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EFFECT OF MICRONUTRIENT ON THE PRODUCTIVITY AND QUALITY OF COTTON SEED cv.TCB 209 (*Gossypium barbadense* L.)

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ABSTRACT

Field experiments conducted during summer and winter 1996 seasons with 10 treatments involving zinc and boron in various combinations showed significant differences for yield attributing characters in cotton. The number of sympodia plant^{-1} (30.0%), number of bolls plant^{-1} (39.2 %), boll weight (49.8 %), seed weight boll^{-1} (36.8 %), number of seeds boll^{-1} (10.8 %) were significantly higher for plants given combined soil application of $ZnSO_4$ (50 kg ha^{-1}) and borax (10 kg ha^{-1}). The seed cotton yield and seed yield were 47.1 % and 19.2 % higher for the same treatment over control. The quality of resultant seeds in terms of 100 seed weight, germination, speed of germination, seedling growth, drymatter production, vigour index, dehydrogenase enzyme activity and oil content were also significantly higher for the seeds from plants received both $ZnSO_4$ and borax through soil or foliage.

KEY WORDS : Micronutrients, Zinc, Boron, Cotton

Premature floral abscission and failure to set seeds are the common problems in cotton seed production. These are to certain extent attributed to micronutrient deficiencies such as boron, zinc, copper and so on. The anthers and pollen grains accumulate relatively large amounts of zinc and get translocated to the resultant seed (Polar, 1970 ; 1975). Sawan *et al.* (1989) reported increased seed yield plant^{-1}, seed viability and seedling vigour with increase in N rate and foliar application of Ca (50 mg lit^{-1}), Cu, Zn (1.25 mg lit^{-1}), Fe, Mn (25 mg lit^{-1}) in cotton. Lakshmi (1995) also reported that soil application of zinc sulphate followed by two foliar sprays increased the seed quality. The present study was undertaken to study the effect of soil, foliar and combined application of zinc and boron on the seed yield and seed quality of cotton cv. TCB 209.

MATERIALS AND METHODS

Field experiments were carried out at Agricultural College and Research Institute, Coimbatore in two seasons *viz.*, summer and winter in 1996. The experiment was laid out in black cotton soil in randomized block design using 20 m^2 plots with four replications. Seeds were dibbled at 60 x 45 cm spacing. Basal application of half the dose of N, full P and K (120:60:60 kg ha^{-1}) was done in all the plots, along with zinc sulphate (50 kg ha^{-1}) and borax (10 kg ha^{-1}) according to treatments. Remaining half dose of N was applied at square formation stage. Plant protection measures and cultural operations were followed as per the recommended package of practices.

Treatment particulars :

T_0 - Control

T_1 - Soil application of zinc sulphate (50 kg ha^{-1})

T_2 - Soil application of borax (10 kg ha^{-1})

T_3 - Soil application of zinc sulphate (50 kg ha^{-1} + borax (10 kg ha^{-1})

T_4 - Foliar application of zinc sulphate (0.5%) on 90 and 110 days after sowing (DAS).

T_5 - Foliar application of zinc sulphate (0.5) on 70, 90 and 110 DAS

T_6 - Foliar application of borax (0.5%) on 90 and 110 DAS.

T_7 - Foliar application of borax (0.5%) on 70,90 and 110 DAS

T_8 - Foliar application of zinc sulphate (0.5%) + borax (0.5%) on 90 and 110 DAS.

T_9 - Foliar application of zinc sulphate (0.5%) + borax (0.5%) on 70, 90 and 110 DAS.

Biometric observations such as number of sympodia plant^{-1}, number of bolls plant^{-1} boll weight, seed weight boll^{-1}, number of seeds boll^{-1} were recorded in five plants marked randomly in each treatment, replicationwise and the mean value expressed. After final picking, seed cotton was pooled and weighed. Seeds were sampled after ginning of seed cotton from each treatment for seed quality parameters such as, 100 seed weights, and germination test (ISTA, 1993), speed of germination (Maguire, 1962), root length, shoot length, dry matter production of seedling, seedling vigour index (Abdul-Baki and Anderson, 1993), electrical conductivity of seed leachate (Presley, 1958) and dehydrogenase enzyme activity (Kittock and Law, 1968).

RESULTS AND DISCUSSION

Seed yield and yield contributing parameters such as number of sympodia plant^{-1}, number of bolls plant^{-1}, boll weight, seed weight boll^{-1}, number of seeds boll^{-1} and seed cotoтn yield plot-1 upheld the superiority of T_3 treatment (Soil application of zinc sulphate at 50 kg ha^{-1} + borax at 10 kg ha^{-1} in the winter crop by registering 42.8, 31.3, 41.7, 40.7, 41.1, 8.0 and 42.3 per cent increase over control (T_0), respectively (Table 1). In summer crop too, soil application of zinc sulphate + borax excelled all other treatments with each one of the yield contributing parameters except boll weight, seed weight boll^{-1} and number of seeds boll^{-1} where, foliar application of borax (0.5 per cent on 70, 90 and 110 DAS upheld the superiority over T_3. The results reported by Laksnmi (1995) is in conformity with the present findings, where soil application of zinc sulphate followed by two foliar sprays showed the best effect. The pooled analysis of variance also brought out the superiority of the soil application of zinc sulphate + borax with respect to number of seeds boll^{-1}, seed cotton yield plot^{-1} and seed yield plot^{-1} by registering 39.2, 4.7 and 49.2 per cent respectively (Table 1). In summer crop too, soil application of zinc sulphate + borax excelled all

Table 1. Effect of micronutrient on yield and yield contributing response parameters of cotton cv. TCB 209.

Treatments	Number of sympodia plant^{-1}		Number of bolls plant^{-1}		Boll weight (g boll^{-1})		Seed weight (g boll^{-1})		Number of seeds boll^{-1}		Seed cotton yield (kg plot^{-1})		Seed yield (kg plot^{-1})	
	S	W	S	W	S	W	S	W	S	W	S	W	S	W
T_0	14.0	16.0	27.0	24.0	2.92	2.85	1.95	1.85	22.0	25.0	2.050	2.268	1.364	1.733
T_1	17.0	17.0	35.0	28.0	3.29	3.16	2.14	2.07	24.0	26.0	2.890	3.333	1.878	2.182
T_2	15.0	19.0	30.0	27.0	2.93	3.53	1.69	2.29	21.0	22.0	1.973	2.715	1.284	1.763
T_3	18.0	21.0	37.0	34.0	3.63	4.01	2.36	2.61	25.0	27.0	3.318	3.795	2.155	2.466
T_4	14.0	15.0	27.0	26.0	2.87	3.07	1.87	2.00	22.0	24.0	1.953	2.165	1.270	1.698
T_5	16.0	18.0	25.0	27.0	3.10	2.84	1.89	1.85	24.0	23.0	1.838	2.860	1.286	2.021
T_6	16.0	17.0	30.0	27.0	3.03	2.87	1.80	1.87	22.0	24.0	2.070	2.313	1.345	1.502
T_7	14.0	19.0	27.0	26.0	3.99	3.47	2.59	2.26	23.0	24.0	2.655	2.413	1.726	1.570
T_8	16.0	16.0	31.0	26.0	3.47	2.96	2.26	1.93	24.0	23.0	2.265	2.930	1.471	1.904
T_9	16.0	17.0	26.0	27.0	4.61	3.55	2.51	2.31	25.0	26.0	2.498	2.815	1.623	1.830
Mean	15.6	17.5	29.5	27.2	3.38	3.23	2.11	2.10	23.0	24.0	2.351	2.846	1.540	1.867
CD ($P=0.05$)	1.17	1.15	1.60	2.12	0.79	0.41	0.12	0.27	2.39	1.56	0.330	0.340	0.280	2.390

S = Summer 1996, W = Winter 1996.

Table 2. Effect of foliar and soil application of micronutrient on the quality of resultant seeds in cotton cv.TCB 209

Treatment	100 seed weight (g)		Germination (%)		Speed of germination		Root length (cm)		Shoot length (cm)		DMP (mg)		Vigour Index		EC dSm^{-1}		Dehyrogenase activity (O.D)	
	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W
T_0	6.505	6.402	77.0 (61.63)	80.0 (63.12)	24.7	24.0	12.8	14.0	15.0	16.3	438	347	2141	2394	0.627	0.819	0.422	0.360
T_1	7.398	6.895	88.0 (69.86)	86.0 (68.05)	27.7	27.9	12.6	14.0	16.1	16.9	546	527	2524	2654	0.588	0.536	0.614	
T_2	6.453	7.278	90.0 (71.06)	86.0 (67.45)	27.4	27.3	13.1	14.5	16.1	17.4	414	409	2630	2702	0.722	1.008	0.573	0.529
T_3	7.845	7.433	93.0 (75.06)	87.0 (68.66)	29.5	27.8	14.8	14.6	17.8	18.4	528	527	3027	2874	0.618	0.529	0.417	0.541
T_4	6.570	6.655	82.0 (65.50)	77.0 (61.45)	22.4	24.0	12.3	13.7	16.8	16.1	439	437	2393	2276	0.652	0.740	0.473	0.408
T_5	6.797	6.915	82.0 (64.93)	85.0 (66.84)	22.4	24.0	12.3	13.7	16.8	16.1	439	437	2393	2276	0.652	0.740	0.473	0.408
T_6	6.225	6.325	74.0 (59.36)	78.0 (62.23)	23.3	24.6	12.6	12.4	15.8	16.0	352	364	2102	2166	0.765	0.823	0.444	0.426
T_7	6.545	6.587	77.0 (61.63)	81.0 (63.84)	23.3	24.1	13.5	12.8	15.8	16.3	393	437	2299	2440	0.741	0.743	0.574	0.573
T_8	6.258	6.688	86.0 (67.65)	79.0 (62.75)	25.9	26.1	13.6	12.8	15.8	16.3	393	437	2514	2271	0.619	0.657	0.420	0.432
T_9	6.815	7.150	84.0 (66.50)	80.0 (63.27)	26.1	26.1	13.2	13.4	16.4	17.3	475	480	2485	2404	0.647	0.531	0.417	0.485
Mean	6.741	6.833	83.0	82.0	25.6	25.9	13.1	13.6	16.3	16.8	444	443	2459	2467	0.665	0.684	0.483	0.464
CD (P=0.05)	0.222	0.315	5.91	2.57	2.17	1.02	0.99	0.61	0.78	0.49	33.68	18.67	25.83	121.55	0.035	0.038	0.015	0.031

S = Summer 1996, W = Winter 1996

(Figures within the parantheses are arcsine transformed values) other treatments with each one of the yield contributing parameters except boll weight, seed weight boll^{-1} and number of seeds boll^{-1} where, foliar application of borax (0.5 per cent) on 70, 90 and 110 DAS (T_7) and foliar application of zinc sulphate (0.6) per cent + borax (0.5 per cent) on 70, 90 and 110 DAS upheld the superiority over T_3. The results reported by Lakshmi (1995) is in conformity with the present findings, where soil application of zinc sulphate followed by two foliar sprays showed the best effect. The pooled analysis of variance also brought out the superiority of the soil application of zinc sulphate + borax with respect to number of seeds boll^{-1}, seed cotton yield plot^{-1} and seed yield plot^{-1} by registering 39.2, 4.7 and 49.2 per cent respectively (Table 1).

The quality of resultant seeds assessed in terms of germination was significantly higher for the seeds from T_3, T_2 and T_1 in summer crop with mean values of 93, 90 and 88 per cent, respectively and it remained on par. In winter crop, seeds from T_1, T_2 and T_5 while on par recorded the mean germination ranging from 85 to 87 per cent (Table 2). The computed values for speed of germination exhibited similar results as that of germination in both the season. The root length of seedlings for the resultant seeds from T_3 was significantly higher (14.8 cm) than other treatments, in the summer crop. On the other hand seeds from T_3, T_2 and T_1 while on par were superior to other treatments (Table 2). The resultant seeds from T_3 of the summer crop registered significantly higher shoot length of 17.8 cm while the seeds from T9 was found to be significantly better in the winter crop.

The results of dry matter production of seedlings projected similar trend in both the seasons - summer and winter, where the seeds from T_1 and T_3 while on par were superior to the seeds from rest of the treatments. The computed vigour index also showed similar trend in both season trials. It were significantly higher for the seeds from T_3 closely followed by that from T_2. Other treatments were significantly lower than T_3 and T_2, but the difference among them remained at par (Table 2).

The values for the electrical conductivity (EC) of seed leachate did not show consistency for treatments in both the seasons. For example, seeds from T_6 in summer crop registered the lowest value (0.880 dSm^{-1}), while in winter crop seeds from T_5 recorded the minimum value (0.456 dSm^{-1}) (Table 2). In summer crop seeds from T_1, T_7, T_2, T_5 and T_4 recorded significantly higher activity for dehydrogenase enzyme while in winter seeds from T_7 alone registered significantly higher enzyme activity.

The seeds from summer crop gained better treatment effect than that of the winter crop. The low EC values recorded for the seeds of summer crop confirmed the better quality vested with the seeds in terms of membrane integrity. On the contrary, seeds from winter crop although showed significant improvement in all seed quality attributes on account of micronutrient application, it registered higher EC values which remains unexplainable. These results are in confirmity with the results reported by Sawan *et al.* (1989) and Lakshmi (1996) in cotton.

It was noted that the zinc and boron contents in seeds were high when mother plants received there foliar applications of zinc sulphate and borax than the seeds from plant received only through soil application.

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