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RESEARCH ARTICLE :

Influence of various levels of sulphur and boron supply on nutrient uptake by soybean (*Glysine max* L.)

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SUMMARY : An experiment was carried outduring *Kharif* season 2015 at Indira Gandhi Krishi Viswavidyalaya, Krishak Nagar Raipur (Chhattisgarh) in vertisol with objective to evaluate the influence of sulphur and boron application on nutrient uptakeby soybean. The experiment was laid out in a RCBD with 16 treatments comprised four levels of sulphur *viz.*, 0, 15, 30 and 45 kg ha^{-1} and four levels of boron *viz.*, 0, 0.5, 1.0 and 1.5 kg ha^{-1}. Sulphur and boron application resulted in increased nutrient uptake by soybean. Maximum nitrogen, phosphorus, potassium, sulphur and boron uptake (147.03, 10.17, 39.61, 8.35 kg ha^{-1} and 98.71 g ha^{-1}, respectively) was observed with 30 kg S ha^{-1}. Maximum uptake of nitrogen, phosphorus, potassium, sulphur and boron (131.51, 9.10, 36.85, 7.74 kg ha^{-1} and 89.38 g ha^{-1}, respectively) was associated with application of 1.0 kg B ha^{-1}.Yield of soybean was significantly influenced by different sulphur levels and maximum yield (20.04 kg ha^{-1} seed yield and 22.55 kg ha^{-1} stover yield) was observed with 30 kg sulphur per hectare. Among boron levels, 1.0 kg boron per hectare was superior to others for getting maximum soybean yield (18.82 seed yield and 21.05 kg ha^{-1} stover yield).

KEY WORDS :
Boron, Nutient uptake, Soybean, Sulphur, Yield

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BACKGROUND AND OBJECTIVES

Soybean designated as "miracle bean" has established its potential as an industrially vital and viable oilseed crop in many areas of India. It is a cheapest source of vegetable oil and protein. It contains about 40% protein, well balanced in essential amino acids, 20% oil rich with poly unsaturated fatty acids specially Omega 6 and Omega 3 fatty acids, 6-7% total mineral, 5-6% - area of 12.2 m ha, with production potential of 11.95 million tonnes and average productivity of 979.3 kg ha^{-1} (Anonymous, 2013a). The productivity of soybean is less in India as compared to world average (2484.1 kg ha^{-1}). Global area and production of soybean is 111.27 m ha and 276.4

million tonnes respectively (Anonymous, 2013b). The imbalanced and inadequate nutrition is found to be one of the major limiting factors for its poor yield. Sulphur is the 13th most abundant element in the earth crust with an average concentration of 0.06%. It is now considered as the 4th major plant nutrient after nitrogen (N), phosphorus (P) and potassium (K)for oilseeds. Sulphur is an important part of every living cell, required for the formation of chlorophyll and for the activity of ATP-sulphurylase (the enzyme involved in sulphur metabolism). It is involved in several important physiological functions in soybean including oil synthesis and acts as precursor for many amino acids, namely cysteine (26%S), cystine (27%S) and methionine (21%S) which act as building blocks for the synthesis of protein. As soybean is rich in both oil and protein, the requirement of sulphur is quite high. Over the years due to intensive cultivation and use of sulphur free fertilizers, the deficiency of sulphur has begun to appear and it is slowly becoming a major constraint for realizing higher yield in soybean. Sulphur deficiencies are now widespread in Indian soil and reports of more areas found deficient in S are coming in regularly. Besides sulphur, boron is another element, which is highly important in the physiological functions in soybean. Boron's widespread role within the plant includes cell wall synthesis, sugar transport, cell division, differentiation, membrane functioning, root elongation, and regulation of plant hormone levels.Boron has particularly attended an important position in intensive agriculture. Boron is required for the proper development of growing tips, phloem and xylem. Boron helps in germination and growth of pollen grains and also development of pollen-tube thus facilitating fertilization in plant and grain yield.

In Chhattisgarh, agriculture is mainly based on rainwater; therefore most of the crops are grown as rainfed in *Kharif* season. Soybean occupies 1.52 lac hectares in Chhattisgarh with a productivity of 11.54 q ha^{-1}. More acreage of soybean in Chhattisgarh state is in plain area namely Durg, Bemetara, Rajnandgaon, Mungeli and Kabirdham districts. In Kabirdham district soybean is grown in 44.25 thousand hectare area with a productivity of 12.10 q ha^{-1}. Among the fertilizer elements, sulphur requirement of oilseed crops is quite high as compared to other crops. Oil seed crops respond to liberal application of sulphur and it is involved in the synthesis of fatty acids and also increases protein quality through the synthesis of certain amino acids such as cystine, cystein and methionine. Boron is associated with calcium utilization, cell division, flowering and fruiting, water relations, and protein synthesis. The fertility status of soils has been declining continuously due to non-judicious use of chemical fertilizers and intensive cropping without proper replenishment of nutrients and organic matter. Consequently, in addition to N, P and K deficiencies, deficiencies of some other nutrients such as S, Zn and B are being observed in many parts of the country. Many research works have been done on the effect of N, P and K fertilizers on the yield of soybean crop. But, a few works have been carried out on the effect of sulphur and boron on yield of soybean.

RESOURCES AND METHODS

The experiment was carried out during *Kharif*, 2015 at Indira Gandhi Krishi Viswavidyalaya, Krishak Nagar Raipur (Chhattisgarh) in vertisol with objective to evaluate the influence of sulphur and boron application on nutrient uptake by soybean. The experiment was laid out in a RCBD with 16 treatments comprised four levels of sulphur *viz.*, 0, 15, 30 and 45 kg ha^{-1} and four levels of boron *viz.*, 0, 0.5, 1.0 and 1.5 kg ha^{-1}, replicated thrice. Soybean var. JS-335 was sown with spacing of 70 x 20 cm, seed rate 20 kg ha^{-1} and RDF 120:60:40 kg ha^{-1}.Macro nutrient (N, P and K), secondary nutrient (S) and micro nutrient (B) uptake in seed and stover yields were computed by multiplying their respective nutrient contents with yields using of following formula:Nutrient uptake (kg/ha) in seed = Concentration (%) x straw yield (q ha^{-1}) and Nutrient uptake (kg/ha) in stover = Concentration (%) x straw yield (q ha^{-1}). Seed yield of the net plot was noted down, after threshing, winnowing and drying then calculated in q ha^{-1} with appropriate multiplication factor. The harvested produce from each net plot was tied in bundles separately. Stover yield of plot was calculated after subtraction of seed yield from bundle weight. Bundle weight was recorded with the help of spring balance and converted into q ha^{-1}. Analysis of variance method (Gomez and Gomez, 2003) was followed for statistical analysis of various data. Significance of different sources of variations was tested by "error mean square method" of Fisher Snedecor's 'F' test at probability level 5%. In the tables of result the standard error of mean (S.E.±) and the value of least significant difference (critical difference) at 5% between mean have been provided.

Data on weed count and weed biomass were subjected to square root transformation $\sqrt{X+0.5}$ to make the analysis of variance valid (Gomez and Gomez, 2003).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Effect nitrogen of uptake (kg ha^{-1}) :

Uptake of nitrogen by seed and stover of soybean together with total uptake is presented in Table 1. It is obvious that application of different sulphur level significantly influenced the nitrogen uptake by seed, stover and total uptake and maximum uptake (122.17, 24.86 and 147.03 kg ha^{-1} in seed, stover and total, respectively) was associated with 30 kg S ha^{-1} and minimum uptake (80.12, 16.86 and 96.97 kg ha^{-1} in seed, stover and total, respectively) with the treatment where sulphur was not

Table 1 : Effect of sulphur and boron application on nutrient uptake by seed and stover of soybean

Treatments	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	Seed	Stover	Total	Seed	Stover	Total	Seed	Stover	Total
T_1 - S_0B_0	76.50	15.46	91.96	4.37	1.79	6.16	7.23	18.13	25.37
T_2 - $S_0B_{0.5}$	79.13	16.87	96.00	4.42	2.00	6.42	7.60	19.42	27.02
T_3 - $S_0B_{1.0}$	82.01	18.05	100.06	4.75	2.27	7.02	7.93	20.03	27.97
T_4- $S_0B_{1.5}$	82.82	17.04	99.86	4.72	2.11	6.83	7.83	20.02	27.85
T_5 - $S_{15}B_0$	77.26	16.48	93.74	4.37	2.05	6.42	6.73	19.59	26.32
T_6 – $S_{15}B_{0.5}$	94.28	18.81	113.09	5.30	2.34	7.64	8.55	21.75	30.30
T_7 – $S_{15}B_{1.0}$	105.64	22.01	127.65	6.07	2.73	8.80	11.34	25.03	36.37
T_8 – $S_{15}B_{1.5}$	108.60	21.89	130.49	6.19	2.52	8.71	10.39	23.91	34.30
T_9 – $S_{30}B_0$	116.48	22.46	138.94	6.65	2.81	9.46	11.56	24.94	36.49
T_{10} – $S_{30}B_{0.5}$	125.35	24.54	149.89	7.43	2.86	10.29	11.44	28.25	39.69
T_{11} – $S_{30}B_{1.0}$	125.39	26.76	152.15	7.36	2.96	10.32	13.00	29.23	42.23
T_{12} – $S_{30}B_{1.5}$	121.46	25.70	147.15	7.18	3.43	10.61	11.95	28.07	40.02
T_{13} – $S_{45}B_0$	95.83	18.74	114.57	5.13	2.51	7.63	8.95	22.70	31.66
T_{14} – $S_{45}B_{0.5}$	117.93	23.97	141.90	6.87	3.04	9.91	10.91	27.24	38.14
T_{15} – $S_{45}B_{1.0}$	120.39	25.78	146.17	7.11	3.14	10.25	11.46	29.37	40.82
T_{16} – $S_{45}B_{1.5}$	117.58	25.47	143.05	6.88	3.00	9.88	10.91	28.17	39.08
S levels (kg ha^{-1})									
0	80.12	16.86	96.97	4.57	2.04	6.61	7.65	19.40	27.05
15	96.45	19.80	116.24	5.48	2.41	7.89	9.25	22.57	31.82
30	122.17	24.86	147.03	7.15	3.02	10.17	11.99	27.62	39.61
45	112.93	23.49	136.42	6.49	2.92	9.42	10.56	26.87	37.43
B levels (kg ha^{-1})									
0	91.52	18.28	109.80	5.13	2.290	7.42	8.62	21.34	29.96
0.5	104.17	21.05	125.22	6.00	2.560	8.56	9.63	24.16	33.79
1.0	108.36	23.15	131.51	6.32	2.776	9.10	10.93	25.91	36.85
1.5	107.61	22.52	130.14	6.24	2.766	9.01	10.27	25.04	35.31
S.E.±									
S Level	4.39	0.86	5.07	0.270	0.141	0.380	0.506	1.088	1.471
B Level	4.39	0.86	5.07	0.270	0.141	0.380	0.506	1.088	1.471
(SXB) Interaction	8.78	1.73	10.13	0.540	0.283	0.759	1.011	2.177	2.941
C.D. (P=0.05)									
S Level	12.67	2.49	14.63	0.78	0.408	1.10	1.46	3.14	4.25
B Level	12.67	2.49	14.63	0.78	NS	1.10	1.46	3.14	4.25
(SXB) Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

applied *i.e.* 0 kg S ha^{-1}. Increase in level of boron resulted in significantly increase in nitrogen uptake by seed and maximum uptake (108.36, 23.15 and 131.51 kg ha^{-1} in seed, stover and total, respectively) was observed in plot where boron was not applied (0 kg B ha^{-1}). Nitrogen uptake with 1.5 kg B ha^{-1} and 1.0 kg B ha^{-1} were statistically at par with each other but significantly higher over control *i.e.* 0 kg B ha^{-1}. Nitrogen uptake by soybean was not significantly affected by interaction of sulphur and boron level. However, maximum uptake (125.39, 26.76 and 152.15 kg ha^{-1} in seed, stover and total, respectively) was associated with $T_{11}(S_{30}B_{1.0})$ followed by $T_{10}(S_{30}B_{0.5})$ and T_{12} $(S_{30}B_{1.5})$.

Effect of phosphorus uptake (kg ha^{-1}) :

The data pertaining to total phosphorus uptake ranged from 6.16 to 10.32 kg ha^{-1} (Table 1). Significant difference was observed in respect of phosphorus uptake by seed and stover of soybean together with total uptake due to different sulphur level at 5 % level of probability. Maximum phosphorus uptake (7.15, 3.02 and 10.17 kg ha^{-1} in seed, stover and total, respectively) was associated with 30 kg S ha^{-1} and it was closely followed by 45 kg S ha^{-1} (6.49, 2.92 and 9.42 kg ha^{-1} in seed, stover and total, respectively). Phosphorus uptake in these two treatments was statistically at par with each other. Maximum total phosphorus uptake (9.10 kg ha^{-1}) was obtained with 1.0 kgB ha^{-1} followed by 1.5 kg B ha^{-1} (9.01 kg ha^{-1}) and 0.5 kg B ha^{-1} (8.56 kg ha^{-1}). Phosphorus uptake in these plots was significantly higher than those of 0 kg B ha^{-1} but statistically similar with each other. Maximum phosphorus uptake by seed (7.43 kg ha^{-1}) was recorded with $T_{10}(S_{30}B_{0.5})$, However maximum total phosphorus uptake (10.61 kg ha^{-1}) andmaximum uptake by stover (3.43 kg ha^{-1}) was associated with $T_{12}(S_{30}B_{1.5})$. But interaction effect between sulphur and boron level was found to be non-significant.

Effect on potassium uptake (kg ha^{-1}) :

Potassium uptake by seed and stover of soybean together with total uptake was observed that potassium uptake by stover was more than that of potassium uptake by seed. Increase in sulphur level resulted in significantly higher potassium uptake by seed, stover and total uptake and maximum uptake (11.99, 27.62 and 39.61 kg ha^{-1} in seed, stover and total, respectively) was associated with 30 kg S ha^{-1} and minimum uptake (80.12, 16.86 and 96.97 kg ha^{-1} in seed, stover and total, respectively) with the treatment where sulphur was not applied *i.e.* 0 kg S ha^{-1}Increase in level of boron resulted in significantly increase in potassium uptake by seed and maximum uptake (10.93, 25.91 and 36.85 kg ha^{-1} in seed, stover and total, respectively) was observed application of 1.0 kg B ha^{-1} followed by 1.5 kg B ha^{-1} and 0.5 kg B ha^{-1}. Different sulphur and boron level had no significant effect on potassium uptake by soybean. Higher total potassium uptake (42.23 kg ha^{-1}) was observed with T_{11} $(S_{30}B_{1.0})$ followed by T_{15} $(S_{45}B_{1.0})$ and T_{12} $(S_{30}B_{1.5})$.

Effect on sulphur uptake (kg ha^{-1}) :

Total sulphur uptake ranged from 4.94 to 8.94 kg ha^{-1} (Table 2) significant difference was observed in sulphur uptake by seed and stover of soybean together with total uptake due to different sulphur level. Higher sulphur uptake (6.39, 1.96 and 8.35 kg ha^{-1} in seed, stover and total, respectively) was associated with 30 kg S ha^{-1} and it statistically at par with 45 kg S ha^{-1} (5.89, 1.94 and 7.83 kg ha^{-1} in seed, stover and total, respectively). Minimum total sulphur uptake (5.56 kg ha^{-1}) was observed with 0 kg S ha^{-1} and it was statistically lower than sulphur applied plots. Statistically higher total sulphur uptake (7.74 kg ha^{-1}) was obtained with1.0 kg B ha^{-1} followed by 1.5 kg B ha^{-1} (7.62 kg ha^{-1}) and 0.5 kg B ha^{-1} (7.05 kgha^{-1}). However sulphur uptake in these treatments was statistically similar with each other.Interaction between sulphur and boron level was found to have no significant effect on sulphur uptake and maximum total sulphur uptake (8.94 kgha^{-1}) was recorded with T_{11} $(S_{30}B_{1.0})$. Results are in agreement with those of Ganeshamurthy (1996) who reported that sulphur significantly increased the S uptake. Similar result was found by Chand *et al*. (1997) in mustard.

Effect on boron uptake (g ha^{-1}) :

Boron uptake by seed and stover of soybean along with total uptake was observed that boron uptake by seed was more than that of boron uptake by stover. Different sulphur level significantly influenced boron uptake by seed, stover and total uptake and maximum uptake (73.89, 24.82 and 98.71 kg ha^{-1} in seed, stover and total, respectively) was associated with 30 kg S ha^{-1} and minimum uptake (47.70, 17.00 and 64.70 kg ha^{-1} in seed, stover and total, respectively) with 0 kg S ha^{-1} Increase in boron level resulted in significantly higher boron uptake by seed, stover and total uptake. Maximum total uptake (90.08 kg ha^{-1}) was observed with application of 1.0 kg B ha^{-1} followed by 1.5 kg B ha^{-1} (89.38 kg B ha^{-1}) Interaction of sulphur and boron level had no significant effect on potassium boron uptake by soybean. In this study it might be concluded that boron uptake was influence by B application, this probably due to the application of boron in the field and high grain yield. The results are in concurrent with the findings observed by Kumar *et al.* (1996) who reported that uptake of boron increased due to boron application.

Effect on yield :

Seed yield of soybean ranged from 13.72 to 21.83 q ha^{-1} (Table 1). The highest seed yield (21.04 q ha^{-1}) was obtained with 30 kg S ha^{-1} followed by (19.67 q ha^{-1}) was obtained from 45 kg S ha^{-1}. The lowest one 14.15 q ha^{-1} was associated with 0 kg S ha^{-1} Seed yield of soybean was significantly influenced by boron level. Significantly higher seed yield was (18.82 q ha^{-1}) with 1.0 kg Bha^{-1}

Table 2 : Effect of sulphur and boron application on nutrient uptake by seed and stover of soybean

Treatments	Sulphur uptake (kg ha^{-1})			Boron uptake (g ha^{-1})		
	Seed	Straw	Total	Seed	Straw	Total
T_1 - S_0B_0	3.79	1.15	4.94	43.59	16.19	59.78
T_2 - $S_0B_{0.5}$	3.95	1.35	5.30	48.62	15.34	63.95
T_3 - $S_0B_{1.0}$	4.41	1.52	5.93	50.82	18.33	69.15
T_4- $S_0B_{1.5}$	4.61	1.47	6.08	47.78	18.12	65.90
T_5 - $S_{15}B_0$	4.00	1.38	5.38	47.98	17.50	65.48
T_6 – $S_{15}B_{0.5}$	5.16	1.42	6.58	56.88	22.15	79.03
T_7 – $S_{15}B_{1.0}$	5.68	1.87	7.55	61.33	22.00	83.33
T_8 – $S_{15}B_{1.5}$	5.50	1.99	7.49	68.23	20.06	88.29
T_9 – $S_{30}B_0$	5.65	1.77	7.42	67.84	22.26	90.10
T_{10} – $S_{30}B_{0.5}$	6.23	1.92	8.15	72.78	22.33	95.12
T_{11} – $S_{30}B_{1.0}$	7.02	1.93	8.94	77.85	26.02	103.88
T_{12} – $S_{30}B_{1.5}$	6.65	2.24	8.90	77.10	28.66	105.76
T_{13} – $S_{45}B_0$	5.15	1.47	6.62	54.60	17.36	71.96
T_{14} – $S_{45}B_{0.5}$	6.01	2.16	8.17	75.57	25.61	101.18
T_{15} – $S_{45}B_{1.0}$	6.39	2.14	8.53	75.09	26.06	101.14
T_{16} – $S_{45}B_{1.5}$	6.02	1.99	8.01	73.17	27.20	100.38
S levels (kg ha^{-1})						
0	4.19	1.37	5.56	47.70	17.00	64.70
15	5.08	1.67	6.75	58.60	20.43	79.03
30	6.39	1.96	8.35	73.89	24.82	98.71
45	5.89	1.94	7.83	69.61	24.06	93.66
B levels (kg ha^{-1})						
0	4.65	1.44	6.09	53.50	18.33	71.83
0.5	5.34	1.71	7.05	63.46	21.36	84.82
1.0	5.88	1.86	7.74	66.27	23.10	89.38
1.5	5.70	1.92	7.62	66.57	23.51	90.08
S.E.±						
S Level	0.264	0.092	0.333	2.828	1.290	3.498
B Level	0.264	0.092	0.333	2.828	1.290	3.498
(SXB) Interaction	0.528	0.184	0.666	5.656	2.581	6.997
C.D. (P=0.05)						
S Level	0.76	0.265	0.96	8.17	3.727	10.104
B Level	0.76	0.265	0.96	8.17	3.727	10.104
(SXB) Interaction	NS	NS	NS	NS	NS	NS

NS=Non-significant

followed by 1.5 kg B ha^{-1} (18.71 q ha^{-1}) and 0.5 kg B ha^{-1} (18.23 q ha^{-1}) whereas the lowest seed yield (16.02 q ha^{-1}) was obtained from 0 kg B ha^{-1}. The highest seed yield (21.83 q ha^{-1}) was recorded with T_{11} ($S_{30}B_{1.0}$) and the lowest one (13.72 q ha^{-1}) with T_1 (0 kg B ha^{-1} and 0 kg S ha^{-1}). But interaction effect between sulphur and boron level was found to be non-significant. Stover yield of soybean significant influence with different sulphur level. The highest stover yield of 22.55 q ha^{-1} was recorded with 30 kg S ha^{-1} and the lowest one (16.29 q ha^{-1}) was found with 0 kg S ha^{-1}. Boron level showed significant influence on stover yield of soybean. The stover yield was more (21 .05q ha^{-1}) with 1.0 kg B ha^{-1} as compared to the stover yield of 20.88 and 20.06 q ha^{-1} which was associated with 1.5 and 0.5 kg B ha^{-1} respectively and lowest stover yield (17.94 q ha^{-1}) was obtained from 0 kg B ha^{-1}. The stover yield of soybean did not vary significantly by the interaction effect of sulphur and boron level.The sum total effect will be higher seed yield. The results confirm the findings of Kumar *et al.* (1996) and Sarkar *et al.* (2002). These finding were also supported by Halepyati (2001) and Singaravel *et al.* (2006). Results are in accordance with that of Singh *et al.* (2003), who documented that crop yields, in general, have been promoted by regular application of boron. Chowdhury *et al.* (2000) also reported that seed yield of cowpea increased significantly with the increase in boron application.

Table 3 : Effect of sulphur and boron on yield of soybean

Treatments	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})
T_1 - S_0B_0	13.72	15.57
T_2 - $S_0B_{0.5}$	13.77	15.98
T_3 - $S_0B_{1.0}$	14.52	16.96
T_4- $S_0B_{1.5}$	14.60	16.64
T_5 - $S_{15}B_0$	13.90	16.56
T_6 – $S_{15}B_{0.5}$	16.66	18.49
T_7 – $S_{15}B_{1.0}$	18.12	20.02
T_8 – $S_{15}B_{1.5}$	18.96	20.48
T_9 – $S_{30}B_0$	19.78	21.04
T_{10} – $S_{30}B_{0.5}$	21.75	22.66
T_{11} – $S_{30}B_{1.0}$	21.83	23.26
T_{12} – $S_{30}B_{1.5}$	20.81	23.25
T_{13} – $S_{45}B_0$	16.68	18.59
T_{14} – $S_{45}B_{0.5}$	20.73	23.10
T_{15} – $S_{45}B_{1.0}$	20.82	23.96
T_{16} – $S_{45}B_{1.5}$	20.47	23.15
S levels (kg ha^{-1})		
0	14.15	16.29
15	16.91	18.89
30	21.04	22.55
45	19.67	22.20
B levels (kg ha^{-1})		
0	16.02	17.94
0.5	18.23	20.06
1.0	18.82	21.05
1.5	18.71	20.88
S.E.±		
S Level	0.74	0.78
B Level	0.74	0.78
(SXB) Interaction	1.47	1.55
C.D. (P=0.05)		
S Level	2.13	2.24
B Level	2.13	2.24
(SXB) Interaction	NS	NS

NS=Non-significant

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REFERENCES

Anonymous (2013 a and b). Food and Agriculture Organization (FAO) of theUnited Nations.*www.faostat.org.*

Chand, L., Sharma, A.S. and Jat, S.C. (1997). Quality and uptake of nutrients in mustard as affected by foliar spray of urea and sulphur application. *Ann. Biol.,* Ludhiana, **13** :103-10.

Chowdhury, M.M.U., Ullah, M.H., Rahman, M.A. and Islam, M.S. (2000). Effect ofboron and nitrogen fertilization on cowpea growth, nodulation and grainyield in Rangamati, Bangladesh. *Legume Res. Arch.,* **23** : 9-14.

Ganeshamurthy, A.N. (1996). Critical plant S content and effect of sulphur application on grain and oil yield of rainfed soybean in vertic ustochrepts. *J. Indian Soc. Soil Sci.,* **44** : 290-294.

Gomez, K.A. and Gomez, A.A. (2003). *Statistical Procedure for Agricultural Research*. John Wiley and Sons, London, U.K. pp. 139-167 and 204-207.

Halepyati, A.S. (2001). Conjunctive use of organic and inorganic fertilizers in rabi/summer groundnut in UKP area. *Karnataka J. Agric. Sci.,* **14** (2): 454-455.

Kumar, A., Singh, K.P., Singh, R.P. and Sarkar, A.K. (1996). Response of groundnutto boron application in acid sedimentary soil. *J. Indian Society Soil Sci.,* **44** : 178-179.

Sarkar, S.K., Chowdhury, M.A.H. and Zakir, H.M. (2002). Sulphur and boronfertilization on yield quality and nutrient uptake by Bangladesh soybean. *J. Biol. Sci.,* **2** : 729-733.

Singaravel, R., Parasath, V. and Elayaraja, D. (2006). Effect of organics andmicronutrients on the growth, yield of groundnut in coastal soil. *Internaional J. agric. Sci.,* **2** (2): 401-402.

Singh, M.V., Patel, K.P. and Ramani, V.P. (2003). Crop responses to secondary andmicronutrients in swell-shrink soils. *Fertilizer News,* **48**(4):63-66.