Available Soil Manganese

1. Application

This procedure covers the extraction and analysis of plant available manganese (Mn) from soil.

2. Summary of Methods

Available manganese is extracted with 0.1 $\underline{N}$ H_3PO_4. The extracted Mn is determined by (AA) atomic absorption 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.

4. Interferences

Ca, Fe, and Al may interfere unless masked by a manganese buffer.

5. Apparatus and Materials

5.1   Soil scoop calibrated to hold 5 g of light-colored silt loam soil
5.2   Phillips beaker, (125 ml)
5.3   Pipettes (3, 25 ml)
5.4   Filter paper (9 cm Whatman No. 2 or equivalent)
5.5   Funnel tubes, (10 ml)
5.6   Disposable plastic test tubes (13x100)
5.7   Time-controlled oscillating shaker (Eberbach) set at 160 excursions per minute.
5.8   Atomic absorption spectrophotometer (Varian Spectra AA 220 FS with SIPS pump unit and auto sampler SPS-5)

6. Reagents

6.1   Extracting solution (0.1 $\underline{N}$ H_3PO_4): Dilute 2.28 ml of 85% H_3PO_4 to 1 liter with deionized water.
6.2   Phosphoric acid: H_3PO_4, 85 %
6.3 NH_4OAc, 1 $\underline{N}$: add 57 ml of glacial acetic acid to approximately 800 ml of deionized water in a volumetric flask. Mix thoroughly. Add 67 ml concentrated NH_4OH

slowly, in small increments, swirling flask after each increment. Mix; cool to room temperature. Adjust the pH of the solution to 7.0 with dilute NH_4OH or HOAc.

6.4 Manganese buffer (6:41-6:44)

6.4.1 Add 100 ml of 1 $\underline{N}$ NH_4OAc to a 1 liter volumetric flask, and dilute to approximately 300 ml with deionized water.

6.4.2 Add 37.2 g of Na_2EDTA, and swirl to dissolve.

6.4.3 Dissolve 0.88 g of $CaCl_2 \cdot 2H_2O$, 0.24 g $FeCl_3$, and 0.49 g $Al_2(SO_4)_3 \cdot 18H_2O$ in approximately 100 ml of deionized water and transfer to above solution.

6.4.4 Add 35 ml of concentrated NH_4OH, dilute to 1000 ml with deionized water, and mix thoroughly.

6.5 1000 ppm Mn stock solution

6.6 8 ppm Mn Bulk Std. (4 ml 1000 ppm Mn stock solution diluted to 500 ml with 1:1 mixture of 0.1 $\underline{N}$ Phosphoric Acid: Mn Buffer solution)

7. Method

7.1 Place a 5 g scoop of soil into a 125 ml Phillips beaker.

7.2 Add 25 ml of extracting solution with a pipette.

7.3 Shake on an oscillating shaker for 15 minutes.

7.4 Filter into funnel tubes through filter paper.

7.5 Dilute 3ml of soil extract with 3 ml of manganese buffer and mix.

7.6 Determine Mn by AA using a bulk Mn standard containing 8ppm Mn, which is then diluted by the AA to make as many standards as the user specifies.

8. Calculations

8.1 ppm Mn in soil = ppm Mn in solution x 5, where ppm Mn in solution is the concentration in the initial soil extract or the standard solutions before dilution.

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

10. Reporting

Results are reported as ppm available Mn in soil.

11. References

11.1 Hammes, J.K., and K.C. Berger. 1960. Soil Sci. 90:239-244.

11.2 Randall, G.W., E.E. Schulte, and R.B. Corey. 1976. Correlation of plant manganese with extractable soil manganese and soil factors. Soil Sci. Soc. Am. J. 40:282-287.

11.3 Whitney, D.A. 1998. Micronutrients: Zinc, iron, manganese, and copper. Pp. 41-44. 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.