Soil Sampling—Why, When, How and What to Expect

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Soil sampling is one of the most important operations a producer can perform in support of their production system. A properly collected soil sample will indicate the current nutrient status of the area sampled and the results will provide nutrient recommendations for the specific crop(s) to be grown next. There are two primary ways to lose money in a soil fertility program: fertilizing fields that have adequate present fertility, "wasting money" on unnecessary inputs, and not applying needed fertilizer which can result in yield and income losses. Soil samples submitted to your local County Extension office can range from free (no charge) to about $8 per sample, depending upon the county. This investment will provide information that can reduce management costs and increase profits. The purpose of this article is to discuss best times to collect samples, how to collect samples, and what to do with the resulting information.

The University of Kentucky Cooperative Extension Service recommends collecting soil samples every 1 or 2 years, depending on the crop, crop management, and fertility management strategy. Soil samples should be collected more often for higher value crops and crops with high nutrient removal rates. For example, dark-fired tobacco (high value), silage corn (high removal), and alfalfa (high value and high removal) should be sampled every year. A corn-wheat-double crop soybean rotation can be sampled every other year and soil fertility adequately maintained, in most instances. Most of the residue from the corn, wheat, and soybean is returned to the field and only the grain is removed. Years with abnormally high or low yields may result in an out-of-cycle sampling. Annual sampling is always acceptable and allows more precise nutrient management.

Soil samples can be collected at any time during the year. However, fall sampling is usually preferred over other times of the year. In the fall, after harvest, soils tend to be drier than in the spring or winter, soil testing labs tend to be less busy, and there is plenty of time before planting to make fertility decisions. There can be some seasonal variation between fall and spring sample results due to residue breakdown, residual fertilizer salts and rainfall, so it is best to be consistent in the time samples are collected from any one field. Fertility recommendations were made on average based on research done across the entire state and might lack specificity, but they provide the best starting point. In this context, soil test history provides value to improve site specific recommendations. Compare samples over time to see how they vary from year to year, based on fertilizer application and estimated nutrient removal. If soil sample test results trend up or down over a several year period following provided recommendations, adjustments can be made using this historical information.

Soil sampling depth depends on tillage. Fields that are tilled should be sampled to 6 inches or the depth of primary tillage tool operation. No-till and minimum-till fields should be sampled to a 4 inch depth. These depths show the best correlation between crop response and nutrient additions in Kentucky. If sampling shallower or deeper, the results can lead to erroneous fertilizer rate recommendations. For example, if a 2 inch sample is collected in a NT field the results will be higher than a sample collected at 4 inches due to the stratification of nutrients at the soil surface. This higher nutrient status will result in a lower fertilizer rate recommendation for that field. Collecting soil samples to the correct depth is a critical component to getting reliable nutrient recommendations.

Use a clean plastic bucket to collect soil cores. Galvanized buckets release zinc to the soil sample, causing erroneously high zinc soil test results. It is best to sample similar areas within a field while avoiding anomalies such as old fence rows, feeding areas, low areas, or any place that would result in a considerably different soil test result. Soil samples should represent areas no larger than 20 acres in size if relatively uniform or no more than 10 acres with less uniform fields. Remember, the results of the soil sample are only as good as the sample submitted to the lab. Take 10 – 20 cores per sample, mix well in the bucket, and place enough soil in the sample bag or box to meet the requirements of the lab. Record all the requested information on the sample submission form and submit the sample to your local County Extension Office.

What you receive as soil test results depends on the analyses requested, but not the lab the sample is submitted to, as long as the lab methods are the same. Soil pH, buffer pH, and plant available phosphorus, potassium, and zinc should all be evaluated, regardless of the lab. Most labs will also report plant available calcium and magnesium, but these nutrients are seldom low enough to limit crop yield in Kentucky as long as an adequate pH is maintained. Some labs will also report plant available sulfur, copper and iron. These values have very little meaning in Kentucky, because they are not supported by crop response correlation and calibration research done on Kentucky soils. A few sulfur deficiencies have been reported in Kentucky, as has one copper deficiency, but there have been no reports of iron deficiency on pasture and row crops. The area of sulfur and copper deficiencies has been too small to permit any crop response research. Field history, long-term soil test records, visual

diagnosis, and tissue testing should all be used as part of a strategy to manage sulfur and micronutrients like iron or copper.

The results provided will be for the next specific crop to be grown. When using one soil sample for a multi-year rotation, remember that the recommendations provided will only be for the next crop specified. Go to AGR-1 (link at bottom of page) for the fertilizer rate recommendations for any following crops in the rotation. Recommended rates of phosphorus and potassium can either be applied prior to each crop (preferred) or summed together and all added at the beginning of the rotation (not as efficient). Any lime rate recommendation is designed to cover a period of 3 to 5 years, depending on the amount of acid forming fertilizer being used and should be applied prior to the first crop in the rotation. If the next year of the rotation is small grain followed by double crop soybean, the phosphorus rate recommendation should be based on the need of the small grain and the potassium rate recommendation should be based on the need of soybean.

Other information found in some soil test reports include CEC (cation exchange capacity), % Base Sat (base saturation), and particular nutrient ratios. These values are not the basis of valid fertilizer rate recommendations in Kentucky. The CEC is a measure of the soil's negative charge, which can influence the amount of positively charged nutrient ions a soil can hold. Approximately 85% of the surface soils in Kentucky have a CEC between 11 and 18 meq/100 grams of soil. So the variation is small and wouldn't greatly influence recommendations. The CEC typically reported is a numerical estimate, based on the buffer pH and extractable plant available potassium, calcium and magnesium, and varies +/- 2 to 3 meq/100 grams of soil. At best, this is a rough estimate of the true CEC, which is much more costly and time consuming to determine. The CEC can provide information regarding soil texture and/or organic matter content. But soil texture can be better determined by quick observation during soil sample collection and soil organic matter can be accurately determined in the lab for a nominal fee. Base saturation is the relative concentration of "base cations" in the soil, including potassium, calcium, magnesium and sodium. This is also based off the "estimated CEC" typically found in most soil test reports. It is not the ratio of nutrients that influences plant uptake and growth, but is rather the absolute amount of available nutrients. This is why CEC, base saturation, and nutrient ratios are not as important to good fertilizer rate recommendations as using the available nutrient concentrations as determined in conventional soil test extractions. It is important to note that there are still sources that recommend use of cation/nutrient ratios as a way to manage nutrient applications or use of CEC to manage nitrogen rate applications. However, these philosophies have been repeatedly debunked and are generally regarded as nonsense throughout the scientific community. You'd be wise to steer clear of anyone promoting these approaches.

Remember, when taking soil samples, collect them to the right depth based on tillage, at a similar time of the year, using the appropriate bucket, and to adequately represent the field. The results returned are only as good as the sample submitted. Consult with your local County Extension Agent with any additional questions or concerns regarding soil sampling.

Ritchey, E.L. and J.M. McGrath. 2018. AGR-1. 2018-2019 Lime and Fertilizer Recommendations. University of Kentucky Cooperative Extension Publication. http://www2.ca.uky.edu/agcomm/pubs/agr/agr1/agr1.pdf