FREQUENT USER ★ ★ ☆

TOPSOIL MAPPER

Comparison of different soil sampling methods

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Initial situation

In precision farming, management zones are created from various sources, such as yield maps, NDVI imagery etc. Datasets are frequently having a common problem, that these data are mainly indirectly measure or indicate real soil parameters, since the main observed medium is the vegetation itself. Since we are planting to the soil, not to our previous years yield, not to vegetation indices, but to the soil, it is important to get to know our soils and plan our decisions. Most farmers know, that on an actual field, better conditions for farming activities are located. The higher humidity of the soil also equals with better soil conditions, such as overall nutrient status, users believe. These observations are driven by other data layers and multi-year observations during field work.

The case might differ from experience driven expectations. The pattern of available nutrients can vary significantly on soil chemical and physical properties. Soil type can affect nutrient availability indirectly by affecting yield potential and nutrient removal. Crop and soil management practices also have significant influence on nutrient supply and changes in availability.

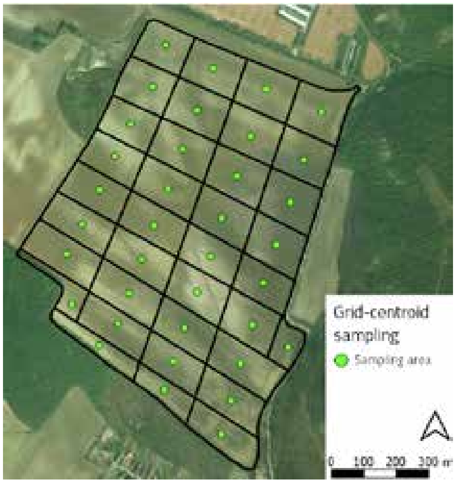
Overview of the tested area framed in black

Test field

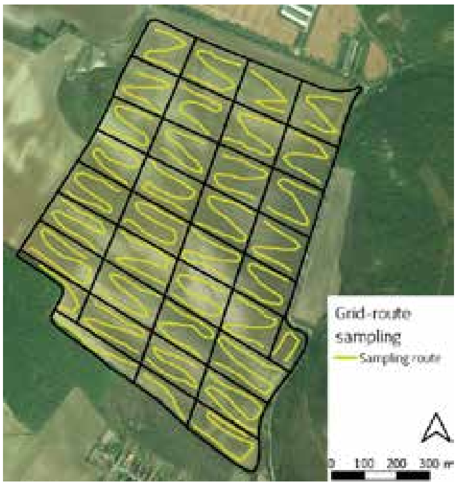
Tests were carried out on a field of 82.5 ha plot which has in overall a silty/sandy clay soil. On the test field conditions were ideal for a disturbance free scanning. Surface was smooth, right after pea harvest, we found nearly zero plant residue.

Grid sampling

From the total surface of 82.5 ha we have collected a number of 36 soil samples, which yields roughly a sample from as low as 2.3 ha. Grid sampling was executed by two independent teams, in order to simulate both main approaches of grid sampling. One team was collecting subsamples within the zones in a zig-zag pattern while the other team was collecting in a buffer of 30 m circle around the centroids of each zone.



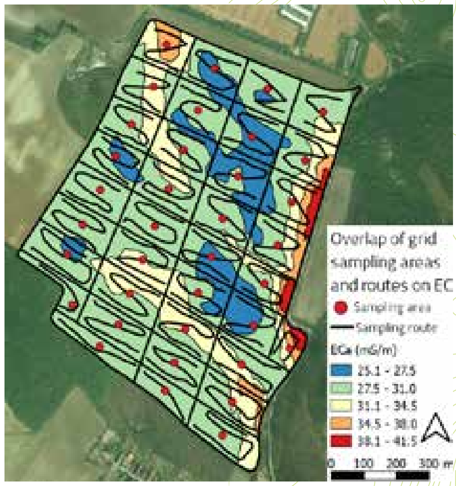
Centroid grid sampling



Route grid sampling

Difficulties of grid sampling

Grid sampling subdivides a field into - in most of the cases - even portions of small areas or cells. Sampling approaches can differ from one to the other provider. Although, at the end of the day our grid samples most probably will contain numerous samples which are containing mixed (caused by zig-zag sampling) or dislocated (buffer sampling) samples, affected by neighboring soil zones. In order to minimize the effects of soil variability it might be necessary to manage the actual grid zones in two or even three different ways.



Grid sampling buffer areas and sampling routes overlapping of ECa scan.

Creating management zones, based on real soil parameters, using Topsoil Mapper

Sampling procedure of Geoprospectors is very similar to conventional grid soil sampling, but instead of having the whole field sampled we use our soil scanner Topsoil Mapper to determine and select areas with the same apparent electrical conductivity (ECa). These zones are represented with consistant electrical conductivity values which let us suppose that areas within the same range of EC are having identically the same physical and chemical soil properties.

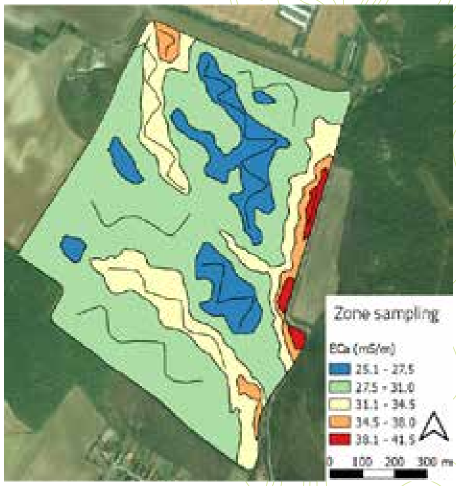
Scanning the field

We have scanned the field on 20 m of tramline spacing. This distance is a good trade-off between quick and cost-effective yet still detailed scanning result. Maximum speed on the field is determined on the surface conditions of the actual field and of our vehicle. Proper mount/support of the sensor allows us to scan on higher speeds with minimizing sensor disturbance of undesirable movements during scanning. Sensor distance from the surface should not be higher than 35 cm height above ground.

Zone sampling

After processing the scan, we are able to immediately visualize our soil zones in Field Management Suite (FMS) processing software and of course in any farm management software. Furthermore, we can determine our zone sampling route for collecting subsamples from the predefined eight zones.

We have executed the zone sampling procedure on the same day of the scanning as well as the grid sampling.



Zone sampling with Topsoil Mapper

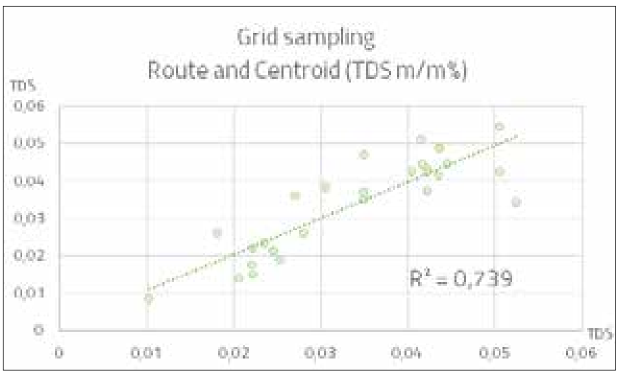
Laboratory measurements

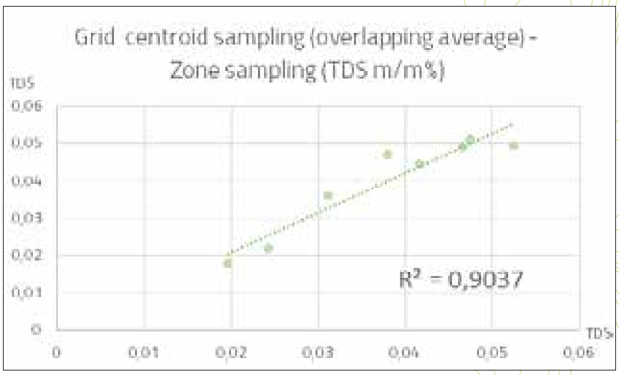
All our three sets of samples were taken to an accredited lab to get a full picture of chemical and physical properties of the soil samples. The total dissolved solids (TDS) were our highest priority test, since over the years several researches have been confirming the close correlation of soil apparent electrical conductivity and lab TDS.

Data correlation

It is obvious that among both sampling methods, differences in soil test results are expected to occur. Centroid sampling has a smaller area represented, while route sampling within the grid cell boundaries represents a greater area.

The procedure behind our test is to establish the degree of correlation among both grid sampling method, then spatially join our centroid sampling points within the management zones delineated from our ECa map and check the correlation among these data as well.





While in grid sampling methods for all 36 zones are having a rather poor correlation, caused by the different size of the covered area of subsamples.

Samples collected from the same ECa management zone compared to grid centroid sampling results have a significant correlation, which indicates, that unmixed samples even from different areas of the field, with matching ECa can highly describe spatial distribution of soil nutrient status. Spatial overlap was possible to establish among 17 grid centroid sampling point and eight individual EC zones. Comparison of TDS with the average values of spatially overlapping grid centroid samples and EC zone samples, show an R^2 as high as, 0,9.

Conclusions

While our sampled areas had similar sizes, our teams were using different duration of time to execute their tasks due to the difference of sampling routes.

Most time-consuming way was the subsample collection on a route manner for grid sampling. Grid centroid sampling was significantly quicker, since our sample takers had to visit only the centroids of the grid-net.

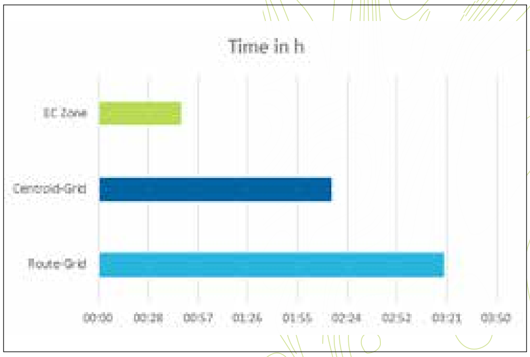
However, contractors expect the similar outcome for grid route and centroid sampling, our test shows the significant differences in soil test results, due to mixed subsamples. Regarding our results grid centroid sampling describes on a more precise way soil TDS than route sampling.

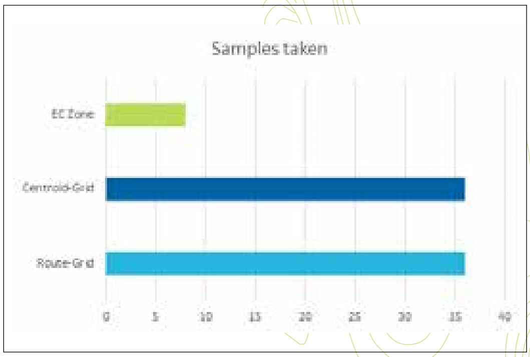
Sampling was the quickest and the most cost effective, using our predefined ECa zones, collecting on a zig-zag route.

Our EC zone sampling approach is capable to indicate the TDS of soils as good as grid centroid sampling. Significant differences were occurring regarding time and costs, between ECa zones and grid centroid sampling.

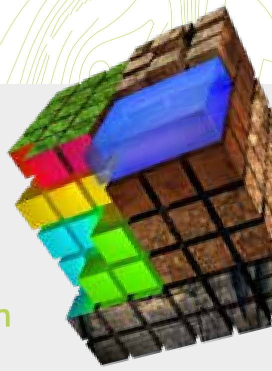
Sample takers for grid centroid sampling were collecting 36 samples in nearly 2 hours, while the team for EC zone sampling was ready in 45 minutes with collecting all the subsamples from the eight zones.

In this manner our approach was nearly **60 % quicker and 70 % cheaper** in terms of labor and sample costs to get the same results as grid centroid sampling.





Cost calculations were including two sample takers on an hourly rate of € 20 and the cost of laboratory measurement of € 30 per sample.



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