Channel Seedsmanship At Work

Agronomy ADVICE | Tips from the Channel® Field Check Up Series

Assessing Nutrient Availability for Corn

Key Points

- A current soil test can indicate if a field requires additional fertilizer to maximize crop growth.
- Lime is best applied in the fall and incorporated at least one month prior to P and K application.
- If P and K soil test values are below the critical level, buildup fertilizer should be applied.
- Continuous corn operations should consider crop residue and its impact on N availability for the next corn crop.

Maximizing corn yield potential depends greatly on maintaining soil fertility. Realistic yield goals in conjunction with other agronomic factors and nutrient crop removal are important considerations for maintaining adequate fertility.

Soil Testing

A soil test can indicate if a field or area of a field requires additional fertilizer to help maximize crop growth. When soil test values for a particular nutrient are below a critical level, which indicate nutrient deficiencies, appropriate build-up fertilizer should be applied to increase soil nutrient levels. In addition, fertilize for the amount of nutrients removed by the crop, which is often referred to as maintenance or crop removal fertilizer applications. Soil tests should include an analysis for macronutrients, micronutrients, pH, buffer pH, organic matter, and cation exchange capacity.

Soil pH and Lime Application

A soil pH between 6.0 and 7.0 is generally the recommended range where plant nutrients are most available. Nutrient deficiency symptoms may appear if soil pH falls below 5.5. In low pH soils, the primary macronutrients, nitrogen (N), phosphorus (P), potassium (K)), and important secondary macronutrients sulfur (S), magnesium (Mg), and calcium (Ca) may become less available to growing plants. Lime neutralizes soil acidity and adds Ca, a micronutrient essential to plant growth. Soil pH indicates the level of acidity or alkalinity, while buffer pH is used to determine, if needed, the rate of lime application. Lime takes time to dissolve in the soil and neutralize acidity; fall application provides the needed 3-6 months time before planting for it to dissolve adequately. Lime should be applied and incorporated a month or more before adding fertilizers, since it can interfere with the availability of other nutrients, especially P. Particular attention should be paid to different liming material sources. Differences among products in their neutralizing efficiency (calcium carbonate equivalent and particle size) will influence optimum application rates.

Crop Nutrient Removal

Soil fertility levels for P and K are affected by their inherent availability in the soil, crop removal, and soil pH. Nutrients with high requirements for production (N, P, K) or that have high harvest index values (P, Zn, S, N) are important to help maximize yield potential (Table 1).[1] Crops cut for silage remove more nutrients because the majority of the above ground tissue is harvested. Additionally, potential yield levels illustrate how fertilizer rates can be affected (Table 2).[2] By understanding crop nutrient uptake and removal, a farmer can better match plant nutritional needs for a target yield in a field environment.

Continuous corn operations should factor crop residue into nutrient availability because nutrients are unavailable for plant use until released from the residue. Nitrogen, in particular, can be tied up as soil microbes use N as they decompose the residue. Research has not consistently shown a benefit to fall N applications assisting in residue breakdown. Timing, cooler fall temperatures, and/or dry weather may play a role in the success of fall N applications aiding in residue breakdown.

Table 1. Macronutrient Uptake (lbs/bu) By Targeted Corn Yield.

Corn Yield (bu/acre)	N	P_2O_5	K_2O
150	203	81	206
200	270	108	274
250	338	135	343

Source: Potash & Phosphate Institute.[1]

Table 2. Nutrient Removal (lbs) by Targeted Corn Yield.

Corn Yield (bu/acre)	N	P_2O_5	K_2O
150	135	57	40.5
200	180	76	54
250	225	95	67.5

Source: Calculations made using International Plant Nutrition Institute data.[2]

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Recommendations for Nitrogen, Phosphorus, and Potassium

Nitrogen (N). Inadequate fertilization, leaching and/or denitrification of nitrate from heavy rainfall, and flooding can result in N loss. Symptoms appear on leaves as a yellow coloration in a V-shaped pattern, starting at the tip and progressing toward the leaf collar (Figure 1, left). Nitrogen deficiency symptoms usually appear first on lower leaves. Ideally, N should be applied according to crop need at different times during the season. Rapid N uptake begins at about V6 (six visible leaf collars) growth stage.[3] Prior to that stage, the plant takes up less than 5% of total N uptake for the season. Therefore, application close to rapid growth can be more efficient, as N applied earlier may be lost due to denitrification and leaching. Crop growth, soil moisture, available labor, and equipment can influence an operation's ability for timely in-season N applications and should be taken into consideration.

In the mid to upper Midwest, much of the N is fall applied as anhydrous ammonia, which can be readily lost when soil temperatures are above 50° F. Nitrification inhibitors should be considered where appropriate to help reduce the potential for N loss.

Phosphorus (P). Reddish-purple corn leaves may indicate P deficiency (Figure 1, center); however, cool temperatures, mechanical, herbicide or insect root pruning, wet or dry soil, and compaction can mimic P deficiency and be the cause for inadequate uptake by the roots. Fall application accompanied with tillage (where applicable and appropriate) is best because P is immobile in soil. If a P deficiency is detected early in the season, a sidedress injection may be beneficial to place P near the roots, but care should be taken not to damage roots in the process.

Potassium (K). Low K levels can result in yellow leaf margins beginning on the lower leaves (Figure 1, right). Because K may be recycled to the soil through crop residue, deficiencies can be common when the prior crop is one where vegetation is removed from the field such as alfalfa or corn silage. Potassium fertilizer may be applied in the fall as it is relatively immobile in the soil, but caution should be taken when applying K to sandy soils as leaching may occur. Potassium may also be applied in the spring or in-season.

A starter fertilizer may help improve N, P, and K availability early in the season, especially in minimum or no-tillage systems. The greatest response to starter in corn is given by N, followed by P.[4]

Micronutrients

Even though the uptake of other nutrients, such as sulfur (S), zinc (Zn), and manganese (Mn) is less then one percent of N, P, and K, it is important to acknowledge their contribution to corn growth and development. Higher corn yields increase the removal of micronutrients; therefore, without adequate testing and replenishment, micronutrient deficiencies may occur, which can cause reduced growth, and loss in potential yield. Additionally, sandy soils that are low in organic matter may not supply adequate S, while Mn and Zn availability may be reduced in soils with high pH. Foliar fertilizers to correct deficiencies may be an option.

Summary

In the last decade, corn yield potential has increased considerably because of biotech traits and germplasm advancements. Adequate soil fertility is a key factor in maintaining yield potential and is a function of proper soil tests, crop removal calculations, realistic yield goals, and sound environmental decisions.

Figure 1. Nutrient deficiency symptoms: nitrogen (left), phosphorus (center), potassium (right).

Sources

[1]Murrell, S.T. 2005. Average nutrient removal rates for crops in the Northcentral Region. International Plant Nutrition Institute. http://www.ipni.net; [2] Nutrient removal in the harvested portion of selected crops, Table 4.5. 2014. International Plant Nutrition Institute. http://www.ipni.net; [3]Hoeft, R. G. et al. 2000. Modern corn and soybean production. Chapter 6. Nutrient management for top profit. pp. 107-171. MCSP Publications, Champaign, IL; [4] Sawyer, J. and A. Mallarino. 2009. Getting ready for fall fertilization. Integrated crop management news. Iowa State University. http://www.extension.iastate.edu; Fernandez, F. G. and R. G. Hoeft. 2009. Managing soil pH and crop nutrients. Chapter 8. Illinois Agronomy Handbook. http://extension.cropsci.illinois.edu. Mallarino, A. P. et al. 2011. Nutrient Uptake by corn and soybeans, removal , and recycling with crop residue. 2011 Integrated Crop Management Conference. Iowa State Univerersity. http://www.agron.iastate.edu. Abendroth, L. J. et al. 2011. Corn growth and development. Iowa State University. Web sources verified 11/07/14.

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