

Sodium bicarbonate extraction for labile phosphorus in soils

Purpose

This method is for the sodium-bicarbonate extractable phosphorus (P) and is commonly followed as part of a sequential P fractionation. Sequential P fractionation, where the lability of soil (and manure) P is characterized based on solubility in a series of extractants is a useful method to study the effects of different variables on P transformations and availability. A fairly standardized designation is separation of extracted P into labile P (water-extractable and sodium bicarbonate-extractable), moderately labile P (sodium hydroxide-extractable, assumed to be associated with amorphous Al and Fe oxides and organic matter), stable inorganic P (hydrochloric acid-extractable, assumed to be Ca-associated phosphates), and stable organic P (hydrochloric acid + ashing extractable (Hedley et al. 1982; Ruttenberg 1992; Waldrip et al. 2015).

Soil preparation Soils should be dried in an oven at 60° C for 24 hours, ground, and passed through a 2 mm sieve.

Chemicals

1. **0.5 M sodium bicarbonate** solution (42.00 g NaHCO₃/l)

Protocol

Sodium bicarbonate-extractable P

1. Weigh out 1.0 g (\pm 0.05 g) of each soil sample into 50 mL centrifuge tubes. Record the exact weight of each tube and soil sample. Duplicate all samples.
2. Calibrate a bottletop dispenser or other dispenser and add 25ml of **0.5M sodium bicarbonate solution** (pH 8.5) solution to each sample.
3. Cap all tubes tightly and shake on an orbital shaker (250 rpm) 16 hours.
4. Centrifuge tubes at 4000 x g (about 6000 rpm on VWR benchtop centrifuges) for 30 minutes (remember to balance the rotor or you will break the centrifuge).
5. Decant supernatant and pass through a 0.45- μ m glass fiber or nitrocellulose filter into a clean, labeled scintillation vial. If necessary, centrifuge sample a second time to remove more supernatant.
6. Leave ~10% of the volume of the vial empty to allow the sample to expand upon freezing by pouring off excess sample. Put samples in freezer.
7. Weigh the tube with the soil sample and entrained solution and record.
8. Save soil residue in the original tube.

* Note: Steps 7 and 8 are only for if you decide to do the next step in the sequential P fractionation.

Colorimetric analysis

Analyze all samples for P on the LACHAT using the molybdate-blue procedure. Be sure to make all calibration standards in the extraction solution matrix. For more information

on making standard curves see protocol on [making a standard calibration curve](#). You do not need to filter the standards through a filter.

References:

Hedley, M. J., J. W. B. Stewart, and B. S. Chauhan. 1982. Changes in Inorganic and Organic Soil Phosphorus Fractions Induced by Cultivation Practices and by Laboratory Incubations¹. *Soil Science Society of America Journal* 46: 970. doi:10.2136/sssaj1982.03615995004600050017x.

Ruttenberg, Kathleen. 1992. Development of a Sequential Extraction Method for Different Forms of Phosphorus in Marine Sediments. *Limnology and Oceanography* 37: 1460–1482. doi:http://www.jstor.org/stable/2837963.

Waldrip, Heidi M., Paulo H. Pagliari, Zhongqi He, R. Daren Harmel, N. Andy Cole, and Mingchu Zhang. 2015. Legacy Phosphorus in Calcareous Soils: Effects of Long-Term Poultry Litter Application. *Soil Science Society of America Journal* 79: 1601. doi:10.2136/sssaj2015.03.0090.