

NEWS & VIEWS

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Got Enough P and K for Your Soybeans?

MOST SOYBEAN FARMERS in the Midsouth and Southeast will remember 2003 as one of their better years. Soybean yields met or exceeded past records in many states. State average yields ranged from 33 bu/A in Georgia to 43 bu/A in Kentucky. Since 1980...a contrasting drought year in much of the Midsouth...state average soybean yields have been increasing. The yield increase has averaged about 0.3 bu/A/year in Georgia and the Carolinas to 0.5 bu/A/year in most Midsouth states (Figure 1).

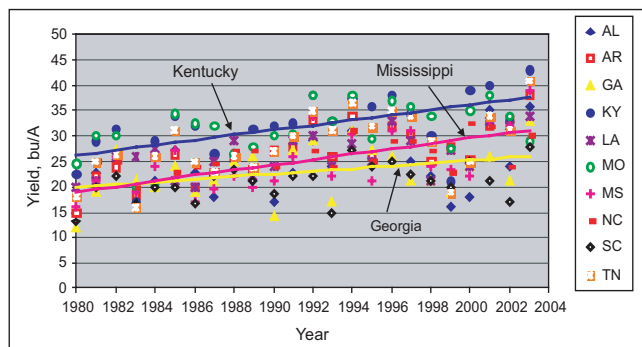
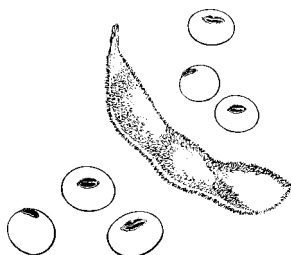


Figure 1. State average soybean yields in southeastern states and trend lines in selected states.

A number of plant nutrition questions are being asked by progressive soybean farmers and many land owners who recognize the opportunity to take advantage of good markets in 2004. This article includes many of the more popular questions and it provides science-based answers.



Question — What soybean yields are possible in the Midsouth and Southeast U.S. with good management?

Answer — Research at a number of locations across the Midsouth and Southeast has shown that soybean yields ranging from 45 to 50 bu/A are common, and that yields above 55 to 60 bu/A are within reach for many farmers using good management practices with adequate moisture or irrigation. In fact, many researchers are consistently producing yields above 70 to 80 bu/A with progressive management.

Question — How much phosphorus (P) and potassium (K) is removed from fields in the harvest of soybean seed?

Answer — Soybeans remove about 0.8 lb of P_2O_5 (0.35 lb of P/A) and 1.4 lb of K_2O (1.17 lb of K/A) for each harvested bushel. So, a 50 bu/A soybean harvest removes about 40 lb of P_2O_5 /A and 70 lb of K_2O /A.

Question — How much P and K do soybeans need to take up from the soil and from fertilizer to achieve good yields?

Answer — The uptake of nitrogen (N), P_2O_5 , K_2O , magnesium (Mg), and sulfur (S) by soybeans is shown in **Table 1**.

Table 1. Soybeans take up large quantities of nutrients.

Yield, bu/A	N	$P_2O_5^1$	K_2O^1	Mg	S
	----- lb/A taken up -----				
40	220	38	140	16	14
55	290	53	190	22	18
70	360	67	220	28	22

¹P and K expressed in oxide terms, to better relate to fertilizer equivalents.



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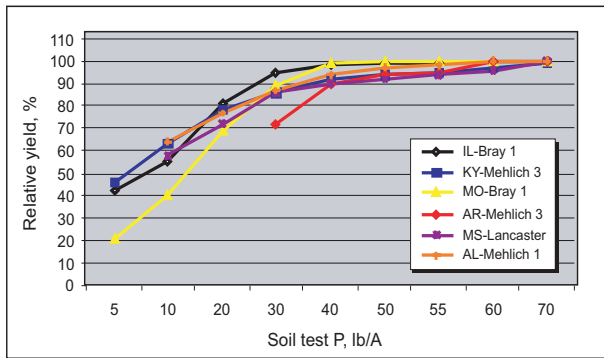


Figure 2. Relative soybean yield response to soil test P levels, among selected states and soil test extractants.

Question — What are the optimum soil test P and K levels for soybeans?

Answer — University researchers have correlated soil test P and K levels with soybean yields. As soil test P and K levels increase, soybean yields increase up to optimum levels where P and K are no longer yield-limiting. A review of current university soil test P and K interpretations indicates there is a great deal of similarity in interpretations of the agronomic optimum P and K levels for soybeans. Most land grant university research shows that 90 to 95% of the maximum soybean yield is reached when extractable soil test P levels are at or above 40 to 50 lb/A ...20 to 25 parts per million (ppm), assuming a 6-in. soil sampling depth...and extractable soil test K levels are at or above 220 to 280 lb/A (110 to 140 ppm) on silt loam soils, based on most common soil test extractants employed in the region (see **Figures 2 and 3**).

*Note: The curves illustrated in **Figures 2 and 3** are general in nature and subject to revision, based on recent and on-going research by land grant university scientists. The optimum interpretations will differ for very sandy soils and for clays (consult your laboratory for specific interpretations).*

Question — Are the fertilizer recommendations developed 10 to 20 years ago appropriate for the higher soybean yield expectations and reduced tillage systems used today?

Answer — Soybean yields achieved today are frequently much greater than the yields achieved in past fertilization and crop nutrition research. It is safe to assume that soil P and K needs today will be at least as high as predicted by past studies. The key is to strive for high soil fertility levels to remove P and K as factors limiting soybean yields. With reduced tillage (no-till, strip till, ridge-till, stale seedbed), farmers must pay very close attention to the soil sampling depth. Be sure to use a very consistent sampling depth, and sample accurately from the surface to the depth recommended by your laboratory. In

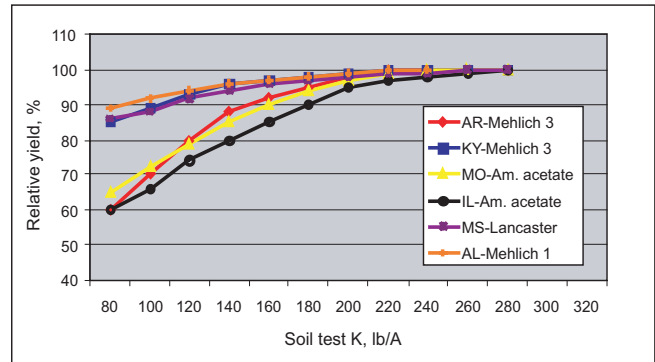


Figure 3. Relative soybean yield response to soil test K levels, among selected states and soil test extractants.

reduced tillage systems, P and K levels are often much higher in the top 3 in. than at 3 to 6 in. deep. Sampling 3 to 4 in. deep instead of 6 in. deep can result in high soil test results and may cause farmers and crop advisers to mistakenly believe soil fertility is adequate.

Question — How much will soil test P and K change in one year after a high-yielding soybean crop (such as 2003)?

Answer — Remember that soil test levels...determined by different soil extractants and methods...are just indicators of the relative fertility level, and they do not measure the exact amount of nutrients accessible to a given crop during a growing season. On silt loam soils, it generally takes 6 to 14 lb of P_2O_5/A to raise the soil test P level by 1 lb/A, and it takes 4 to 8 lb of K_2O/A to raise the soil test K level by 1 lb/A. *These amounts are the excess addition...above crop harvest removal...required to change soil test P or K levels.* The precise amount of excess required to raise soil test levels will depend on the initial soil test levels, soil mineralogy, soil chemistry, and physical factors. It may take similar P_2O_5 and K_2O removal rates to lower soil test P and K levels by 1 lb/A.

A 50 bu/A yield may lower soil test P by about 4 lb/A and soil test K by about 12 lb/A. Years of harvest removal of nutrients without replacement fertilization can take a heavy toll on soil fertility and limit the yield potential. Research by Iowa State University scientists (Dr. Antonio Mallarino, personal communication) showed that without P fertilization for 10 years, a corn-soybean rotation cut soil test P levels in half...from the initial 84 lb/A down to about 40 lb/A. Farmers who have not collected soil samples on their fields, or who have not fertilized in recent years, might be surprised to learn how much they have mined soil P and K.

A higher soybean yield potential coupled with good crop prices calls for good fertility and a progressive nutrient management plan.

Table 2. General total sufficiency ranges for soybeans in the South at or near reproductive growth.

Nutrient	N	P	K	S	Ca	Mg	Fe	Mn	Zn	Cu	B
Concentration	----- % -----						----- ppm -----				
Uppermost	3.6	0.31	1.5	0.20	0.6	0.30	50	17	21	5	20
mature	to	to	to	to	to	to	to	to	to	to	to
trifoliolate leaf	4.7	0.5	2.5	0.60	1.4	0.8	350	100	50	30	60

For more about plant tissue analysis, go to: www.ppi-ppic.org/tissue

Question — What kind of yield response can be expected from P and K fertilization on low fertility soils?

Answer — Response to adequate P fertilization on low P soils can range as high as 11 to 18 bu/A per year. Response to K on low K soils can exceed 10 bu/A per year. If 60 lb of P₂O₅/A and 90 lb of K₂O/A were applied on a low P and K soil, with soybean prices at \$8/bu, the net return could exceed \$100/A (assuming costs: \$0.27/lb P₂O₅, \$0.16/lb K₂O, and an application cost of \$4.50/A).

To be sure that soybean plants are receiving proper nutrition, and to verify the performance of your soil fertility program, consider collecting plant leaf samples for nutrient analyses. The values shown in **Table 2** illustrate the optimum nutrient levels at first bloom. Consult your plant analysis laboratory for guidance in collecting and submitting samples.

Question — Is all the fertilizer P₂O₅ and K₂O used up the year it is applied?

Answer — On average, about 10 to 20% of the applied P is taken up by the crop the year it is applied. The remainder, because of P chemistry reactions in the soil, is stored in the soil for future crop use. Plant recovery of the applied K may range from 30 to 60% during the season of application. The remainder is held on soil cation exchange sites and in clay minerals for subsequent crop use. If soil tests are built to medium to high levels, a greater fraction of the applied fertilizer may be used in plant uptake.

Question — Cotton responds well to K applications, but I have heard that soybeans actually remove more at harvest than cotton...is that true?

Answer — A cotton crop yielding 1,200 lb of lint/A takes up about 170 lb of K₂O/A (142 lb of K/A), with about 50 lb of K₂O/A (42 lb of K/A) actually removed from the field at harvest in the seed and lint. A 50 bu/A soybean crop also takes up about 170 lb of K₂O/A, with 70 lb of K₂O/A removed from the field at harvest in the seed. So, even though the K uptake by cotton and soybeans at these yield levels is the same, about 40% more K is removed in the harvest of soybeans, compared to cotton.

Conclusion

Both P and K are essential elements for all crops and animals. Adequate amounts of these nutrients enable soybeans to:

- capture sunlight and convert it to energy more efficiently;
- increase root growth for efficient uptake of soil moisture and other nutrients;
- increase the absorption of N₂ gas from the air by symbiotic bacteria in nodules on roots, to nourish plants with N necessary for making amino acids and protein;
- resist damage from several plant diseases; and
- yield more, which will result in a higher profit potential.

Don't let inadequate P and K nutrition limit soybean yield potential in your fields this year. ■

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