

Using Soil Test Analyses as the Basis for Fertility Recommendations

Doug Pryor - Agronomist, Green Key Solutions, Portage La Prairie, MB, R1N 3E9

A fertility recommendation to a grower has many integral components that can be easily overlooked. The process begins in having confidence in the data. One has to understand how the soil sample was taken and analyzed. You must be comfortable with how the data was derived. We need to realize that fertility recommendations from soil test labs are based on research data and computer models that may not completely reflect with the crop production factors in your region. Every farm has a unique management style and the lab generated recommendations may or may not coincide with this.

Factors that need to be considered in making a fertility recommendation are:

- Soil test data
- Establishing a realistic target yield
- Intended crop and frequency in rotation
- Appropriate soil credits
- Tillage System
- Fertilizer type and timing

Establishing a fertility recommendation is only part of a fertility plan. In order to have a comprehensive fertility plan follow up is essential. Evaluation of the fertility recommendation may contain the following components;

- Visual observations
- Tissue sampling
- Yield
- Nutrient budget
- Data trends

When making a soil test recommendation the first question you need to ask is “Who took the sample?” Did you take the sample yourself or was it another staff member and what is their commitment to the job that they are doing? Does who ever taking the sample realize that there can be millions of dollars of crop production dependant on the soil test recommendation so it best be as accurate as possible. The soil sample needs to be handled with care and attention to detail. Equipment should be clean to avoid contamination from other samples. Contamination from the person sampling can be a big concern so the sampler needs to ensure that this does not occur. The time at which the sample was taken should be accounted for. Was the sample taken Sept 1st, or was it taken a week before planting? Knowing this timing will allow you to apply the appropriate credits. Field history can affect the sample results immensely. In a lot of cases the land has not been farmed the way it is today for an extended period of time. The way a field was farmed 30 years ago often helps diagnose problem areas of a field and determine where not to sample. When you receive your soil sample results, what method do you use to determine anomalies? Years ago I would look at a sample and if I did not believe it I would disregard it and just to what we did the previous year. This did not identify the problem it only avoided it exacerbated it. We now compare soil sample data to geo-referenced samples from previous years as well as correlate it to the tissue samples that were taken in the past growing season and previous years.

When you are making a fertility recommendation you not only need to be comfortable with how the sample was taken but also with the laboratory analysis that you receive. There are 5 or 6 Soil Test Laboratories and you have to determine which lab’s methodology best fits the type of soils you are working with as well it must provide you with both the quality and quantity of information that you require to create a well informed fertility recommendation.

How we arrive at a target yield for our grower requires many considerations. I like to work with a 5 year average for regional parcels of land. Farms are becoming large enough that a 5 year farm average is not suitable in many cases and it requires using more localized data due to changes in soil type and limitations. Varietal selection must also be taken into account when generating a fertility recommendation. What is the yield potential of variety and its nutrient use efficiency as compared to another variety? We know that we have to increase nutrient levels with high yielding varieties. On the flip side, what is the varieties ability to with stand lodging under high rates of fertility? We also need to take into consideration the soil's potential for crop production and nutrient availability. What is the soils pH, OM, CEC, and how do these affect the soils ability to provide nutrients required for plant growth and yield production? When developing the target yield, soil limitations such as internal structure and infiltration, surface drainage, moisture holding capacity, and salinity need to be considered. Farm management capabilities can also have a major effect on the target yield. Is the farm appropriately capitalized with equipment allowing the crop to take advantage of early seeding dates, or is the farm spread too thin and a percentage of the crop is planted 2-3 weeks later than optimum? This has a direct effect on what the target yield should be.

Crop rotation and frequency can also affect the fertility recommendation. Does the effect of disease become more of a limiting factor than the fertility? Often correct fertility levels will help mitigate the effects of disease on a crop by keeping the crop healthier and under less stress. Weed control issues due to crop rotation and frequency have an effect on how, when and what rates of fertilizer are applied. Very low or very high residue levels due to crop rotation will also affect fertilizer rates and timing.

Soil credits need to be calculated when creating fertility recommendations. Pulse crops may or may not fix N in the soil depending on production practices, but most pulse crops will require very little soil N if any for residue degradation. Therefore the reduction of nitrogen immobilization must be accounted for. Forage crops may or may not leave residual N depending on the type of crop, the percentage of legume in the crop and the timing at which the crop is taken out of production. A very sparse alfalfa stand may receive very little N credit, while a heavier stand may also receive very little N credit if taken out of production late in the season. The latter however, would receive a credit in the second year as more nitrogen becomes available to the crop. We have just grown a field of 9 foot tall crop of corn and left all but the kernels in the field. There is a tremendous amount of biomass that is required to breakdown in the soil, thereby increasing the amount of N immobilization and creating a nitrogen deficit. We need to compensate for this in the following crop's fertility recommendation or there is a very good chance that nitrogen deficiency will become evident. Growing corn after canola has demonstrated Phosphorous deficiencies in the corn. This is primarily due to the fact that canola does not support the growth of soil mycorrhiza that enhance P uptake by the plant roots. Keeping this in mind we would need to alter the Phosphate rate in this situation. Last years crop failures also need to be considered. The field of beans that was hailed out in late July will require much different fertility rates than the 3000 lb crop that was taken to harvest. These fields are best sampled as close to the time of planting as possible.

Timing of fertilizer application and the type of fertilizer used will have a bearing on the rates of fertilizer that you apply. If you have a soil with a CEC of 14 it is not a good idea to apply fall Nitrogen but if you do how much N will be required as a top dress application. On these soils, spring broadcast 46-0-0 will be more efficient than fall banded NH₃. What are the specific N losses that will occur on the soil type that you are working with? Low CEC soils as mentioned are more prone to leaching losses of N while soils with a high CEC are more likely to have N losses due to denitrification. The appropriate timing and nitrogen source can mitigate some of these losses but some losses still need to be compensated for in the fertility recommendation.

The type of tillage system that a grower is using will affect the fertility recommendation based on fertilizer type and timing. Conventional systems allow maximum flexibility when applying fertilizer but

other systems require more management to maximize fertilizer efficiency and crop safety. Reduced tillage systems will limit when you apply fertilizer as well as the form of fertilizer you use. The goal is to have less soil disturbance than conventional systems while not limiting fertilizer efficiency or crop safety. This system can at times be more challenging to create a fertility recommendation for as the plan is often comprised of more than one form of fertilizer. Fall banded NH_3 , spring broadcast sulphur, and higher than recommended rates of seed placed P&K is not an uncommon application in a reduced tillage situation. Quite often the most limiting factor is the equipment in a reduced tillage regime. Now fertility recommendations become easier in a one pass “Zero Till” situation. The equipment is designed to apply high rates of fertilizer in a band far enough away from the seed to allow for seedling safety. In a Zero Till situation we need to take into consideration where the grower is on the adoption curve.

The first years a field is in Zero Till will require higher rates of N due to an increased rate of immobilization as there is no cultivation to promote mineralization. Further into the Zero Till cycle the rate of mineralization will equal that of immobilization and the N application rates can be decreased. The application efficiency of fertilizer must be a part of the fertility recommendation.

Considering all these factors allows us to create a “Modified Lab Recommendation” for our growers. This is only part of the equation. There must still be data collection to determine if what we are recommending is correct and what changes are required in the future.

Tissue sampling plays an integral part of a “Comprehensive Fertility Plan”. Tissue sampling is a snapshot in time as it shows you what the plant nutrient levels are at the time of sampling. This data shows us if there are nutrient deficiencies but also if there are excessive levels of a particular nutrient. It is very dangerous however to use this data to make a recommendation solely on its own merit. Tissue samples are very useful when used as a diagnostic tool comparing good versus poor areas of the field or when compared with other years tissue and soil test data. It is one more piece of data that allows us to verify the soil test data and strengthens our ability to make well informed decisions.

Yield is both the beginning and the end of our Fertility Plan. Yield is the final report card as to whether our recommendations are correct. Yield data is a necessary component of our fertility plan if we are going to continue to improve our grower’s profitability. It is impossible to manage anything effectively if you are not measuring the impact of your management decisions. Yield is required on a field by field basis if it going to be of any use in managing fertility. Due to soil variability and environmental conditions a farm average for each individual crop is not adequate. Yield data often creates more questions. In 2003 very few if any growers fertilized for 70 plus bushels per acre of hard red spring wheat, yet yields of over 70 bushels per acre were quite common. Where did all the yield come from? Yield from field test strips is an effective method of analyzing if a new product or management tool has a fit on your client’s farm. This allows us to look into the future while mitigating the risk of trying new products, all for a few more minutes at the time of application and harvest.

Data trending is a crucial factor in creating a fertility recommendation. Keeping record of both soil and tissue data on a field allows us to develop nutrient level trends for specific fields, entire farms and geographic regions. The collection of this data will allow you the Agronomist to develop regional fertility recommendations based on multiple site years of data for your area. In order to gain the maximum value from this data it should be geo-referenced in order to remove differences in the soil as a year to year variable.

Soil Test Laboratories have different philosophies when it comes to a fertility recommendation. An agronomist needs to know what the laboratory bases its recommendations on and why. The lab may use an aggressive build philosophy, a soil maintenance, or a soil maintenance with a slow build philosophy. The lab’s recommendations are created from a computer model based mostly on University and Extension

research. These recommendations do not allow for regional effects of climate and topography, nor do they account for recent changes in plant genetics. They do not know your client and what his short and long term goals are for fertility management on his farm.

As illustrated below the lab recommendation is a starting point when creating “Fertility Plan” for your client but it is definitely not what the grower should receive as his final fertility recommendation from you the Agronomist.

