

Gravimetric Water Content and Soil Nutrient (NH₄, NO₃, PO₄) Pools

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Objective: To obtain soil nitrogen pools of ammonium and nitrate or soil available phosphate. Exchangeable soil nitrogen pools are determined by extracting 2mm sieved soils in 2M Potassium Chloride (KCl) or 0.5M Sodium Bicarbonate (NaHCO₃) **NOTE: if you are determining N and/or P pools and processes, you need to measure soil moisture in a subsample to determine the amount of dry grams of soil.**

Reagents:

Mixing 2N KCl:

F.W = 74.55g KCl/ M

Multiply F.W. by desired molarity 74.55

2 M KCl X 74.55 g KCl / 1 M = 149.1g KCl to 1 liter DI H₂O

20L= 2982g KCL dissolved in water

Mixing 0.5M NaHCO₃:

10L=420g NaHCO₃ dissolved in water

Calculations:

Soil moisture

Soil moisture (%) = ((soil wet wt (g)-soil dry wt (g))/soil dry wt (g))*100

Oven dry weight (g) = Soil wet wt (g)*(100/(100+(soil moisture %)))

Example calculation for pools of ammonium: After determination of NH₄-N in extract as mg NH₄-N/L or ug NH₄-N /ml, you can calculate the ug NH₄-N /g dry soil

ug NH₄-N /g dry soil = (ug NH₄-N/ml)*(X ml+(soil wet wt (g)-oven dry wt (g)))/soil oven dry wt (g)

X is the amount of extract used (typically 50 ml if extract 10 g of soil or 75ml if extract 15 g of soil)

(soil wet wt (g)-oven dry wt (g)) -this corrects for the amount of soil water in g or ml of water in soil that add to extract amount

Example calculation for net mineralization and nitrification: After determination of ug/g dry soil for KCl_i and KCl_f

Mineralization: (KCl_f NO₃+ KCl_f NH₄)-(KCl_i NO₃ + KCl_f NH₄)

Nitrification: (KCl_f NO₃-KCl_i NO₃)/days left in the dark

Soil Processing:

1. Sieve soil with 2 mm sieve to remove coarse fraction (May hand sieve with nitrile glove if low rock content and/or high clay content because will clog sieve)

Gravimetric water content

Use soil balance (3pt optimal but 2 pt is ok) to subsample for GWC (gravimetric water content)

1. Record number on pre-numbered aluminum tins on weighing spreadsheet or in lab book.
2. Tare balance to zero. Record tin weight
3. Tare tin weight.
4. Weigh out 25 g of wet soil into the tin. Record wet soil weight.
5. Put tin in drying oven at 105 degree C.
6. Pull out of oven into plastic desiccator (with desiccant) to cool.
7. Record dry weight after cooled.

Nitrogen pools and process rates

Subsample soil for N and P pools and processes

1. Label two new specimen cups with [sample ID] KCl (this will be KCl_i if doing net mineralization and nitrification: see below) and [sample ID] PO_4 .
2. Place [sample ID] KCl specimen cup on scale and record tare cup weight and then weigh out 10g of field moist soil. (**NOTE:** I like to weigh out 10g +/- 0.05 because if I forget to record, I have weight that is within 0.05 error. However, if you are in need of speed, record soil 10g +/- 0.5. This will go more rapidly).
3. Record weight of [sample ID] KCl on spreadsheet.
4. Repeat this same procedure for a "[sample ID] PO_4 " cup but use **2.0g of soil**.
5. Extract using the following process:
 - a. Add 50ml of 2M KCl or 40mL 0.5 $NaHCO_3$
 - b. Shake for 1 hr on shaker. [If in field, you can hand shake for 1 minute and then let stand overnight]
 - c. Fold Whatman 1 filters into funnels (wearing clean nitrile gloves) or Whatman 40 filters for PO_4
 - d. Pre-leach filters 2-3 times with 2M KCl or 0.5 $NaHCO_3$ with (fill funnel with KCl and allow to leach)
 - d. Label tubes with proper labels
 - e. Pour off supernatant and filter extract into labeled tube (make sure correct extract lined up with centrifuge label)
6. Save filtrate in two tubes (set A and B) or smaller tubes
7. Keep samples frozen until they are ready to be run on autoanalyzer for concentrations of inorganic nitrogen (NO_3 and NH_4) or phosphorus.

NOTE: For each batch of 10 samples, make sure to make 2 blanks (samples with no soil) and process them with the other soil samples. For example, for KCl, you will add 50ml of 2M KCl to two empty cups and then shake, filter and save solution. Make sure to label these samples as blanks.

Net mineralization and nitrification rates:

If you want to obtain net mineralization and/or net nitrification rates then in addition to the KCl specimen cup another KCl_f specimen cup will received the same 1:5 ratio of soil to KCl. The sample will then be covered with plastic wrap and a rubber band and placed in the dark for 7 days before the KCl is added and taken through the extraction process.

References

Robertson, G.P., D. Wedin, P.M. Groffman, J.M. Blair, E.A. Holland, K.J. Nadelhoffer, and D. Harris. 1999. Soil Carbon and Nitrogen Availability Nitrogen Mineralization, Nitrification, and Soil Respiration Potentials. Standard Soil Methods for Long-Term Ecological Research. G.P. Robertson, D.C. Coleman, C.S. Bledsoe and P. Sollins. New York, Oxford University Press: 115-142.