AGVISE LABORATORIES

Methods for Measuring the Biological Activity of Soil

The interest in measuring the biological activity of the soil is growing. The principle reason for measuring biological activity is to obtain a value for the microbial life of a soil or to measure the potential of a soil to mineralize nutrients. Researchers tend to be interested in knowing the soil they are conducting experiments on have microbial life. The farming community is more interested in knowing the mineralization potential of a soil.

AGVISE offers three methods of measuring the microbial activity of the soil. The most popular method chosen by many researches is to measure the microbial biomass of the soil. The microbial biomass of soil is defined as the part of the organic matter in the soil that constitutes living microorganisms smaller than the 5-10 um^3. It is generally expressed in the milligrams of carbon per kilogram of soil or micrograms of carbon per gram of dry weight of soil. Typical biomass carbon ranges from 1 to 5% of soil organic matter. The degradation of organic compounds, such as industrial chemicals and pesticides, can be monitored by following changes in the soil microbial biomass.

Condensing towers used to analyze microbial biomass

AGVISE currently employs a soil fumigate method for measuring the biomass of the soil. The soil is fumigated with chloroform to kill the microbial population. After the microbes are killed by fumigation, cytoplasm is released into the soil environment. The soil microbial biomass carbon is extracted with potassium sulfate on both fumigated and un-fumigated soil. The carbon content of the extract is tested and the biomass is calculated based on the difference between the carbon content of fumigated vs. the un-fumigated soil. The carbon content can be measured by dichromate oxidation or by using an automatic carbon analyzer with an IR detector.

A biomass reading is a snapshot picture of the microbial population on the day the sample was tested in the laboratory. It is not a stable number like the CEC or the texture of a soil. The biomass number will change with the environment in which the soil undergoes. After the soil is removed from a field setting, the biomass can and will change with storage conditions of the soil. Recommended storage conditions for biomass samples is 4°C. Freezing of soil samples is not recommended due to the adverse biocidal effects on the soil microbial biomass. If samples must be frozen, they should be preincubated for 7 to 10 days prior to testing. The drying of soil samples for biomass readings must be strictly avoided. Also, after the sampling procedure takes place, samples should not be exposed to direct sunlight. Our experience at AGVISE also indicates the long-term storage under refrigerated conditions in sealed containers can and will affect the biomass results too. Samples reanalyzed after a month or more of storage can have a significant reduction in the biomass reading. I strongly suspect the microbes may have used up the oxygen supply in sealed containers after prolonged storage.

AGVISE also employs the staining and counting method of determining the biomass content of the soil. The method involves a quantitative microbiology

count of the concentration of colony-forming units (CFUs) in a sample. An outline of the methods is as follows. A biologist dilutes a volume of soil into sterile water. Since the actual concentration of the microbes in a sample is unknown it is common practice to dilute the sample serially (for example 1/10, 1/100, 1/1000, etc.). The highest dilutions will produce the lowest number of CFUs and the lowest dilutions will produce the highest number of CFU's. A sub sample of the soil-water mix is then spread across a petri plate that contains an agar media specific to the type of organism in question. The plates are allowed to incubate for a number of days before counts on the colony-forming units are made. AGVISE has agars specific for bacteria, fungi, actinomycets and anaerobic bacteria.

Samples in an incubator for the determination of bacteria, fungi, and actinomycets.

In recent years the interest has risen to access a soil for it's potential to mineralize soil nutrients, primarily nitrogen. Nitrogen mineralization has been difficult to assess. We are not to the point where we have developed a value that can be included in the formulas for adjusting nitrogen recommendations for field crops. Many attempts have been made to develop such an index, but the methodologies to do so have been elusive.

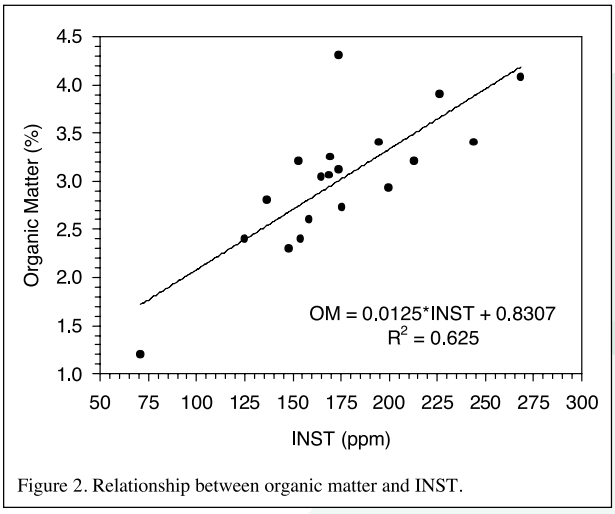
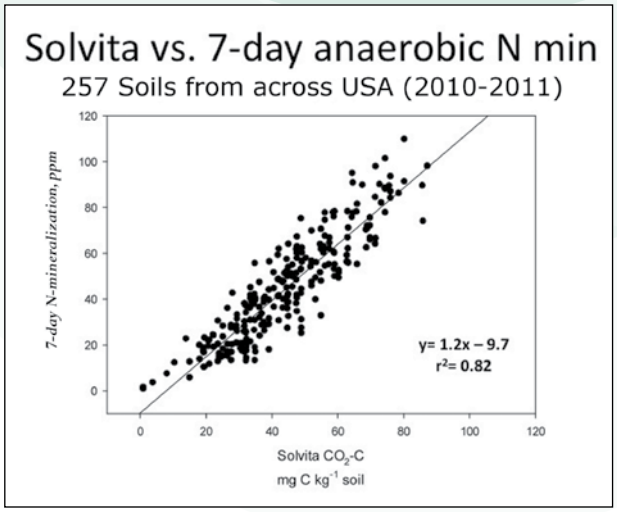


Figure 2. Relationship between organic matter and INST.

Relationship between soil organic matter and the INST soil test.

Approximately 10 years ago research from Illinois indicated that the amino sugar-N level of soil could predict soils that may not respond to nitrogen. This test was later referred to as the Illinois Nitrogen Soil Test (ISNT). If the ISNT value for a soil was over 225 ppm, the thought was this site would not respond to nitrogen. The yield response data from Illinois looked good and AGVISE did offer this test for a few years. As research in other states on this method continued, results looked less promising in predicting nitrogen mineralization. Our own research indicated the test value obtained form ISNT was just a number highly correlated with the soil organic matter. Many other researchers conclusions were similar to ours as indicated by the graph below taken from a research publication.

The latest soil test showing promise to measure the biologic life in soil is called the Solvita test. Two scientists possessing decades of experience in environmental biology and chemistry discovered the Solvita method in 1994. The Solvita tests measures the CO_2 burst of a dry soil after it is moistened. The increase in CO_2 is a byproduct of increased microbiologic activity in the soil. This respiration spike has been correlated to the microbial biomass carbon content for the soil. One application is this respiration spike serves as indication of the amount of nitrogen the soil has a potential to release. Both lab and field trials have shown a high correlation to 7- and 28-day nutrient mineralization. The Solvita test has successfully correlated phosphorus release also. AGVISE will begin offering the Solvita test in 2012 to our customers.



Soil microbial analysis clearly has potential as a tool for growers to assess their management methods and their soils. In the next few years we should see progress in the interpretation of the Solvita tests to soils in our area for this purpose. If the Solvita test fails to identity the mineralization potential of soils, research in this area will continue. If you have a need to access the biologic activity of your soil, please give AGVISE a call.