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Automated soil sampling machines provide different results compared to hand sampling[2]

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Introduction

Soil sampling to characterize levels of soil fertility is one of the foundations of profitable management. Soil fertility below optimum levels reduces yield potential, while soil fertility above optimum levels results in lost opportunity costs, profits and potential environmental degradation. In site specific fertility management, soil testing is especially important as it is the basis upon which variable rate prescriptions are written.

While the need for soil sampling is generally agreed upon, questions remain on the best techniques to collect soil samples, as well as soil sampling approaches (Mueller et al., 2001). Sawchik and Mallarino (2007) compared soil sample density along with various approaches to sampling including dense and intermediate grid sampling, and zone sampling by soil series, elevation and EC zones. In their analysis, dense soil sampling at 0.2-0.4 acre grids explained soil fertility variation better than grid sampling at 2.5 acre grids. Sampling at 2.5 acre grids was significantly better than any zone sampling approach. Franzen and Peck (1995) compared soil sampling approaches from samples taken at 82.5', 165', 220' and 330' grids. In their results, sampling grids at 165' and 220' were better correlated with the most intensive sampling (82.5') compared to sampling at 330' grids. Lauzon et al. (2005) sampled 23 Ontario fields at every 100' and simulated soil test variability at various densities by eliminating points. In their results, only one field, sampled at the commercial standard of 330' grids, fully assessed the spatial patterns in soil test phosphorous and potassium.

While there exists some consensus that soil sampling at greater intensities provide more reliable soil test results, the common grid sampling approaches in Iowa remains 330-660' (2.5 to 5.0 acre grids). The main reasoning behind this sampling approach is related to time and costs. It is not generally believed farmers will pay for more intensive sampling and soil sampling contractors do not have sufficient time for more intensive soil sampling (Wittry and Mallarino, 2004). So sampling at 2.5 or 5.0 acre grids remains the industry standard as a compromise between accuracy and costs.

A recent development in the soil sampling industry is automated soil sampling machines. Machines such as AutoProbe collect soil samples mechanically reducing the time and labor requirements of soil sampling. In the case of the AutoProbe machine, soil probes are attached to a track that collects soil samples every 7.5'. Soil samples are then mechanically bulked into grid sizes per customer preference. As the Autoprobe machine uses a completely different sampling approach compared to the industry standard, research was conducted to understand if the two approaches differed in their characterization of soil test variability within fields.

Materials and methods

The AutoProbe sampling approach was compared with hand sampling in two fields of 40 and 80 acres. Sample collection intensities for both fields were 1.25, 2.5 and 5 acre grids. Collected soil samples were lab analyzed for P, K, OM, and CEC using commonly accepted lab procedures.

Soil test data was analyzed and compared using the following geo-statistical procedures. First, Moran's I statistic was used to characterize the presence of spatial variability with low probabilities indicating spatial structure. High probabilities indicate absence of spatial structure indicating random variation and not

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[2] *Data for this research was kindly provided by Beck's Practical Farm Research.*

inappropriate use of kriging. Second, soil test values were interpolated using ordinary kriging to create visual maps and calculate fertilizer spread maps for comparison of soil sampling approaches. Root mean square errors were calculated as the summation of the differences between the kriging prediction and actual values. High root mean square errors were considered as poorer soil sampling approaches since much spatial variability remained unexplained.

Results

Spatial variability for soil characteristics was large in Field 1. Based upon Moran's I and root mean square error statistics, Autoprobe sampling better accounted for spatial structure for potassium and organic matter compared to hand-point sampling. Fertilizer savings in potassium at Field 1 ranged from $12-20/acre for AutoProbe sampling vs hand sampling.

Table 1. Spatial statistics for Field 1. (RMSE= root mean square error; Moran's I= pr<F)

Soil sample approach	Potassium		Organic matter	
	RMSE	Moran's I	RMSE	Moran's I
Hand sample @ 1.25 acre grids	51	0.00	95	0.00
Autoprobe sample @ 1.25 acre grids	24	0.00	56	0.00
Hand sample @ 2.5 acre grids	41	0.71	111	0.00
Autoprobe sample @ 2.5 acre grids	25	0.00	62	0.01
Hand sample @ 5.0 acre grids	27	0.97	107	0.95

Spatial variability was low in Field 2. Further, interpolation techniques were constrained by the geometry of the field (Mueller et al. 2004). Despite these constraints, the Autoprobe sampling approach provided different results compared to hand sampling, especially for organic matter (Figure 1). Based upon Root Mean Square Errors, AutoProbe sampling at 1.25 acre better characterized field variability compared to 2.5 acre grids.

Soil sampling results from these two fields strongly indicate that automated soil sampling and hand sampling produce different results in terms of map quality and potential prescriptions. Based upon spatial statistics, the machine soil sampling approach was superior to hand sampling at all densities of soil sampling. Further characterizations of these two approaches will be conducted in 2017.

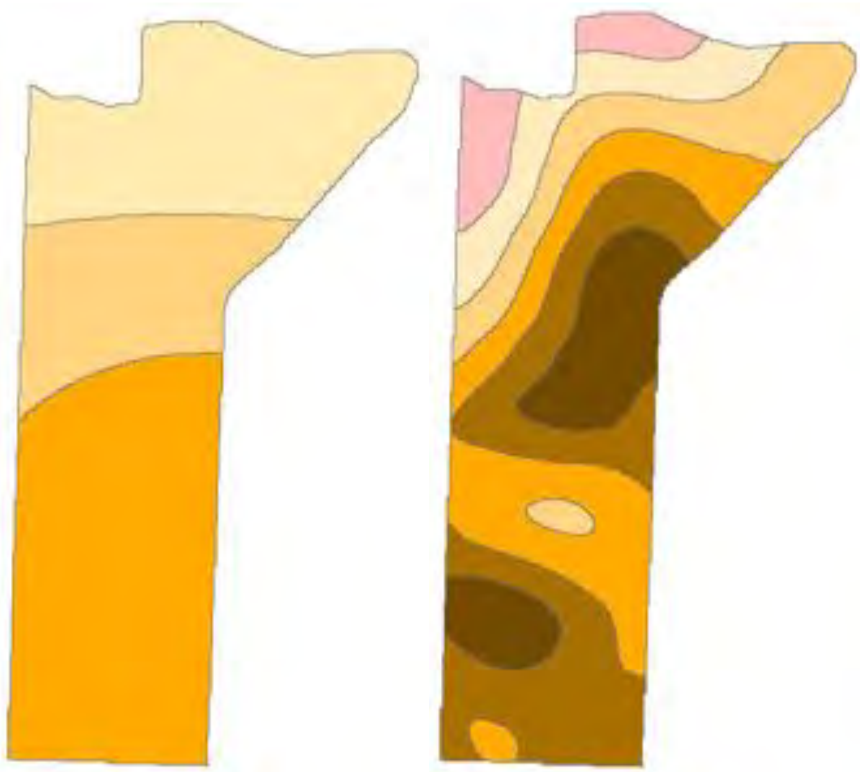

Figure 1. Comparison of map quality for organic matter based upon two soil sampling approaches at 2.5 acre grids. Left is hand sampled, Right is machine sampled.

References

Franzen, D.W., T.R. Peck. 1995. Field Soil Sampling Density for Variable Rate Fertilization. Journal of Prod. Agriculture 8, 4:568-574.

Lauzon, J.D., I.P. O'Halloran, D.J. Fallow, A.P. von Bertoldi, D. Aspinall. 2005. Spatial Variability of Soil Test Phosphorous, Potassium and pH of Ontario Soils. Agron. J. 97:524-532.

Mueller, T.G., F.J. Pierce, O. Schabenberger, D.D Warncke. 2001. Map Quality for Site-Specific Fertility Management. Soil Sci. Soc. Am. J. 65:1547-1558.

Mueller, T.G., N.B Pusuluri, K.K. Mathias, P.L. Cornelius, R.I. Barnhisel, S.A. Shearer. Map Quality for Ordinary Kriging and Inverse Distance Weighted Interpolation. 2004. Soil Sci. Soc. Am. J. 68:2042-2047.

Sawchik, A.P. Mallarino. 2007. Evaluation of Zone Soil Sampling Approaches for Phosphorus and Potassium Based on Corn and Soybean Response to Fertilization. Agron. J. 99:1564-1578.

Wittry, D.J., Mallarino, A.P. 2004. Comparison of Uniform- and Variable-Rate Phosphorus Fertilization for Corn-Soybean Rotations. Agron. J. 96:26-33.