

## Soybean Fertility in Medium- to High-Yield Environments

In 2000, the average soybean yield was 38.1 bushels per acre. In 2009, the average soybean yield per acre was 44 bushels—an increase of .9 bushels over the previous record and a 5.9 bushel increase from 2000. This year, the average soybean yield is expected to be 44.4 bushels per acre.<sup>1</sup> With soybeans accounting for more acres and greater yields, it is time to consider whether soil fertility levels are adequate for the higher yield expectations of modern production.

**Nutrient Removal by the Crop.** Although fertilizing before planting soybeans is not a common practice, on a per bushel basis, soybean can use more nutrients than corn (Table 1). Each bushel of soybean harvested per acre removes approximately 3.8 pounds of N, 0.84 pounds of P<sub>2</sub>O<sub>5</sub>, and 1.3 pounds of K<sub>2</sub>O (Table 1). Additionally, yield levels illustrate how fertilizer rates can be affected (Table 2). Soybean provides approximately 50% of the nitrogen required for growth through N-fixation; however, higher levels of soybean production may require higher levels of some nutrients to achieve yield goals.

**Importance of Soil Test.** Even when soybean does not exhibit symptoms of nutrient deficiency, there may still be an underlying problem. A soil test can indicate whether a field or area of a field requires additional fertilizer to reach a critical value. When soil test values are below a critical value, a crop often responds to additional fertilizer. The farther below the critical value the soil test is, the more likely a yield response is.

Soil tests should be done every two years to monitor nutrient levels. In no-till systems, nutrient levels should be monitored more closely because nutrients may become stratified in the soil and not accessible to the plant. The best time to sample soil is in the fall. Soil sampling to assess SCN population densities can be done at the same time.

**Soil pH.** At soil pH levels between 5.5 and 7.0, nutrients such as nitrogen and phosphorus are most available to the plant.

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.

**Minor Nutrients.** Boron, calcium, iron, molybdenum, sulfur, and zinc are some of the more important minor nutrients involved in plant processes such as photosynthesis, N-fixation, and protein synthesis. Availability of these nutrients is often dependent on pH levels and deficiencies can be yield limiting. Tissue tests can confirm deficiencies. Foliar fertilizers to correct deficiencies may be an option.

**Yield Goals.** The past 10 years have brought changes in crop production such as increased yield potentials, partially due to advancements in germplasm. While soybean maximum yield potential is genetically determined, actual yield potential depends on environmental conditions and management practices. In the past, nutrient levels remaining in the soil after corn production may have been adequate for soybean production purposes. As yield expectations for corn and soybeans increase, it becomes more important to monitor soil fertility and account for nutrient removal by the previous crop.

**In summary:** When nutrients are limited, plant processes such as photosynthesis, water transport, and protein, oil, and carbohydrate production can be negatively affected. Therefore, it is important that nutrients are 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.

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

Crop	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Corn grain	0.9	0.38	0.27
Soybean grain	3.8*	0.84	1.3

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

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

Soybean	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
45 bu/A	37.8	58.5
60 bu/A	50.4	78
75 bu/A	63	97.5

Source: Calculations made using International Plant Nutrition Institute data.

**Sources:** <sup>1</sup>United States Department of Agriculture-National Agricultural Statistics Service. 2000-2009 U.S. Corn and Soybean production. Online at <http://www.nass.usda.gov>; International Plant Nutrition Institute. Average Nutrient Removal Rates for Crops in the Northcentral Region. Online at <http://nanc.ipni.net>  
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