

Mehlich 3 extraction protocol

Description

Mehlich 3 (M3) estimated plant available micro- and macro-nutrients on soils. It correlated well with crop response to fertilizer P. During the extraction, P is solubilized by several different mechanisms. (1) nitric and acetic acid increases the solubility of Fe and Al- phosphates and extracts a portion of calcium phosphates if present. (2) Acetic acid buffers the solution below pH 2.9 to prevent calcium fluoride from precipitating. (3) FI will complex Al^{2+} that potentially bind with P. (4) NH_4^+ exchanges with potassium, calcium and magnesium and EDTA chelates iron, manganese, zinc, and copper

P and cations can be determined by ICP-AES instrumentation simultaneously. P content in solution can also be determined spectrophotometrically at an acidity of 0.20M H_2SO_4 (Rodriguez et al., 1994) by reacting with ammonium molybdate using ascorbic acid as a reductant in the presence of antimony (Murphy and Riley, 1962).

Reagents

1. Ammonium nitrate (NH_3NO_3), fw = 80.05, CAS# 6484-52-2
2. Ammonium fluoride (NH_4F), fw = 37.04, CAS# 12125-01-8
3. Nitric acid (HNO_3), 68-70%, fw = 63.02, 15.5N, CAS# 7697-37-2
4. Ethylenediamine tetraacetic acid (EDTA), ($HOOCCH_2$)₂ $NCH_2CH_2N(CH_2COOH)$ ₂, fw = 292.25, CAS# 60-00-4
5. Acetic acid, glacial [CH_3COOH] fw = 60.05, CAS# 64-19-7

Mehlich 3 stock solution (5000 samples)

Ammonium fluoride-EDTA stock solution (3.75M NH_4F , 0.25M EDTA)

1. Dissolve 138.9g of NH_4F in 600 mL of deionized water
2. Add 73.06 g EDTA (or 93.06 g of $Na_2-EDTA \cdot 2H_2O$) and mix thoroughly.
3. Bring to 1000 mL final volume.

Mehlich 3 extracting solution (4L)

0.2 N acetic acid, 0.25N ammonium nitrate, 0.015N ammonium fluoride, 0.013N nitric acid, and 0.001M EDTA at pH 0.25 ± 0.05 .

1. Dissolve 80.05g NH_3NO_3 in 3L of DI water.
2. Add 16.0 mL of 3.75M NH_4F , 0.25M EDTA stock solution and mix well.
3. Add 46 mL of concentrated glacial CH_3COOH .
4. Add 3.3 mL of concentrated HNO_3 .
5. Bring to 4L final volume and check pH.
6. Adjust pH if necessary to 2.50 ± 0.05 .

Extraction

1. Weigh 2.0 ± 0.05 g of air-dried, ground soil into a 50 mL centrifuge tube.
2. Add 20.0 mL of Mehlich 3 extracting solution. Make sure to include **blanks** and **reps**.
3. Place centrifuge tubes on their sides on the shaker table for 5 minutes.
4. Immediately after shaking, filter the soil suspension through a #41 whatman filter paper into 23 mL plastic sample bottles.
5. If the samples are not analyzed right away, store them in the fridge.

Analysis

Run for ortho-phosphate on LACHAT QuikChem 8000 series by spectrophotometrically at an acidity of 0.20M H₂SO₄ (Rodriguez et al., 1994) by reacting with ammonium molybdate using ascorbic acid as a reductant in the presence of antimony (Murphy and Riley, 1962).

Calculations

Soil mass (mg/kg)

Report M3 extractable macronutrients to the nearest 0.1 mg/kg and micronutrients to the nearest 0.01 mg/kg

$$\text{Soil nutrients mg/kg} = (\text{mg/L in extract} - \text{blank}) \times 10$$

Soil pool (kg/ha)

Soil nutrients kg/ha (assuming 15 cm depth and bulk density of 1.3 g/cm³)

$$\text{Soil nutrients kg/ha} = \text{soil nutrients mg/kg} * 195$$

References

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