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Effect of Soil Applied Boron on Seed Cotton and Lint Yield

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Abstract: *A field experiment was conducted to study the effect of graded levels of boron in a boron deficient soil, hot water soluble boron (hws B:0.2 mgkg^{-1}), having pH 8.1, electrical conductivity (EC) 0.28dSm^{-1}, medium organic carbon (0.58 per cent), medium available phosphorus (16 kg ha^{-1}), high in available potassium content (242 kg ha^{-1}). Boron was applied @ 0 (control), 0.5, 1.0, 1.5, 2.0 and 2.5 kg ha^{-1}. The experiment was laid out in a randomized block design with three replications. Results revealed that significant increase in monopods plant^{-1}, sympods plant^{-1}, boll number and boll weight was observed with boron application and maximum increase was observed with the application of boron @ 1.5 kg ha^{-1}. Similarly, seed cotton yield and lint yield were also highest with the application of boron @ 1.5 kg ha^{-1}.*

Keywords: *Boron fertilizer; Seed cotton yield; monopods ; sympods; lint yield.*

INTRODUCTION

Boron (B) application strongly influences cotton growth and yield, Dong, 1995[7]. Boron deficiency in cotton decreases photosynthate translocation through vascular bundles of petioles, leading to stunted growth and abnormal reproductive development, Liu *et al.*, 1986[11]; Wang and Zhou, 1992[21]. Requirement of boron is quite high for cotton (*Gossypium hirsutum L.*) which is main reason for B deficiency in crop, Shorrocks, 1992[20]. There is increase in cotton yield with soil application of boron even when boron deficiency was not noticeable in the plants, Anderson and Boswell, 1968[1]. Application of boron fertilizer is beneficial to cotton production in sandy and silt loam soils in several parts of USA and Africa, Murphy and Lancaster, 1971[15]; Mathews, 1972[12]; Roberts *et al.*, 2000[18]. Yield attributes like number of bolls produced per unit area and boll weight determine cotton yield, Sawan *et al.*, 2002[19]. Climatic factors,management practices and insects/pests affect fruiting pattern and boll retention, Bhatt, 1977[3]; Reddy *et al.*, 1992[17]; Sawan *et al.*, 2002[19], Pettigrew, 2004[16] and Brooks *et al.*, 1992[5]. Survival of the bolls increased when the bolls are present on the middle portion, Constable, 1991[6]. Nutrition had strong affect on boll retention and fruit shedding reported by Guinn, 1985[8]. Keeping in view the importance of B for cotton and its wide spread deficiency, the present study was aimed at to investigate the effects of boron fertilization on seed cotton yield under semi arid environment.

MATERIALS AND METHODS

A field experiment was conducted during kharif, 2013 at Research Farm of Punjab Agricultural University, Regional Station, Bathinda (30.2300°N and 74.9519° E), a typical representative of semi arid conditions. The experimental soil was alkaline (pH 8.1), had electrical conductivity (EC) 0.28 dSm^{-1}, medium organic carbon (0.58 per cent), medium available phosphorus (16 kg ha^{-1}), high in available potassium content (242 kg ha^{-1}) and low in hot water soluble boron (hws B:0.2 mgkg^{-1}). The experiment was laid out in randomized block design with three replications. Cotton variety Raghav-855 was sown

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Table 1
Effect of different boron levels on yield and yield attributes of cotton

Boron dose (B Kg/ha)	*Plant Height (cm)*	*Monopods Plant^{-1}*	*Sympods Plant^{-1}*	*Bolls plant^{-1}*	*Boll Weight (g)*	*Lint yield Kg ha^{-1}*	*Seed cotton yield Kg ha^{-1}*
Control	144	2.0	19.0	32	3.40	713	2026
0.5	148	2.5	25.0	39	3.73	800	2189
1	157	2.7	26.0	43	3.70	866	2309
1.5	162	4.0	28.7	47	4.16	993	2487
2	153	3.7	26.0	42	4.06	940	2441
2.5	152	3.7	25.0	41	3.79	927	2423
C.D (5%)	NS	1.21	3.8	2.4	0.37	115.2	137.3

on 13th May, 2013 at a spacing of 67.5 × 75 cm. Full dose of phosphorus was applied before sowing while nitrogen dose was applied in two splits *i.e* first half at the time of thinning and remaining half at flowering stage. The treatments consisted of six levels of B *viz.* 0, 0.5, 1.0, 1.5, 2.0 and 2.5 kg B ha^{-1} as granubor (14.3% B) which was applied before sowing. Crop received normal irrigations and standard management practices were adopted for growing the crop. Crop was kept free of insect-pests through regular pesticide sprays.

RESULTS AND DISCUSSION

The data on plant height, monopods, sympods, no.of bolls, boll weight, lint and seed cotton yield as influenced by boron application is presented in Table 1.

Plant Height

A maximum plant height of 162 cm was recorded when boron was applied @1.5 kgha^{-1} which represented an increase of 12.5 percent over the control, but this increase in plant height was not significant. A perusal of the data revealed that different levels of boron had no significant effect on plant height

Monopods Plant^{-1}

Monopods plant^{-1} is an crucial yield parameter that plays vital role in final yield. Number of monopods plant^{-1} data is presented in table 1. The data indicated that number of monopods plant^{-1} significantly doubled from 2.0 in control to a maximum of 4.0 with the application of 1.5 kg B ha^{-1}. But further increase in B application did not have a significant effect on monopods plant^{-1} rather monopods plant^{-1} decrease non significantly to 3.7 but remained higher than control.

Sympod Plant^{-1}

The number of sympodial branches plant^{-1} is an important factor which contributes to the final yield. The yield is directly related to the number of sympodial branches plant^{-1}. More the number of sympodial branches plant^{-1}, more will be the yield. The data regarding number of sympodial branches plant^{-1} is given in table 1. Data for sympod plant^{-1} reveals that number of sympods plant^{-1} increases significantly with increasing levels of boron over control. Sympods plant^{-1} increases significantly from 19.0 in control to a maximum 28.7 with the application of 1.5 kg B ha^{-1}. But the difference in treatments where different levels of boron were applied was not significant, there by indicating that B application at rates greater than 0.5kg B ha^{-1} did not have any significant effect on number of sympods plant^{-1}.

As B fertilizer is directly and indirectly involved in many physiological and biochemical processes during plant growth, such as cell elongation and division, cell wall biosynthesis, membrane function, nitrogen metabolism and photosynthesis, Blevins and Lukaszewski, 1998[4]. Higher number of sympodia (fruiting branches), higher foliage and large plant structure with the boron application was also observed by Heitholt, 1994[9]; Zhao and Oosterhuis, 2003[22].

Bolls Plant^{-1}

Cotton crop yield rely on the number of bolls plant^{-1}. It is directly related to the final yield. The data representing number of bolls plant^{-1} are given in table1 which indicates that increase in bolls plant^{-1} with the increase in boron levels. Number of bolls plant^{-1} increases significantly over control with the increase in levels of B application. A maximum number of 47 bolls plant^{-1} was observed with the application of 1.5 kg Bha^{-1} which represented a significant increase of 46.8 per cent over control. Graded levels of boron significantly increases bolls plant^{-1} but maximum increase in boll plant^{-1}was observed with the application of boron at 1.5 kg ha^{-1}. Further application of B @ 2 and 2.5 kg ha^{-1} reduced the number of bolls plant^{-1}. Similar results were also observed by Muhammad *et al.*, 2007[14].

Boll Weight

Boll weight is a vital contributor towards final yield of cotton crop. From present study it was concluded that boll weight ranged from 3.40 to 4.16(g) and boll weight significantly affected by different treatments. Maximum number of boll weight was observed with the application 1.5 kg B ha^{-1} and minimum number boll weight was observed in control treatment. Boll weight increased significantly by 22.3, 11.5 and 12.4 percent with the application of 1.5 kg B ha^{-1} over control and B applied at the rate of 0.5 and 1kg ha^{-1}. However the boll weight decrease with the increase in boron levels from 1.5 kg B ha^{-1}to 2 and 2.5 kg B ha^{-1}. Boron applied at the rate of 2 and 2.5 kg B ha^{-1} remained at par with 1.5 kg B ha^{-1}. An increase in boll weight with boron application was also observed by Muhammad *et al.* 2007[14].

Lint Yield

The data for lint yield is presented in the table 1. A perusal of the data reveals that lint yield ranged from 713 to 993 kg ha^{-1}. There is significant increase of 39.2, 24.1 and 14.6 percent in lint yield with the application of boron at 1.5 kg ha^{-1} over control, 0.5 kg B ha^{-1}and 1 kg B ha^{-1}.Further boron application at 2 and 2.5 kg ha^{-1}did not exert any significant on lint yield as compared to B applied at1.5 kg ha$^{-1.}$ However lint yield decrease with the increase in boron level from 1.5 to 2 and 2.5 kg ha^{-1}.

Seed Cotton Yield

The final yield is the function of combined effect of all the yield components under a particular set of environmental conditions. Data regarding seed cotton yield are given in the Table 1. A perusal of the data reveals that seed cotton yield ranged from 2026 to 2487 kg ha^{-1}. Seed cotton yield increases significantly by 8.0, 13.9, 22.7, 20.4 and 19.6 per cent over control with application of 0.5, 1.0, 1.5, 2.0 and 2.5 kg B ha^{-1} respectively. A maximum of 22.7 percent in yield was observed with the application of 1.5kg B ha^{-1}. The yield declined with the application of 2.0 and 2.5 kg B ha^{-1} but this decrease was non-significant over 1.5 kg B ha^{-1}. Increase in seed cotton yield was the consequence of increased bolls per plant and boll weight. Mortvedt and Woodreuff 1993[13] recommended 0.34 - 2.24 kg B ha^{-1}for cotton crop in various states of US. High B fixation in calcareous soils, Batey, 1971[2] and high B requirement of cotton, Shorrocks, 1992[20] are also reasons of increase in seed cotton yield. An increase in the yield in the present study is also supported by other researchers Howard *et al.*, 1998[10]; Robert *et al.*, 2000[18].

CONCLUSION

Boron application increased seed cotton yield by strongly influencing yield attributes which directly contribute to the final yield. An significant increase of 22.7 percent in seed cotton yield was observed with the application of 1.5 kg B ha^{-1} over control. However, seed cotton yield decreased with the increase in boron levels from 1.5 to 2 and 2.5kg B ha^{-1}. The results of this study indicated that application of 1.5 kg B ha^{-1} to cotton may be required to get the desired yield of cotton in its deficient soils. However, more number of studies in diverse soils are required to confirm this.

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