

Original Research Article

The Effect of Different Boron Doses on Ginning Traits Fiber Yield and Seed Quality of Cotton Ginning traits, fiber and seed quality of cotton as influenced by foliar application of boron

Abstract

The experiment was conducted at Central Cotton Research Farm, Sreepur, Gazipur during cotton growing season of 2009-2010. Cotton variety cv. CB-10 was used as material under experiment.

Eight levels of boron (0.0 (Control), 0.25, 0.50, 0.75, 1.0, 1.25, 1.50 and 1.75, g L⁻¹ water) were

sprayed at reproductive stage of cotton as treatment. The design of the experiment was randomized completely block design (RCBD) with three replications. Data on ginning, fiber and seed quality were taken under present experiment. Result revealed that, foliar application of boron has significant influence on different traits of cotton. The highest ginning out turn (40.52%) was recorded at foliar application of B at 1.00 g B L⁻¹ whereas the lowest ginning out turn (39.09%) was observed in case of foliar B application of 1.75 g B L⁻¹ water. The highest lint yield (0.47 t ha⁻¹) was obtained in 1.00 g B L⁻¹ water than that of control. The highest germination (95.58%) was recorded at 1.00 g B L⁻¹ water than that of control. Foliar boron fertilizer increased seed oil and protein content but it was insignificant. Numerically, the highest oil content (19.06%) was found at 1.25 g B L⁻¹ water and protein (23.75%) at 1.75 g B L⁻¹ water foliar spray. Foliar application of boron may improve the performance of cotton plant by reducing the percentage of boll shattering and increasing the growth of square for better quality fiber.

Keywords: Cotton, ginning, lint, fibre, seed oil, seed protein and germination

Introduction

Upland cotton (*Gossypium hirsutum*) and hill cotton (*Gossypium arboreum*) are mostly cultivating in Bangladesh from very old era for its quality industrialized fibre. Cotton yield and fibre and seed quality can be adversely affected by boron deficiency. This is partly because insufficient boron negatively affects cell division, cell wall synthesis, mass translocation, protein synthesis, phenolic acid and nucleic acids metabolism (Schon and Blevins, 1987). It performs a key function in the growth and fruiting process especially in pollination and seed development (Albers *et al.*, 1993). While boron is essential for all stages of cotton growth, an available supply is most important during flowering and boll development as it improves fibre quality (Stewart, 1986). Boron deficiency also cause small deformed bolls, poor boll retention and reduce lint yields of cotton. Thus pre-plant soil application of boron is recommended for soils testing low in available boron. However, there are several difficulties in soil applied boron as the narrow range of tolerance between boron deficiency and toxicity and soil applied boron is easily bound by organic matter, iron and aluminum hydroxides (Gupta *et al.*, 1985). In addition, boron is quite immobile in plant so

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that redistribution of this element from vegetative tissues to developing sinks is a great problem. Boron occurs in the soil as an unchanged molecule and leaches readily. Boron that is held by the soil is associated primarily with organic matter and is released as the organic matter decomposes. Dry weather can also trigger a temporary deficiency as organic matter decomposition slows. Furthermore, dry weather slows root growth and limits boron uptake. In such circumstances, foliar boron fertilization may be an effective and alternate way of quickly supplying boron during critical period of flowering and boll development (Howard *et al.*, 1998). Because small amounts of boron are required, foliar application of boron may be more efficient in flower production, boll retention percentage, lint yield and improvement in fibre quality. Furthermore, boron is directly linked with the process of fertilization, pollen producing capacity of anther, viability of pollen grains, pollen germination and pollen tube growth (Agarwala *et al.*, 1981). Therefore, this experiment was conducted to find out optimum concentration of foliar boron for increasing lint yield, and fibre and seed quality of cotton.

MATERIALS AND METHOD

The experiment was conducted at Central Cotton Research Farm, Sreepur, Gazipur during cotton growing season of 2009-2010. The soil characteristics, environmental condition and crop management practices followed in this experiment were described in earlier experiment. Cotton variety Cv. CB-10 was used for experimental purpose. Eight levels of boron (0.0 control, 0.25, 0.50, 0.75, 1.0, 1.25, 1.50 and 1.75, g L⁻¹ water) were sprayed at reproductive stage of cotton. Foliar B spraying was done for three times at the time of flower emergence to boll formation stage at ten days interval. Boron was derived from Borax. The design of the experiment was randomized completely block design (RCBD) with three replications. Unit plot size was 7 m x 3 m and the distance between the plots was 1.00 meter. The treatments were assigned randomly in each replication. Data on different growth parameter, yield, and fibre and seed quality were determined as procedures described in first experiment. All data were subjected to statistical analysis by analysis of variance (ANOVA). Microsoft EXCEL and MSTAT software programs were used wherever appropriate and the means were compared according to Duncan's Multiple Range Test (DMRT). Functional relationships among the parameters were established through correlation and regression analysis by using SPSS software program.

3. RESULTS AND DISCUSSION

3.1 Ginning characteristics

3.1.1 Ginning Out Turn (GOT)

The highest ginning out turn (40.52%) was recorded at foliar application of B at 1.00 g B L⁻¹ water, (but foliar application of 0.75, 1.00 and .25 g B L⁻¹ water is statistically not different from each other.) and it was followed by most of other treatments of foliar B applications (Table 1). The lowest ginning out turn (39.09%) was observed in case of foliar B application of 1.75 g B L⁻¹

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water. This result indicates that applied foliar B improves the ginning out turn to some extent and in excess reduces ginning out turn of cotton.

3.1.2 Lint yield

Lint yield differences were significant between foliar B treatments and control. The highest lint yield (0.47 t ha⁻¹) was obtained in 1.00 g B L⁻¹ water application followed by treatment 0.75 g L⁻¹ (They shared the same statistic group it means statistically not different) water and the lowest lint yield (0.38 t ha⁻¹) was recorded when no foliar B application was done (Table 1). The maximum increase in lint yield was about 25% with B application 1.00 g B L⁻¹ water as compare to no foliar B application. Similar results were also reported by Anderson and Boswell (1968) and Heitholt (1994) in field experiments where lint yield increased significantly with an increase in B application rate.

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Table 1. Effect of foliar application of B ginning characteristics of cotton

Foliar boron concentration (g L ⁻¹ water)	Ginning Out turn (%)	Lint yield (t ha ⁻¹)
0	39.64 ab	0.38 b
0.25	39.62 ab	0.42 ab
0.50	39.45ab	0.43 ab
0.75	40.18 a	0.45 a
1.00	40.52 a	0.47 a
1.25	40.00 a	0.44 ab
1.50	39.64 ab	0.44 ab
1.75	39.09 ab	0.43 ab
CV (%)	9.25	9.77

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3.2 Fiber quality

3.2.1 Span length and uniformity

Fibre quality of cotton differed significantly by foliar B application (Table 2). The highest 50% span length (12.19 mm) was observed in foliar B application with 1.00 g B L⁻¹ water and the lowest 50% span length (10.67 mm) was obtained in no foliar B application. However, there were no significant differences in 50% span length found from 0.50, 1.25 and 1.75 g B L⁻¹ water foliar B application. Earlier studies (Heitholt, 1994) also showed greater 50% span length in foliar B treatments than the control. Fibre Uniformity was also affected by foliar B application and it was highest (46.17) in foliar B application of 1.00 g B L⁻¹ water and the lowest fibre uniformity (41.50) was observed in no foliar B application. The beneficial effects of foliar B in enhancing fibre properties were also reported by Gormus (2005).

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3.2.2 Micronaire value

Micronaire values were maximum (4.47) at 1.00 g B L⁻¹ water and it was similar to 0.75 and 1.25 g B L⁻¹ water foliar spray (Table 2). Other rates of foliar B reduced micronaire values. Such variation in micronaire values not only depends on B availability but also depend on availability of other nutrients and the crop growing environment (Boman *et al.*, 1997). Fibre strength however did not affected by foliar B application .

Table 2. Effect of foliar application of B on span length, uniformity ratio, pressly strength and micronaire value of cotton

Foliar boron concentration (g B L ⁻¹ water)	50% Span length (mm)	Uniformity Ratio	Micronaire Value	Pressly Strength (PSI)
0	10.67 c	41.50 d	4.47	4.47
0.25	11.18 bc	42.00 cd	4.47	4.47
0.50	11.43 ab	43.50 bcd	4.47	4.47
0.75	11.48 ab	44.67 ab	4.47	4.47
1.00	12.19 a	46.17 a	4.47	4.47
1.25	11.43 ab	44.33 abc	4.47	4.47
1.50	11.18 bc	45.17 ab	4.47	4.47
1.75	11.18 bc	43.67 bcd	4.47	4.47
CV (%)	6.8	3.71	4.19	2.32

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3.3 Seed quality

3.3.1 Seed index

Foliar B application increased seed index of cotton (Table 3). Seed index increased with the increase of foliar B fertilization which indicated that B is essential for increasing seed index of cotton. Seed index was the highest (9.90 g) at 0.75 g B L⁻¹ water and remained identical to other higher levels of B concentrations. Therefore, this concentration of foliar B may be considered as threshold level for increasing seed index of cotton.

3.3.2 Germination

Results of germination percentage revealed that germination of cotton seed obtained from different levels of foliar B application differed significantly over the treatment combinations (Table 3). The highest germination (95.58%) was recorded at 1.00 g B L⁻¹ water and it was similar to most of the treatments except 0.25 g B L⁻¹ water foliar spray. The desirable effect

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of spraying B at seed filling stage may be due to accumulation of more metabolites in seeds which in turn increased seed germination (Ching and Rynd, 1978).

3.3.3 Seedling characteristics

Root length of cotton seedling influenced significantly due to foliar B spraying at the time of reproductive stage of cotton (Table 3). Root length characteristics of cotton seedlings were almost resembled to that of germination apttern where higher is the B concentration higher is the seedling root length. A similar phenomenon was also observed in seedling shoot length although it did not vary at different levels of foliar B concentrations.

3.3.4 Electrical conductivity

Different levels of foliar B showed similar values of seed leachate electrical conductivity but there was significant difference over the control treatment (Table 3). The cotton seeds derived from foliar B spray had much lower electrical conductivity values which indicated that these seeds are superior quality in comparison to seeds of control treatment. This may happened because B is involved in Carbohydrate metabolism in seed and improved seed quality (Hazra and Som, 1999).

Table 3. Effect of foliar application of B on seed quality attributes of cotton

Foliar boron concentration (g B L ⁻¹ water)	Seed index (g)	Germination (%)	Root length (cm)	Shoot length (cm)	Electrical conductivity (μScm ⁻¹ g ⁻¹)
0	8.84 d	85.60 c	9.93 c	10.63	148.00 a
0.25	9.06 c	89.80 b	10.47 bc	10.97	112.00 b
0.50	9.17 bc	90.22 ab	10.63 abc	11.07	106.67 b
0.75	9.90 a	89.80 b	10.90 ab	11.27	103.67 b
1.00	9.01 bc	95.58 a	11.33 a	11.30	107.00 b
1.25	9.82 a	94.32 a	11.10 ab	11.20	107.00 b
1.50	9.64 ab	92.13 ab	10.93 ab	11.17	113.00 b
1.75	9.53 ab	91.22 ab	10.73 ab	11.23	112.83 b
CV (%)	6.35	5.32	3.67	2.74	10.95

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3.3.5 Seed oil and protein content

Foliar boron fertilizer increased seed oil and protein content but it was insignificant (Table 4). Numerically, the highest oil content (19.06%) was found at 1.25 g B L⁻¹ water and protein (23.75%) at 1.75 g B L⁻¹ water foliar spray. Better oil and protein content in cotton seed under foliar B application might be attributed to its improvement in seed size.

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As foliar B increased seed size of cotton, it is expected to contain higher proportion of oil and protein in bolder seed.

Table 4. Effect of foliar B application on grain quality of cotton

Foliar B concentration (g B L ⁻¹ water)	Oil content (%)	Protein content (%)
0	21.61	18.54
0.25	22.57	18.64
0.50	22.61	18.69
0.75	23.25	18.63
1.00	22.94	18.99
1.25	22.60	19.06
1.50	23.59	18.73
1.75	23.75	18.78
CV (%)	4.38	4.47

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Conclusion

Cotton showed the best performance towards foliar application of B at 1.00 g B L⁻¹ than that of control under present experiment. So, it may be said that, foliar application of boron may improve the performance of cotton plant by reducing the percentage of boll shattering and increasing the growth of square for better quality fiber.

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