 ppm Phosphorus and diluting to 1 liter with extracting solution; this solution contains 5 ppm of phosphorus. Pipette 4, 8, 12, 16, and 20 ml of the second stock solution into 100-ml volumetric flasks and bring to volume with extracting solution. These solutions contain 0.2, 0.4, 0.6, 0.8, and 1.0 ppm of phosphorus.)
- 6.4 Sulfuric-molybdate solution (Dissolve 8.5716 g ammonium molybdate, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4 \text{H}_2\text{O}$, in 500 ml of deionized water. Dissolve 0.1959 g of antimony potassium tartrate, $\text{K}(\text{SbO})\text{C}_4\text{H}_4\text{O}_6 \cdot \frac{1}{2} \text{H}_2\text{O}$, in the above solution. Slowly add 100 ml of H_2SO_4 and mix well.) Let cool and dilute to 1 liter. Store in a brown polyethylene or Pyrex bottle in a refrigerator.
- 6.5 Ascorbic acid solution (Dissolve 0.528 g of ascorbic acid in 30 ml of deionized water. Prepare fresh each day.)
- 6.6 Color reagent (Add 30 ml of ascorbic acid solution to 70 ml of sulfuric-molybdate stock solution. This solution should be made fresh daily.)

7. Methods

- 7.1 Place a 1.5 g scoop of soil into a 500-ml Erlenmeyer flask.
- 7.2 Add 150 ml of 0.002 N sulfuric acid.
- 7.3 Shake the suspension on shaker for 30 min.
- 7.4 After shaking, immediately filter suspension through filter paper. Filtrate should be discarded until clear.
- 7.5 Place 5 ml of filtrate into a clear 10-ml tube and add 1 ml of sulfuric-molybdate and ascorbic acid solution.
- 7.6 Shake tube and wait 15 minutes.
- 7.7 Transfer solution to a colorimeter tube.
- 7.8 Percent transmittance is determined by a spectrophotometer set at 882 m μ or by a filter colorimeter at 660 m μ , and concentration of P is determined using a standard curve.

8. Calculations

In lieu of direct calibration of the colorimetric scale, calculate extractable P, ppm P in soil = ppm P in solution x 150 ml/1.5 g = ppm P in solution x 100.

9. Quality Control

- 9.1 Laboratory Reagent Blank (LRB) – At least one LRB is analyzed with each batch of samples to assess contamination from the laboratory environment. Contamination from the laboratory or reagents is suspected if LRB values exceed the detection limit of the method. Corrective action must be taken before proceeding.
- 9.2 Standard soil – One or more standard soils of known extractable forest P content are analyzed with each batch of samples to check instrument calibration and procedural accuracy.

10. Reporting

Results are reported as ppm P in soil. (Strictly speaking, the results should be reported as Mg P per dm³ of soil because a known volume, rather than a weight is used. This is not a familiar unit however. Use of a volume of soil is reasonable because it represents a volume-fraction of an acre plow layer.)

11. References

- 11.1 Truog, 1930. Journal Am. Soc. Agr. 22 (pgs 874-882)
- 11.2 Murphy and Riley, 1962.
- 11.3 Wilde, S.A., R.B. Corey, J.G. Iyer and G.K. Voigt. 1979. Soil and Plant Analysis for Tree Culture. Oxford IBH, Bombay and New Delhi. Reprinted 1985.