

# CHARACTERIZATION OF BORON USE BY COTTON IN ARKANSAS

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## RESEARCH PROBLEM

In commercial cotton production boron (B) is routinely applied as soil and foliar applications irrespective of soil B status. However, this recommendation was based largely on research conducted 30 years ago, and there has been no recent work to substantiate this with modern cultivars and production practices. Furthermore, there is only a limited understanding of boron use by the cotton plant and the effect on the physiology of the cotton plant has not clearly been documented.

## BACKGROUND INFORMATION

Boron is an essential element required by cotton (*Gossypium hirsutum* L.) for optimal growth and development. Anderson and Boswell (1968) showed that a 0.4 lb/acre side-dress application of B to field-grown cotton caused a 7.3% increase in yield. Current production recommendations in Arkansas call for an initial preplant soil application of 1.0 lb B/acre and 3-5 foliar applications of 0.1 lb B/acre. This was based largely on research conducted over 30 years ago (Miley, 1966; Baker *et al.*, 1956; Maples and Keogh, 1963). However, modern high-yielding, earlier-maturing cultivars have changed considerably. There is a dire need to investigate B use by cotton in Arkansas, and the effect of B deficiency on growth and yield of the plant. This report covers the effect of soil and foliar applications of B, and soil nitrogen status, on cotton yield. The effect of B on the physiology and growth of the plant is covered in a separate report (Zhao and Oosterhuis, 2000).

## RESEARCH DESCRIPTION

In 1999, the study was conducted at five locations: two at the Southeast Branch Station in Rohwer, one in St. Francis County (Joe Whittenton Farm), and in Desha County (Roy West Farm), and at the Arkansas Agricultural Research and Extension Center in Fayetteville. Experimental details are given in Table 1. At Rohwer the cotton cultivar was ST 474 planted on 14 May 1999 into a Hebert silt loam soil. In St. Francis

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county the cultivar PM1560 BG was planted on 14 May 1999 into a Loring silt loam, and in Desha county ST BXN47 was planted on 11 May into a Herbert silt loam. At Fayetteville the cotton cultivar Suregrow 125 was replanted on 4 June 1999 into Captina silt loam. Row spacing was 38-inches between rows with three to four plants per foot of row. Plot size was at least 4 rows by 50 ft. Fertilizer, irrigation, weed control, and insect control was according to current recommendations.

Treatments consisted of (1) a control with no added foliar treatments, (2) soil-applied at 1.0 lb B/acre, (3) soil-applied at 1.0 lb B/acre, followed by foliar-applied 0.1 lb B/acre, or (4) no soil-applied at 1.0 lb B/acre followed by foliar-applied at 0.1 lb B/acre. The soil B treatment was applied preplant soil incorporated at 1.0 lb B/acre. The foliar B treatment was applied at 1, 2, and 4 wk after first flower with a CO<sub>2</sub> backpack sprayer in 10 gal water. The B source was solubor from US Borax. The experimental design was a randomized block, split plot for high and low nitrogen, with five (seven in Rohwer) replications. In Fayetteville, 1-m row plant samples were taken at first flower, 3 and 6 weeks after first flower for dry matter and leaf area determination and analysis of B content in plant components. Lint yield and boll weight were determined at the end of the growing season.

## **RESULTS**

### **Lint Yield**

In general, the soil or foliar B treatments had only small affects on lint yields (Table 2). At Fayetteville, in the low soil N plots there were no significant differences between B treatments, and in the high soil plots only the foliar-B treatment reduced yield compared to the control. There were no significant differences between B treatments at the Whittenten Farm in Desha County. In St. Francis County, there were once again, no differences between soil-B and foliar-B treatments, but the combined soil+foliar B treatment inexplicably decreased yield. However, the study in St. Francis County was unfortunately oversprayed with B, and the results are therefore questionable. At Rohwer, there was no significant yield effect in the dryland study. However, in the irrigated study, the soil-B and foliar-B treatments increased yield in the low nitrogen regime. This was the only response recorded from the nitrogen treatment.

### **Growth Analysis and Boron Content**

This was only recorded at the Fayetteville location. Due to the moderately high initial soil B status (e.g., 0.49 lb N/acre in Fayetteville) there were no significant differences in leaf, stem, petiole, or total dry matter or plant B at the first flower stage or 3 weeks later (data not shown). The foliar B and soil+foliar B treatments had the highest leaf B content. There were also no differences in B content between the high and low soil N treatments.

## **PRACTICAL APPLICATION**

The results in 1999 indicated that soil or foliar-applied B may not have been beneficial for obtaining high cotton yields. There were no positive responses to applied

soil-B or foliar-B in the high N soil level in any of the five experiments. There was only one situation where the low N treatments responded to applied B. These results should not be taken to mean that B is not important for optimal cotton growth and yield (see report by Zhao and Oosterhuis in this issue). This study merely indicates that application of additional B as a routine procedure may not always be necessary. These results also need to be interpreted in relation to the initial soil N and B status. This study will be continued in 2000 with sponsorship from the Arkansas Soil Test Research Program.

#### LITERATURE CITED

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Table 1. Experimental details for the four locations of the boron study in 1999.

	Location		Rowher <sup>z</sup>
	Fayetteville	St. Francis Co.	
Soil series	Captina	Herbert silt loam	Herbert silt loam
Cultivar	Suregrow 125	PM 1560BG	ST 474
Planting date	June 4, 1999	May 14, 1999	May 14, 1999
Row spacing	38 in.	38 in.	38 in.
Pl. population	3-4 plants/ft.	3-4 plants/ft.	3-4 plants/ft.
Replications	5	5	7
Plot size	4 rows x 15 ft.	4 rows x 400 ft.	4 x 30 ft.
Initial soil N status	31 lb N/acre	10 lb N/acre	2 lb N/acre at 6 inches
N rate (low)	50 lb N/acre	----- <sup>y</sup>	0 lb N/acre
N rate (high)	100 lb N/acre	95 lb N/acre	100 lb N/acre
Initial soil B status	0.49 lb B/acre		0.09 lb B/acre
Soil B rate	2.0 lb B/acre	2.0 lb B/acre	2.0 lb B/acre
Foliar B rate	0.1 lb B/acre	0.2 lb B/acre	0.2 lb B/acre
Volume of spray	10 gal/acre	13 gal/acre	10 gal/acre
Method of spray	CO <sub>2</sub> backpack	highboy sprayer	CO <sub>2</sub> backpack
Dates of foliar sprays	1, 2, and 4 wks after 1st flower	1, 2, and 4 wks after 1st flower	2, 3, and 5 wks after 1st flower
No. foliar sprays	3	3	3

<sup>z</sup> Two experiment, irrigated and dryland, were conducted at Rohwer.

<sup>y</sup> Treatment not included.

Table 2. Effect of soil and foliar-applied boron on cotton yields for the five experiments conducted in Arkansas in 1999.

Treatment	Fayetteville		Desha Co.		St. Francis Co. <sup>z</sup>		Rohwer	
	Irrigated		Irrigated		Irrigated	lint yield (lb/acre)	Irrigated	Dryland
High N - Control	1173		1187		986		1432	883
High N - Soil B	1149		1196		955		1466	942
High N - Foliar B	1181		1209		944		1420	945
High N - Soil + Foliar	1249		1216		927		----- <sup>y</sup>	-----
Low N - Control	1238		-----		-----		721	898
Low N - Soil B	1072		-----		-----		1024	953
Low N - Foliar B	1044		-----		-----		1007	929
Low N - Soil + Foliar	1166		-----		-----		-----	-----
LSD (0.05)	NS <sup>x</sup>		54		50		184	NS

<sup>z</sup> Fields oversprayed with 1 lb B/acre three weeks after first flower.

<sup>y</sup> Treatments not included.

<sup>x</sup> NS = non significant (P=0.05)