

# Applications of Soil Electrical Conductivity in Production Agriculture

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Greater understanding of soil electrical conductivity (EC) could offer useful information for crop management decisions. Several years of study at Clemson University have identified some important insights, outlined in this article.

Considerable soil variation occurs within and across production fields in the Southeastern USA. The photo below shows the typical variation in soil texture for a Coastal Plain soil. Soil texture relates to factors that have a major impact on productivity and will affect management strategies. For example, irrigation scheduling is closely related to soil type and water holding capacity of the soil. Mobile nutrients are used, lost, and stored differently as soil texture varies. Yield potential of sandy soils generally is less than clay soils; therefore, crop inputs should be based on economical returns. Variations in texture within the soil profile can also have an effect on tillage decisions.

Soil texture will also affect pest management. For example, nematodes such as Columbia lance and root knot nematodes prefer sandy soils. Spiral nematodes like heavier soils and Ring nematodes live only in sandy soils. Soil insects such as southern corn rootworm prefer poorly drained, less sandy soil with high organic matter content, while lesser cornstalk borer will have much higher population on sandy soils. Soil-applied herbicide should be matched to soil properties. Therefore, a good soil texture map could help growers make intelligent management decisions.

Soil EC is an important characteristic that can be used to map the spatial variability of soil within a production field. Basically, soil EC describes the ability of a soil to transmit an electrical current. An EC mapping system is commercially available and many farms in South Carolina and other states are already using this technology for nutrient management.



A typical production field in the Southeastern Coastal Plain, showing variation in soil texture.

Abbreviations and notes for this article: N = nitrogen.



A view of the Veris 3100 soil electrical conductivity equipment.

The Veris 3100 (see photo above) resembles a small disk-tillage implement and measures soil EC continuously (on-the-go) across the field. The implement can be operated at speeds ranging from 8 to 12 mph and measures a 40 to 60 ft. swath in most fields. This equipment allows a 100-acre field to be mapped for soil texture in about 2 hours. The operation cost in South Carolina is around \$5/A for commercial operators and \$1/A if leased by farmers.

Since sands have low EC, silts have medium EC, and clays have high EC, the EC map would be strongly correlated to soil particle size and texture. **Figure 1** shows an example of a soil EC map from a production field, with yellow areas having light soil and brown areas having heavier soils. In addition to texture, EC has been proven to correlate closely to other soil properties, such as organic carbon, cation exchange capacity (CEC), and depth of topsoil.

Our work during the past 12 years at Clemson University has shown that soil EC is positively correlated to percent clay, and negatively correlated to percent sand. Also, the overall EC



Figure 1. Aerial photo and EC map of a typical production field in the Southeastern Coastal Plain.



Farmers in South Carolina are finding practical benefits of information on soil electrical conductivity.

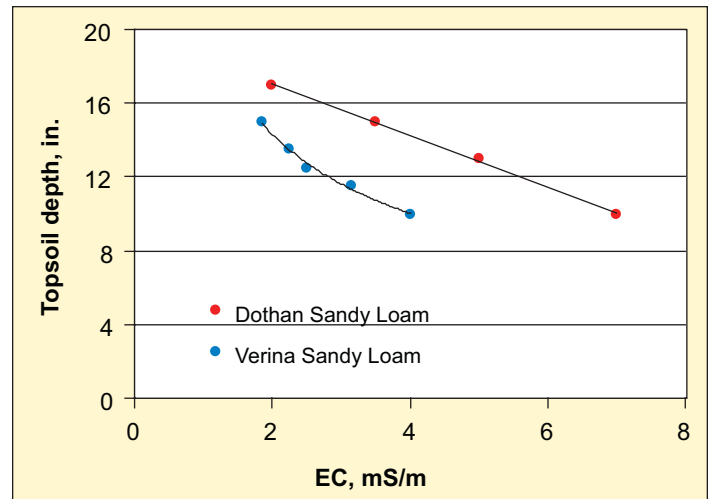
values increased with increased soil moisture, but the relative values remained consistent. The response curves were parallel for different moisture contents in all areas of the field.

Nematode management relies heavily on the use of nematicides such as Temik 15G applied at planting at a cost of about \$16/A or pre-plant soil fumigation with Telone II at about \$33/A. Usually, farmers apply a uniform rate of one of these nematicides across an entire field or even an entire farm. However, nematodes are not uniformly distributed within fields and therefore uniform applications result in nematicides being applied in areas with and without nematodes. Our work has showed that soil EC can be effectively used for variable-rate applications of nematicides in production fields. Nematode densities were also highly correlated to soil texture as measured by soil EC. This technology is being used by several farmers in South Carolina.

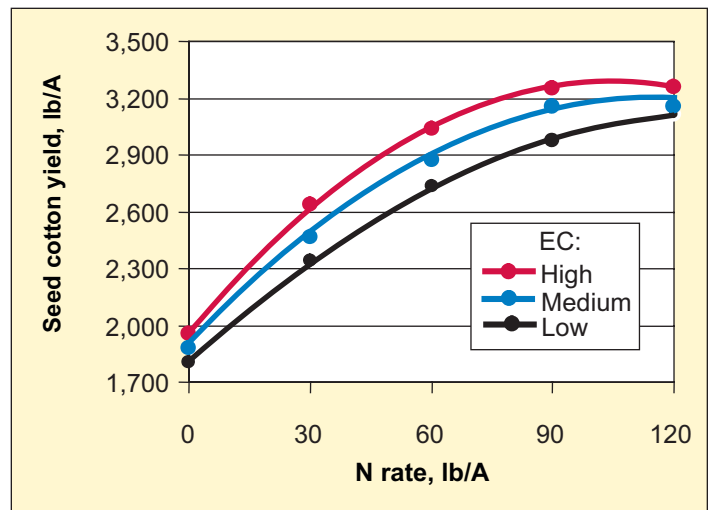
Soil compaction management in the Coastal Plain region relies heavily on the use of annual deep tillage, usually to a uniform depth throughout the field. Our work indicated that variable-depth tillage could be used to significantly reduce fuel requirements for tillage operations. Predicted tillage depths were inversely correlated to the soil EC. The soil EC data were good estimates of the topsoil thickness (**Figure 2**).

Furthermore, our work showed strong correlations between soil EC maps and water holding capacity, plant vigor, and crop yield maps. Additionally, geo-referenced soil EC maps were successfully used to match soil properties with the lowest herbicide rate needed for effective weed control. This was true only for soil-applied herbicides such as fluometuron (cotoran). For example, to achieve 80% control of pitted morningglory, the fluometuron rate in heavy soils was five times higher than in light soils.

Results from 2007 and 2008 studies showed that there is a potential to use mid-season specific plant Normalized Difference Vegetation Index (NDVI) data for variable-rate application of N fertilizer in cotton and corn production. However, the soil EC data should be included in the N-rate prediction equation



**Figure 2.** Soil electrical conductivity can estimate topsoil thickness. Predicted tillage depth are inversely correlated to the soil EC.



**Figure 3.** Seed cotton yields increased as N rates increased in low EC areas, but there was no yield response to N rates higher than 90 lb/A in medium and high EC areas.

for the Southeastern Coastal Plain region. For example, seed cotton yield increased as N rates increased in low EC areas. As shown in **Figure 3**, there was no yield response to N rates higher than 90 lb/A in medium and high EC areas. **BC**

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