Agronomic Spotlight

Fertilizing Corn in Medium- to High-Yield Environments

- Optimum nutrient levels are required to avoid deficiencies and help achieve high yield potential.
- It is important to apply fertilizers based on soil test recommendations.
- Outdated fertilizer recommendations should be adjusted due to the advancement in agronomics, genetics, and the use of biotechnology traits.

Background

Recent research suggests that corn products with resistance to rootworms may have increased root growth, nutrient uptake, and yield potential.[1] This, in addition to advances in corn breeding and agronomic management practices, may lead to changes in fertilizer recommendations and increased yield potential.

Corn Macronutrient Use

Nitrogen (N). Inadequate fertilization, leaching of nitrate from heavy rainfall, and flooded soil are some of the causes of N deficiency. Symptoms appear on older leaves as a yellow coloration in a v-shaped pattern, starting at the tip and progressing toward the leaf collar (Figure 1).[2]

Figure 1. Nitrogen deficiency symptoms.

Nitrogen should be applied according to crop need and is recommended to be ideally applied in two to three splits per season, depending on growing conditions. A split application of N can reduce the likelihood of N loss from leaching and denitritification typical during wet spring weather. Corn can extract only 15% of needed N prior to rapid vegetative growth.[3] To help maximize potential yield, N should be applied prior to rapid vegetative growth, or around the V5 to V8 growth stages. Synchronizing N application timing with rapid N uptake by corn can help improve N use efficiency. A corn plant will need the most N at the V10 growth stage, which usually occurs around 40 days after plant emergence.[3]

Phosphorus (P). Phosphorus deficiency often occurs when corn plants are young and soil temperatures are relatively cool. Cool soil temperatures limit root growth, which can limit P uptake, resulting in delayed growth and purplish leaves (Figure 2). Phosphorus deficiency may be common when corn is grown after rice and may also be a problem when grown after cotton or soybeans. Symptoms will often fade when optimum soil temperatures resume and root growth continues. It is best to apply P in the fall and incorporate it into the soil. In dryland fields, if P deficiency is detected early in the season, the nutrient may be injected as a sidedress treatment to help the nutrient reach the corn roots. However, care should be taken not to damage roots in the process. Treating a chronic P deficiency may take time as P is relatively immobile in the soil.

Figure 2. Phosphorous deficiency symptoms.

Potassium (K). Potassium deficiency symptoms appear first on lower leaves as yellow leaf margins that migrate toward the midrib (Figure 3). Potassium can be recycled in the soil by incorporating crop residue. However, deficiencies can be common when prior crop vegetation is removed from the field as in silage production. Rotations that include soybean tend to remove more K than other row crops. Potassium is also relatively immobile in the soil, so fertilizer can be applied in the fall. Incorporating K into the soil may help reduce nutrient runoff, 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, especially in conservation tillage systems.

Figure 3. Potassium deficiency symptoms.

Additional Corn Nutrient Use

Higher corn yields can lead to increased depletion of all nutrients from the soil. This increases the probability of nutrient deficiencies, which can cause plant abnormalities, reduced growth, and yield loss. Although nutrients such as sulfur, zinc, and manganese make up less than one percent of fertilizer applied in corn, they are essential to corn development and it is important to identify and manage deficiency symptoms.[4]

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Sulfur (S). Sulfur deficiency occurs more often in sandy, acidic soils low in organic matter. Cool and wet conditions also increase the probability of S deficiency. Symptoms include general yellowing, possibly with yellow-white intervein striping. Sulfur is relatively immobile in plants, so symptoms will appear first on younger leaves. Plants may also be stunted. If symptoms are a result of cool, wet soils, corn may recover as soon as soil conditions improve.

Zinc (Zn). Like S, Zn deficiency also occurs more frequently in sandy soils low in organic matter during cool, wet conditions. However, unlike S deficiency, Zn deficiency is more common in alkaline soils. Zinc is also relatively immobile in the plant, so symptoms appear on young leaves as whitish bands that start at the base of the leaf and move toward the tips. Leaf margins and tips typically remain green. Symptoms may be observed several weeks after planting. Internodes may be shortened, but corn typically will recover once favorable conditions return.

Manganese (Mn). Manganese is often immobile in corn, and can become deficient in high pH soils that may also be high in organic matter or are considered peat or muck soils. Symptoms may be observed in younger plants as olive-colored variations.4,5 Banded and foliar-applied sources of Mn are available.

Soil Analysis and pH

Understanding soil sampling and soil test results is critical in medium- to high-yield environments. Soil sampling and analysis are used to identify fields or areas of a field that may require additional fertilizer to meet crop demand. Generally, a crop responds to additional fertilizer if soil test values are below a critical amount. A yield response is more likely when soil test results are well below the critical amount. Fertilizer application is necessary in corn production, which may increase the potential for soil acidity.

Soil pH can cause problems for crop growth and development especially under high rainfall and warm environmental conditions. Ideal soil pH for corn should be around 6.0 to 7.0. Below a soil pH of 5.5, corn plants can show signs of nutrient deficiencies. Primary macronutrients (nitrogen, phosphorus, and potassium) and secondary macronutrients (sulfur, magnesium, and calcium) may become less available to corn plants in soils with low pH. Low pH may also increase the availability of other elements such as aluminum and manganese which could lead to plant toxicity.

Soil test results can be used to determine lime requirements for decreasing soil acidity. Soil testing laboratories use buffer pH to determine lime requirements. Buffer pH is a laboratory-derived value used to evaluate the ability of a soil to respond to liming. The larger the difference is between the original soil pH and buffer pH, the more responsive a soil will be to lime application, and the lower amount of lime required to raise soil pH. Lime is recommended to be applied in the fall to allow adequate time to neutralize soil acidity. If lime is unable to be applied in the fall, spring application is recommended.[6]

Conclusion

A study performed at the University of Illinois demonstrated a 15.8% increase in yield potential for corn products with resistance to corn rootworm when compared to corn products without resistance. This increase in yield potential may have been attributed to a stronger root system in the resistant corn products taking up more nutrients from the soil.[1]

In the last decade, there has been considerable increase in yield potential due to the use of biotechnology traits and advancements in crop genetics. In order to achieve this increased yield potential, changes in fertility should be considered. It is important to fertilize according to soil test recommendations and sample soil regularly to ensure adequate nutrients are available as soil may be depleted faster in high-yield environments. Soil and tissue analysis, nutrient removal, and realistic yield goals can be used to determine the amount of fertilizer needed. High yield potential can be realized when nutrients are applied according to recommendations and when demands are highest.

Sources

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