Managing phosphorous and potassium SOIL Fertility

Know your soil

Many fields have areas that test low for P and K, limiting yield and reducing profitability. Knowing nutrient levels of your soil will enable fertilizer management for profitable yields.

Knowing P and K removal with harvest is essential to maintain optimal soil-test values over time and assure long-term yields and profitability.

Making the most of phosphorous and potassium fertilizers and soil fertility

Although Iowa soil profiles typically contain thousands of pounds of phosphorus (P) per acre, only a small fraction is available to growing plants. Phosphorus and potassium (K) fertilizer applications are needed for most Iowa soils to maintain a highly productive cropping system.

Many fields have areas that test low for P and K, limiting yield and potential profitability. Farmers are encouraged to apply recommended P and K rates for low-testing soils. A significant yield increase — up to 80 percent in soils testing very low — is likely.

Even in fields with adequate nutrient levels, maintenance fertilization is recommended to assure long-term high yields. Most Iowa soils retain P and K in crop-available forms (i.e., they have little or no fixing capacity). As a result, a management strategy to increase and maintain soil P and K is possible. P and K remain available long after they're applied, even for multiple years.

Retention, but little "fixation," is the main reason a fall application is as effective as a spring application and that multi-year applications work well. Soil sampling and testing are useful for identifying P and K deficiencies and for assuring that appropriate levels are maintained. Decreases in available P and K occur mainly due to crop removal and from surface runoff.

P and K help increase farmer profit primarily through increased soybean yields. P enhances photosynthetic rate, uptake and transfer of nutrients and nodulation. K helps maintain the plants defenses against diseases and insects.

The ABCs of soil sampling

Fertilizer application should be preceded by soil sampling and testing. It's a good practice to collect samples in the same season, especially when testing for soil K levels. Collect composite samples with an adequate number of samples and cores, to appropriately represent the field. The soil test value and the resulting fertilizer recommendation will be less relevant if the sampling does not represent the field nor the portion of field to be fertilized.

How do you decide the number of samples to collect per field?

Good method: Samples represent each soil map unit and no more than about 10 acres (unless available information suggests larger field areas have little variation). Collect at least 10 to 12 cores per composite sample or more when fertilizers and manure have been banded.

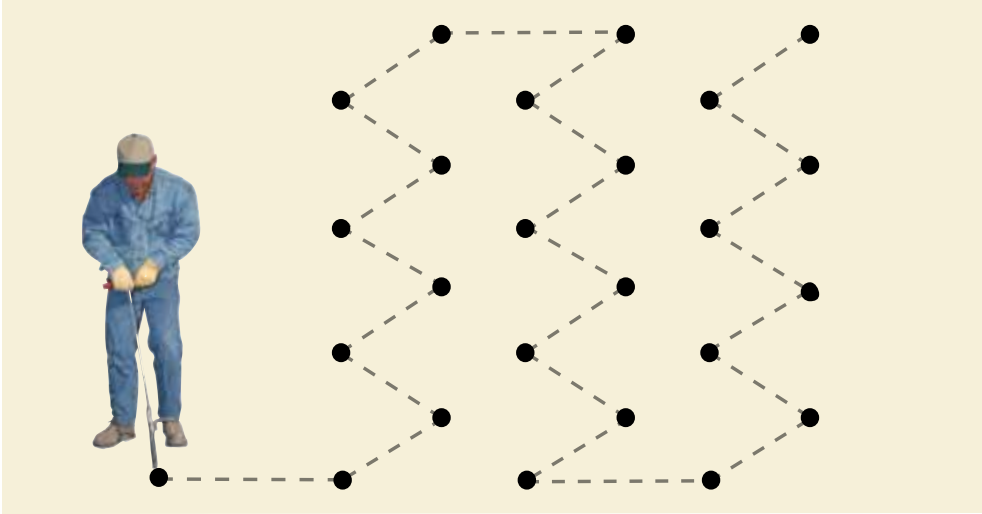
Better method: A smaller area per sample is advantageous, and grid or zone sampling methods are better sampling approaches. A zone sampling method utilizes information in addition to soil survey maps, to separate sampling areas. It improves the traditional "sampling by soil type" approach, while usually taking fewer samples than grid sampling. You may use yield maps, electrical conductivity maps and aerial or satellite images. Having multiple test results per field helps determine appropriate fertilizer application rates because (usually) there is high within-field test variability. Multiple tests also accommodate better site-specific nutrient application using variable-rate technology.

Research has shown that each grid soil sample should represent areas smaller than three to four acres, and each sample should include at least 10 to 12 cores. It is possible to take too many samples, too: The cost won't justify potential returns from the knowledge gained. The cost of sampling areas smaller than about 2.5 acres would be too high for prevailing crop/fertilizer prices, even when sampling every three or four years.

Frequency and depth of soil sampling

Fields should be sampled every two to four years for most crops, or once in a crop rotation. It's better that fields be in the same crop, and approximately the same time of the season, each time they're sampled. This reduces variability of test results over time.

Iowa State University suggests a six-inch sampling depth for P, K and other nutrients. Research shows there is no clear advantage for either shallower or deeper sampling depths in the region, even for no-till or pastures. Existing soil-test interpretations are based on field research using a six-inch sampling depth. Using other depths with interpretations based on the six-inch standard will skew fertilization rates. Collect soil cores using a consistent depth to get comparable results over time.



Collect 10 to 12 cores per composite sample. Each composite sample should represent four to 10 acres.

Significant yield increases are possible

Apply P and K where the chance of yield increase is significant and the expected yield increase is sufficient to at least pay for the applied nutrient.

Understanding the soil-test interpretation categories, as well as appreciating the difficulty of precisely predicting a yield increase from fertilization, is an important step in the process of deciding P and K fertilization. The likelihood that P and K applications will produce a yield response within each ISU soil-test interpretation category is as follows:

P and K soil test level	Likelihood of yield increase
Very low	80%
Low	65%
Optimum	25%
High	5%
Very high	<1%

**The rates recommended for these soil-test categories are based on field response trials, attempt to optimize long-term profitability by avoiding yield losses where responses are large and very likely, and provide a high probability of maximized profits at current prices.*

As soil-test levels increase, the probability of a yield response (due to fertilization) falls, as does the magnitude of the expected yield increase and total net return.

Fertilizer application to maintain soil-test values in the optimum category (16 to 20 ppm by the Bray-1 test, for example), based on P and K removal with harvest, is a good practice to sustain profitable crop production. Soybean and corn yields have been increasing significantly in recent years, so knowing yield levels and accounting for nutrient removal is important. Yield monitors and yield maps are excellent tools for gauging nutrient removal across a field.

Note: When levels are in the optimum category, applications can be withheld until the next year or reduced, especially when product supply is short, funds are needed for other more critical inputs or land tenure is uncertain. The economical response to P and K application the year they're applied is small in the current optimum category and becomes even more uncertain as the crop/fertilizer prices become unfavorable.

P and K, soybean and corn

Applying P and K before corn in a corn-soybean rotation to meet the needs for both crops is an acceptable practice. It reduces application costs, and research shows it is as effective as applying those nutrients ahead of each crop. But in low-testing soils in particular, growers must be certain sufficient P and K are applied for the soybean crop that follows corn.

Potassium deficient soybeans, above and below, show yellowing on leaf edges. Symptoms appear primarily in the older, lower canopy as leaves with yellow margins that become brown and expand inward over the leaves with extreme K deficiency.

Potassium deficient corn. Symptoms first appear as yellowing and dying of lower leaf margins. Plants with impaired root systems are most likely to show symptoms after about V6 when plant potassium uptake increases. Potassium-deficient corn tends to lodge late in the season.

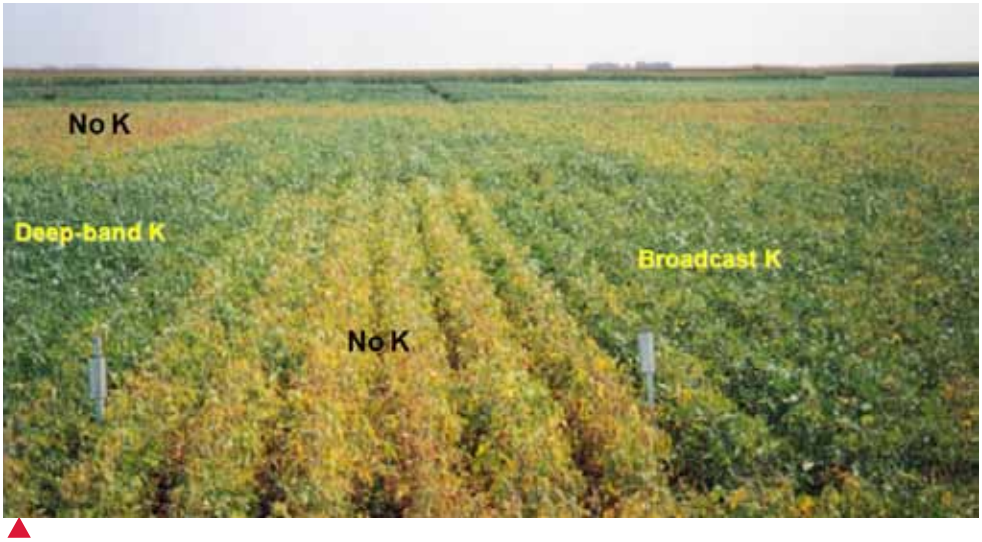
Research on P and K placement methods for soybean and corn has shown little or no difference between broadcast and band application methods for P, other than a response to a small amount of starter fertilizer for corn under some conditions. However, deep-banding K fertilizer (5 to 7 inches) is usually advantageous in fields managed with ridge-tillage, and often for fields managed with no-till or strip tillage. Research also shows that reducing the application rate when banding is risky, and not recommended.

High crop yields — especially in soybeans — depend on adequate soil pH and liming of acid soils. Extremely acidic or high pH (calcareous) soil sometimes found in other regions may require a change in the fertilizer rate or the application method. However, there is no evidence of this need for Iowa soils, even in those considered calcareous.

Nonetheless, research has shown the Bray-1 P test is unreliable in many high-pH, calcareous Iowa soils. So, the Olsen (bicarbonate) and Mehlich-3 P tests should be used for soils with a pH higher than 7.3.

Further information on soil sampling can be found in the Iowa State University Extension publications PM 287 (Take a Good Sample to Help Make Good Decisions) and NCMR 348 (Soil Sampling for Variable Rate Fertilizer and Lime Application), which are available from ISU Extension.

Further information on P, K, and lime management can be found in the Iowa State University publication PM 1688 (A General Guide for Crop Nutrient and Limestone Recommendations in Iowa).



Research on P and K placement methods for soybeans and corn has shown little or no difference between broadcast and band application methods for P. (Northern Iowa State University Research Farm photo, research funded by the Iowa Soybean Association)

This fact sheet was prepared by the Iowa Soybean Association and Dr. Antonio Mallarino, Iowa State University.

Iowa Soybean Association
1255 S.W. Prairie Trail Parkway
Ankeny, IA 50023

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