Estimating Seasonal Soil N Mineralization from Short-Term CO_2 Evolution

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Introduction

Although the N cycle has been extensively studied, an accurate estimate of soil's in-season contribution to plant-available N is still unknown. The tight coupling of the C and N cycles provides a unique opportunity of using a biologically-based soil test to estimate N mineralization from CO_2 production. A correlation has been shown between 28-day net N mineralization and 72-Hour CO_2 evolution (Franzluebbers et. al, 2000), but no reliable estimation has been shown. The overall objective of this study is to provide a quick, reliable soil lab test to estimate soil N mineralization in order to provide a more accurate fertilizer N recommendation.

Materials & Methods

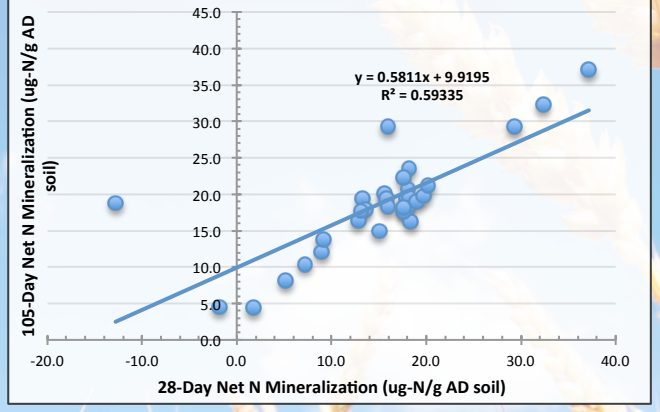
A wide variety of California soils were sampled to a depth of 30cm and tested in a lab. Parallel incubations were run to explore the relationship between long-term (105 day) net N mineralization and short-term (24 and 72-Hour) microbial respiration upon rewetting of air-dried soil.

Results & Discussion

Cumulative 24-Hour CO_2 production is highly correlated to 72-Hour correlation (R^2=0.802, data not shown), which allows for a more rapid proxy to be utilized in a soil test lab setting.

Figure 1 shows the positive correlation between 28-day and 105-day net N mineralization, although this relationship is largely due to the fact that for most soils, the majority of the mineralization was completed by day 28.

Fig. 1. The relationship between 28-day and 105-day net N mineralization.



Results & Discussion (cont'd)

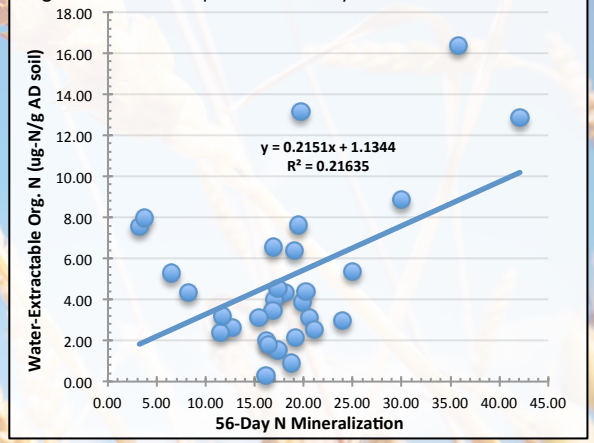
Table 1 shows the correlation between cumulative CO_2 production and N mineralization at various time points. No significant correlations were found, although the best correlation was between 72-Hour CO_2 evolution and 56-day net N mineralization.

Water-extractable organic nitrogen (WEON) provided a better estimate of soil N mineralization than any respiration measurements (Figure 2.)

Table 1. Regression coefficients relating microbial respiration to net N mineralization at various time points. The values in parentheses represent R^2 values.

	6-Hour CO_2	24-Hour CO_2	72-Hour CO_2
28-Day net N Mineralization	0.2199x + 187.86 (0.0004)	3.6227x + 429.82 (0.01887)	18.553x + 1050.3 (0.05957)
56-Day net N Mineralization	0.213x + 195.03 (0.00028)	7.1716x + 352.79 (0.05919)	28.178x + 821.15 (0.10192)
105-Day net N Mineralization	-1.5559x + 220.26 (0.0113)	3.829x + 410.82 (0.01294)	17.919x + 995.42 (0.03162)

Fig. 2. The relationship between 56-day mineralization and WEON.



Conclusions

Seasonal (105-day) N mineralization can be predicted using a shorter-term incubation of 28 days. Microbial respiration of CO_2 does not serve as a better estimator of N mineralization than current chemical indices. Further exploration of soil properties may show that within a narrower range of properties, this relationship holds, but on a broad range of CA soils, this has not yet been shown.

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Literature Cited

Franzluebbers, A.J., Haney, R.L., Honeycutt, C.W., Schomberg, H.H., Hons, F.M. 2000. Flush of Carbon Dioxide Following Rewetting of Dried Soil Relates to Active Organic Pools. Soil Science Society of America Journal 64, 2, 613.