AGRONOMIC Spotlight

Technology Development by MONSANTO

Importance of P and K in Corn and Soybean Development

As crop planting approaches, fertilizer programs containing both phosphorus (P) and potassium (K) should be evaluated prior to the growing season. Skipping or limiting applications of P and K can impact yield potential and stress tolerance. Using current soil test values and determining the crop removal rates of P and K can help guide fertility management decisions.

Phosphorus (P)

Phosphorus is a nutrient required in relatively large amounts by plants. It is considered an "immobile nutrient", compared to N, as it has a relatively short range of movement in the soil. Efficacy of P uptake is enhanced by the availability of soil moisture. Therefore, dry soil conditions can negatively impact uptake by the root system. Early-season P uptake will be used for crop establishment and then later will be redirected for reproduction.

General Role of P. Plants need P for growth throughout their life cycle, especially during the early stages of growth and development. The primary role of phosphorus compounds in plants are to store and transfer energy produced by photosynthesis to be used for growth and reproduction. Adequate P levels are required to enhance shoot and root growth and promote early maturity. These effects often increase water use efficiency and yield potential. When P levels are inadequate, corn and soybeans cannot grow, produce, or tolerate stresses as they should. Skipping or reducing fertilizer applications for one year may have minimal impact on yield potential in many cases, due to the "banked" levels of P. However, inadequate P levels in the soil can impact the plant, especially under stressful conditions.

Critical Growth Stages Corn plants increase P uptake rapidly after the V6 growth stage of development, which is about four to six weeks after corn planting. The uptake can continue until near maturity.

In soybeans, the demand for P is greatest during pod and seed development where more than 60% of P ends up in the pods and seeds.

Symptoms of P deficiency in both corn and soybeans include stunted plants and yellowing of the leaf margins of the older leaves. Symptoms appear first on the lower leaf tips and extend down the margins toward the leaf base (Figure 1, A). Leaf edges may become brown and lower leaves often die when P deficiency is severe, especially during hot, dry, and windy conditions. In addition, stalks may be thin and short and maturity can be delayed. Deficiency can be confirmed with soil testing for P level.

Potassium (K)

Potassium in the soil is not readily available for plant growth and development. Almost all of K in the soil is involved in the structural component of soil minerals. Therefore, the amount supplied by soils varies, which translates to variation in the amount of K fertilizer applications needed across soil types.

Figure 1. Phosphorus deficiency symptoms in corn outer leaf margins; first appear on lower leaves (A). Potassium deficiency symptoms in corn on outer leaf margins; first appear on lower leaves (B). Potassium deficiency symptoms in soybean (C).

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General Role of K. Potassium is one of 12 nutrient elements required for normal corn growth and development. Basically, K is associated with movement of water, nutrients, and carbohydrates within the plant. These functions will stimulate early growth, increase protein production, and improve the efficiency of water use and resistance to diseases and insects.

Plants with insufficient K have difficulty absorbing water and N from the soil, which increases drought stress. Corn and soybean plants conserve water and reduce moisture stress by a mechanism regulated by K, which is closing of leaf stomates (openings in the leaves). Plants with inadequate K may be slower at closing their stomates, which reduces protection from drought stress. Additionally, deficient plants may have trouble making energy via photosynthesis.

Adequate potassium levels are important to maximize soybean yield potential. Peak absorption of K occurs from flowering through early pod development. A shortage of K during this period can result in yield loss without obvious foliar symptoms.

Stalk Rots and the role of Potassium Stalk rots are among the most common and damaging of the corn diseases. Yield losses result from premature plant death and lodging. The severity of stalk rot loss can be minimized with optimum balance between K and N levels in plant tissue. Excessive N that is out of balance with K can cause a rapid flush of growth, which may cause the plant to have insufficient structural composition to guard against fungal pathogens. Potassium has been associated with improvement of stalk strength. When corn plants take up sufficient K, stalk drydown is moderated after maturity and the risk of lodging may be reduced.

Critical Growth Stages In corn, K uptake increases rapidly after about the V6 growth stage, approximately four to six weeks after corn planting. Uptake of potassium is completed soon after silking (R1 stage). When K demand becomes large and there is not enough available K, deficiency symptoms become visible.

Symptoms of K deficiency in both crops are characterized by yellowing or browning of the leaf margins, beginning at the leaf tips, and can often be confused with N deficiency. Like N, K is mobile in the plant so older leaves are affected first (Figure 1, A-B).

In addition to a low soil-available K level, soil compaction and conservation tillage practices, where no subsurface band of K is applied, may also show deficiencies. Dry soil conditions can also negatively affect soil K uptake by corn roots.

In soybean, K is important for nodule formation and therefore N fixation. Deficient plants may have green stems and retain their leaves at maturity.

Managing P and K

The soil fertility levels for P and K are greatly impacted by their availability in the soil and previous crop removal. For corn, each bushel harvested per acre removes approximately 0.4 pounds per acre of P_2O_5 and 0.29 pounds per acre of K_2O. For soybeans, each bushel harvested per acre removes approximately 0.85 pounds per acre of P_2O_5 and 1.45 pounds per acre of K_2O. Crops cut for silage remove significantly more, approximately 8 pounds per silage ton of K_2O, because the majority of the above-ground tissue is harvested.

Soil fertility tests should be conducted at least every other year to verify that appropriate fertility levels are maintained. If there is concern about fertility, especially due to very high or very low yields, soil tests can aid with fertility decisions. It is important to apply fertilizers based on the values of the soil test.

When soil test levels are in the optimum range, recommendations for P and K are equal to the amount of nutrients removed at harvest. Always consider residual fertility from previous crops and manure applications when determining application amounts.

It is possible to raise soil test levels if nutrient application rates exceed the crop removal rate. In general, 12 to 28 pounds of P_2O_5 and eight to 16 pounds of K_2O above crop removal are required to raise the soil test levels one part per million for P and K , respectively. The actual amount of each nutrient needed depends on the initial soil test level, soil texture, clay minerals, and organic matter level.

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