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) F 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\(_2\)SO\(_4\) (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\(_3\)NO\(_3\)), fw = 80.05, CAS# 6484-52-2
2. Ammonium fluoride (NH\(_4\)F), 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\(_2\)CH\(_2\)N(CH\(_2\)COOH), fw = 292.25, CAS# 60-00-4
5. Acetic acid, glacial [CH\(_3\)COOH] fw = 60.05, CAS# 64-19-7

Mehlich 3 stock solution (5000 samples)
Ammonium fluoride-EDTA stock solution (3.75M NH\(_4\)F, 0.25M EDTA)
1. Dissolve 138.9g of NH\(_4\)F in 600 mL of deionized water
2. Add 73.06 g EDTA (or 93.06 g of Na\(_2\)-EDTA•2H\(_2\)O) 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\(_3\)NO\(_3\) in 3L of DI water.
2. Add 16.0 mL of 3.75M NH\(_4\)F, 0.25M EDTA stock solution and mix well.
3. Add 46 mL of concentrated glacial CH\(_3\)COOH.
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
Soil nutrients mg/kg = (mg/L in extract – blank) x 10

Soil pool (kg/ha)
Soil nutrients kg/ha (assuming 15 cm depth and bulk density of 1.3 g/cm³
Soil nutrients kg/ha = soil nutrients mg/kg * 195

References