

Available Boron

1. Application

This method covers extraction and analysis of available boron (B) in soil, using hot, distilled water as the extractant and colorimetric analysis of the extracted B.

2. Summary of Methods

Boron is extracted with near-boiling deionized water on a heating block. Boron in the extract is reacted with curcumin to form an orange-colored complex. The concentration of B is determined colorimetrically, or by UV-Vis spectrophotometry.

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.

Normal precautions and common sense with heating blocks must be followed.

4. Interferences

Soluble organic matter, moisture, and sediment give positive interferences. Activated charcoal can be used to remove color from extracts of organic soils. Moisture is removed by heating an aliquot of the extract, and turbidity is avoided by flocculating colloids with CaCl_2 and by careful filtration. Samples should be filtered while still hot to prevent reabsorption of boron.

5. Apparatus and Materials

- 5.1 Soil scoop calibrated to hold 10 g of light-colored silt loam soil
- 5.2 Folin digest tubes, 50-ml
- 5.3 Heating block capable of reaching 150° C
- 5.4 Filter paper, boron free (11 cm Whatman #40 or equivalent)
- 5.5 Pipetting device, 0.5-ml, 2-ml, and 10-ml
- 5.6 Beaker, 50-ml, polypropylene
- 5.7 Water bath or oven, 55° ± 3° C
- 5.8 Colorimeter tubes
- 5.9 Vortex stirrer or similar
- 5.10 Colorimeter or spectrophotometer

6. Reagents

- 6.1 Curcumin reagent: Dissolve 0.04 g of curcumin and 5 g oxalic acid in 100 ml of 95% ethanol. Store in freezer. Prepare fresh reagent weekly.
- 6.2 Standard B solution (100 ppm B):
- 6.3 Working B standards (0.25, 0.5, 1.0, and 2.0 ppm B)

7. Methods

- 7.1 Transfer a 10 g scoop of soil to a 50-ml folin digestion tube.
- 7.2 Add 20 ml of deionized water.
- 7.3 Place in a heating block set at 125° C, which has been preheated to approximately 85° C.
- 7.4 Bring samples to a boil and continue to boil samples for 3 to 5 minutes, stirring frequently.
- 7.5 Remove from heat, stir and filter immediately through B-free filter paper.
- 7.6 Place a 0.5-ml aliquot of the filtrate into a 50-ml polypropylene beaker.
- 7.7 Add 2-ml of curcumin reagent, and mix thoroughly.
- 7.8 Evaporate to dryness in a 55° ± 3° C oven.
- 7.9 After all visible liquid has disappeared; continue to heat for 15 min.
- 7.10 Add 10 ml of 95% ethanol, and stir to dissolve residue.
- 7.11 Transfer to a colorimeter tube.
- 7.12 Read the color at 540 nm. within 2 hours with a colorimeter or UV-Vis spectrophotometer.
- 7.13 Calibrate the instrument to read directly in ppm B in soil using the working B standards. These standard preparations are treated in the same manner as the soil extracts.

8. Calculations

(Note: intermediate dilutions are not included because standards and soil extracts are diluted alike.)

$$\text{ppm B in soil} = \text{ppm B in final solution}$$

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 B content is analyzed with each batch of samples to check for instrument calibration and procedural accuracy.

10. Reporting

Results are reported as ppm B in soil.

11. References

- 11.1 Berger, K.C., and E. Truog. 1964 Soil Sci. Soc. Am. Proc. 10: 113.
- 11.2 Dible, et. Al. 1954. Anal. Chem. 26: 418
- 11.3 Watson, M.E. 1998. Boron. Pp. 45-48. *In* J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region. NCR Publ. No. 221 (revised). Missouri Agr. Exp. Sta. SB 1001. Columbia, MO.