How soil heterogeneity in a field may lead to different soil testing values

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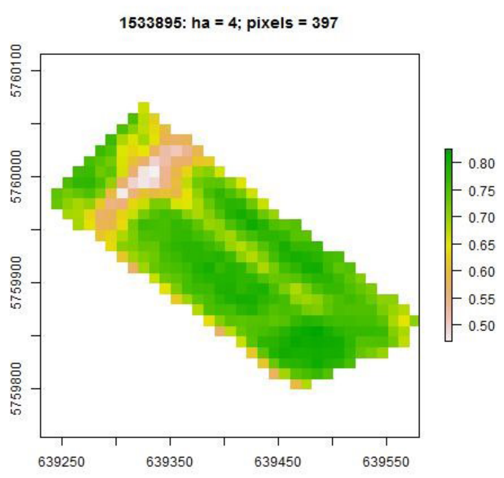
Testing soil using sensor technology makes farmers and advisors take more soil samples from a field then they were used to, because of lower costs and convenience. These soil testing results can deviate from "old" soil testing results or soil samples from the same field (part) can give completely different results. Although many factors may lead to different test results, one of the major reasons is the soil heterogeneity within the field. In this blog from dr. Peter van Erp, Director of Research and Development at AgroCares, we want to give you some more background information on this topic.

Agricultural land is not homogenous

All farmers, advisors and agronomist know agricultural land is not homogenous. This is very obvious in fields of several hectares where farmers know exactly where crop growth or crop yield is deviating from the rest of field. They often have an explanation for this: the soil is sandy or clayey. As an example Figure A gives a satellite image showing differences in crop growth within one field caused by differences in clay content.

Figure A: A Satellite image showing the effect of soil texture on crop growth



Source: SoilCares own research

Variations in organic matter content

Differences not only exist on large agricultural fields. Figure B gives as an example the organic matter content and bulk density of a 60*30 m field where in 72 samples (5*5 m area) were taken and analysed. Within this area the organic matter content varied from 0,54 to 2,15 percent and the bulk density from 0,79 till 1,28 g/cm3. Often these mid-scale differences are not visible to the naked eye.

These differences may lead to different sub optimal fertilisation rates. Think about liming recommendations: when organic matter content is higher, the soil will have a higher pH buffer capacity and because of that more lime is needed to give a comparable pH increase after liming.

Figure B: Field layout showing the sampling points with values of soil bulk density and organic matter content (in parenthesis)

FIELD LENGTH	FIELD WIDTH (m) 30m					
	5m					
5m	0.81 (1.64)	0.91 (1.61)	0.99 (1.41)	0.99 (1.48)	1.03 (1.54)	1.01 (1.68)
	0.88 (1.48)	0.79 (1.74)	0.97 (1.61)	0.97 (1.61)	1.17 (1.61)	0.98 (1.54)
60m	1.17 (1.01)	1.06 (1.01)	1.10 (0.94)	1.17 (0.94)	1.04 (1.01)	1.28 (0.94)
	1.03 (0.94)	0.78 (0.74)	1.16 (0.94)	1.04 (1.14)	1.22 (0.87)	1.12 (1.07)
	1.00 (1.34)	0.97 (1.41)	0.98 (1.01)	0.90 (1.14)	0.94 (1.14)	1.02 (1.27)
	1.02 (1.27)	1.17 (1.14)	1.04 (1.21)	0.98 (1.14)	0.98 (1.21)	1.12 (1.14)
	1.26 (0.87)	0.91 (0.94)	1.05 (0.80)	0.85 (0.94)	1.05 (0.94)	0.93 (0.40)
	1.12 (1.01)	1.10 (1.14)	0.83 (0.87)	1.01 (1.07)	1.15 (0.87)	0.97 (0.87)
	1.15 (1.07)	0.98 (2.15)	1.07 (0.94)	1.00 (1.14)	1.26 (1.21)	1.24 (1.21)
	1.11 (0.94)	0.93 1.88	1.24 (0.87)	0.85 (0.87)	1.08 (1.07)	1.11 (1.01)
	0.94 (0.74)	1.05 (0.41)	1.02 (0.87)	0.97 (0.40)	1.01 (0.74)	0.98 (0.47)
	1.07 (0.87)	0.93 (0.88)	1.45 (1.07)	1.24 (0.80)	1.45 (0.54)	1.24 (0.74)

Source: D.J. Oyedele and A.A. Amusan, Variabilities of soil properties.

Figure C gives an example of the variation in potassium status on a short distance (Schuffelen, Hudig and Wttewaall). From a square meter they took borings at 10 cm intervals. When the average K status of this square meter was set at 100 the status of the individual 10*10 cm spots ranged from 43-200. The distance between the highest and lowest status was only 40 cm!

Figure C: Field layout showing the sampling points with values of soil bulk density and organic matter content (in parenthesis)

121	**43**	**100**	**86**	**121**	**57**	**43**	**86**	**100**	**64**
186		**178**			**121**	**127**		**107**	
	64		**86**		**86**		**130**		**79**
86		**193**			**130**	**93**		**157**	
142	**86**	**100**	**86**		**100**	**71**	**57**	**64**	
86		**100**			**71**		**57**	**71**	**143**
	107		**171**		**130**	**71**		**157**	
57		**79**			**43**		**64**		**86**
	79		**128**		**157**	**128**		**71**	
142		**200**			**100**		**43**		**64**

Source: Schuffelen, A. C., J. Hudig & B. W. G. Wttewaall: Scheikundige verschillen in de bouwvoor in horizontale richting en op korte afstand.

Soil testing laboratories vs. sensor technology

When farmers or soil testing laboratories take a soil sample from a field they mostly aim at one sample representing the average status of that field. They take several soil cores (5-40 per ha) and mix this to one sample, which is then used for soil testing at the laboratory. The laboratory reports back the soil test value of this mixed sample. Based on the test value the farmer decides upon the optimal fertiliser application rate on that field.

However when the mixed soil sample mentioned above is analyzed with a sensor technology tool, a comparable soil test value will be reported back. This is the experience of most users of tools with sensor technology.

However, using this new technology for soil analysis means you can take a lot more soil samples within a field at the same time for low costs. When several soil samples are taken and measured this may lead to different soil testing values because of the heterogeneity within the field. This brings us to the main advantage of this technology: with numerous samples per field it can be used to quantify and locate the existing variation within a field.

What does this mean?

New tools with sensor technology, like the AgroCares Scanner can be used by farmers and advisors to get a better overview of the soil nutrient status within their field. With this information farmers can change or adjust their farm management and fertiliser use resulting in a better crop growth and higher crop yield in the end. This is the first step towards precision farming.

Conclusion: different soil testing values due to variation in the soil fertility status of a field

The soil fertility status of the rooting zone of agricultural fields is often not homogenous. This leads to different soil test values when several samples from the same field are being measured. New tools with sensor technology can be used to determine these differences in soil fertility status in an affordable, quick and reliable way. Knowledge on variation within a field enables farmers to adjust their fertilisation strategy and farm management towards precision farming and a higher income.

References

1) Schuffelen, A. C., J. Hudig & B. W. G. Wttewaall: Scheikundige verschillen in de bouwvoor in horizontale richting en op korte afstand. Landbouwk. Tijdschrift 56-57 (1944-1945) 457-465.

2) D.J. Oyedele and A.A. Amusan, Variabilities of soil properties; part of SIMPLE SOIL, WATER AND PLANT TESTING TECHNIQUES FOR SOIL RESOURCE MANAGEMENT, Proceedings of a training course held in Ibadan, Nigeria, 16-27 September 1996. Available at http://atl.org.mx/files/DirectricesAgricultores/8.pdf

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