CDFA FREP Project Suggestion: ***EVALUATION OF A 24 HOUR SOIL CO_2 TEST FOR ESTIMATING POTENTIAL N-MINERALIZATION TO REASSESS FERTILIZER N RECOMMENDATIONS.***

Project location: ***State of California***
Project duration: ***Three years***

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Problem to be addressed: (Diagnostic tools for improved fertility fertilizer recommendations)

The soil microbial biomass plays a critical role in controlling the supply of N to crops. Even where crops are dependent for N from inorganic fertilizers, turnover and activity of soil biomass often accounts for more than 50% of total crop N uptake, as indicated by studies using isotopically labeled fertilizers. Therefore, the rate of soil biological activity should serve as a reliable index of the soil's capacity to supply N and perhaps other nutrients such as P to crops. Long-term soil incubations are commonly used by researchers for this purpose but are not suitable for the quick turn-around needed by agricultural analytical laboratories to make N fertilizer recommendations. Development of a simple, rapid, and reliable method for quantifying soil biological activity contribution to available soil N has proven elusive.

Recent studies have shown the flush of CO_2 following drying and rewetting of soil with a wide range of organic mater contents mimics some natural processes and characteristics of long-term incubations and has been observed to correlate with N-supply potential. Some studies have shown that this short-term flush of soil CO_2 explained 97% of the variability in N mineralization over several weeks. However, such laboratory respirometry methods have not attracted serious attention by commercial soil labs due to the high cost of required labor, specifics of reagent handling and data interpretation. A recent development of a quick-test to capture a 24-hr CO_2 burst from a rapid-rewetting procedure can simplify laboratory processing of soils. Initial laboratory trials (2009-2010) at Rutgers University soil lab and the University of Maine have indicated promising correlations to other methods including Walkley Black-carbon (active carbon), N-mineralization (28-day extraction and 7-day anaerobic incubation) and N-uptake

infield plot studies (Temple Experiment Station, TX and UMO field plot study, Highmoor Farm ME). We will collaborate with the USDA Agricultural Research Service Soil Lab in Texas to compare our results to commercial versions available for use in soil test labs. Soils in Texas have similar organic matter contents and use irrigation making them suitable to compare to California.

The potential usefulness of a "Quick Soil CO_2 Test" in evaluating contributions of soil N from soil biological activity and from soil amendments will be evaluated. We intend to evaluate a range (up to 100) of row and specialty crop soils that vary in fertilizer N requirements, inputs of soil amendments (crop residues and manures and composts) and other management such as crop rotation and tillage. The data will be used to develop correlations to other tests such as total soil N, total soil organic matter, pre-crop nitrate levels and total crop N uptake. We will cross compare soils with the USDA ARS in TX to incorporate more soils. The success of the "Quick Soil CO_2 Test" will be determined by its good correlation with soil N mineralization potential and growing season crop N uptake. We will also evaluate the cost effectiveness of performing a rapid assay to offer a simple and rapid solution as opposed to the more complicated systems that commercial labs hesitate to adopt. Such a test if used by more soil labs and soil consultants could aid in more efficient fertilizer application rates and improve upon our understanding of the role of soil biological activity in fertility management.

Target Audience: The target audience ranges from California producers, soil laboratories, soil consultants and the fertilizer industry. Of most importance is to demonstrate a cost-effective test that can be readily implemented by soil test labs, which routinely perform soil tests to estimate soil N contribution for crop uptake to optimize fertilizer N recommendations.

Goals and Objectives: We will evaluate a biologically based soil test (24 hr CO_2 evolution) to evaluate a range of soils that vary in fertilizer N requirements, soil amendments (crop residues and manures and composts), organic matter contents and other agronomic practices. Develop correlations to other tests such as total soil N, total soil organic matter, crop N uptake and pre-crop nitrate levels to predict soil N mineralization potential and reassess fertilizer N applications. Evaluate the cost effectiveness of implementing biologically based soil assays and procedures in commercial soil test labs.

Task 1. Conduct a literature review on the use of soil respiration (CO_2 output) and soil organic matter (SOM) based tests for estimating active carbon, biomass, and potentially available N. Evaluation of existing methods will include assessing the feasibility, reliability and ease and cost of laboratory analyses of soil samples.

Task 2. Develop sampling protocols and analyze a range of target soils for a variety of properties including total-carbon (C), water-soluble carbon (WSOC), water-soluble nitrogen (WSN) and other standard chemical properties (pH, color, texture, aggregate stability).

Task 3. Validate the "24 hr CO_2 evolution test" against long-term soil incubations to confirm estimates of soil N mineralization potential

Task 4.Field validate "24 hr CO_2 evolution test" against field N application rates and crop N uptake at across varying sites with a range of soil organic matter contents with objective of reassessing fertilizer N recommendations. Cross compare soil samples with USDA ARS, TX.

Task 5. Construct guidelines for soil test labs for performing the "24 hr CO_2 evolution test".

Task 6. Conduct an outreach program to educate soil test labs and growers on the usefulness of the "24 hr CO_2 evolution test" in reassessing fertilizer N recommendation rates.