Soil EC Zone Mapping Offers Cost Savings and Efficiency

Agriculture Solutions now offers Soil Electrical Conductivity (EC) Mapping. Soil EC mapping is a low- cost, effective way to identify and chart different zones for soil testing, spreading fertilizer and plant tissue testing based on the soil's electrical conductivity or EC.

What is Soil Electrical Conductivity (EC)?

Soil EC is a measurement of how much electrical current soil can conduct. Soil textures (sand, silt, loam or clay) conduct different amounts of current. For example, smaller clay particles conduct more current than do larger silt and sand particles.

What is Soil EC Mapping?

The EC Mapping device is produced by Veris Technologies, Inc. Soil EC is detected and captured by this machine as it is pulled through the field as seen in the photo. Veris products are of excellent quality, and are being used in over 25 countries, worldwide, to map farms with the accuracy and intensity you need to capture the soil variability that exists on your farm.

Soil EC mapping creates a comprehensive picture of the soil EC, as represented in"zones" of your farm. Zones appear as different colors on your map such as in this example (below).

Why should you care about Soil EC Mapping?

Better accuracy from soil testing: The zones from the soil EC map are used to designate different areas of the field from which soil samples can be pulled. Samples are taken at various locations within each EC zone.

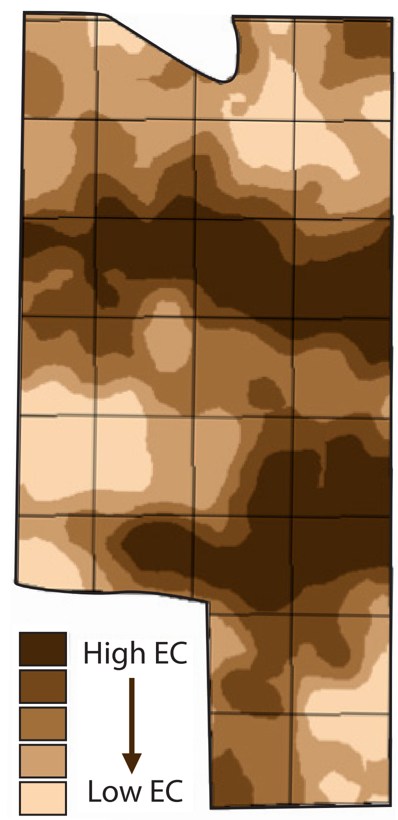
Prescription fertilizer mapping: Based on the soil samples that are collected from the zones of the soil EC map, we can see the fertility variability on your farm. From the mapping and for each zone, we can provide a variable rate fertilizer prescription that is based on the field's unique spatial characteristics and nutrient requirements.

Time + money saved: Having this data saves you time, and ultimately cost, since not all zones require the same level and/or type of nutrients. You significantly increase efficiency on all fertilizer applications.

Less fertilizer wasted + environmental benefit: Because you'll know how much fertilizer to spread where, over-fertilizing is minimized, resulting in reduced leaching and run-off and better balance for enhanced availability and uptake.

Your investment lasts a lifetime: Unlike soil testing which is recommended to be done every 1-3 years, soil EC mapping is completed once, so your investment in this service lasts for the life-time of your farm.

The power of Soil EC Mapping: only add what fertilizer is needed, where it is needed, according to your costs of production.



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More about Electric Conductivity

Soil electrical conductivity (EC) is a measurement that correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. This publication discusses: 1) How, with field verification, soil EC can be related to specific soil properties that affect crop yield, such as topsoil depth, pH, salt concentrations, and available water-holding capacity; 2) Soil EC maps often visually correspond to patterns on yield maps and can help explain yield variation; and 3) Other uses of soil EC maps (Table 1), including developing management zones, guiding directed soil sampling, assigning variable rates of crop inputs, fine tuning NRCS soil maps, improving the placement and interpretation of on-farm tests, salinity diagnosis, and planning drainage remediation.

Introduction

Farmers practicing precision agriculture can now collect more detailed information about the spatial characteristics of their farming operations than ever before. In addition to yield, boundary and field attribute maps, new electronic, mechanical, and chemical sensors are being developed to measure and map many soil and plant properties. Soil EC is one of the simplest, least expensive soil measurements available to precision farmers today. Soil EC measurement can provide more measurements in a shorter amount of time than traditional grid soil sampling.

Usefulness of Soil Conductivity

The electrical conductivity of soils varies depending on the amount of moisture held by soil particles. Sands have a low conductivity, silts have a medium conductivity, and clays have a high conductivity. Consequently, EC correlates strongly to soil particle size and texture.

In addition to EC values separating variations in soil texture, EC has been shown to relate closely to other soil properties used to determine a field's overall productivity.

Water-holding capacity/drainage: Drought-prone areas typically have distinct textural differences from those with excess water; these can be identified using EC. Soils in the middle range of conductivity, which are both medium-textured and have medium water-holding capacity, may be the most productive. Since water holding capacity typically has the single greatest effect on crop yield, this is likely the most valuable use of EC measurements.

Cation exchange capacity (CEC): CEC is related to percent of clay and organic matter (O.M.). As the percent of clay and organic matter increase, the CEC also increases. Research bears out the correlation between conductivity and CEC through its relationship to clay.

Depth to clay-pan or rock outcropping: The response of conductivity to the presence of clay has been used to accurately predict the depth of topsoil over a clay layer or rock outcropping.

Porosity: The greater the total soil porosity, the more easily it conducts electricity. Soil with a high clay content has more total pore space than sandier soils when other soil parameters remain constant.

Salinity: An excess of dissolved salts in the soil is readily detected by electrical conductivity.

Temperature: As temperature decreases to the freezing point of water, soil EC decreases slightly. Below freezing, soil pores become increasingly insulated from each other, and overall soil EC declines rapidly.

Prescriptions that can be developed from soil EC maps include:

- Variable seeding and N rates based on yield goals and CEC levels
- Variable seeding rates based on the depth of topsoil
- Variable herbicide rates based on organic matter, texture, and CEC
- Variable lime rates based on zone sampling according to CEC levels
- Limit applications of gypsum to sodic areas

Correlation of Soil EC and Crop Yield

After precision farmers create yield maps and conduct a preliminary evaluation of the yield response, they will identify the manageable causes of crop yield response (see Interpreting Yield Maps – "I gotta yield map – now what?", Virginia Cooperative Extension publication 442-509). Differences in soil properties are some of the most obvious reasons for yield variability. Soil EC has the potential to estimate variations in some soil physical properties in a field.

Yield maps are frequently correlated to soil EC, as shown in Figure 5. In many situations, these similarities are explained through differences in soil. The water-holding capacity of the soil is a major factor affecting yield, and the yield map will likely show a strong correlation to the soil EC. In general, soil EC maps may indicate areas where further exploration is needed. Most likely, soil EC maps give valuable information about soil differences and similarities, which makes it possible to divide the field into smaller management zones. Zones that have consistent EC readings are areas that have similar soil properties and can be grouped together for soil sampling and management.

Impact of Soil Water on Results

The question regarding soil water that seems central to evaluating the usefulness of EC mapping in precision agriculture is: Does a field mapped under different soil water conditions show new zones that change based on different field moisture conditions? For soil EC maps to have value, the patterns and areas identified must be consistent and repeatable.

In fields with different cropping histories or for soil EC readings taken on the same field at different times, EC readings may need to be normalized (standardized). For example, consider a field where the field was planted half to corn and harvested several weeks before the soybean crop on the adjacent half of the field. These fields had different electrical conductivity measurements, but these differences were due to soil water content and not soil properties. The corn side of the field had plenty of soil moisture from post-harvest rains, but the soybeans depleted much of the soil water during this time period. This left the field with a large variation in soil moisture between the side with no growing crop (corn harvested) and soybeans that were still growing and using water.

Mapping both sides of the field immediately after soybean harvest produced a map with three distinct zones within the field. But the zone differences are primarily from the differences in soil moisture content associated with the different crops. Standardizing the soil EC across the two halves of the field effectively removed the soil moisture influence. After standardizing the soil EC measurements, the soil EC values along the field boundaries of the two halves of the field matched very closely, and there were only two distinct zones within the field.

It has been demonstrated that fields mapped several times during the year with varying moisture contents had soil EC value changes but the zone delineation did not. With the exception of almost pure sand, the soil EC varies by only 5 percent to 10 percent. As a result, variations in soil type can be detected no matter what the moisture condition of the field. On the other hand, this also means that conductivity is not the tool of choice for determining the moisture content of soils, but rather its relative moisture holding capacities.

Information sourced from the Virginia Cooperative Extension website at http://pubs.ext.vt.edu/442/442-508/442-508.html with contributions from Robert "Bobby" Grisso, Professor and Extension Engineer; Mark Alley, W.G. Wysor Professor of Agriculture and Soil Fertility Specialist; David Holshouser, Associate Professor and Extension Soybean Specialist; and Wade Thomason, Assistant Professor and Extension Grain Crops Specialist; Virginia Tech