LEOPOLD CENTER
FOR SUSTAINABLE AGRICULTURE

A smartphone-based device for measuring soil organic matter

Abstract:

The project evaluated the potential of utilizing a smartphone-based system for the in-field analysis of Soil Organic Matter. Although it demonstrated that the performance of the smartphone-based spectrometer can be comparable to commercial spectrometers, the results suggest that it is challenging to identify the spectral "signatures" of the SOM due to the morphology and moisture variation of soil samples.

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The researchers developed a compact smartphone-based spectral analyzer that can be used in-field to collect reflection spectrum from soil. They expected to establish the correlation between the soil organic contents and the measured reflection spectra from soil samples.

ECOLOGY

What was done and why?

Soil organic matter (SOM) is one of the most important soil factors impacting resiliency of rain-fed cropping systems. Soils with higher SOM content offer greater crop production resiliency due to their ability to retain water, release multiple plant macro- and micro-nutrients at a desired rate, and serve as a major nitrogen source for crops. In addition, SOM is dynamic and can be impacted favorably, but more often has been affected unfavorably by a combination of soil and crop management practices.

The importance of linking farm management choices to SOM gain or loss and the resulting impact on soil resiliency and crop production stability cannot be overemphasized. Routine laboratory analysis procedures for measuring SOM, such as dichromate oxidation and dry combustion analysis of organic carbon, are complex, time-consuming, and expensive. In the search for a less expensive technology, the visible and near infrared diffuse reflectance spectroscopy has been exploited for the rapid characterization of SOM. New tools that complement the remote hyperspectral imagery sensing (HIS) and provide SOM data with high spatial and temporal resolutions could increase the knowledge about the variability of SOM in Iowa.

The project objectives were to:

- Develop a smartphone-based reflectance spectrometer that is capable of measuring SOM contents of topsoil and
- Establish the correlation between the SOM contents and reflection signatures from soil samples.

What did we learn?

The project results suggest that the sample preparations, including surface polishing and drying, are the key steps to the success of the project. The application of soil analysis based on the reflectance is challenging. The researchers were unable to identify the spectral signatures at the wavelengths used in earlier research studies. Therefore, the future development of this technology should focus on developing a strategy to process soil samples taken from field sampling.