AGRONOMIC Spotlight

Technology Development & Agronomy by MONSANTO

The Importance of Fertility in a Soybean Crop

- Soybean plants require at least 13 elements from the soil and three (carbon, hydrogen, oxygen) from air and water.
- Nutrients are required for water uptake, transpiration, photosynthesis, and protein and oil production processes for growth and development.
- Soil testing is the best way to monitor soil pH and nutrient levels and can serve as the foundation for making lime and fertilizer recommendations.

Nitrogen (N), phosphorus (P), and potassium (K) are the three major soil-supplied nutrients that are needed in greater amounts. The secondary nutrients, calcium (Ca), magnesium (Mg), iron (Fe), boron (B), manganese (Mn), zinc (Zn), copper (Cu), molybdenum (Mo), chlorine (Cl), and sulfur (S) are needed in small amounts, and deficiencies may appear on soybean plants only under certain conditions. Availability of the secondary nutrients is often dependent on soil pH levels and deficiencies that can limit yield potential.

N, P, and K Removal

Although fertilizing fields before planting a soybean crop is not a common practice, Table 1 shows, on a per bushel basis, that a soybean plant can take up more nutrients than a corn plant. Each bushel of soybean harvested per acre can remove approximately 3.8 pounds of N, 0.84 pounds of P_2O_5, and 1.3 pounds of K_2O. Additionally, Table 2 shows that fertilizer rates can be affected by yield levels. Since soybean plant is a legume, it can provide approximately 50% of the needed N through the N-fixation process; however, higher soybean yields may require higher levels of some nutrients to achieve yield goals.

Table 1. Average Nutrient Removal by Crop (lbs/bu).

Crop	N	P_2O_5	K_2O
Soybean grain	3.8*	0.84	1.3
Corn grain	0.9	0.38	0.27

*N from nitrogen fixation and soil removal.
Source: International Plant Nutrition Institute.

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

Soybean	P_20_5	K_20
45 bu/A	37.8	58.5
60 bu/A	50.4	78.0
75 bu/A	63.0	97.5

Source: Calculations made using International Plant Nutrition Institute data.

Soil Analysis

A soil test can indicate whether a field or area of a field requires additional fertilizer to reach a critical value. When soil test results are below a critical value, a crop often responds to additional fertilizer. The further the soil test result is below the critical value, the more likely a yield response occurs.

Soil tests should be done every two years. In no-till systems, nutrient levels should be monitored more closely as nutrients may become stratified in the soil and not accessible to the plant. Fall is the best time for soil sampling to assess nutrient levels and to determine Soybean Cyst Nematode (SCN) population densities.

Soybean fertilization and liming should be based on soil fertility status. Soil tests when used with past fertilizer programs and cropping history, can provide soil fertility guidelines. A soil test can indicate whether a field or area of a field requires additional fertilizer to reach a required level. Nutrient deficiencies and the warranting of a foliar fertilizer application can be confirmed with the help of a plant fertility analysis.

Soil pH and Nutrient Availability

Nitrogen and P are most available to the plant at soil pH levels between 5.5 and 7.0. Maintaining soil pH levels in this range should optimize the microbial breakdown of crop residues and symbiotic nitrogen fixation. Soils, where the 0- to 8-inch surface pH is 5.8 or less and the subsoil pH is 6.0 or less, can benefit from lime application. A soil pH of 6.5 should be targeted.

Availability of minor nutrients is often dependant on soil pH and deficiencies can limit yield potential. Elements such as B, Ca, Fe, S, and Zn are important for photosynthesis, N-fixation, and protein/enzyme synthesis. These processes are important for plant growth and development.

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Yield Targets

In the past several years, germplasm advancements have resulted in crop production changes, such as increased yield potentials. While maximum soybean yield potential is genetically determined, actual yield potential depends on environmental conditions and management practices.

In the past, nutrients remaining in the soil after corn may have been adequate for soybean production. However, as yield expectations for corn and soybean increase, it becomes more important to monitor soil fertility and account for nutrient removal by the previous crop.

Summary

- When nutrients are limited, photosynthesis, water transport, and protein, oil, and carbohydrate production can be negatively affected.
- Nutrients should be in adequate supply to maximize yield potential. Soil tests, crop removal rates, and yield goals can be used to determine how much fertilizer is needed.
- If multiple-year yield performance suggests higher yield potential can be obtained, it may be time to further evaluate if adequate soil fertility levels are available to meet these expectations.
- Soybean plants grow and yield best on highly fertile soils but fertilization and liming programs should be based on soil test results.
- A plant analysis can help determine the nutrient and deficiency status of the plant, but is most effective when used with a regular soil testing program.

Figure 1. Soil sampling tools.

Sources:
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