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Soil Properties and Crop Yield under Boron Nutrition Management for Paddy crop in Coastal Karnataka, India

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A B S T R A C T

A field experiment was conducted during *kharif* of 2014 and 2015 at Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi district, Karnataka, to investigate the effect of Boron nutrition management on soil properties, soil available nutrients yield of paddy under different Boron nutrient management studies. The experiment was laid out in RCBD design with four replications and five treatments involving different levels of Boron applications in comparison to package of practice as control. After two years of experimentation, the study revealed that, significantly higher HWE-Boron was observed in treatment T5: T2+10 kg Borax, followed by the treatment T4: T2+7.5 kg Borax and T3: T2+5 kg Borax. Grain yield and straw yield was found significantly higher in the treatment which received boron nutrient when compared to control.

Introduction

In India rice is grown in 43.86 million ha, the production level is 104.80 million tones and the productivity is about 2390 kg/ha (Agricultural Statistics at a glance- 2015). It is grown under diverse soil and climatic conditions the productivity level of rice is low compared to the productivity levels of many countries in the world. Also about 90 % of the cultivated land belongs to Marginal, Small and Medium farmers which is another constrain in increasing the productivity of rice in the country. Rice is one of the most important food crops and feeds more than 60 per cent population of India. The area under rice crop was 30.81 million/ha in 1950-51 which has increased to 43.86 million hectares during 2014-15 which is nearly 142 per cent higher. The rice production has registered an appreciable increase from 20.58 million tonnes in 1950-51 to 104.86 million tonnes during 2014-15, which is nearly 5 times. The yield was 668 kg/ha in 1950-51 which has increased to 2390 kg/ha during 2014-15. Major share of rice production is in *Kharif* season (National food Security mission report 2016).

Boron is most soluble under acid conditions. It apparently occurs in acid soils in part as boric acid (H3BO3), which is readily available to plants. In quite acid sandy soils, soluble B fertilizers may be leached downward with comparable ease. In heavier soils, especially if they are not too acid, this rapid leaching does not occur. At higher pH B is less easily utilized by plants. This may be due to lime induced fixation of this element by clay and other minerals, since the Ca and Na borates are reasonably soluble. In any case over liming can and often does result in a deficiency of B. B is held in organic combinations from which it may be released for crop use. The content of this nutrient in the top soil is generally higher than that in the subsoil. This may in part account for the noticeably greater B deficiency in periods of dry weather. Apparently, during drought periods plant roots are forced to exploit only the lower soil horizons, where the B content is quite low. When the rains come, plant roots again can absorb B from the topsoil, when its concentration is highest.

Materials and Methods

A field experiment was conducted during *kharif* season of 2014 and 2015 at Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi district, Karnataka, the effect of Boron nutrition management on soil properties, soil available nutrients yield of paddy under different Boron nutrient management studies. The experimental site is situated between 74^0 45’ to 74^0 46' East longitude and 13^0 24' 45’’ to 13^0 25’ North latitude and an altitude of 25 meters above mean sea level. Soil type is sandy loam in texture and pH was acidic (5.20). The soil was medium in available nitrogen (348.70 kg ha-1), high in available phosphorus (88.57 kg ha-1) and medium in available potassium (74.43 kg ha-1). The organic carbon content was high (1.031 %) in range. MO-4 (Red rice) a popular medium duration variety was transplanted in July with a spacing of 20 cm X 10 cm. Experiment included five treatments consisted of T_1: 100% NPK (POP; N:P:K= 60:30:60 kgs/ha), T_2: T_1 + 2.5 kg Borax, T_3: T_2 + 5 kg Borax, T_4: T_2 + 7.5 kg Borax, T_5: T_2 + 10 kg Borax. Data on yield (biological and economical) was recorded from individual plots at harvest and converted to kg/ha. Composite soil sample were used to assess soil nutrient status. Standard statistical methods were used for comparing the treatment means.

Results and Discussion

The results obtained from two years of experiment is pooled and anlysed using standard statistical tools. Results pertaining to the effect of Boron nutrition management soil properties and soil available nutrients is presented in Table 1 and 2. Results shown that there is no significant difference was observed among the treatments in case of in pH, electrical conductivity, organic carbon, soil available Phosphorus, potassium, exchangeable calcium, Magnesium and available Sulfur.

It is quite evident from the result that boron nutrient management showed significant results. A significant higher hot water extractable Boron was obtained in treatment T5: T2 + 10 kg Borax (0.440 ppm) and T4: T2 + 7.5 kg Borax (0.425 ppm), followed by T3: T2 + 5 kg Borax(0.408 ppm). Similar observations were resulted by Dolui and Sarkar (2001) Narendra babu., (2011) Ranjit (2005) Mukhopadhyay and Das (2001) and Sarkar *et al.*,(2008).

Table.1 Soil properties of the experimental site (2015)

Treatments Details		pH	EC	OC	Av. P	Av. K	Ex. Ca	Ex. Mg	Av. S	HWE-B
			dSm^{-1}	%	Kg/ha	Kg/ha	C.mol(P^+) kg^{-1} soil		kg/ha	(ppm)
	Initial	5.20	0.056	1.031	88.57	74.43	0.806	0.452	17.24	0.381
T_1	100% NPK (POP) (N:P:K= 60:30:60 kgs/ha)	5.11	0.058	1.123	93.91	67.18	0.795	0.308	16.87	0.361
T_2	T_1 + 2.5 kg Borax	5.39	0.052	1.077	93.81	65.78	0.822	0.402	18.83	0.403
T_3	T_2 + 5.0 kg Borax	5.15	0.063	1.060	94.27	65.07	0.866	0.385	17.66	0.453
T_4	T_2 + 7.5 kg Borax	5.23	0.053	1.031	90.68	64.57	0.843	0.367	18.01	0.473
T_5	T_2 + 10.0 kg Borax	5.23	0.067	1.017	94.69	64.97	0.837	0.379	17.05	0.488
	SEM±	---	---	---	---	---	---	---	---	0.011
	CV	---	---	---	---	---	---	---	---	4.507
	CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	0.032

Table.2 Soil properties of the experimental site (2016)

Treatments Details		pH	EC	OC	Av. P	Av. K	Ex. Ca	Ex. Mg	Av. S	HWE-B
			dSm^{-1}	%	Kg/ha	Kg/ha	C.mol(P^+) kg^{-1} soil		kg/ha	(ppm)
	Initial	5.22	0.068	1.021	63.49	63.25	0.782	0.346	15.43	0.296
T_1	100% NPK (POP) (N:P:K= 60:30:60 kgs/ha)	5.28	0.081	1.019	64.53	58.77	0.815	0.350	16.69	0.304
T_2	T_1 + 2.5 kg Borax	5.16	0.058	0.994	66.06	60.00	0.743	0.417	17.32	0.334
T_3	T_2 + 5.0 kg Borax	5.28	0.052	1.011	65.53	62.05	0.847	0.315	16.73	0.363
T_4	T_2 + 7.5 kg Borax	5.23	0.049	1.045	68.76	61.78	0.760	0.339	17.05	0.376
T_5	T_2 + 10.0 kg Borax	5.16	0.054	1.084	67.20	61.82	0.843	0.317	17.62	0.392
	SEM±	---	---	---	---	---	---	---	---	2.128
	CV	---	---	---	---	---	---	---	---	6.385
	CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	0.037

Table.3 Effect of boron nutrition on grain and straw yield (kgs/ha) of paddy

	Treatments	Grain Yield		Pooled	Straw yield		Pooled
		2015	2016		2015	2016	
T_1	100% NPK (POP; N:P:K= 60:30:60 kgs/ha)	5898	5800	5849	7055	6875	6956
T_2	T_1 + 2.50 kg borax soil application	6395	6263	6329	7128	7368	7248
T_3	T_2 + 5.00 kg borax soil application	6528	6418	6473	7498	7360	7429
T_4	T_2 + 7.50 kg borax soil application	6600	6525	6562.5	7288	7445	7366.5
T_5	T_2 + 10.00 kg borax soil application	6460	6537	6498.5	7530	7498	7514
	SEm±	79.449	92.324	88.447	----	----	----
	CV	2.409	2.870	2.451	----	-----	----
	CD (0.05)	235.965	279.743	261.74	NS	NS	NS

Results pertaining to the Boron nutrition management on grain and straw yield of paddy is presented in Table 3. After two years of experiment, the data obtained on grain and straw yield is pooled and analyzed statistically. Result shows that the application of lime and secondary nutrients along with recommended dose of nutrients had very good impact to improve the soil available nutrients that resulted in higher grain yield contrastingly showed non significant difference in case of straw yield. Significantly higher grain yield as obtained in the treatment T4: T2 + 7.5 kg Borax (6562.5 kg ha-1), T5 : T2 + 10 kg Borax (6498.5 kg ha-1) and T3: T2 + 5 kg Borax (6473 kg ha-1) followed by T2: T1+2.5 kg Borax (6329 kg ha-1) Similar observations were resulted by Saleem *et al.*,(2011) Dharmendra (2012) Hossain *et al.*, (2011) Shimpei *et al.*, (2011) and Sheelarani 2013.

From two years of investigation reveals that application of recommended dose of fertilizer along with borax at 7.5 kg ha^{-1} and 10 kg ha^{-1} recorded significantly higher HWE-Boron and also improved soil available nutrients over other treatments. In any case over liming can and often does result in a deficiency of B This may in part account for the noticeably greater B deficiency in periods of dry weather. Apparently, during drought periods plant roots are forced to exploit only the lower soil horizons, where the B content is quite low. When the rains come, plant roots again can absorb B from the topsoil, when its concentration is highest. Which resulted in higher nutrient uptake by the crop, thus make favourable influence of soil available nutrients. Which ultimately influenced the significant increase in HWE-Boron and grain yield.

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