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Understanding Soil Test Recommendations

Soil testing is an important tool to help make sound fertility decisions for profitable canola production. Many producers however, do not regularly test their soil. Instead, they apply fertilizer without knowing exactly how much is needed.

Some producers don't trust soil tests because recommendations may call for what 'seems' to be too much or too little additional nutrient. Another common complaint is that different labs will come up with different recommendations based on the same soil sample.

Despite these reasons that are widely held as truths, science can prove that soil tests make economic sense – if they're taken properly and followed with common sense.

Taking a good soil sample

The key to an accurate soil test recommendation begins with taking the soil sample in the field. Avoid sampling areas that may exaggerate the soil test readings. These areas include low spots, sandy ridges, old yard sites, hilltops, saline areas and old burn piles. If a custom soil sampler is being used, advise or accompany the person taking the samples to be sure those areas are avoided in a field where a composite sample is collected.

Here are some sampling patterns to consider:

Random sample—This approach involves collecting 20 to 30 soil cores at random from a field and then mixing them to produce a single representative composite sample for analysis. While this is the simplest and most often used sampling method, it does not provide any estimate of how nutrient levels vary in a field. Sometimes, it may misrepresent the true fertility status of a field.

Benchmark sample—This method involves selecting a few small representative areas, for example a quarter acre, in the field from which 15 to 20 soil cores are collected. Variability is assumed to be lower in a small area, and using a global positioning system (GPS) to return to the benchmark location from year-to-year will provide a better indication of soil nutrient trends over time.

Grid sample— Grid sampling involves the systematic collection of samples in a pattern with a grid size of 1 to 5 acres, usually involving use of GPS technology. While this method is the most expensive means of sampling a field, the large number of samples provides an accurate measure of field variability, fitting the goals of variable rate nutrient application.

Smart sample—This method is a hybrid between the benchmark and grid sampling methods. It involves separating the field into distinct management units based on soil type, topography, and/or yield map history. Management units in the field can then be sampled separately, resulting in three to five samples from a field. Smart sampling improves the assessment of soil fertility status over a single benchmark sample and allows for the implementation of site-specific fertilizer management in optimizing crop production.[1]

Sample depth is also an important consideration. Regardless of the sampling pattern used, it is critical that sampling depth is consistent and accurate. Ideally, multiple depth samples (0-6", 6 – 12" & 12 – 24" or 0 – 6" & 6 – 24") will provide a better picture of the status of various nutrients throughout the soil profile. Deeper sample depths will be better for assessing mobile nutrients such as nitrogen and sulphur.

Choosing a lab for analysis

The next step is determining where to send the soil samples for analysis. There are several labs available to producers in western Canada. It is important to understand that different labs may use different chemical extraction methods for determining nutrient levels in soil samples.

Fertilizer recommendations are made on the basis of either a nutrient response database or the use of crop removal factors. The nutrient response database provides response curves, generated from field research. When crop removal is used for fertilizer recommendations, the lab considers your set yield goal and the soil residual nutrients and comes up with a recommendation to make up for any nutrient shortfall.

It is important that the lab chosen for your sample analysis uses appropriate extraction methods and that its recommendation philosophy matches your operational goals.

Fertilizer recommendations will vary depending on the philosophy of the lab. Some common recommendation philosophies used by different labs include:

Sufficiency Approach – This approach is based on the concept that there are certain levels of nutrients in soils that can be defined as 'optimum'. Crops will respond to applied nutrients when levels are below optimum. Recommendations are based on crop response to the nutrient. There will be no response to additions above the sufficiency level. This approach is most useful when fertilizer budgets are tight or when land is leased for a short period of time. It is important to know what extraction methods are used for the nutrient analysis and where the data was gathered to determine how much fertilizer would be needed. The extraction method and response data must be appropriate for the particular area that the soil samples came from. It is also important to know the recommendations will mesh with your planned application method. Broadcasting and incorporating require higher recommendations than banding.

Build and Maintenance Approach – This approach is used when nutrients are applied in excess of crop removal to increase the soil test level to the non-responsive range. This is most commonly used with nutrients such as phosphorus and potassium because they are less mobile and rarely lost from the soil. This concept is based on a soil response to the nutrient, but the practice is not common in western Canada.

Basic Cation Saturation Ratio (BCSR) – This approach promotes the concept that maximum yield is achieved by creating an ideal ratio of calcium, magnesium and potassium. BCSR does not apply to nitrogen, phosphorous, sulphur and micronutrients. BCSR works well on soils that are highly weathered with low pH and low to moderate cation exchange capacity. Following this approach exclusively can be expensive because it ignores the soil test level (sufficiency) and focuses on the nutrient ratio. However, an imbalance in this ratio, combined with insufficient levels of some of these nutrients, may provide further evidence of a nutrient problem and increase the likelihood of a positive response to the appropriate fertilizer.

Providing necessary data

Regardless of the lab used, it is important to provide the lab with all their required information which will be used in making the fertilizer recommendation. Some common items that are required include:

- Date sampled
- Legal land description
- Crop rotation
    - Continuous cropping or summerfallow
    - Previous crop – type and yield
    - Stubble management – baled or spread
- Sampling depth
- Depth of moist soil
- Prospective crop and target yield

Sending the same sample to various labs can generate different recommendations. Technically, each sample is slightly different, and if the uniformity of the sample is skewed due to improper sampling procedures, extraction results will be different. The recommendations made by the lab will reflect the recommendation philosophy used by each lab.

Understanding every sample is unique

In trials conducted in western Canada, a soil sample was taken from a field and a portion sent to six different labs for analysis. The six labs generated six different fertilizer recommendations and treatments within the study followed each fertilizer recommendation.

This example shows the importance of sending soil samples to labs that make recommendations based on the area the samples are taken from.

Table 1; Fertilizer Recommendation, Yield and Revenue for Wheat Near Irricana, AB.[2]

Fertilizer Recommendation (lb/ac) (N-P-K-S)	Yield (bu/ac)	Revenue ($/ac) (Gross revenue – fertilizer cost)
55-20-0-0	51.7	216.10
60-20-19-5	52.9	216.50
60-23-0-4	53.4	217.6
65-20-0-0	54.4	224.70
110-20-10-14 +3Cu	55.7	210.80
129-24-25-0 +1Cu +1B	55.9	214.00

The high fertilizer recommendations did produce slightly higher yields, but at a cost to total revenue. The largest difference between the highest revenue and the lowest revenue is in the nitrogen and sulphur part of the recommendation. The lab that produced the lowest economic return is from an area where nitrogen and sulphur are almost always lost from the soil throughout the winter with precipitation. The lab with the high fertilizer recommendation does not take into account any residual nitrogen and sulphur that may have been available to the crop, something we can count on in western Canada.

Using crop removal data to predict nutrient needs

Interest in using crop removal to help determine nutrient applications is growing each year. This method provides specific patterns in the nutrient levels. It also overcomes the challenge of under applying nutrients to the crop and becoming overly reliant on soil reserves, which ultimately leads to costly deficiencies.

Start by setting realistic yield goals, then convert this goal into nutrient removal based on previous research in your region. You would only use soil test results to tell you what is in the soil and potentially available to plants. Deduct this soil value from the crop removal amount to provide an estimated fertilizer recommendation.

The method has some flaws, such as not accounting for the nutrient uptake in the straw of the crop, or nitrogen mineralization from the field. However, it is a system that works fairly well, accounts for what the soil has to offer, and allows farmers to move up the yield responses.

Taking the guesswork out of fertilizer decisions

There are no absolute answers with soil testing, but it does provide a baseline to make more accurate fertilizer decisions. Soil fertility changes over time with additions and removals that are difficult to predict accurately. There are different agronomic services available in western Canada that use soil test information as the basis to make fertilizer recommendations. Recommendations will be adjusted based on additional parameters including crop removal, estimated nutrient addition and removal and various production models.

It is important to understand all aspects of the fertilizer recommendation and ask for clarification for any questions that may arise. Soil testing is an important tool that when properly used will take the guesswork out of making costly fertility decisions.

References:

1. Johnston, Adrian M., PhD, You Can't aAfford to Cheat on Soil Testing. Progress Through Knowledge, Crop Fertilization Considerations for Fall 2001.
2. Johnston, Adrian, Potash and Phosphate Institute, Rigas Karamanos, Western Co-operative Fertilizers Ltd. Philosophy of Soil Testing or How We Make Fertilizer Recommendations, http://www.ppi-ppic.org/

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