Soil Mapping

The First Step To Increasing Fertilization Efficiency

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Introduction

Next generation Best Management Practices (BMPs) include soil mapping technologies that rely upon Differential Global Positioning Systems (DGPS) to support site-specfic fertilization or the Right rate of fertilizer applied to the Right place (2 or the 4 R's of fertilizer managment). On-the-go soil mapping technologies have spatial dependence ranges that are much less than the distances used by USDA soil surveys or even most grid sampling techniques. On-the-go mapping technologies are increasingly being used to guide variable applications of irrigation, fertilizer, herbicides, and pesticides in the field.

Figure 1. Veris Unit. Photo credit: Cheryl Mackowiak

Soil Sampling

Soil sampling is the first step in determining the land's fertility throughout a field. Typically, a farmer will collect random soil subsoils across a field, composite those samples into a bucket and then send a subsample of it to a lab for soil fertility analysis. There is no ability to identify good or poor spots in the field. In comparison, for soil mapping, an initial soil grid sampling technique (every 2 to 5 acres) is used, where these samples are sent to a lab for ferility analyses. The results are then used to calibrate the on-the-go mapping results, since on-the-go technologies measure a single soil attribute that is then correlated with the true soil fertility. The classic, soil grid results would be used directly for guiding fertilization management. The on-the-go mapping takes it to the next level.

On-the-go Sensors

Soil electrical conductivity (or apparent EC, ECa) can be correlated with various soil physical and chemical attributes, such as soil texture, moisture, pH, and nutrients. Two of the most common on-the-go mapping technologies to measure ECa are direct contact (Veris Technologies), and electromagnetic induction (Dualem Inc.).

Veris

Veris units are composed of coulter disks on a toolbar. Usually in two pairs, the disks come in contact with the soil to measure the electrical conductivity. One pair of disks sends an electrical current into the soil, and the other reads the voltage coming back from that initial electrical current. The Veris unit collects data from two depths, 1 foot, and 3 feet.

Dual System

With the Dual system, a transmitter coil sends an electromagnetic (EM) field through the soil, and a receiver coil measures variations in the eddy currents that can also be a reflection of soil electrical conductivity. The voltage differences among EM fields is converted into ECa. This non-contact sensor typically collects data from 1 and 3 feet. However, it is sensitive to metallic structures, and vegetation density (Serrano et al., 2014).

Overview

The DualEM method is no-contact, so theoretically the instrument can travel along the soil surface more rapidly than the direct contact (Veris) system. Serrano et al. (2012) found the two technologies correlated with one another. The Dual method was useful when penetrating the soil is difficult, whereas the Veris system tended to have greater stability of readings over time across wide variations in soil moisture. Some Florida fertilizer retailers currently provide soil mapping services and variable rate fertilizer applications. Check with your county agent to learn more about soil mapping service providers in your area!

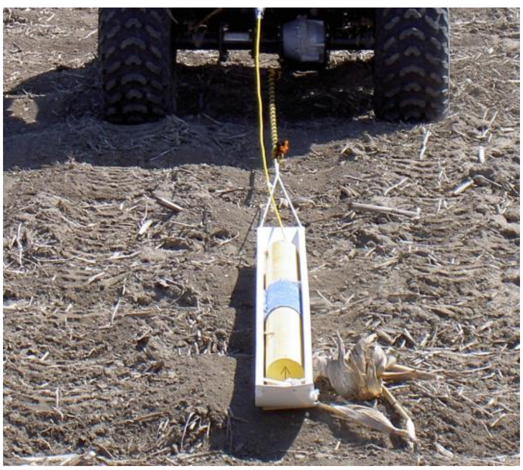

Figure 2. DUALEM-1S sensor in small open sled.
Photo credit: Dualem Inc.

Further reading

Doolittle, J.A. and E.C. Brevik. 2014. The use of electromagnetic induction techniques in soil studies. Geoderma. 223-225: 33-45.

Serrano, J., S. Shahidian, and J.M. da Silva. 2014. Spatial and temporal patterns of apparent electrical conductivity: DUALEM vs. Veris sensors for monitoring soil properties. Sensors. 2014 (14) 10024-10041.

Sudduth, K.A., N.R. Kitchen, G.A. Bollero, D.G. Bullock, and W.J. Wiebold. 2003. Comparison of electromagnetic induction and direct sensing of soil electrical conductivity. Agronomy Journal. 95:472-482..

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