FIELD MEASUREMENTS AND MAPPING OF SOIL ELECTRICAL CONDUCTIVITY

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ABSTRACT

The zone-specific application of inputs such as seed, fertilizer or crop protection chemicals has the potential to maximize yields, reduce input costs and minimize detrimental environmental impacts. In this paper, the variables of soil electrical conductivity (EC) data in an about 9 ha field were firstly analyzed, and then spatial distribution maps were constructed at ARDS Simnic Craiova. Statistical analyses indicated significant differences between the EC properties of soil samples .

The results reveal that optimal number of sole-specific management zones for the study area was thee. The management zone 1 presented the highest potential crap productivity, management zone 2 the medium, whereas management zone 3 the lowest. We concluded that using EC variables to delimate management zones and mapping of soil EC from an objective basis for development of "zone-specific" application strategies.

INTRODUCTION

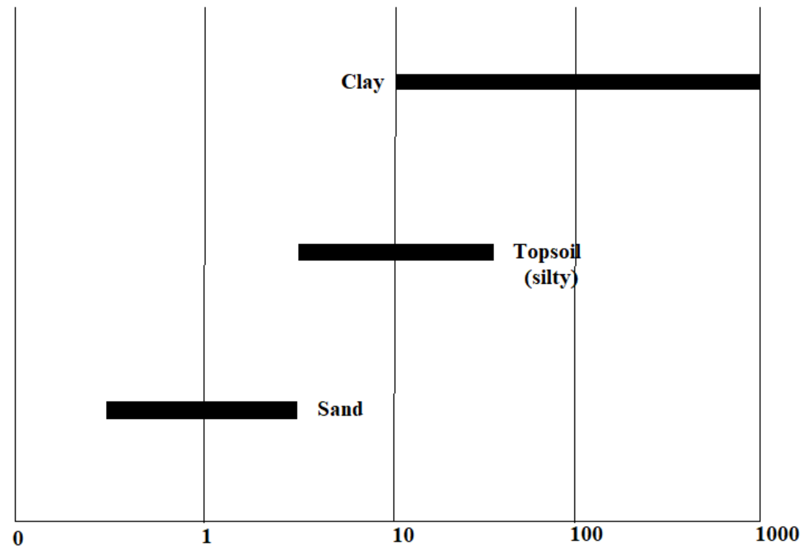
Conventional farming currently treats a field uniformly, ignoring the naturally inherent variability of soil and crop conditions between and within fields The spatial variability within a field is highly significant and amounts to a factor of 3-4 or more for crops (Corwin et al., 2003).

Spatial variation in crops is the results of a complex interaction of biological (pests, earthworms, microbes), edaphic (salinity, organic matter, nutrients, texture), anthropogenic (soil compaction, leaching efficiency), topographic (slope, elevation) and climatic (relative humidity, temperature, rain fall) factors.

The "zone-specific" crop management is the management of agricultural crops at a spatial scale smoller than the whole field by considering local variability with the aim of maximizing crap production and minimize detrimental environmental impacts (Corwin si Lesch, 2005).

Precision agriculture utilize electronic information technologies to modify land management in a site-specific manner as conditions change spatially and temporally (Van Schilfgaarde, 1999). The measurement of apparent soil electrical conductivity (EC_a) is a tool for identifying the soil physic-chimical properties influencing crop yield patterns and for establishing the spatial variation of these soil properties (Corwin et al., 2003).

The usefulness of soil conductivity stems from the fact that sands have low conductivity, silts have a medium conductivity and clays have a high conductivity. Consequently, conductivity (measured at low frequencies) correlates strongly to soil grain size and texture (figure 1).



Conductivity mill; Siemens/meter
Figure 1 - Soil electrical conductivity depends on soil grain size and texture

Electrical conductivity (EC) is the ability of a material to transmit (conduct) an electrical current and is commonly expressed in units of micro siemens per cm (μS/cm). A 1000 μS/cm is equal to 1 millisiemens/cm. Siace the electrical current flow increases with increasing temperature, the EC values are automatically corrected to a standard value of 25^0C and the values are than technically referred to as specific electrical conductivity. A good EC meter will have automatic temperature compensation so you can get accurate results regardless of sample temperature.

Soil map is a geographical representation showing diversity of soil types or soil properties in the area of interest.

The utility of EC mapping comes from the relationsships that frequently exist between EC and variety of other soil properties highly related to crop productivity these include properties sach as water holding capacity, soil drainage organic mather level, cation exchange capacity, soil nutrient levels, salinity, and subsoil characteristics.

The objective of this study was to investigate the development of potential "management zones" using Soil EC in a experimental field.

MATERIALS AND METHODS

Soil sampling and analysis

Site-specific nutrient management for crop production begins with an inventory of soil test nutrient levels in a field. Fertilizer recomendations are based on expected response to fertilizer application as a function of soil test levels. Precision usually increases as fields ere divided and sampled as smaller areas. The common approach to active systematic soil sampling is fo overlay a square or rectangular grid on a map or photograph of the field, identify and drive to the middle of each grid cell, and collect a soil sample at that point (figure 2). The soil sample consists of several soil cores collected within a 3 m radius of the cell center.

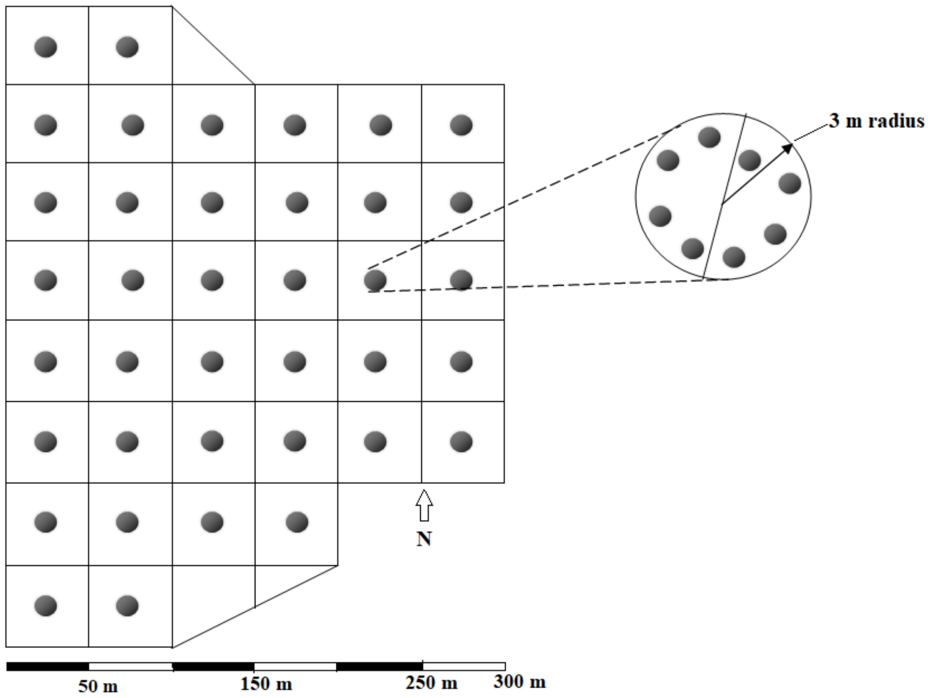


Figure 2 - Schematic showng the leyant of a square grid and locations where soil cores were collected – a grid of equally spaced lines (50 m), 8 soil cores randomly collected wthin a 3 m radius at the grid center, cores composited as one soil sample.

The investigation was conducted in an experimental field of A.R.D.S. Simnic Craiova situated in North of Craiova City, in a region with annual precipitation of 537,3 mm and annual mean temperature of 10,8^{0}C. The soil is pedologically classified as Redish brawn soil.

The top soil (0-30 cm) samples (28 samples) were taken in the spring of 2017. The laboratory analyses was performed using a Cond 3310 (EC) meter WEW Germany (1:5 soil water suspensions; Ly et al.,2008).

Statistical analysis The EC data were analysed using Microsoft Office Excel.

RESEARCH RESULTS

It can be seen evidently (figure 3) that high EC values were distributed in the South-West past, and East past of the study area. The low EC values were distributed in the middle, North-East and West parts of the study. The middle EC values were distributed in Nord West part of study area.

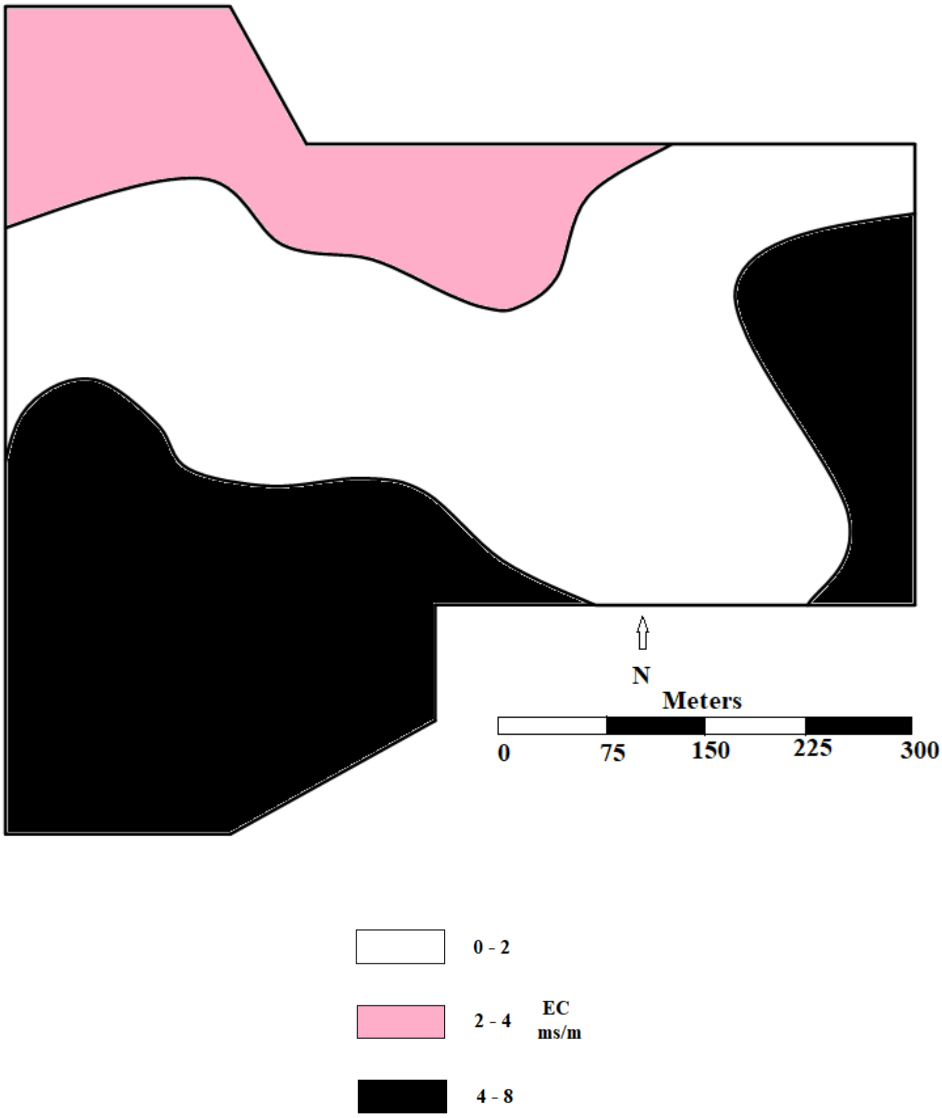


Figure 3 - Shows the EC mapps obtained from EC measurements with the COND 3310 sensor in the experimental field

Table 1

Spatial distribution of EC 1:5 values in management zones

Management zones	**No of samples**	**EC properties (ms/m)**				
		Ẋ	**± SD**	**Minim**	**Maxim**	**CV* %**
1 low EC	11	1,30	0,54	0,2	2,0	41,53
2 middle EC	6	3,28	0,71	2,1	4,0	21,64
3 high EC	11	5,66	1,43	4,1	8,0	25,26

*Coeficient of variation

The results revealed distinctly different soil EC 1:5 proporties for the 3 management zone (table 1). Mean EC 1:5 value in management zone 1 was low, 1,30 mS/m compared with 3,28 mS/m in zone 2 and 5,66 mS/m in zone 3. The coefficient of variation demonstrates high variability in the EC 1:5 data in the management zone 1, 41,53 % compared an 21,64 % in management zone 2, and 25,26 % in management zone 3.

Lucas et al., 2009, in their investigations in South Moravia reported a mean CE value of 9,07 mS/m and a CV of 61,20 %.

CONCLUSIONS

1.The results show that the method of soil EC 1:5 measurement is a suitable tool for the mapping of spatial variability of soil conductivity.

2.Statistical analysis showed that different management zones had different electrical conductivity.

3.The procedures used in the study can be effective in identifying different management zones.

4. The defined management zones may be a more economical method of developing variable rate technology application maps.

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