Department of Sustainable Natural Resources

SOIL SURVEY STANDARD TEST METHOD

AVAILABLE PHOSPHORUS: BRAY NO 1 EXTRACT

ABBREVIATED NAME	BP
TEST NUMBER	C8
TEST METHOD TYPE	A
VERSION NUMBER	3-1
ADOPTION DATE	1995

RECORD OF AMENDMENTS

Version	Date	Reason for/Nature of Amendment	Authorised By
3	1995	Save time and minimise glassware by extracting in the centrifuge tubes and developing the colour in the spectrophotometer tubes.	B Craze

CAUTION: This procedure involves the use of hazardous chemicals. Refer to laboratory safety guidelines before proceeding.

SCOPE

This test outlines the procedure for the determination of available phosphorus in soils. Bray No 1 solution is designed to extract adsorbed forms of phosphate only and is for use with soils with a pH <7.5.

PRINCIPLE

Phosphorus is extracted from the soil using Bray No 1 solution as extractant. The extracted phosphorus is measured colourimetrically based on the reaction with ammonium molybdate and development of the 'Molybdenum Blue' colour. The absorbance of the compound is measured at 882 nm in a spectrophotometer and is directly proportional to the amount of phosphorus extracted from the soil.

SPECIAL APPARATUS

- Centrifuge (6 000 rpm).

- Diluter/Dispenser (Brand Diluette® Cat No 7046 54).

- High strength centrifuge tubes with caps (15 mL capacity).

- Spectronic 20 photometer with 10 mL tubes.

REAGENTS

Bray No 1 Extracting Solution

Dissolve 2.22 g Ammonium Fluoride A.R. (NH_4F) in deionised water and transfer to a 2 L volumetric flask. Add 5 mL concentrated hydrochloric acid and bulk to volume with deionised water.

Reagent A

Dissolve 17.14 g ammonium molybdate A.R. [$(NH_4)_6Mo_7O_{24}.4H_2O$] in 200 mL of warm deionised water. Dissolve 0.392 g potassium antimonyl tartrate A.R. ($KSbO.C_4H_4O_6$) separately in 150 mL deionised water. Place 500 mL deionised water in a 2 L volumetric flask and slowly add 200 mL concentrated sulphuric acid with mixing. When cooled, add the cooled molybdate and tartrate solutions, then mix and bulk to volume with deionised water.

Reagent C

Dissolve 0.53 g L-Ascorbic Acid A.R. ($C_6H_8O_6$) in deionised water and transfer to a 500 mL volumetric flask. Add 70 mL of Reagent A and bulk to volume with deionised water. Prepare fresh a volume of this solution sufficient for the day's work by proportioning the above quantities.

Standard Phosphorus Solution (P ≡ 50 mg/L)

Dissolve 0.2195 g potassium dihydrogen orthophosphate A.R. (KH_2PO_4) in 100 mL deionised water, transfer to a 1 L volumetric flask, add 5 mL concentrated sulphuric acid (A.R.) and bulk to volume with deionised water.

Phosphorus Working Standard (P ≡ 2.50 mg/L)

Pipette 5 mL standard phosphorus solution into a 100 mL volumetric flask and bulk to volume with deionised water.

PROCEDURE

1. Dispense 7 mL Bray Extracting Solution into the oven-dry equivalent of 1 g of air-dry soil contained in a centrifuge tube. Include one tube containing the Bray Solution only for the blank.

2. Stopper the tube and shake vigorously for 1 minute.

3. Transfer the tubes to the centrifuge and spin at 6 000 rpm for 5 minutes.

4. Dispense 0.50 mL of the supernatant plus 2.0 mL Reagent C into a colourimeter tube. Mix and stand for 30 minutes.

5. Prepare a set of reference standards from the 2.50 mg/L phosphorus solution using the diluter/dispenser and the following table as a guide:

Table 1

DILUTION TABLE FOR STANDARDS			
mls 2.5mg/L Ref.	mls Reagent C	Phos. Conc. (μg/2.5 mL)	Typical Absorbance Value
0.05	2.45	0.125	0.06
0.10	2.40	0.250	0.09
0.20	2.30	0.500	0.17
0.30	2.20	0.750	0.26
0.40	2.10	1.000	0.34
0.50	2.00	1.250	0.40

6. Set instrument zero (∞ Abs.) and then set full scale (zero Abs.) using the blank solution prepared above.

7. Measure and record the absorbance of the standards and samples at wavelength 882 nm.

8. Prepare a chart or graph from the standards data to plot phosphorus concentration against absorbance, or derive the equation of the line of best fit using linear regression. Use the chart or equation to determine the phosphorus concentration in the sample solutions.

CALCULATIONS

Calculate Available Phosphorus content.

$$Available\ Phosphorus\ (mg/kg) = \frac{C\ x\ 14}{ODW}$$

Where:
C   =   Phosphorus concentration from chart/equation (μg/2.5 mL)
ODW   =   Oven-dry sample weight (g)
14   =   Dilution factor

REPORTING THE RESULTS

Report the Bray No 1 available phosphorus results in mg/kg as a whole number.

REFERENCES

Bartlett, GN, Craze, B, Stone, MJ & Crouch, R (ed) 1994, *Guidelines for Analytical Laboratory Safety*. Department of Conservation & Land Management, Sydney.

Bray, RH & Kurtz, LT 1945, Determination of total, organic, and available forms of phosphorus in soils. *Soil Science*, 59: 39-45.

Menage, PMA & Pridmore, B 1973, Automated determination of phosphate using Bray No 1 Extractant. CSIRO Division of Soils. *Notes on Soil Techniques*, pp80-82.