Cornell University
School of Integrative Plant Sciences

Soil Health Manual Series Fact Sheet Number 16-15

Add-on Test: Potentially Mineralizable Nitrogen

Potentially Mineralizable Nitrogen (PMN) is an indicator of the capacity of the soil microbial community to convert (mineralize) nitrogen tied up in complex organic residues into the plant available form of ammonium. Soil samples are anaerobically incubated for seven days, and the amount of ammonium produced in that period is measured as an indicator of nitrogen mineralization. This indicator has been replaced with the soil protein and respiration measurements in the CASH package, as those two separately indicate the activity of the microbial community in aerobic conditions, and the availability of N containing organic residues. However, PMN is available as an add-on test.

How PMN relates to soil function

Nitrogen is the most limiting nutrient for plant growth and yield in most agricultural situations (Fig. 1). Almost all of the nitrogen stored in crop residues, soil organic matter, manures and composts, is in the form of complex organic molecules (e.g., proteins) that are not available to plants (i.e., cannot be taken up by plant roots). We rely on several microbial species to convert this organic nitrogen into the ammonium and nitrate forms that plant roots can utilize. The PMN test provides us with one indication of the capacity of the soil biota to recycle organic nitrogen that is present into plant available forms.

FIGURE 1. Nitrogen is the most limiting nutrient in crop production. The center two rows of sweet corn are severely nitrogen deficient.

FIGURE 2 a and b. SOM building practices. (a) Rolling cover crop with a roller - crimper (green manure) and (b) applying manure (amendment).,

Managing constraints and maintaining optimal nitrogen mineralization

Building and maintaining healthy, biologically active soil with large reserves of decomposting plant tissue in organic form is a good approach to provide a crop with its N needs over time. In contrast, plants may not immediately use soluble forms of applied N and it may be lost to the environment. Soils with high levels of nitrogen-rich organic matter tend to have the highest populations of microbes involved in nitrogen mineralization and the highest PMN rates. Organic forms of N reserves are built over years and should be maintained to the extent possible.

Accumulation and retention of N in organic matter as well as stimulation of a soil's biological activity is improved by:

- Keeping the soil covered with plants or residues throughout the season.
- Increasing diversity of species in the system through rotations, interseeding, or intercropping (Fig. 2a).
- Adding fresh, microbially degradable amendments (Fig. 2b).
- Growing biomass in place by maintaining living roots for as much of the year as possible.
- Reducing the use of biocides such as pesticides, fungicides, and herbicides.

Beneficial soil biological activity tends to decrease with increased soil disturbance such as tillage, heavy traffic, and compaction, as well as with extremes in low or high pH, or contamination by heavy metals or salts.

Add-on Test: Potentially Mineralizable Nitrogen

Add-on tests

The suite of soil analyses in the Cornell Assessment of Soil Health packages are all available as individual tests. Certain analyses, such as Potentially Mineralizable Nitrogen, are not part of the Basic or Standard packages but are available as add-ons or as individual tests. A complete list of the packages we offer in addition to the add-on tests is available on our website at bit.ly/CSHLPackages.

Basic protocol

- As soon as possible after sampling, the fresh soil sample (stored at 40°F) is sieved.
- Two 8g soil samples are placed into 50 ml centrifuge tubes.
- 40 ml of 2.0 M potassium chloride (KCl) solution is added to one of the tubes, which is shaken on a mechanical shaker for 1 hour, and filtered.
- 20 ml of the filtrate is collected from this tube and analyzed for ammonium concentration, as a measure of pre-incubation ammonium.
- 10 ml of distilled water is added to the second tube, which is hand shaken, capped with a nitrogen gas (N_2) atmosphere, and incubated for 7 days at 30°C (86°F).
- After the 7 day anaerobic incubation, 30 ml of 2.67 M KCl is added to the second tube (creating a 2.0 M solution). The tube is shaken, filtered, and the filtrate is collected and analyzed for ammonium concentration (Fig. 3).
- The difference between the pre-incubation and post-incubation measurements is used as an indicator of N mineralization.

FIGURE 3. Potentially Mineralizable Nitrogen (PMN) processed in the lab. The difference between pre-incubation and post-incubation measurements of ammonium is used as an indicator of N mineralization.

Scoring function

Results of the Potentially Mineralizable Nitrogen analysis are provided in a table sent as a separate file outside of the CASH report. However, measured values are scored using the scoring function in Figure 4 below. Scoring functions were combined for all textural classes because no effects due to texture were observed in the data set.

The red, orange, yellow, light green and dark green shading reflects the color coding used for scoring PMN results. It should be noted that extremely high N mineralization could increase losses of N to the environment, but this is not included in our interpretation.

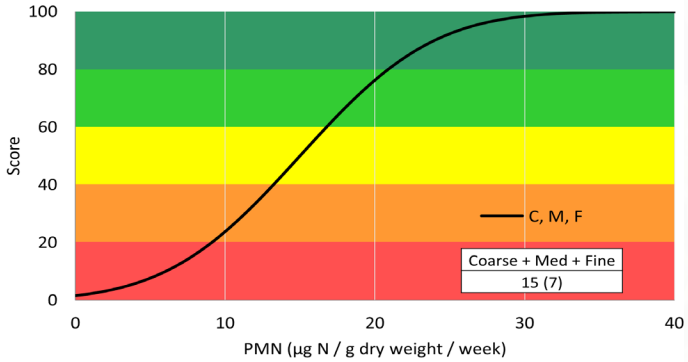

FIGURE 4. Potentially Mineralizable Nitrogen (PMN) scoring functions and upper limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) is provided. In this case higher scores indicate potentially higher levels of N rich organic matter, indicating higher levels of microbial population involved in N mineralization.

CSHL Potentially Mineralizable Nitrogen Standard Operating Procedures (CSH 08) can be found under the 'Resources' tab on our website.

For a more comprehensive overview of soil health concepts including a guide on conducting in-field qualitative and quantitative soil health assessments, please download the Cornell Soil Health Manual at bit.ly/SoilHealthTrainingManual.

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