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Evaluation of Boron Levels and Organics on Soil Nutrients and Yield of Groundnut in Coastal Sandy Soil

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A pot experiment was carried out in the Department of Soil Science and Agricultural Chemistry, Annamalai University with groundnut var. VRI 2 during June - September 2006, to evaluate different levels of boron along with organics on the yield of groundnut and nutrient availability in coastal sandy soil. The experimental soil was sandy in texture, taxonomically classified as *Typic udipsaments* with pH-8.39; EC-1.61 dS m^{-1} and represented low status of organic carbon and B. The treatments studied were T_1-NPK; T_2- NPK + Borax @10kg ha^{-1}; T_3- NPK + Borax @ 15 kg ha^{-1}; T_4-NPK + Borax @ 20 kg ha^{-1} and T_5- NPK + Borax @ 25 kg ha^{-1}. All the treatments received a common organic addition of composted coirpith @ 12.5 t ha^{-1}. The experiment was arranged in a Completely Randomized Design (CRD) with four replications. The experimental results revealed that the application of NPK + Borax @ 15 kg ha^{-1} along with composted coirpith @12.5 t ha^{-1} was significant in increasing the nutrient availability, growth and yield of groundnut. The yield increase recorded with borax application @ 15 kg ha^{-1} along with CCP was 18.47 percentage of pod and 13.71 percentage of haulm as compared to control.

Key words: Coastal Sandy Soils, organics, boron, nutrient availability, yield, groundnut

The major production constraints in coastal sandy soils are mainly the low organic matter, poor nutrient retention and deficiency of nutrients. The light texture sandy soils are also well known for the deficiency of micronutrients especially boron. In groundnut production boron plays a vital role in promoting growth, quality of seeds and yield. It also arrests flower drop and plays a pivotal role in cell division in the process of nodule formation besides its involvement in carbohydrate and fat synthesis. Several earlier works have emphasized the need for application of these nutrients for increasing the growth, yield and quality of groundnut (Nayyar *et al.,* 1990; Sudarsan and Ramaswami, 1993). Hence the present study was attempted to evaluate boron requirement of groundnut in coastal sandy soil.

Materials and Methods

A pot experiment was carried out in the Department of Soil Science and Agricultural Chemistry, Annamalai University during June - September 2006, to evaluate different levels of boron along with organics on the growth, yield of groundnut and nutrient availability in coastal sandy soil. The following treatments were evaluated T_1- NPK alone; T_2- NPK + Borax @ 10 kg ha^{-1} + composted coirpith @ 12.5 t ha^{-1}; T_3- NPK + Borax @ 15 kg ha^{-1} + composted coirpith @ 12.5 t ha^{-1}; T_4- NPK + Borax @ 20 kg ha^{-1} + composted coirpith @ 12.5 t ha^{-1} and T_5- NPK + Borax @ 25 kg ha^{-1} + composted coirpith @ 12.5 t ha^{-1}. Treatments were replicated four times in a Completely Randomized Design (CRD). The test crop was groundnut var. VRI 2. The experimental soil was sandy with pH-8.39; EC-1.61dS $m^{-1}$and organic carbon- 0.27 per cent. The alkaline $KMnO_4$-N; Olsen- P and NH_4OAc- K, were in low, low and medium status, respectively. The soil had hot water extractable B as 0.07 mg kg^{-1}. A fertilizer dose of 22.5: 51: 81 NPK kg ha^{-1} were applied through urea, super phosphate and muriate of potash, respectively. Required quantities of Borax as per the treatment schedule were incorporated. The soil samples were collected at different critical stages of groundnut viz., flowering, peg formation and harvest and analyzed for available N, P, K, Zn and B using standard procedure of Jackson (1973). At harvest stage, pod and haulm yields were recorded.

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Results and Discussion

Growth and yield

The application of B significantly increased all the growth characters and yield of groundnut. (Table 1) In coastal sandy soil, groundnut responded to borax application upto 15 kg ha^{-1}. Application of borax @ 15, 20 and 25 kg ha^{-1} along with CCP @ 12.5 t ha^{-1} rated on par in significantly recording higher growth characters of groundnut. The highest plant height (58.79 cm) and dry matter production (86.05 g pot^{-1}) were recorded with T_5, 25 kg borax ha^{-1} along with CCP application. However, it was on par with treatment T_3 and T_4.

The increased growth parameters of groundnut with B application might be due to the effect of boron for proper development and differentiation of tissues particularly growing tips, phloem and xylem. These results are in conformity with the findings of Balusamy *et al.* (1996) and Kumar *et al.* (1996). Further more, betterment in growth characters of groundnut might be due to the combined application of NPK + organics in the presence of borax, which might have increased the plant dry matter production. The applied nutrients by their effect on metabolism of cell, promoted the meristematic activity of the crop and its better uptake would have resulted in increased dry matter accumulation. The result obtained in the present investigation is in agreement with the findings of Deb (1997).

Table 1. Effect of organics and boron on the growth characters of groundnut

Treatment	Plant height (cm)			Dry matter production (g pot^{-1})			Yield (g pot^{-1})	
	FS	PFS	HS	FS	PFS	HS	Pod	Haulm
T_1-Control (NPK)	18.92	29.84	44.69	33.46	49.81	75.41	36.65	51.76
T_2- NPK + B @ 10 kg ha^{-1}	23.85	36.48	53.55	38.41	54.02	81.27	39.20	55.02
T_3- NPK + B @ 15 kg ha^{-1}	27.76	40.85	58.79	41.51	58.12	86.05	43.42	58.86
T_4- NPK + B @ 20 kg ha^{-1}	29.07	42.06	60.84	42.62	59.43	87.17	43.51	59.98
T_5- NPK + B @ 25 kg ha^{-1}	29.17	42.73	61.18	43.72	60.35	87.28	43.78	60.92
SE_D	0.81	1.13	1.71	1.10	1.55	2.12	1.16	1.25
CD (p=0.05)	1.66	2.31	3.51	2.25	3.17	4.35	2.38	2.56

The profound influence of borax and organics in significantly improving the yield of groundnut in coastal sandy soil was clearly brought out in the present investigation. The groundnut yield increased with borax application upto a level of 15 kg ha^{-1}. The highest pod and haulm yield were recorded with T_5, B @ 25 kg ha^{-1} along with CCP application. However, it was on par with T_3, B @ 15 kg ha^{-1} along with CCP application. The treatment T_3 recorded a pod yield of 43.42 g pot^{-1} and haulm yield of 58.86 g pot^{-1} as compared to 36.65 and 51.76 g pot^{-1} of pod and haulm yield, respectively under control which represented 18.47 percentage of pod and 13.71 percentage of haulm yield as compared to control.

The combined application of NPK + organics in the presence of borax increased the yield of groundnut. Boron exerts its significant role in metabolism of nucleic acid, carbohydrate, protein and auxins. Efficient metabolism and translocation of carbohydrates from source to sink might have increased the seed yield. These results are in accordance with Murthy (2006) and Shinde *et al.* (1990). Further, addition of organics along with borax facilitated the release of nutrient ions from organic manures, which helped in maintaining the continuous availability of nutrients during entire life cycle of plant (Survase *et al.,* 1986).

Available major nutrients

The alkaline $KMnO_4$ -N in the soil was significantly influenced by the application of boron and composted coirpith. (Table 2) The highest amount of available nitrogen content at flowering (95.22 mg kg^{-1}), peg formation (88.42 mg kg^{-1}) and harvest stages (86.80 mg kg^{-1}) were recorded borax @ 25 kg ha^{-1} + CCP @ 12.5 t ha^{-1} (T_5). However, it was on par with the treatment T_3, borax @ 15 kg ha^{-1} + CCP @ 12.5 t ha^{-1} which registered 92.99, 86.82 and 84.64 mg kg^{-1} of alkaline $KMnO_4$-N, respectively, at the same critical stages of groundnut growth.

Table 2. Effect of organics and boron on the major nutrients availability (mg kg^{-1}) in soil

Treatment	Alkaline $KMnO_4$-N			Olsen-P			NH_4OAc-K		
	FS	PFS	HS	FS	PFS	HS	FS	PFS	HS
T_1-Control (NPK)	84.63	79.32	76.70	8.64	8.12	7.52	131.49	116.45	102.32
T_2- NPK + B @ 10 kg ha^{-1}	88.94	83.58	80.86	9.07	8.43	7.86	139.81	128.10	109.48
T_3- NPK + B @ 15 kg ha^{-1}	92.99	86.82	84.64	9.45	8.71	8.14	146.24	134.61	115.61
T_4- NPK + B @ 20 kg ha^{-1}	94.10	87.31	85.93	9.56	8.73	8.24	147.45	135.32	116.72
T_5- NPK + B @ 25 kg ha^{-1}	95.22	88.42	86.80	9.64	8.74	8.30	148.79	137.40	117.78
SE_D	1.89	1.37	1.58	0.15	0.12	0.10	3.08	2.58	2.49
CD (p=0.05)	3.87	2.81	3.24	0.30	0.25	0.21	6.32	5.28	5.10

The persistent and steady supply of N realized with mineralization of added organics (Ganeshappa, 2000). Coupled with increased N fixation with boron application (Sudarsan and Ramaswami, 1993) explains the reason for higher N availability.

The application of borax ranging from 15-25 kg ha^{-1} along with CCP @ 12.5 t ha^{-1} rated equally good in significantly increasing the Olsen-P content of the soil. The treatment T_3, borax @ 15 kg ha^{-1} + CCP application recorded a P content of 9.45, 8.71 and 8.14 mg kg^{-1} at FS, PFS and harvest stages, respectively.

The increased Olsen-P content due to addition of boron along with organics might be due to the role played by organics in dissolution of native phosphorus compounds to the active pool besides

Table 3. Effect of organics and boron on the micronutrients availability (mg kg^{-1}) in soil

Treatment	DTPA-Zinc			Hot water-Boron		
	FS	PFS	HS	FS	PFS	HS
T_1-Control (NPK)	2.10	1.54	0.93	0.075	0.074	0.070
T_2- NPK + B @ 10 kg ha^{1}	2.20	1.63	1.09	0.080	0.078	0.075
T_3- NPK + B @ 15 kg ha^{-1}	2.27	1.70	1.15	0.086	0.082	0.079
T_4- NPK + B @ 20 kg ha^{-1}	2.29	1.73	1.17	0.087	0.083	0.080
T_5- NPK + B @ 25 kg ha^{-1}	2.30	1.74	1.18	0.089	0.084	0.081
SE_D	0.03	0.02	0.02	0.001	0.001	0.001
CD (p-0.05)	0.06	0.05	0.05	0.003	0.002	0.002

mineralization as they contained appreciable content of phosphorus. These results are in agreement with Talashilkar and Chavan (1996).

N and P availability, the K availability was also significantly higher with the treatment NPK + borax @ 25 kg ha^{-1} along with CCP @ 12.5 t ha^{-1} which compared with borax @ 15 kg ha^{-1} along with NPK and organics (T_3).

The availability of K increased due to stimulatory effect of boron on K along with the favourable influence of organics helping in the mobilization and release of K from clay and organic complexes. The present findings are in accordance with the earlier reported as Seshadri Reddy (2005).

Available Micronutrients

DTPA-Zinc

The application of boron along with organic wastes increased the availability of DTPA-extractable zinc. (Table 3) The highest DTPA-zinc concentration was recorded with borax @ 25 kg ha^{-1} along with CCP application. However, it was on par with T_3, borax @ 15 kg ha^{-1} and showed the effect upto a level of 15 kg ha^{-1}. The above treatments T-$_5$ and T_3 recorded a DTPA-zinc content of 1.18 and 1.15 mg kg^{-1}, respectively, at harvest.

The increase in the level of B positively improved the Zn availability in post harvest soil. The increase Zn availability of soil might be due to the stimulatory effect of B on the release of Zn in soil. These findings are in line with earlier report of Tripathy *et al.* (1999).

Hot water-Boron

The influence of boron along with organics in significantly influencing the boron availability of the soil was well evidenced in the present study. Groundnut responded to borax application upto 15 kg ha^{-1} in coastal sandy soil. The application of boron @ 15, 20 and 25 kg ha^{-1} along with CCP @ 12.5 t ha^{-1} rated on par in significantly recording higher boron availability in the soil. The treatment T_3 NPK + borax @ 15 kg ha^{-1} + CCP recorded a B content of 0.086, 0.082 and 0.079 mg kg^{-1} at FS, PFS and harvest stage, respectively. In coarse textured soil, the low availability of B is mainly due to leaching. Organic waste applications in such soil along with B increases B retention in soil by forming complexes, such complexes becomes slowly available to plants and hence increase the recovery of added B (Mandal *et al.,* 1993).

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