Long term soil test monitoring in Minnesota cropping systems

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INTRODUCTION

Applying the optimum fertilizer rate can be important for maintaining long term profitability in crop rotations. Soil sampling is used to periodically monitor soils in crop rotations. These samples may be taken every 2, 3, or 4 years in a field. The subsequent data is used to base future nutrient management decisions. However, some crop consultants have noticed declines in soil test values in spite of standard fertility practices and have questioned why soil tests may be dropping in spite of the practices used. In the case of P and K, small scale variability of these elements can significantly affect the results. Even when zone sampling is used, the samples can be taken from different locations within a zone. Because of this, soil test values can vary greatly. In order to remedy this, researchers suggest taking samples from the same points. One technology that can help reduce this problem is GPS. The use of GPS offers the possibility of returning to the same point on a more consistent basis.

Soil tests are affected by the removal of nutrients in the harvested part of plants. Removal of nutrients is almost always linear. As yield increases so does crop removal. With the recent increased crop yields, there has been an increased potential for greater removal of plant nutrients and potentially faster than normal changes in soil test levels. Research has shown that potassium can vary greatly in the field. Soil temperature and moisture can affect the release of K from residues and soil clays. This can significantly affect the amount extracted with the K soil test. In the case of phosphorus, the change in soil test levels is typically no more than 2 ppm when fertilizer is not applied. Greater changes are not typically expected and if they are happening consistently then a detailed study of fields should be undertaken to closely monitor what may be happening in the field.

This proposal is for long term monitoring of soil test levels within fields around the state of Minnesota. The objectives of this study are to:
1. Assess long-term variability in N, P, K, Zn, and pH levels at a specific point within farmer fields around the state.
2. Evaluate the effects of crop removal and soil moisture on the consistency of soil test values over one or more years.

METHODS

Soil test monitoring will be conducted in cooperation with crops consultants around the state of Minnesota. Field areas will be selected preferably where soil tests have been shown to be declining over time even with a standard fertilizer program. The site(s) will be selected and georeferenced in order be able to return to the same site in the field in following years. Soil samples will be collected to a depth of 6-8” at monthly intervals as soon as possible in the spring and as late as possible into the fall (we would initially plan on sampling each point

about 8 times per year). If possible and the cooperator is willing, soils may be sampled from up to 2' deep in order to measure nitrate. At the end of the season, a small area will be hand harvested around the sampling point in order to get a general estimate of yield. The grain and/or plant will be sampled, dried, ground, and sent out to the lab for analysis to determine nutrient removal. Soil samples will be sent to a single lab for analysis and a subsample will be saved and indexed for further analysis if needed.

Fields will be selected independent of crop or cropping system. Practices such as fertilizer or manure application will be recorded as they occur during the monitoring period. No specified treatments will be applied. Monitoring will be done in production fields that are being fertilized with standard recommended rates. Outside of soil samples, soil moisture will be constantly measured in situ. Depending on the cost and size of the moisture probes, measurements may only be taken at selected locations. We currently are planning for 10 to 20 field locations.

Progress Report: 2012

We were planning on starting about 10 field locations for 2012. However, due to the early spring we were not able to establish that many sites. Only three field locations were established over this time frame in Jackson and Martin Counties.

Table 1. Summary data for samples collected in 2012

Location	Date	pH	Nitrate-N	OM	Bray-P	Olsen-P	K	Zn
Jackson1	13-Jun	6.9	23	5.0	21	14	103	1.4
Jackson1	11-Jul	6.6	27	5.0	46	33	124	2.0
Jackson1	14-Aug	6.6	15	4.9	27	17	103	1.3
Martin1	20-Jun	6.7	16	3.7	65	41	163	3.9
Martin1	27-Jul	6.6	13	3.8	61	40	140	3.5
Martin1	31-Aug	6.8	12	3.8	37	25	121	2.1
Martin2	27-Jul	7.4	26	4.8	79	47	163	3.0
Martin2	31-Aug	7.4	12	4.9	82	47	166	2.9

The data shows significant variability in the three sampling dates at two of the locations in all variables except for organic matter (OM) which should be stable. With the soils being hard and dry, some of the variability could have been due to inconsistencies with sampling depth. The greatest spike in soil test levels was seen at the July sampling for two of the locations. The Martin 2 location was only sampled twice and in both cases the soil test levels were similar.

More locations will be established for the 2013 growing season. In addition, we also are planning on including comparisons between the field moist/slurry soil test for K in order to better understand differences between this test and the air dried test and how it may vary depending on soil properties. Since the first year was as setup year we cannot draw any firm conclusions. With the additional sites we may expand upon the tests ran to better understand some of the variability being encountered out in the field.