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Influence of Sulphur and Boron on Yield Attributes and Yield of Soybean

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Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore, during *kharif* 2007 and 2008 to study the effect of sulphur and boron fertilization on yield attributes and yield of soybean. The experiment was laid out in a factorial combination of S and B following factorial randomized block design replicated thrice. There were 25 treatment combinations consisting of five rates of both S (0, 10, 20, 30 and 40 kg S ha^{-1}) and B (0, 0.5, 1.0, 2.0 and 4.0 Kg B ha^{-1}). The results of the experiments revealed that application of 30 kg *S* ha^{-1} recorded better yield attributes viz., branches plant^{-1}, pods plant^{-1}, seeds pod^{-1} and 100 seed weight and higher yield than the other treatments. Similarly, application of boron 1.0 kg ha^{-1} recorded better yield attributes and higher yield of grain and straw.

Key words: Soybean, Sulphur, Boron, Yield Attributes, Yield

The fertility status of soils has been declining continuously due to 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 (Jahiruddin *et al.,* 1995). Among the fertilizer elements, sulphur requirement of oilseed crops is quite high as compared to other crops (Das and Das, 1994). Oil seed crops respond to liberal application of sulphur. Sulphur 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 (Havlin *et al*., 1999). In general, about 87 % of soils are deficient in sulphur.

Non-judicious use of chemical fertilizers, intensive cultivation, higher cropping intensity and limited use of organic matter are the most probable reasons for S deficiency. Boron (B) deficiency is also reported in some soils and crops causing low yields of crops. Boron is involved in the synthesis of protein (Sauchelli, 1969) and oil (Malewar *et al,* 2001). Many research works have been done on the effect of N, P and K fertilizers on the yield of crops. But, a few works have been carried out on the effect of sulphur and boron on the yield of crops, although it has been experimentally proved in different parts of the country as well as in many parts of the world that sulphur and boron are very much essential to increase the production of soybean. With the above mentioned facts in mind, this study was undertaken to investigate the effect of S and B on yield attributes and yield of soybean.

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Materials and Methods

Field experiments were conducted at the millet breeding station, Tamil Nadu Agricultural University, Coimbatore, during *kharif* 2007 and 2008. The soil of the experimental site was sandy loam in texture having pH 7.8, 0.42 % organic matter, 194 kg ha^{-1} of available N (low), 11.6 kg ha^{-1} of available P (medium), 228 Kg ha^{-1} of available K (medium) 5.93 ppm of available S and 4.70 ppm of available B. The experiment was laid out in a factorial combination of S and B following factorial randomized block design replicated thrice. There were 25 treatment combinations consisting of five rates of both S (0, 10, 20, 30 and 40 kg S ha^{-1}) and B (0, 0.5, 1.0, 2.0 and 4.0 Kg B ha^{-1}). Sulphur as gypsum and boron as borax were applied basally as per the treatments and all other fertilizers were applied according to the fertilizer recommendation guide (20:80:40 kg NPK ha^{-1}) (Anonymous, 2004). Soybean variety JS 335 was used as the test crop. Seeds were sown @ 60 kg ha^{-1} in lines. Intercultural operations were done as and when necessary. Yield attributes, grain and straw yields were recorded. The data were analyzed statistically and significant differences among the treatment means were determined by least significant difference test for interpretation of results.

Results and Discussion

Yield components

All yield attributing characters viz., branches plant^{-1}, pods plant^{-1}, seeds pod^{-1} and 100 seed weight of soybean varied significantly with different sulphur levels (Table 1). All the yield components were the highest with the application of 30 kg S ha^{-1}. It is clear that yield attributing characters were greatly affected by sulphur application. The above results are in conformity with the results of Chaubey *et al*. (2000) who reported that number of primary branches, pods plant^{-1}, 100 kernel weight of groundnut were significantly increased by the application of sulphur. Dubey *et al.* (1997) also reported that sulphur enhanced the branches plant^{-1}, capsules plant^{-1}, seeds capsule^{-1} and 1000 grain weight of lentil. Chowdhury *et al.* (1995) reported that number of effective tillers hill^{-1} and 1000 grain weight of rice were increased by sulphur. Sulphur application also increased the pod length of soybean (Hemantarajan and Trivedi, 1997).

Table 1. Yield attributes and yield of soybean as influenced by sulphur and boron application

Treatment	Branches plant^{-1}		Pods plant^{-1}		Seeds pod^{-1}		Seed index		Grain yield (Kg ha^{-1})		Straw yield (Kg ha^{-1})	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
S level (kg ha^{-1})												
0	5.73	6.42	35.77	40.06	2.38	2.67	11.15	12.49	1127	1262	1859	2082
10	5.92	6.63	39.22	43.92	2.53	2.84	12.03	13.25	1184	1326	1954	2189
20	6.62	7.42	45.19	50.61	2.80	3.14	13.33	14.68	1304	1460	2151	2409
30	7.37	8.23	52.21	59.77	2.97	3.23	13.77	15.61	1467	1534	2237	2511
40	7.35	8.07	53.37	57.17	2.88	3.24	14.33	14.85	1336	1463	2207	2445
SEd	0.25	0.25	1.47	1.70	0.09	0.10	0.43	0.43	40	44	66	77
CD(p=0.05)	0.64	0.62	3.73	4.32	0.52	0.26	1.09	1.08	103	112	167	197
B level (kg ha^{-1})												
0	6.26	7.01	42.56	47.67	2.62	2.94	12.26	13.74	1225	1333	1983	2221
0.5	6.43	7.20	42.83	47.97	2.64	2.96	12.51	13.74	1246	1365	2034	2278
1.0	7.37	8.07	50.97	55.78	2.94	3.21	14.19	15.02	1404	1460	2290	2543
1.5	6.48	7.26	44.80	50.17	2.68	3.00	13.12	14.56	1287	1415	2071	2319
2.0	6.46	7.24	44.60	49.95	2.68	3.00	12.53	13.83	1255	1372	2031	2275
SEd	0.25	0.25	1.47	1.70	0.09	0.10	0.43	0.43	40	44	66	77
CD(p=0.05)	0.64	0.62	3.73	4.32	0.52	0.26	1.09	1.08	103	112	167	197

Different levels of boron also brought a significant variation in respect of yield components. Among the levels of boron, boron @ 1.0 kg ha^{-1} recorded the highest number of branches plant^{-1}, effective pods plant^{-1} and seeds plant^{-1}. Earlier works mark the evidence that application of boron influenced the yield components. Tripathy *et al.* (1999) conclusively suggested that application of boron increased pods plant^{-1}. Havlin *et al.* (1999) also reported that flowering and fruit development were restricted by a shortage of boron. The interaction between sulphur and boron levels was not significant.

Grain yield

Grain yield showed a significant variation for different sulphur levels (Table 1 and Fig 1 and 2). Among the sulphur levels, 30 kg S ha^{-1} recorded the highest grain yield. Higher grain yield in plots applied with sulphur 30kg ha^{-1} might be due to the cumulative favourable effect of the higher number of effective pods plant^{-1} and number of seed plant^{-1} due to better plant metabolism which in turn produced higher yield (Tiwari *et al.,* 1997). This result is in accordance with the findings of Chowdhury *et al.* (1995) who reported that S increased the grain yield of rice. Present result has shown that grain yield increased with S application up to 30 kg ha^{-1} and then

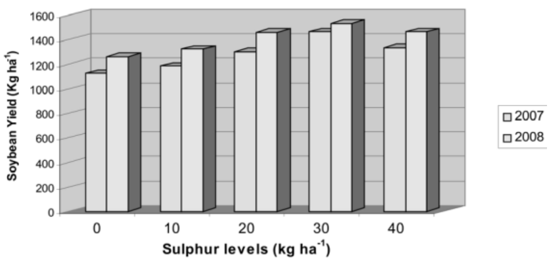

Fig 1. Effect of Sulphur levels on soybean yield

decreased. Tripathy *et al.* (1999) also stated that high rates of S slightly decreased the yield of gram.

Boron also showed a significant variation on grain yield. The grain yield was the highest when the crop received 1.0 kg B ha^{-1}. Results of this study are in concomitance with that of Chowdhury *et al.* (2000) who reported that seed yield increased significantly with each increment of boron. The highest grain yield was recorded with sulphur 30 kg ha^{-1} and boron 1.0 kg ha^{-1}, even though the interaction effect was not significant.

Straw yield

Different levels of sulphur on straw yield also showed the same trend as did the grain yield (Table 1).

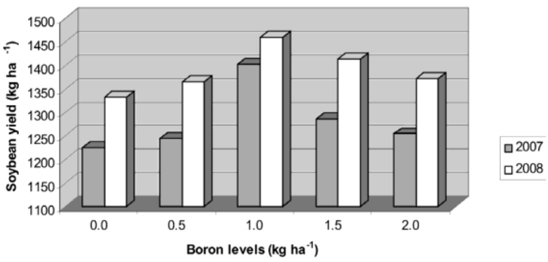

Fig 2. Effect of boron levels on soybean yield

Application of 30 kg S ha^{-1} recorded the highest straw yield and this might be due to the fact that S tends primarily to encourage above ground vegetative growth. The present finding agrees with the result obtained by Tomar *et al.* (1997) who observed that straw yields of mustard increased with increase in S rates. Results also have shown that straw yield was significantly influenced by boron application. Application of B @ 1.0 kg ha^{-1} recorded the highest straw yield. The present result is concordant with the findings of Bhuiyan *et al.* (1998) who reported higher straw yield of lentil due to boron application.

Conclusion

The results of the experiments revealed that among the different levels of sulphur, application of 30 kg *S* ha $^{-1}$ recorded better yield attributes and higher yield than the other treatments. Similarly, among the boron levels, application of boron 1.0 kg ha^{-1} recorded better yield attributes and higher yield than the other levels.

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