



## NUTRIENT MANAGEMENT FOR SOYBEAN PRODUCTION

Soybean requires 16 elements to complete the metabolic processes necessary for growth and reproduction. Regardless of the system of production, lack of an adequate supply of any of these elements will decrease plant growth and potential yield, as well as result in soil nutrient depletion that decreases productivity. To minimize a decrease in soybean yield caused by a lack of any of these nutrients, or to avoid applying nutrients that have a low probability of economically increasing yield, producers should develop and use a nutrient management plan.

Fertile soil supports vigorous plant growth that covers the soil surface early in the growing season. The increased soil cover will decrease soil moisture evaporation, decrease wind and water erosion, and maximize the amount of plant residue remaining after harvest to minimize erosion during the nongrowing season. Vigorously growing plants are more resistant to biotic and abiotic stresses, including diseases and insects, weeds, and adverse weather conditions.

The contents of this White Paper present a short description of and links to resources that can be accessed to provide guidance for making decisions about soil fertility management for optimum economical soybean production in the Midsouth.

### NUTRIENT MANAGEMENT PLAN

An effective [nutrient management plan](#) identifies the amount, source, time of application, and placement of nutrients needed to sustain economic viability of crops, while simultaneously protecting the environment. Development of a nutrient management program begins with collecting soil samples from a production unit or field, followed by a soil test. Sampling protocol is important to ensure accuracy of results and proper application of test recommendations to the unit. Because most fields are variable in topography, slope, and soil series, nutrient levels will vary considerably within a field. Samples must be collected in a systematic manner across a field, or

within variable units within a field.

Click [here](#) for an MSSOY White Paper entitled “Sampling Soil for Fertility and Nematodes” that covers all aspects of soil sampling to assess fertility status. Click [here](#) for an MSU Extension Service publication entitled “Useful Nutrient Management Planning Data” that provides data and conversion factors that will be helpful in the setup and conduct of a nutrient management plan. Click [here](#) for a USDA-NRCS “Conservation Practice Standard for Nutrient Management” that addresses the conservation of soil nutrients for plant production and minimizing nonpoint source pollution that can be attributable to mismanagement in the application and use of soil nutrients.

### NITROGEN

Click [here](#) for an MSSOY White Paper entitled “Nitrogen Fertilizer for Soybeans” that is a comprehensive treatise on nitrogen fertilization pertaining to soybean. The contents of the White Paper cover N fertilizer applied to soybean in a high-yield environment, N fertilizer applied to replace fixed N, starter N fertilizer, and N fertilizer applied during reproductive development. A summary that is up-to-date with current literature is also included.

### PHOSPHORUS

Soybean removes approximately 0.90 pound of phosphate ( $P_2O_5$ ) or about 0.40 pound of actual P for each bushel of seed harvested. On most fields, at least this removal amount should be applied to maintain adequate P fertility. Because P application is not needed every year, it is most economical to apply an ammoniated material ahead of the corn crop in a biennial soybean–corn rotation. This practice results in the most economical application of P by cutting applications and associated costs in half. Growers can select from straight P materials such as triple superphosphate or from liquid or dry formulations of



ammoniated phosphates.

Click [here](#) for an MSU Extension publication entitled “Phosphorus in Mississippi Soils” that gives soil test indices for P for all crops, as well as a list of common P-containing fertilizers and their analysis.

### POTASSIUM

Soybean removes approximately 1.20 pounds of potash (K<sub>2</sub>O) or 1 to 1.25 pounds of actual K per bushel of seed produced. Continued removal without replacement will lower the soil supply to a level that will not support optimum yield. Soil test levels may change considerably from one sampling time to the next. Thus, soil K should be monitored over time, and variable test values should be used with caution.

There are several materials available to supply K to the soil. Potassium chloride (muriate of potash) is the most economical form, and can be applied in the fall or spring preceding the soybean crop, except on sandy, low-CEC soils where it is subject to overwinter loss. If magnesium is also needed for the soybean crop, potassium-magnesium sulfate is a good K source.

Click [here](#) for an MSU Extension publication entitled “Potassium in Mississippi Soils” that gives soil test indices for K for all crops.

### SOIL pH

Midsouth soils used for soybean production often require lime to correct or control soil acidity. A soil test is the only tool that can determine soil pH, and the pH of a sampled soil should be a component of the results provided in the soil test report. Details about the quality of the various materials used for liming are given in an MSU Extension publication entitled “[Soybeans: Liming and Fertilization](#)”.

Research ([Soil pH Influences Soybean Disease Potential](#)) shows that soil pH greater than about 7.0 was associated with high initial soybean cyst nematode (SCN) egg density. Soil pH is also related to iron deficiency chlorosis (IDC) severity (see below

section).

### IRON AND IRON DEFICIENCY CHLOROSIS (IDC)

The element iron (Fe) is required to form chlorophyll, the green pigment in plants. When iron uptake from the soil is limiting to plants, plants become iron-deficient. The most common symptom is interveinal chlorosis in newly developed leaves, where the leaf tissue turns yellow while the veins remain green. This deficiency, termed iron deficiency chlorosis or IDC, can cause moderate to severe yield reductions in soybeans.

Click [here](#) for a comprehensive treatment of IDC—how it affects soybean and how it can be remedied. Click [here](#) for links to company varietal trait data that include IDC ratings for many varieties.

### MICRONUTRIENTS

Micronutrients are essential for crop production, but are required and used by plants in lesser amounts than those of the macronutrients. Critical plant processes are limited if required micronutrients are limited or lacking. Micronutrient deficiencies can be detected by visual symptoms and by testing soil and plant tissue. Soil tests for many of the micronutrients, though adequate, may not be as precise as those for soil pH, K, and P.

Click [here](#) for a Pioneer guide to general micronutrient requirements, deficiency symptoms, soil and plant sampling, and fertilization practices.



## TISSUE SAMPLING

Tissue testing is a tool that can be used to assist in identifying nutrient deficiencies in soybean plants that may be limiting crop growth and yield in the field. The nutrients in the plant at a given time as measured by tissue analysis reflect what the plant has been able to obtain from the soil vs. what nutrients are available in the soil reservoir. The nutrient concentration of a particular plant tissue can be compared to a known critical nutrient concentration to determine if sufficient nutrients are present in the plant to achieve optimum performance and/or yield.

Results from tissue testing cannot be used to correct nutrient deficiencies during the current growing season, but rather can be used in planning for future nutrient applications, or to validate the current fertility program for a specific crop. Thus, tissue testing for nutrient sufficiency or deficiency should be used in conjunction with soil tests.

Click [here](#) for a detailed treatise on this subject, plus guidelines for using this tool to assess the nutrient status of soybean.

## GENERAL INFORMATION

Click [here](#) for a Univ. of Missouri article that gives details for diagnosing nutrient deficiencies in plants. Click [here](#) for an MSU Extension publication entitled “[Soil Fertility and Fertilizers](#)” that covers most subjects pertaining to soil fertility and fertilizers. An Iowa State Univ. publication entitled “Soybean Nutrient Needs” is a good source for information specifically about soybean.

Slaton, Roberts, and Ross of the Univ. of Ark. published “[Fertilization and Liming Practices](#)” (Chapter 5—updated in 2013) in the Arkansas Soybean Production Handbook. The contents of this chapter include a review of soil test-based fertilizer recommendations for soybean production sites, a description of the symptoms of nutrient deficiencies or toxicities in soybean, and research- and/or experience-based insights pertaining to nutrient management strategies for the crop. This is probably the most thorough treatment of the subject matter of this White Paper.

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