

# Foliar Boron Bumps Soybean Yields

**F**oliar fertilization is an effective way of quickly supplying plant nutrients during critical periods of flowering and grain fill at which time soil or root conditions are often unfavorable for optimum root uptake and there is insufficient uptake to supply demand. Boron (B) and other micronutrients have been supplied effectively to soybeans by foliar application and, under top management, often provide the limiting nutrient factor for those extra few bushels at the top of the yield curve. Boron is the most widespread high-yield limiting micronutrient. Boron fertilization is known to promote flowering, pollen germination, grain fill, and yield where B is applied near flowering. Boron is essential for all plant growth. Soybeans, like all legumes, have a high B requirement. Boron is necessary for:

- Stimulation of root growth
- Increased root nodule development for nitrogen (N) fixation
- Increased branching and flowering
- Increased bloom retention
- Increased pod number
- Better seed development and grain yield.

## How it works

Foliar fertilization is the practice of applying nutrients for plant leaves through ground or aerial spraying equipment or through

*Wisconsin, Illinois, Ohio and Missouri field studies show that boron applied at 0.25 lb/A increased yields by 3 percent, overall.*

sprinkler irrigation systems. Even though the rate of nutrient uptake through leaves is somewhat slower than through root pathways, less B (usually half to a fourth as much) is required through foliar application to achieve the same results. Some B studies have shown that foliar-applied B can be 90 percent absorbed within 24 hours of application. Foliar B can be immediately present where needed in the plant at the site of maximum demand and use in plant leaves during the critical times of seed production when movement from soil to root may be inadequate and root activity is declining.

## Practical considerations

**How much?** Many recent studies have shown that 0.25 to 0.5 lb/A of B is the optimum rate of B application, although responses to multiple sprays totaling 1 lb B/A have been observed. A single foliar spray of 0.25 lb B/A can be safely applied

without leaf injury at concentrations up to 0.5 percent B in solution, or split into more than one application using lower volume as in aerial application.

Low volume sprays with up to 1 percent B concentration may be applied singularly in solution, but there may be risk of leaf burn if other chemicals are applied in the mixture. It is an economical practice to apply B or other nutrients together in a tank mix with insecticides, fungicides, other chemicals. This is a good practice and usually works well, but caution is advised.

**Mixing.** Attempts to apply several chemicals together in a minimum amount of water sometimes produce mixtures that are physically and chemically incompatible. Small quantity tests are advisable when trying new combinations of products.

**Immobility.** Foliar sprays are especially important for those plant species in which B is immobile; B uptake from the soil can be insufficient to supply these plants' needs at critical periods of growth and reproductive development. Soybeans are considered one of the B-immobile species.

**Timing.** Proper timing of foliar sprays is essential to ensure that B is applied when its need is most critical. The B fertilizer must be on site, the sprayer must be ready to go, and procedures should be in place to keep the sprayer operating

during the busy season. Applying the recommended B rate also is critical in obtaining optimum crop yields. The window of opportunity for applying foliar B to boost yield is fairly wide and can be effective from the pre-bloom V6 stage through R2 reproductive stage. The best time of day for foliar application is early in the morning while dew is present. Leaf moisture aids the passage of nutrients into the inner leaf tissue. Recent studies have shown that the various types of water-soluble B sources on the market are equally effective in supplying B through the

foliage as shown by plant analysis. The least-cost material is usually the best choice.

**Efficacy** of some pesticides may be affected by increased pH of the pesticide tank mixes. While there is no evidence that pest control is negatively affected by adding B to the tank mix and spraying immediately, some applicators are concerned that adding B increases solution pH to the point that some chemicals start to break down and lose efficacy.

**Pesticides.** Under high pH conditions, some pesticides may

start to break down over time. But the process is usually so slow that most of these pesticides will remain highly effective in the tank for hours or even days. There is no strong evidence that pest control has been adversely affected where chemicals are mixed and sprayed immediately. Most tank mixes are sprayed quite rapidly. Aerial applications take a few minutes and ground applications typically spray 300 gallons in less than two hours.

**Absorption.** Once the application is made most of the material is absorbed into the plant within a few



Figure 1. B-deficient soybean pods, Slaton, U. of Arkansas, 2003.

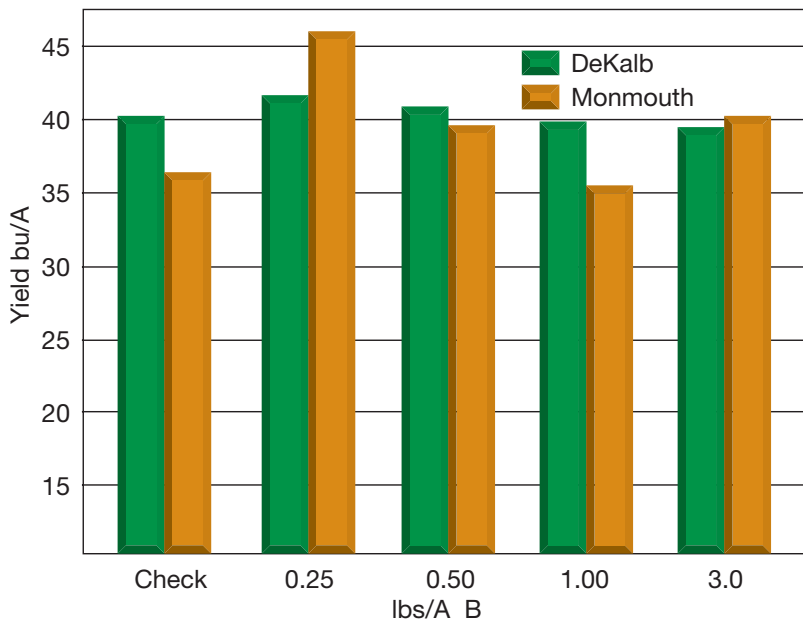


Figure 2. Foliar B effect on soybean yield at University of Illinois experiment stations at DeKalb and Monmouth, 1991. Foliar B at 0.25 lb/A (2-week intervals) at R-1 thru 1 lb/A rate, 3 lbs B/A applied preplant.

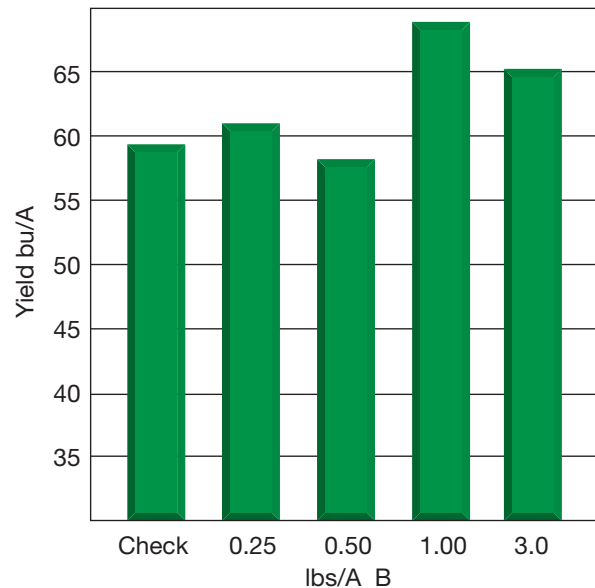


Figure 3. Foliar B effect on soybean yield at the Western Ohio Research Center, 1991-92. Foliar B at 0.25 lb/A (2-week intervals) at R-1 through 1 lb/A rate, 3 lbs B/A applied preplant.

hours. There should also be no worry about pesticides breaking down once they are on the crop. Solution pH is decreased as the plant leaves absorb hydroxyl ions into the leaf apoplast at the cellular level where pH is buffered between 5.5 and 6.5.

**Buffer.** Inclusion of an appropriate buffer to control the pH of tank mixes is suggested for those pesticides whose efficacy is known to be reduced with increased pH.

**Jar test.** The multitude of pesticide-fertilizer-adjutant tank mixes currently recommended for crop management requires that the applicator always conduct a preliminary “jar test” and always be sure that the spray equipment provides proper agitation of mixtures.

### Evidence of response

Figure 1 shows B deficient soybean pods in a 2003 study conducted by Dr. Nathan Slaton, University of Arkansas. Soil on this

study site was an alkaline silt loam where B deficiency was severe. Yield responses to foliar B were reported to be as high as 19 bu/A. Soybean yield increases of this magnitude can be expected on extremely low B soils where plants show visual deficiencies. However, equally substantial increases in yield have been found where no visual deficiencies existed.

**Table 1. Soybean cultivar yield response to foliar B on Bonifay soil, Gascho, Georgia Experimental Station, 1993.**

Boron lbs/A	Cultivar				
	A	B	C	D	E
	Yield bu/A				
0	59	35	46	52	40
0.25	66	41	59	55	46
0.50	61	40	53	55	43
1.00	64	39	65	59	58

Cultivars: A: Braxton, B: Delta Pine, C: NK Coker, D: NK Coker E: Pioneer.

Other sites in Illinois, Ohio, and Georgia, demonstrating responses to foliar B, are shown in Figures 2, 3 and Table 1.

### Determining need

Plant tissue analysis can determine if B is low in soybean plants. Normally, B is suggested where tissue B falls below 20 ppm in the top mature leaves before bloom. However, recent data suggest that additional response to foliar B may occur if leaf tissue is below 40 ppm B. Soil analysis interpretation varies with soil type. In coarse-textured soils, B at 0.4 lb/A may be sufficient, while greater than 1 lb/A may be needed in finer-textured soils. For intensively managed high-yield soybeans, especially under irrigated conditions, B should be applied to ensure that this essential element will not be a limiting factor.

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