Building a Crop Nutrition Program

AGROLIQUID®

The 1ST STEP

John Leif, Field Agronomy Manager

Every grower has a budget for fertilizer– where should the first crop nutrition dollar be spent? The first, most important tool for developing a plant nutrition program is a good soil test. Unless a grower knows the condition of their soil, any fertilizer program will be based on averages and generalities. Significant nutrient deficiencies cannot be adequately addressed without soil test information. In today's economic environment, it is vital to understand what the soil has, and what it doesn't have, in order to make a well-thought-out fertilizer program.

The first step is, of course, collecting a sample. While not complicated, there are a few things to keep in mind when collecting a soil sample.

USE CLEAN EQUIPMENT

Make sure you don't have any sources of contamination that could influence the results of a soil test. For instance, use plastic containers that are dedicated to soil testing and not used for other purposes. The soil samples in Table 1 were taken using a standard soil probe, and the samples were placed in either a plastic bucket or in a galvanized bucket. Soil cores were mixed thoroughly in their respective container before being placed in a soil sample bag and sent to Midwest Labs for analysis. Obviously, the sample placed in the galvanized container had P, K, S, and Fe values similar to the sample placed in the plastic bucket. The Zn level, however was substantially higher in the sample placed in the galvanized bucket.

Container	P	K	S	Fe	Zn
Plastic	5	66	18	46	1.5
Galvanized	8	76	26	43	40.5

Soil Sampling

KNOW YOUR FIELDS

Soil sampling can be done in a grid sampling pattern if nutrients are being applied using precision application and variable rate technology equipment. If variable rate applications are not intended, fields can be separated into similar areas (zones). Often the similar areas can be grouped by soil type. Knowledge of the field is critical, so that distinct areas of the field can be sampled separately. A composite soil sample should represent an area no larger than 20 acres. Larger areas can be split into multiple samples. Sampling should be done in a zig-zag pattern throughout the zone, making sure to stay away from the outside boundaries of each area. Make sure the zone is well represented in the soil sample. Remember that up to 20 acres are to be represented by less than 1 pint of soil in the sample bag, and the lab uses just a small portion of that to do their analysis.

ORDER THE PROPER TESTS

There are many good soil analysis laboratories across the country. It is important that the laboratory conduct tests on cation-exchange capacity (CEC), pH, organic matter, base saturations, and all nutrient levels, including micronutrients. Most laboratories offer several test packages that offer various nutrient tests. Individual tests can be requested in addition to those included in a test package.

BE AWARE OF SEASONAL EFFECTS

Consistency is key when comparing multi-year soils tests. There can be considerable seasonal influence on soil test values, especially on potassium and pH. According to Midwest Labs, clay soils, like those in much of the northern corn belt, have a tendency to have a higher potassium level during winter months. Soil pH values can vary, as well, depending on rainfall or irrigation, nitrogen or sulfur inputs, and soil buffering capacity. It may be wise to take soil samples during periods when these variations hit average values. These periods are generally in the early fall (September-November) and again in the late March-April time frames. However, the ideal timeframe for taking soil samples should be based on ease of field access, so that differences in soil type, slope, drainage and cropping pattern can be most easily accounted for.

EFFECTS OF CULTURAL PRACTICES

Reduced tillage, ridge tillage and zero tillage can cause layered, stratification of organic matter, pH and soil nutrients. According to Midwest Labs, soil samples in areas where these practices are used should include samples that are split into 0”-3” and 3”-7” increments, to assess to what extent stratification is occurring. This is important in getting an informed fertilizer recommendation for the area.

THE NEXT STEP

While properly collecting and submitting soil samples is a critical first step, interpreting the results is another challenge. Upon first glance, a complete soil sample report can look like something a nuclear engineer carries in his briefcase. In our Spring 2018 newsletter, we will take a closer look at each component of a soil analysis report and use the data to build a crop nutrition program.

The 2nd STEP

An article in the Winter 2017 Newsletter discussed the importance of obtaining a good quality soil sample. That's the critical first step. But then what? Once the sample is analyzed, what should be done with the report? The information on that soil test is essential to the Retail Partner or grower understanding the condition of the soil and how to determine nutrient recommendations.

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TODAY'S DATE
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SOIL ANALYSIS REPORT

NEUTRAL AMMONIUM ACETATE (EXCHANGEABLE)

LAB NUMBER *267*	SAMPLE IDENTIFICATION	ORGANIC MATTER L.O.I.	PHOSPHORUS P_1 (WEAK BRAY) 1:7	PHOSPHORUS P_2 (STRONG BRAY) 1:7	PHOSPHORUS OLSEN BICARBONATE P	POTASSIUM K	MAGNESIUM Mg	CALCIUM Ca	SODIUM Na	pH SOIL pH 1:1	pH BUFFER INDEX	CATION EXCHANGE CAPACITY C.E.C.	PERCENT BASE SATURATION (CALCULATED) % K	% Mg	% Ca	% H	% Na
		percent RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE	ppm RATE			meq/100g					
48175	POND PASTU	5.2 VH	58 VH	78 VH		320 VH	327 VH	2383 M	11	7.7	6.6	19.6	4.2	13.9	60.8	20.9	0.2
48176	2HAY FIELD	4.8 VH	12 L	22 M		86 L	323 VH	3282 H	23	[illegible]	6.[illegible]	2[illegible].6	1.[illegible]	13.1	[illegible]9.7	[illegible].6	0.[illegible]

LAB NUMBER *267*	NITRATE-N (FIA) SURFACE ppm	SURFACE lbs/A	SURFACE depth (in)	SUBSOIL 1 ppm	SUBSOIL 1 lbs/A	SUBSOIL 1 depth (in)	SUBSOIL 2 ppm	SUBSOIL 2 lbs/A	SUBSOIL 2 depth (in)	Total lbs/A	SULFUR S ICAP ppm	SULFUR RATE	ZINC Zn DTPA ppm	ZINC RATE	MANGANESE Mn DTPA ppm	MANGANESE RATE	IRON Fe DTPA ppm	IRON RATE	COPPER Cu DTPA ppm	COPPER RATE	BORON B SORB. DTPA ppm	BORON RATE	EXCESS LIME RATE	SOLUBLE SALTS 1:1 mmhos/cm	SOLUBLE SALTS RATE
48175	49	88	0-6							88	11	L	2.5	M	7	L	124	VH	1.4	H	0.4	VL	L	0.3	L
48176	64	115	0-6							115	12	L	1.3	M	3	VL	50	VH	0.9	M	0.4	VL	L	0.5	L

REV. 12/03

An example soil test report from Midwest Labs. As you can see, the report is complete, showing organic matter, pH, Cation Exchange Capacity, Base Saturation, and nutrient levels – including micronutrients.

John Leif, Field Agronomy Manager

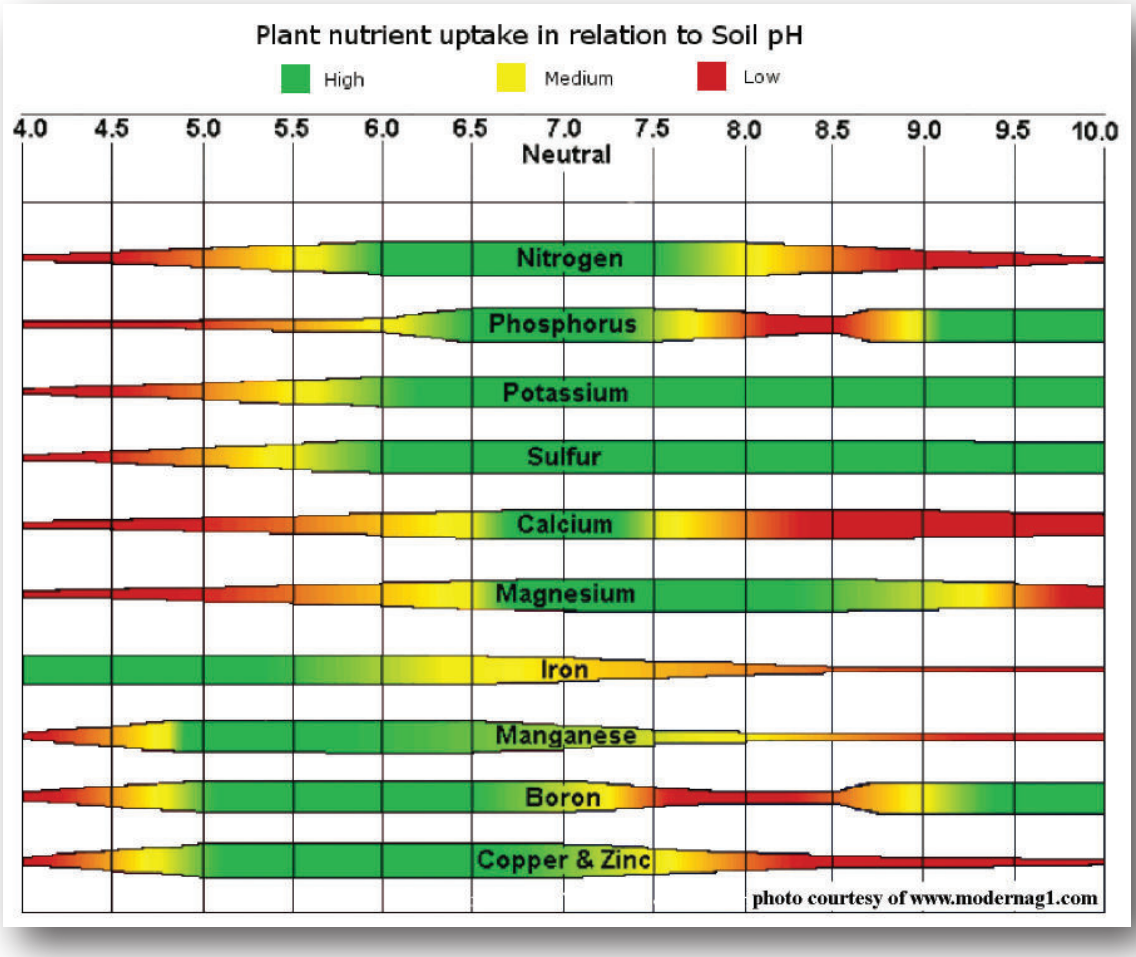
The first section of the soil test to review is the pH, CEC, and percent base saturation section. We get a general indication of the soil texture by the CEC. A soil with a CEC below 8 is considered sandy, whereas a soil with a CEC between 8 and 14 is a medium textured, or loamy soil. When a soil has a CEC higher than 14 there is a fairly high clay content. Those values are not hard-and-fast rules, but generally the higher the CEC the more clay and organic matter the soil contains.

Building a Crop Nutrition Program

Soil pH has a direct effect on nutrient availability. This chart shows relative nutrient availability at various soil pH levels. Most nutrients are readily available when the soil pH is 6 – 7.5. Notable exceptions are aluminum, where availability drops substantially at pH levels greater than 5, and iron & manganese where availability drops starting at pH 6 and higher. It is also important to note that most bacteria and fungi are most active in soils with pH above 5.5.

Base saturation is the ratio, or proportion, of the amounts of potassium, magnesium, calcium, hydrogen, and sodium in the soil. Having the soil's calcium base saturation level between 65 – 75%, magnesium level between 10 – 18% and potassium level between 3 – 5% provide the best opportunity for all nutrients in the soil to be available, good soil structure and water holding capacity, and good microbial activity. When those nutrients are in their desired ranges, soil pH is usually in the upper 6s to 7s. Simple calculations to help determine the amount of calcium, magnesium, or dry potash amendments needed to make base saturation adjustments are available.

Let's turn our attention to the crop nutrition we will need to provide during the growing season.



Nitrogen
Nitrogen recommendations have been well researched for many crops. Most crops have nitrogen recommendation equations that account for yield goals and soil residual nitrogen. Other factors to consider may include nitrogen credit for previous crops.

Nitrate nitrogen is a very mobile nutrient in the soil because it has a negative charge and doesn't attach to soil particles. Although the recommendation equations are a very good starting point, environmental factors such as rainfall, temperatures, and water saturation will influence nitrogen presence in the soil.

Phosphorus
Phosphorous plays a major role in crop production – from the earliest stages of growth through fruit production and maturity. When recommending phosphorus - or any nutrient - the yield goal is important. Phosphorus recommendations depend on yield goal and the readily-available phosphorus in the soil. That value is found in the Bray P1 column when soil pH is less than 7 and the Olsen Bicarbonate column when the soil pH is greater than 7. Some labs use the Mehlich 3 extraction process to determine available phosphorus, which is not dependent on soil pH.

P_2O_5 recommendations also take into account whether there is low, adequate, or high levels of phosphorus in the soil. Applying the amount of P_2O_5 needed to grow the crop and taking advantage of the nutrients already in the soil will provide for good crop production and reduced potential for environmental problems. The actual amount of P_2O_5 needed to grow the crop will vary by crop and yield goal but if the phosphate level is less than 30 ppm most crops will respond to supplemental P_2O_5 application. Crops that are often planted in cool, moist soils, such as corn, will benefit from a small amount of P_2O_5 applied at planting, even in high phosphorus soils.

Potassium
Many crops, especially legumes, fruits, and vegetables, have a high demand for potassium. It is necessary for fruit production and water relationships in the plant, among many other functions.

When recommending K_2O, the yield goal is the first piece of information to be collected. However, in addition to yield goal, the CEC of the soil also figures in to making recommendations for potassium. In sandy soils a potassium level of 150 - 175 ppm is considered adequate for most crops, and in higher CEC soils that value is upwards of 200 – 225 ppm. Those values are reasonable for row crops such as corn, soybeans, and wheat, but may not be adequate for crops that have a high demand for potassium.

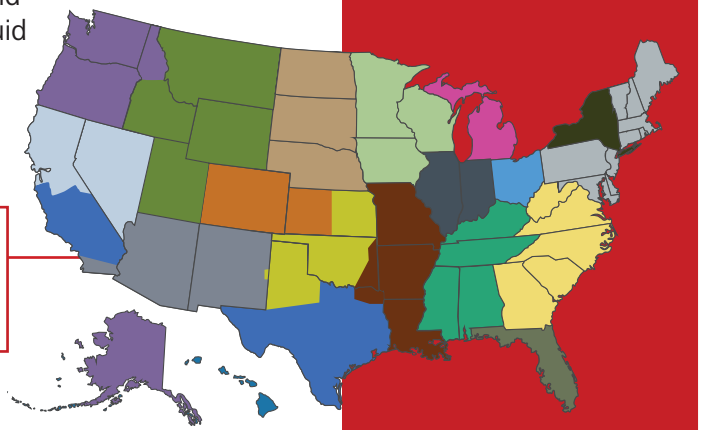
Sulfur

Sulfur is vital to high yielding, high quality crops. It is not required in as high of rate as N, P, and K in most crops, but it is just as vital to plant health. Sulfur recommendations are based on several factors including CEC, organic matter, and pH. A rule of thumb to use for determining sulfur need is that most crops require 1 lb of sulfur for every 10 lbs of nitrogen the plant needs. Most crops will respond to sulfur applications when soil sulfur level is below 25 ppm.

The last section of the soil test is the micronutrient section, but the term "micro" does not mean that they are unimportant. In fact, having the proper amounts of micronutrients available to the crop is as critical to yield and quality as N, P, and K. Micronutrients are needed in much smaller amounts than other nutrients, but again, they are every bit as important as the other nutrients for proper crop growth and production. Crops such as corn, soybeans, apples, cotton, and tomatoes respond very well to additions of zinc, boron and manganese when the soil test calls for it. Crops such as wheat respond most to iron and manganese. Small amounts in the soil are extremely important, however excessive amounts can be phytotoxic.

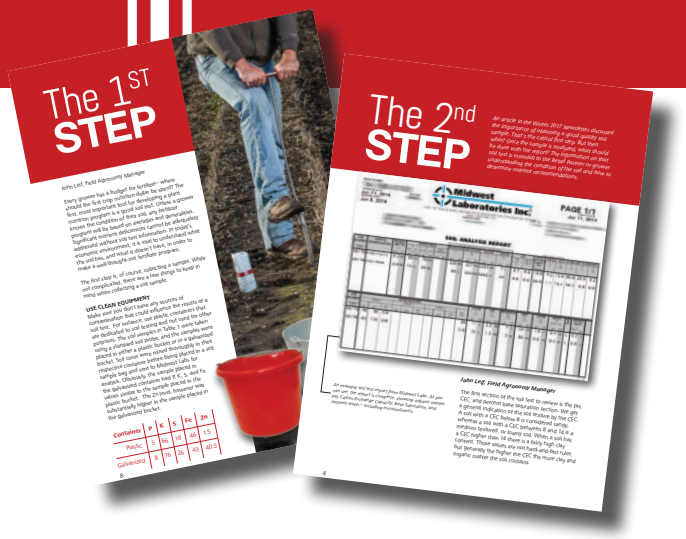
There is a lot of information on a soil test analysis report. For additional information, or assistance in using soil test reports to develop a crop nutrition plan, contact an AgroLiquid Retail Partner, or AgroLiquid representative.

Find a Retail Partner or representative near you at agroliquid.com.



Soil pH has a direct effect on nutrient availability.

The 3rd STEP Tissue Sampling



Carlos Palavicini
Sales Account Manager

After soil testing, the nutritional plant analysis is the most important tool to understand what is happening in the plant regarding the nutritional effects on its physiology. Therefore, it is critical to improving crop nutrition and yield. Only the plant analysis can identify the actual nutrient status of a plant.

The best way to take advantage of a tissue analysis is to use it to decide the next steps of a nutritional program. It's also a great tool to help us identify hidden deficiencies in the crop. Sometimes, the plant analysis is also the best way to get an accurate diagnosis of what we are seeing in the plant, since it isn't always easy to identify the real cause of a problem we have found in our crop. This is especially true when we need to be sure we are identifying a disease or a nutritional deficiency - or both.

It is important to keep in mind that the plant analysis is just a snapshot, a certain point in time, of the nutritional status of the plant. Then, depending of the crop that we are evaluating, we need to set our goal by doing the tissue test.

Because plant physiology is dynamic, it is necessary to compare your plant analysis results with what we expect to see on a plant at the same time that we sampled (the current stage). Of course, how dynamic the physiology of the crop is correlated with the type of crop, so what the plant analysis can tell us differs from one crop to another. A plant analysis is almost like a mid-year report card. How does your crop nutrition plan look, graded against the best in the class?

For intensive crops with a long season, such as greenhouse tomatoes or peppers, or open field chilies, eggplants or papayas, some growers prefer to do a plant analysis every month to ensure the plants are in shape to keep up the production.

In tree crops, we can take one to three plant analyses per year. A tissue analysis made before starting the season, in conjunction with a soil test, is the best way to determine the fertilizer program for the oncoming season. Sometimes a plant analysis before blossom can help us decide if we should do foliar application to assure the best yield, and a final analysis that will tell us how well prepared is the tree for the dormant period and the sprout time.

Row crops may only need one tissue analysis before the reproduction stage, in order to determine if our fertilizer program is in need of a correction. In this case it is very important to do it on time before our next opportunity to apply fertilizer.

If you are interested in making a full review of your crop's nutrient trends throughout the season, you may want to pull a tissue sample weekly. If you intend to establish this type of sampling, pull tissue

samples from the same places in the field, at the same time each week. Nutrient levels will vary dependent on growth stage of the crop, weather patterns, and other variables. Regardless of crop type or analysis schedule, it is very important to make a plan of how many tests will be done during the season – with both plant and soil analysis.

For the results of the tissue analysis to be useful, it is necessary to use a sampling standard methodology. The sampling procedure includes the following aspects:

1. Selection of the tissue to sample
2. Sampling and
3. Preparation of samples for shipment to the laboratory

An important note, when there is an abnormal area in the field, it is necessary to take plant tissue samples and have an analysis from this area separate from the remainder of the field. It is also highly recommended to do a soil test of the same abnormal spot, in order to have as much information as possible. Having analysis of the normal and abnormal areas will help determine the origin of what is happening, and concentrate efforts to solve the problem.

Plant analysis is the best way for the crop or plant, to tell us what nutrients it needs. When sampling a field, it is critical that the correct plant part and stage of growth be sampled, and of course that the lab be clearly informed of this. The lab will calibrate their testing to those conditions, thus the correct identification of which nutrients are low or high depends on accurate information provided to the lab.

It only takes about five minutes to properly pull plant tissues to send for analysis. A plant nutrient analysis typically costs about $20. The time and overall investment involved in acquiring this important mid-season snapshot of your crop is small, compared to the potential opportunity gained. Tweaking applications, finding unseen deficiencies, or pinpointing nutrient uptake trends can help dial in your crop nutrient management strategy for a better return on your fertilizer dollar.