How Much Fertilizer Do I Need to Apply for My Corn Crop?

Adequate soil fertility is a must for corn production. To help maintain corn yield potential, promote plant health, and help reduce fertilizer investment, informed management decisions for fertilizer and manure rates and application methods are needed. First, crop fertility needs vary depending on the nutrient. Nitrogen (N) availability and the amount needed to grow a corn crop is vastly different than for phosphorus (P) or potassium (K) which are all primary crop nutrients. These differences become even greater when you compare primary nutrients to secondary crop nutrients like zinc (Zn) or manganese (Mn). Also, fertilizer application amounts depend on the availability already in the soil. Soil testing is a best management practice and should be the foundation for corn fertility decisions.

Total fertilizer management helps optimize nutrient efficiency to help maximize yield potential and profitability. There are many variables in soil and fertilizer management that can cause sizeable differences in the amount of nutrients needed to meet realistic yield goals and to understand application timing to maximize yield potential. Variables to consider when developing a sound fertility program include:

- Crop rotation (including a legume crop like soybean and alfalfa).
- The use of cover crops and different cover crop species.
- Manure applications.
- Soil organic matter.
- Soil pH.
- Soil cation exchange capacity (CEC).
- Realistic yield goal of the crop.

These factors can either add nutrients, deplete available nutrients, or impact the timing or amounts of each nutrient needed for the planned corn crop.

Nitrogen

Nitrogen is perhaps the most difficult-to-predict nutrient due to high crop requirement, complex internal soil cycling, and high environmental losses.[1] The total soil N (organic N) in an acre of soil is usually greater than 2,000 pounds, but only a small portion of that N (around 2%) is mineralized (the process by which microbes decompose organic N) and available to a corn crop in a growing season.[2] Most forms of organic N cannot be taken up by plants, but plants can readily take up mineral forms of N, including nitrate and ammonia. High yielding corn products can require about 180 to 280 pounds per acre (depending on the yield potential of each field). Therefore, it is important to understand the component of total soil N that acts as a reservoir for the growing crop and the rate and amount of this release. This release is dependent on several important environmental factors including:

- Soil organic matter.
- Type and amount of crop residue on and in the soil.
- The type and timing of tillage (if any).
- Growing conditions including temperature and moisture.
- Soil health.
- Soil type.

Since there are many different soil tests available to help determine the amount of N needed to grow a corn crop it is important to review some of the more popular options.

Soil tests for Nitrogen

Nitrate Soil Test. This test is used to test for nitrate N that is in the soil at the time of testing. This test should be taken every year due to the potential for high year-to-year variability. This test is very popular in the western Corn Belt where the soils are extremely

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low in organic matter (one to two percent) and precipitation is often exceptionally low. Since nitrate N is very susceptible to leaching, any environment with a sandy soil type and the potential for elevated precipitation levels could result in nitrate N movement below the effective corn root zone and overestimate the N nutrition available in the soil. Also, low organic matter soils can have much less N mineralization (process by which microbes decompose organic N from manure, organic matter, and crop residues to ammonium N) available to a corn crop through the growing season.

Pre-sidedress Nitrate Test (PSNT). This test is like the Nitrate test but is taken at sidedress time (V6 through V8) so that the early season N losses due to leaching, denitrification, or volatilization have occurred. The nitrate that is in the soil can then be measured and should be available for plant growth. Results from this test provide an opportunity to adjust sidedress N rates based on residual soil N present at the time of application.

Soil amino sugar test. Often, in humid areas, with high organic matter, soil nitrate N measurements prior to planting cannot predict N needs for the coming growing season.[2] Additional tests are needed to better understand what the potential corn crop N needs under these conditions. Researchers in Illinois reported that among the various organic fractions in the soil, concentrations of amino sugar N are highly correlated with responsiveness of soils to N fertilizer. Accumulation of amino sugar N in the soil reduces the yield response of corn to N fertilization. Soil concentrations of amino sugar N have shown a high correlation with both yield and fertilizer-N response.[2] The Illinois soil nitrogen test (ISNT-N), also known as the Organic N Test and the Solvita Labile Amino-N test, along with numerous other tests, have been developed to go beyond testing for nitrate N to test for soil amino sugar. These tests measure the levels of soil amino sugars to estimate the amount of N that may be potentially released by mineralizable N and available to the crop during the growing season. It is common for 60 to 80 percent of the N used by the crop to be provided by the soil during the growing season through mineralization. Results indicate soil organic N mineralization potential tests are valid for 2 to 3 years. Therefore, when using this method, annual soil sampling is not needed.[2]

Soil Testing

When evaluating other soil nutrients that may be needed to grow a corn crop, a standard soil test is a good place to start. The value of a soil test, in predicting nutrient availability during the growing season, is directly related to how well the sample collected represents the area sampled. Best soil sampling procedures include:

- The best time to sample is when the acreage is lying idle: for example, summer for after a winter small grain crop or later fall and winter after spring-planted crops.
- It is best to use a soil coring device because it takes an equal amount of soil from the surface through the sampling depth (6 to 12 inches or tillage depth if deeper) and uniform soil cores at each sampling location.
- Collect samples from uniform areas using the field map (obtained from FSA or county soil survey).
- For each composite sample, avoid sampling areas with obvious differences of soil color and texture, slope, crop rotation, or fertilizer, lime, and manure applications.
- Each composite soil sample should represent uniform areas of a field and should consist of 15 to 20 separate cores.
- Mix individual samples (15 to 20 separate cores) to obtain a one-pint composite sample in a clean plastic pail (metal pails contaminate the soil with micronutrients).
- A composite sample should not represent more than 20 acres.[3]

A well-taken soil sample can provide a recommended fertilizer rate needed to grow the corn crop. These

samples should be sent in a timely manner to a soil laboratory that has correlation and calibration data for your area.

Leaf tissue tests

In field crop plant tissue analysis, in conjunction with a soil test program, can serve as a check on a fertilizer program. Plant tissue analysis can also serve as a trouble shooting tool to help diagnose a suspected nutrient deficiency. Plant nutrient levels can vary depending on the growth stage of the plant. Therefore, when taking plant samples for analysis as a check on a fertility program, the plant growth stage at sampling is important. Also, the nutrient levels can vary from one part of the plant to the other. Plant nutrient sufficiency levels have been calibrated to certain growth stages and parts of the plant.[4] It is important to know the sampling procedure for the laboratory that will be doing the tissue analysis as there can be significant differences. In-season plant tissue testing can be useful in diagnosing nutrient deficiencies in field crops, but it must be used with caution. Extra care is needed when unusual or extended crop planting and growing (excessive cool or dry) conditions exist. Many times, by the time a leaf tissue test can pick up a nutrient deficiency in a corn crop, there can already be yield loss associated with that nutrient deficiency, even with a quick foliar application for the deficient nutrient.

Conclusions

Adequate soil fertility is one of the important requirements for profitable corn production. Fertilizer nutrient requirements for corn are based on expected yield and soil nutrient availability. When it comes to N recommendations, there are a multitude of testing options that can be used to determine the fertility needed to reach the yield goal.

Soil test methods like nitrate soil test and PSNT provide opportunities to adjust N rates for variation in soil N supply. Similarly, crop sensing methods enable growers to better synchronize soil N supply with crop N needs, resulting in reduced N rates. However, these methods are not without their own shortcomings, including additional costs associated with acquiring and processing soil samples as well as a narrower time window for in-season N applications. Growers should carefully consider the pros and cons of each N management approach, using one or more strategies (or a combination) that maximize profit potential while minimizing risk.

Sources

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