Soybeans

Boron fertilization of soybeans has been shown to increase grain yield at locations across the world when the boron supplying power of the soil is inadequate[2] even though soybeans are listed as tolerant to boron deficiency. University research has found soybean yield increases ranging from 2-17.9[1] bushels per acre due to application of boron to boron deficient soybeans.

Boron deficiency in soybeans has been shown to delay soybean maturity by as much as two weeks thus exposing the crops to the risks of bad weather or shattering. "Timeliness of harvest is an important consideration and possible benefit of B fertilization, which should be considered when growers decide whether to include B as a part of their fertilization regime."[1]

Deficient soybeans have been showed to be stunted, produce fewer seeds per pod, weigh less per plant and have fewer nodes per plant[1]. Soybean seed produced by boron deficient plants and planted back into boron deficient conditions can suffer significant yield losses. Soybeans produced by boron deficient plants but planted in to adequate boron conditions produce well.

Under boron deficient conditions, soybean seed will have greatly reduced boron concentrations. Soybean seed produced in low boron conditions in commercial fields in Arkansas in 2003[1] contained as little as 1.9 mg B/kg seed while boron concentrations in fields without boron deficiency produced seed containing from 26-27 mg B/kg[3].

As with many other crops, the first signs of boron deficiency occurs in the roots. Root tips die causing new roots to initiate causing a rosette appearance. Foliar symptoms include death of the shoot growing point and subsequent proliferation of lateral shoots with brittle petioles[4]. Slaton observed deficiency symptoms that included delayed maturity and leaf senescence.

Beware of Hidden Hunger

In a study site in Arkansas in 2003 with a yield increase of over 17 bushel per acre due to boron fertilization, no deficiency symptoms or apparent growth response to B fertilization were observed until soybean plants neared maturity[1]. The delayed maturity of the boron deficient soybeans would be difficult to notice without boron sufficient soybeans in the field to compare them with.

Application of 1.0 lb. B/acre, averaged across application times, increased soybean yields from 8.2 to 118% (3.9-17.4 bu/acre) above the unfertilized control.

Timing of application

Field studies in Arkansas on timing of boron application under conditions of boron deficiency showed that applications at the V2 stage at rates greater than or equal to 0.5 lb/A produced the best results.

Preplant granular applications of one pound per acre B are effective in preventing B deficiency.

If foliar fertilization is preferred, growers should apply 0.5 lb. B/acre at least once. A second application of 0.25 or 0.50 lbs B/acre may provide additional yield benefits at a minimal cost in fields where severe B deficiency has been observed.

At two Arkansas sites grain moisture measurements were greatest in the untreated checks and were indicative of the magnitude of the maturity differences observed.

Soybean growth and yield were generally maximized when B was applied at rates from 0.5 to 1.0 lb B/acre.

Yield response to boron applications may diminish as the duration of B deficiency is prolonged[1].

Boron deficiency in Arkansas was noted on alkaline silt loam soils in certain regions of the state. Other regions of the state with similar soils showed no boron deficiency.

Soil test information

Soil tests of the four sites in Arkansas noted in this paper as have significant losses due to boron deficiency had soil tests of 0.35 to 0.5 ppm B which would not be considered deficient for soybeans.

Tissue tests for boron

Various sources listed below list the following ranges of tissue values for boron in soybeans.

Deficient 9-10 or less than 10 ppm B, Low 10-20 or less than 20 ppm, Sufficiency range 20-60 ppm, Normal 20-80 or 21-55, High 50-100, greater than 80, 63, 50.1-80 and Excess 63 greater than 80 or greater than 100 ppm.

Data from Dr. Nathan Slaton 2003. Theses data (highlighted) could be added to the Yield data chart on the Soybean Agronomy note:

Treatment	Covington	Hall	Moery	Pine Tree
0	14.7	45.7	35.6	47.3
0.25	33.8	47.7	37.3	50.4
0.5	33.6	49.2	38.1	53.9
1	32.1	51.9	39.5	51.2
2	31	50.4	38.3	52.4

Literature cited

1. Slaton, N. 2003 Soybean Response to Boron Fertilizer Application Time and Rate in Arkansas AR-23F.
2. Gupta U.C.(ed.) 1993. Boron and Its Role in Crop Production . CRC Press Boca Raton
3. Bundy and Oplinger, 1984. Narrow row spacings increase soybean yields and nutrient removal. Better Crops Plant Food 68:16-17.
4. Shorrock –Boron Deficiency Its Prevention and Cure
5. Interpretation of Plant Analysis for several crops J. Benton Jones. P49-50
6. Umesh C. Gupta Chapter 8 Deficiency, sufficiency and Toxicity Levels of Boron in Crops
7. Clemson University Lab Web site
8. Wisconsin A2522 Soil and Applied Boron