



Altering Growth Characters and Seed Cotton Yield under Foliar Application of Boron

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Authors' contributions

This work was carried out in collaboration among all authors. Author MTR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMH, MGGM and MSH managed the analyses of the study. Author MSNC managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at Central Cotton Research Farm, Sreepur, Gazipur during cotton growing season of 2009-2011. Cotton variety cv. CB-10 was used under experiment. Eight levels of boron (0.0, 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. Result revealed that, foliar application of boron has significant influence on different traits of cotton. 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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1. 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 [1]. It performs a key function in the growth and fruiting process especially in pollination and seed development [2]. 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 [3]. 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 [4]. In addition, boron is quite immobile in plant so 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 [5]. 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 [6]. Therefore, this experiment was conducted to find out optimum concentration of foliar boron for increasing lint yield, and fiber and seed quality of cotton.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at Central Cotton Research Farm, Sreepur, Gazipur during cotton growing season of 2009-2010. The soil of experimental area was silty clay in texture. Soil pH was 6.7 and has organic carbon 0.45%.

2.2 Experimental Treatment

Cotton variety Cv. CB-10 was used for experimental purpose. Eight levels of boron (0.0, 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 [7]. A hand garden sprayer was used to spray foliar fertilizer solution. Foliar fertilizers were applied on leaves at evening, because of less sun light, low transpiration and evaporation rate, absorbing more nutrients over night by the plant. 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.

2.3 Data Collection

Monopodial branch were counted from five randomly tagged plants before the commencement of picking. The average number was computed and expressed as number of monopodial branches per plant. Fruiting branches arising on the main stem and above the monopodial branches were counted just before the commencement of picking in five randomly selected plants. The fully opened crossed bolls bearing white cotton thread were counted from the eighteen randomly selected plants. About 10 bolls were selected at random from each treatment as per replication. The seed cotton was separated from each boll and weighed separately. The average boll weight was computed and expressed in grams. The seed cotton yield (t ha⁻¹) was calculated by using the seed cotton yield obtained from the each plot area and care was taken to add the seed cotton weight of the five separately harvested plants,

which were used for determination of yield attributes.

2.4 Statistical Package

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 Growth Attributes

Foliar application of B during reproductive stage had no significant effect on any growth attributes of cotton (Table 1). However, application of 0.75 g B L⁻¹ was tended to increase growth of cotton plants as compared to control and higher levels of B concentration. The increase in growth attributes of cotton after foliar B application suggests that B influenced apical dominance either directly or indirectly [8]. Subsequent decrease in growth parameters of cotton were observed as B becomes toxic at high concentration [9].

3.2 Yield Attributes and Yield

3.2.1 Boll number

Foliar B application increased significantly number of bolls per plant of cotton (Table 2). The highest boll number per plant (21.02) was obtained with the 1.00 g B L⁻¹ water. Other lower or higher levels of foliar B reduced boll number

which indicated that boron at the rate of 1.00 g B L⁻¹ water is optimum for better boll formation of cotton. Since B movement from soil to leaves is dependent upon transpiration system, its deficiency may occur if water and nutrients are bypassed by the vertical xylem during transpiring leaves of the canopy [4,10]. Therefore, foliar application of B might be effective for increased boll number of cotton.

3.2.2 Boll weight

Boll weight of cotton increased significantly due to foliar B application. Boll weight was the highest (5.86 g) at 1.00 g B L⁻¹ water which was statistical identical with 0.75, 1.25, 1.50 and 1.75 g B L⁻¹ water treatments. Such increase in boll weight under foliar B application might be due to quick availability of B during boll development of cotton [5]. Foliar B application remedies B deficiency and inhibits formation of small bolls and consequently increases boll weight of cotton.

3.2.3 Seed cotton yield

Application of foliar B found to increase seed cotton yield compared to untreated control. The highest seed cotton yield (1.16 t ha⁻¹) was recorded at 1.00 g B L⁻¹ water but it was not significantly different to other treatments of foliar B application except 0.25 g B L⁻¹ water and control. The lowest seed cotton yield (0.95 t ha⁻¹) was observed under no foliar B application (Table 2). This result indicates that applied B may improve the utilization of other nutrients by increasing the translocation of different chemical compounds into the bolls. Therefore yield increase of cotton was the consequence of enhanced boll setting and boll weight. Positive crop responses to foliar B are attributed to a greater B requirement by cotton as compared with most other field crops [11].

Table 1. Effect of foliar application of B on growth attributes of cotton plant

Foliar boron concentration (g L ⁻¹ water)	Plant height (cm)	Branch plant ⁻¹	
		Sympodial	Monopodial
0	83.17	11.83	1.92
0.25	84.58	12.02	1.97
0.50	84.92	11.95	1.83
0.75	85.08	12.75	1.93
1.00	84.35	12.68	1.83
1.25	84.17	12.35	1.82
1.50	84.50	12.02	1.93
1.75	84.17	12.42	1.87
CV (%)	7.92	9.58	11.87

Means with common letter(s) within same column are not different significantly at 0.05 by DMRT

Table 2. Effect of foliar B application on yield component and yield of cotton

Foliar boron concentration (g L ⁻¹ water)	Boll plant ⁻¹	Boll weight (g)	Seed cotton yield (t ha ⁻¹)	Seed yield (t ha ⁻¹)
0	14.95 c	4.24 b	0.95 c	0.56 c
0.25	17.77 b	4.91 b	1.06 b	0.63 b
0.50	18.70 b	4.64 b	1.09 ab	0.66 ab
0.75	19.08 b	5.32 ab	1.12 ab	0.67 ab
1.00	21.02 a	5.86 a	1.16 a	0.69 a
1.25	19.25 b	5.55 ab	1.11 ab	0.68 ab
1.50	18.08 b	5.45 ab	1.11 ab	0.67 ab
1.75	18.08 b	5.35 ab	1.10 ab	0.67 ab
CV (%)	8.30	8.32	9.22	8.12

Means with common letter(s) within same column are not different significantly at 0.05 by DMRT

3.2.4 Seed yield

Seed yield of cotton increased significantly with the increase of foliar B levels and it was the highest (0.69 t ha⁻¹) at 1.00 g B L⁻¹ water. Increase in seed yield might be due to increase of seed setting as B has direct effect on seed formation as well as seed development of cotton. Boron is also responsible for assimilate translocation to developing seed and ultimately increases seed yield of cotton (Table 2).

4. CONCLUDING REMARKS

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. The findings obtained from the present investigation should be confirmed by conducting similar type of experiment in different agro-ecological zones (AEZ) of Bangladesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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