ACTIVE CARBON AS A SOIL QUALITY INDICATOR

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INTRODUCTION

A large portion *(50-100%)* of soil organic matter *(SOM)* is bonded onto the mineral matrix of soil. Soil can be defined as a biological entity similar to living tissue with a complex biological reaction. (*Quastal 1946*).

According to Jacques Diouf, who served as Director General of F.A.O. *(U.N. Food and Agriculture Organization)* by year 2050, the world population will double. It is estimated that crop production will need to keep pace to prevent world hunger. SOM has declined drastically in the U.S. and all over the world. In the U.S. alone, we lose more than 2 billion pounds of topsoil each year through erosion. Soil is becoming salt-effected and diseased. (*F.A.O. Summary 2011*). Many research findings show that active organic matter (AOM) can be a measure of soil quality. For every 1% of improvement in SOM, growers can achieve $750 dollars per-acre of free nutrients. Furthermore, soil water-holding capacity can increase 2.3% for every 1% OM increase. *(Lawton)*

For more than a decade, growers have been improving their soil using humic substances-the by-products of leonardite, (Humic Acid, Fulvic Acid and Humin) biochar, green mineral crops, and compost. These practices will not only enhance soil quality, but our research shows that it assists fertilizer and water-use efficiency by influencing soil's physical, chemical, and biological properties. (*Chen, MacCarthy, Jones*)

FARMER'S PERCEPTION

In order to create sustainable soil and crop fertility it is very important for the grower to know exactly what happens to soil AOM. Therefore, growers must have an easy and effective tool to evaluate soil quality and improve their crop production. *(Islam, Sundermeier)* In general, for sustainable soil fertility, growers believe and research shows that SOM stimulates naturally occurring soil biology, changes soil physical characteristics (flocculate), stimulates crop biomass, releases tied-up nutrients, buffers salts, improves water penetration, water-holding capacity, and enhances long-term soil sustainability. *(Chen, MacCarthy, Jones)*

HOW TO EVALUATE SOIL AOM AS A MEASURE OF SOIL QUALITY

Research shows that SOM is the most important factor for soil quality (citation). Using GPS technology and intermittent measuring of active fractional OM may provide a good baseline for soil's functional carbon capacity in response to grower's cultural practices. By applying neutral dilute solution of potassium permanganate ($KMnO_4$) to the SOM, it reacts with the most active fraction of SOM, changing the deep purple color of the solution to a light pink. The lighter the color of the $KMnO_4$ solution, after reacting to SOM, the greater the amount of functional active OM content, which indicates soil quality.

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METHODOLOGY

Apply 0.02M $KMnO_4$ (and other chemical reagants) to the air-dried soil. We can do this drying method by spreading small thin samples of soil on thick black cardboard or plastic. This will act as a solar collector. Let soil dry for 10 minutes under natural sunlight.

Procedure:

1. GPS location of field, taking (0.07 ozs) 20 grams of topsoil, spreading on black thick cardboard or plastic. Let it dry for 10 minutes under natural light.
2. Add 0.02M KMnO4 to a spoonful of the 5 grams dry soil. (0.17 ozs) in glass vial and fill that with tap water to the top of the vial tape mark (20 ml). Mix thoroughly.
3. Put cap on vial and shake for 2 minutes (100 times per minute).

Color comparison of $KMnO_4$ solution after shaking with soil

Poor soil quality	Fair soil quality	Good soil quality	Excellent soil quality
> 0 to 400 AOM lbs/A	> 400–800 AOM lbs/A	> 800–1600 AOM lbs/A	> 1600 AOM lbs/A
> 0–12 lbs available N/A	> 12–26 lbs available N/A	> 26–40 lbs available N/A	> 40 lbs available N/A

Soil quality, active organic matter (AOM), and available N color chart

Ohio State University

Following the color comparison chart of KMnO solution against the color of the experimental soil, the grower can determine soil quality (active OM) and plant-available nitrogen. This is an easy test that can be used to create baseline data for AOM in the farmer's field during the growing season (Spring, Summer & Fall) and for future crop production.

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