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Effect of Gypsum and Borax Application on Yield, Nutrient Content and Uptake in Maize under Different Nutrient Management Practices

Arunkumar B. R.[1*] and N. Srinivasa[2]

Department of Soil science and Agricultural chemistry, College of Agriculture, V C Farm, Mandya, University of Agricultural Sciences, GKVK, Bengaluru-560 065, Karnataka, India

*Corresponding Author E-mail: arunybr011@gmail.com

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ABSTRACT

Field experiment was conducted at College of Agriculture, V. C. Farm, Mandya during Kharif, 2014 on sandy loam soil to find out the performance of maize to gypsum and boron under different nutrient management practices. The experiment was laid out in split plot design with three main treatments viz. package of practices, UAS, Bengaluru (M_1), STCR dose for targeted yield of 90 q ha^{-1} (M_2) and STCR dose for targeted yield of 110 q ha^{-1} (M_3) and six sub treatments viz. control (S_1), 200 kg gypsum ha^{-1}(S_2), 2.5 kg borax ha^{-1}(S_3), 5 kg borax ha^{-1}(S_4), 200 kg gypsum + 2.5 kg borax ha^{-1} (S_5) and 200 kg gypsum + 5 kg borax ha^{-1}(S_6). Among different nutrient management practices, M_3 recorded significantly higher grain yield (93.0 q ha^{-1}), stover yield (184.25 q ha^{-1}), yield attributing parameters and higher total nutrient content and uptake compared to M_1 and was found to be on par with M_2. Two per cent deviation (88.78 q ha^{-1}) was observed in M_2 when compared M_3. Among gypsum and borax treatments, S_4 recorded significantly higher grain yield (89.86 q ha^{-1}), stover yield (160.78 q ha^{-1}), yield attributing parameters and higher nutrient content and uptake over S_1 and S_2 and was on par with S_3, S_5 and S_6.

Key words: *boron, gypsum, Maize, STCR, Targeted yield, Nutrient uptake.*

INTRODUCTION

Maize (*Zea mays* L.) is one of the fourth important cereal crops next to rice, wheat and sorghum in the India and third important cereal crop in the world next to wheat and rice. It is known as "Queen of cereals" due to its great importance in human diet. Maize is cultivated in all seasons viz., *kharif*, *rabi* and summer with production 23.93 m t from 9.4 m ha area with productivity of 2567 kg ha^{-1}[, 2]. The productivity of maize is largely dependent on nutrient management and soil fertility status. Proper nutrient management is an important aspect in its production management system. Applying the required quantities of nutrient at all stages of growth and understanding the soil's ability to supply those nutrients is critical in profitable crop production.

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The yield potential of our present maize verities and hybrids is high enough but it has not been explored fully due to some production constraints like indeterminate and imbalanced use of primary nutrients supplying fertilizers resulted in multiple nutrient deficiency particularly in the irrigated areas, that's affects the physico-chemical properties of soil and finally crop yield is reduced.

Calcium and boron play a pivotal role in increasing the yield of cereals. Calcium is a multifunctional nutrient in physiology of crop plants which helps in growth and development of plants and boron is an essential micronutrient required for better pollination, seed setting, growth and development of higher plants. Combined application of Gypsum and Boron along with NPK is recommended in all types of soils in order to achieve higher yield. Kanwal[8] reported that application of calcium antagonised boron concentration in shoots of maize cultivars, Ca/B ratio is important in growth, nutrient uptake and yield of maize. Keeping in view the above facts, the present study was undertaken to determine the effect of combined application of Gypsum and Boron on yield, nutrient content of maize and post harvest soil nutrient content.

MATERIAL AND METHODS

A experiment was conducted during *kharif* 2014 on sandy loam soil to find out the effect of gypsum and boron application on growth and yield parameters of maize crop under different nutrient management practices. at college of agriculture, V. C. Farm, Mandya district situated in the southern dry zone (Zone-6) of Karnataka with 11° 30' to 13° 05' North latitude and 76° 05' to 77° 45' East longitude at an altitude of 695 meters above mean sea level initial soil sampling was done before experiment laid down and the soil of the experiment site was sandy loam in texture, neutral in soil reaction, low in organic carbon and available nitrogen, high in available phosphorus, medium in available potassium, Exchangeable calcium and available Boron. The characteristic of experimental soil is given in the **Table 1.** The experiment was laid out in split plot design with three main treatments *viz.* package of practices UAS(B) (M_1), STCR dose for targeted yield of 90 q ha^{-1} (M_2) and STCR dose for targeted yield of 110 q ha^{-1} (M_3) and six sub treatments *viz*. control (S_1), 200 kg gypsum ha^{-1} (S_2), 2.5 kg borax ha^{-1} (S_3), 5 kg borax ha^{-1} (S_4), 200 kg gypsum + 2.5 kg borax ha^{-1} (S_5) and 200 kg gypsum + 5 kg borax ha^{-1} (S_6).

The quantity of fertilizer required for each treatment was worked out by three approaches such as package of practice, UAS, Bengaluru-Recommended dose of fertilizer, STCR- targeted yield 90 q ha^{-1} and STCR- targeted yield 110 q ha^{-1}. Calculated quantity of FYM recommended in package of practice 10 t ha^{-1} were applied 15 days before sowing of maize crop as per the treatment details. Nutrients nitrogen, phosphorus, potassium, Calcium and Boron supplied in the form of urea, DAP, MOP, gypsum and borax. 50 % nitrogen, entire quantity of phosphorus, potassium, calcium and boron was supplied at the time of sowing as a basal dose to each plot and remaining 50 % of nitrogen was applied at 30 days after sowing as indicated in the treatments details.

RESULTS AND DISCUSSION

Yield attributes of maize

The increase in grain yield due to nutrient management practices and different combination of gypsum and borax application in sub plot treatments could be attributed to proportionate increase in yield parameters such as cob length, number of rows per cob, number of grains per cob and test weight (**Table 2**)

Among the different nutrient management practices STCR dose recommended for yield target of 110 q ha^{-1} (M_3) recorded higher cob length, number of rows per cob, number of grains per cob and test weight 18.001 cm, 16.96, 540.77 and 32.22 g respectively compare with STCR dose recommended for yield target of 90 q ha^{-1} (M_2) and package of practice (M_1), resulting in higher grain yield. These results are in conformity with Shivashankar and Sudhakar Babu[14].

In sub treatments S_5 recorded higher cob length of 17.17 cm, whereas S_4 recorded more number of rows per cob (17.14), number of grains per cob (573.06) and test weight of 31.87 g, ultimately resulting in higher grain yield in sub treatment S_4. Application of borax individually helped in increasing the above yield parameters. The combination of borax with gypsum has not helped the cause and it could be due to interaction effect of calcium and boron. Tariq and Mott[17] and Kanwal *et al.*[8] have reported that application of excess calcium antagonise the boron concentration in shoots and suggested to consider Ca/B ratio for optimization of yields. Sarkaut *et al.*[13] and Muhammad[11] have reported that application of boron significantly increased the cob length, number of rows per cob, grains per cob and test weight. The boron content of experimental soil was 0.4 ppm which is deficient. Application of borax at 5 kg ha^{-1} has resulted in good response of yield parameters in maize.

Grain, stover yield (q ha^{-1}) and harvest index of maize

The data on grain yield (q ha^{-1}), stover yield (q ha^{-1}) and harvest index of maize as influenced by different treatments under the study are presented in **Table 2**.

Among main treatments, M_3 (110 q ha^{-1} target) targeted yield was not achieved; it fell short by nearly 15 %. However, it recorded significantly higher maize grain and stover yield (93.00 and 184.25 q ha^{-1}) over M_1 (66.69 and 115.82 q ha^{-1}), respectively. In M_2 targeted yield was achieved. This was on par with M_3 and it was significantly higher than that observed in M_1 (66.69 q ha^{-1}) and The harvest index ranged between 0.37 with package of practice to 0.34 with STCR approach for targeted yield 110 q ha^{-1}. This could be attributed due to luxuriant growth in M_3 plots resulting in higher stover yield and higher stover to grain ratio, which has finally resulted in lesser conversion rate from source to sink. This could be also the reason for lower harvest index in M_3.This was evidenced through findings of Jayaprakash *et al.*[7].

Significantly higher grain yield was recorded in S_4 (89.86 q ha^{-1}) treatment which received borax at 5 kg $ha^{-1}$and it was on par with S_3 (87.34 q ha^{-1}) and lower grain yield was recorded in S_1 (73.01 q ha^{-1}). However, significantly higher stover yield of 168.61 q ha^{-1} was recorded inS_5. Lower stover yield was in S_1 (129.56 q ha^{-1}) compared to S_2, S_3 and S_4 treatments and sub treatments, significantly higher harvest index was recorded with S_1, S_3 and S_4 (0.36) and significantly lower harvest index was recorded with S_5 (0.33). This could again be due to high dry matter in S_5 due to high stover yield but lesser conversion rate from source to sink. Muhammad[11]and Sarkaut *et al.*[13] have reported that application of boron significantly increased the yield of maize due to increase in pollination and seed setting.

Interaction due to different nutrient management practices with application of gypsum and boron did not show any significant effect on grain and stover yield and harvest index of maize crop.

Nutrient content in different parts of maize crop

NPK Content in leaf, grains and stover:

The concentration of nitrogen in leaf at tasseling and at harvest in grain and stover **(Table 3)** was significantly higher in treatments where fertilizer was applied based on STCR basis compared to package of practices. The concentration of N in grain was higher (1.27%) as compared to stover (0.60%) which may be due to the fact that N is a constituent of protein and essential for seed formation. Similar findings have been reported by Feroze and Abdul (1999). The phosphorus concentration in leaf (0.53%) and at harvest in grain (0.45%) and stover (0.28%) was highest in treatment M_3 (STCR targeted yield of 110 q ha^{-1}) compared to package of practices. It is due to application of higher dose of phosphate fertilizer application on STCR basis in M_3 and maize is nutrient responsive crop. Similar findings were reported by Mehta *et al.* (2005) and Arya and Singh[3], that higher application of fertilizers resulted in higher concentration and uptake of P nutrient in maize. The K concentration in leaf (1.77%) and at harvest in grain (0.55%) and stover (1.23%) was highest in treatment M_3 (STCR targeted yield level of 110 q ha^{-1}) compared to package of practices. Similar trend was observed in potassium uptake by maize crop, with higher potassium uptake recorded in M_3 treatment, due to application of higher potassium fertilizer dose on STCR basis for targeted yield of 110 q ha^{-1}. Further, the nutrient losses are very less in potassium besides maize being the explorative crop. The continuous availability of potassium and higher efficiency resulted in more uptake of potassium as compared to recommended doses. Similar results were reported earlier by Shivashankar and Shudhakar Babu[14] and Singh *et al.*[15].

Among sub plots highest potassium concentration in grain was observed in treatment S_4 and S_6, respectively. Higher dry matter accumulation in leaves and stem was observed in present study and this could be the reason for higher potassium concentration in S_6.

Ca and B Content in leaf, grains and stover:
The main treatments observed no significant difference in content of calcium and boron nutrients due to fertilizer application. But uptake of Ca and B in grain and stover was highest in STCR dose based target yield plots. The higher uptake of Ca and B due to application of nutrients based on STCR approach may attribute to improvement in growth and yield, which helped in higher Ca and B uptake.

Among sub treatments the results revealed higher Ca concentration in leaf (0.44) at tasseling stage and at harvest in grain (0.43) and stover (0.60) was observed in S_6. This may be due to application of Ca in treatment S_6 through gypsum. Ca uptake in grain and stover was highest in S_5 treatment, (**Table 4**). This trend was observed in treatments where application of gypsum and borax was in combination. This could be due to application of boron because boron has synergistic effect on Ca uptake by maize crop[1]. Boron concentration among subplot treatments in leaf at tasseling stage and at harvest in grain and stover was higher in S_4 treatment and it was on par with other treatments except S_1 and S_2 where borax was applied alone compared to combined application of gypsum and borax. In present study boron content was numerically lesser in treatments where gypsum and borax was applied in combination compared to B alone treated plots. This could be due to higher calcium application to soil through gypsum may reduced B content in maize plant. Kanwal *et al.*[8] have reported that application of excess calcium reduces the boron concentration in shoots and suggested to consider Ca/B ratio for optimization of yields.

Uptake of nutrients by grain and stover of maize

The data on the uptake of nutrients by irrigated maize at harvest as influenced by application of gypsum and boron under different nutrient management practices are presented in **Tables 5**.

NPK uptake by maize crop

NPK uptake by grain

Highest NPK uptake by grain (118.53, 42.06 & 51.35 kg ha^{-1} respectively) was recorded in the treatment (M_3) which received STCR targeted yield levels of 110 q ha^{-1} and it was on par with the application of STCR targeted yield levels of 90 q ha^{-1} M_2 (112.12, 36.45 & 46.69 kg ha^{-1} respectively). However, lowest NPK uptake by grains was noticed in the UAS, Bengaluru, package practice, M_1 (65.67, 19.20 & 26.15 kg ha^{-1} respectively). There was significant influence of gypsum and borax application on NPK uptake by grain and S_4 recorded highest uptake (111.14, 39.19 & 49.49 kg ha^{-1} respectively) when compared to S_1, S_2, S_5 and S_6. However, interaction effect between main and sub treatments had no significant influence on N uptake by grain.

NPK uptake by stover

Significantly higher (111.07, 51.01 & 57.77 kg ha^{-1} respectively) NPK uptake was recorded in the treatment M_3. Lower uptake of nitrogen by stover was recorded in the recommended dose of fertilizer M_1 (56.62, 22.29 & 34.34 kg ha^{-1} respectively). Among the sub treatments S_5 (200 kg of gypsum and 5 kg of borax ha^{-1}) recorded significantly higher N & P uptake (100.07 & 45.78 kg ha^{-1} respectively) in stover, but highest K uptake was reported in S_4 treatment and it was on par with S_5 treatment.

Lowest NPK uptake (66.22, 25.75 & 37.21 kg ha^{-1} respectively) was noticed in S_1 (control) treatment. There was no significant difference of nitrogen uptake in stover due to main and sub treatments interaction.

The enhanced values of yield attributing characters witnessed the tendency of nitrogen in accelerating growth, photosynthetic activity and translocation efficiency which might have contributed for higher nutrient uptake. This was reported earlier by Omraj *et al.*[12] and significantly higher uptake of NPK by grain and stover was observed in S_4 and S_5 treatments, respectively. However, the total uptake by maize was significantly higher in S_4 treatment. The higher uptake of nutrients due to application of gypsum and boron may be attributed to improvement in growth. This helped in higher nutrient uptake. Hythum and Nasser[6] and Soomro *et al.*[16] have reported higher grain and stover dry matter accumulation due to application of boron.

Calcium uptake by maize crop

Calcium uptake by grain and stover of maize differed significantly due to different nutrient management practices (**Table 6**).

Calcium uptake of grain and stover was 21.45 & 56.71kg ha^{-1} respectively in (M_1) UAS, Bengaluru, package of practice. It was significantly higher in STCR based treatment M_3 (31.42 and 92.87 kg ha^{-1}, respectively), and M_2 (30.29 and 82.87 kg ha^{-1}, respectively) which were statistically on par with each other. Highest maize grain calcium uptake was recorded in S_6 (35.56 kg ha^{-1}) compared to S_2, S_4, S_3 and S_1 (30.29, 25.87, 22.84 and 17.07 kg ha^{-1}, respectively) and highest stover calcium uptake by S_5 treatment. Calcium uptake did not differ significantly due to interaction of main and sub plot treatments. This could be due to application of boron because boron has synergistic effect on Ca uptake by maize crop. Adem *et al.*[1] have reported that increased levels of boron application increased shoot and leaf Ca concentration. These are in conformity with the results of Kanwal *et al.*[8].

Boron uptake by maize crop

Among main plot treatments boron uptake was higher in treatments where fertilizers was applied based on STCR targeted yield (M_3 and M_2). However, the total B uptake by maize was significantly higher in M_3 treatment, the higher uptake of B due to application of fertilizers based on STCR target yield may be attributed to improvement in growth and yield of maize, which helps in higher B uptake. Among subplot treatments significantly higher B uptake by grain and stover was observed in borax treated plots (S_4 and S_3). However, higher total B uptake by maize was significantly higher in S_4 treatment. The higher uptake of B due to application of borax may attribute to improvement in growth and yield of maize, which helps in higher B uptake. Kanwal *et al.*[8] have reported that application of excess calcium reduces the boron concentration in shoots and suggested to consider Ca/B ratio for optimization of yields. Similar findings were reported by Tariq and Mott[17].

Table 1: Initial soil properties of soil at experimental site

Sl. No	Properties/ Parameter	Value
1	pH 2.5	7.4
2	EC 2.5 (dSm^{-1})	0.23
3	OC (g kg^{-1})	4.5
4	Avail. N (kg ha^{-1})	277
5	Avail. P_2O_5 (kg ha^{-1})	61
6	Avail. K_2O (kg ha^{-1})	148
7	Exch. Ca ($cmolkg^{-1}$)	3.4
8	Hot water soluble boron (mg kg^{-1}).	0.4

Table 2: Cob length, number of rows per cob, number of grains per cob, test weight, harvest index, grain and stover yield of maize as influenced by application of gypsum and borax under different nutrient management practices

Treatments		Cob length (cm)	Number of rows per cob	Number of grains per cob	Test weight (g)	Harvest index	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
M_1		15.12	15.02	433.88	26.99	0.37	66.69	115.82
M_2		16.46	16.63	526.96	31.22	0.35	88.78	164.14
M_3		18.01	16.96	540.77	32.22	0.34	93.00	184.25
S.Em±		0.28	0.35	18.17	0.97	0.01	0.89	1.99
CD(p=0.05)		1.09	1.38	71.35	3.80	0.01	6.22	7.82
S_1		15.73	14.83	408.89	28.24	0.36	73.01	129.56
S_2		15.83	15.37	456.18	28.96	0.35	80.95	149.64
S_3		16.78	16.67	535.79	31.31	0.36	87.34	154.69
S_4		16.85	17.14	573.06	31.87	0.36	89.86	160.78
S_5		17.17	16.23	495.66	30.21	0.33	82.23	168.61
S_6		16.82	16.97	533.65	30.27	0.34	81.94	165.14
S.Em±		0.72	0.46	13.88	0.77	0.01	1.05	1.95
CD(p=0.05)		NS	1.33	40.10	2.33	0.02	7.30	5.64
Interaction M X S	**S.Em±**	0.421	0.81	85.26	4.72	0.04	1.89	11.89
	CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 3: NPK content in different plant parts of maize as influenced by application of gypsum and borax under different nutrient management practice

Treatments		N (%)			P (%)			K (%)		
		Tasseling stage (Leaf, 45DAS)	Harvest		Tasseling stage (Leaf, 45DAS)	Harvest		Tasseling stage (Leaf, 45DAS)	Harvest	
			Grain	Stover		Grain	Stover		Grain	Stover
M_1		1.44	0.98	0.51	0.32	0.29	0.19	1.33	0.39	0.62
M_2		2.26	1.26	0.57	0.43	0.41	0.26	1.56	0.52	1.18
M_3		2.29	1.27	0.60	0.53	0.45	0.28	1.77	0.55	1.23
S.Em±		0.018	0.025	0.008	0.006	0.016	0.009	0.021	0.010	0.011
CD (p=0.05)		0.070	0.10	0.03	0.02	0.06	0.03	0.08	0.040	0.040
S_1		1.95	1.10	0.50	0.40	0.34	0.21	1.50	0.45	0.90
S_2		1.99	1.14	0.55	0.41	0.36	0.23	1.52	0.45	0.93
S_3		2.03	1.20	0.56	0.42	0.40	0.24	1.56	0.52	1.01
S_4		2.04	1.23	0.58	0.43	0.43	0.24	1.56	0.54	1.05
S_5		2.08	1.17	0.59	0.46	0.37	0.26	1.60	0.48	1.07
S_6		2.09	1.19	0.59	0.45	0.38	0.25	1.58	0.49	1.09
S.Em±		0.034	0.030	0.026	0.016	0.019	0.012	0.032	0.018	0.025
CD (p=0.05)		NS	NS	NS	NS	NS	NS	NS	0.052	0.07
Interaction M X S	**S.Em±**	0.21	0.18	0.16	0.09	0.11	0.07	0.19	0.11	0.15
	CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

*DAS: Days after sowing

Table 4: Calcium and boron content in different plant parts of maize as influenced by application of gypsum and borax under different nutrient management practice

Treatments		Ca (%)			B (mg kg^{-1})		
		Tasseling stage (Leaf, 45DAS)	Harvest		Tasseling stage (Leaf, 45DAS)	Harvest	
			Grain	Stover		Grain	Stover
M_1		0.30	0.32	0.48	16.63	16.33	4.44
M_2		0.31	0.34	0.50	16.84	16.38	4.60
M_3		0.32	0.34	0.50	16.93	16.39	4.63
S.Em±		0.012	0.006	0.01	0.37	0.21	0.24
CD (p=0.05)		NS	NS	NS	NS	NS	NS
S_1		0.20	0.23	0.35	10.39	9.41	3.13
S_2		0.38	0.37	0.56	10.63	9.29	3.36
S_3		0.21	0.26	0.40	19.90	20.05	5.89
S_4		0.20	0.29	0.41	20.63	20.49	6.40
S_5		0.43	0.42	0.61	19.26	19.08	4.41
S_6		0.44	0.43	0.60	19.99	19.87	4.13
S.Em±		0.012	0.009	0.014	0.63	0.53	0.30
CD (p=0.05)		0.03	0.03	0.04	1.83	1.55	0.87
Interaction M X S	**S.Em±**	0.07	0.05	0.09	3.81	3.23	1.83
	CD (p=0.05)	NS	NS	NS	NS	NS	NS

*DAS: Days after sowing

Table 5: Uptake of NPK by maize as influenced by application of gypsum and borax under different nutrient management practices

Treatments		Nitrogen			Phosphorus			Potassium		
		Grain (kg ha^{-1})	Stover (kg ha^{-1})	Total (kg ha^{-1})	Grain (kg ha^{-1})	Stover (kg ha^{-1})	Total (kg ha^{-1})	Grain (kg ha^{-1})	Stover (kg ha^{-1})	Total (kg ha^{-1})
M_1		65.67	56.62	125.29	19.20	22.29	41.49	26.15	34.34	60.48
M_2		112.12	94.38	206.50	36.45	43.36	78.81	46.69	51.05	97.74
M_3		118.53	111.07	229.60	42.06	51.01	93.08	51.35	57.77	109.12
S.Em±		2.93	0.82	3.12	1.42	1.76	3.03	0.86	1.37	1.92
CD (p=0.05)		11.52	3.20	12.24	5.58	6.90	11.88	3.36	5.40	7.54
S_1		82.05	66.22	148.27	25.75	28.09	53.84	33.19	37.21	70.40
S_2		95.04	83.96	179.00	30.20	35.43	65.63	37.32	45.52	82.83
S_3		105.56	87.94	193.50	35.95	38.40	74.34	46.18	49.32	95.50
S_4		111.14	93.96	205.11	39.19	40.53	79.72	49.49	52.35	101.84
S_5		98.83	100.07	198.90	31.65	45.78	77.43	40.50	51.09	91.59
S_6		100.01	97.99	198.00	32.67	43.10	75.78	41.70	50.81	92.50
S.Em±		2.92	4.60	5.72	1.47	2.21	2.80	1.52	2.16	3.04
CD (p=0.05)		8.44	13.29	16.51	4.25	6.39	8.09	4.39	6.25	8.79
Interaction M X S	**S.Em±**	17.78	27.62	34.43	8.93	13.39	17.08	9.16	13.05	18.36
	CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6: Uptake of calcium and boron by maize as influenced by application of gypsum and borax under different nutrient management practices

Treatments		Calcium			Boron		
		Grain(kg ha^{-1})	Stover(kg ha^{-1})	Total (kg ha^{-1})	Grain(g ha^{-1})	Stover(g ha^{-1})	Total(g ha^{-1})
M_1		21.45	56.71	78.16	1117.52	519.16	1636.68
M_2		30.29	82.87	113.32	1474.69	764.49	2239.18
M_3		31.42	92.87	124.45	1539.25	861.29	2400.53
S.Em±		0.64	0.90	0.35	21.41	52.17	60.22
CD (p=0.05)		2.52	3.55	1.39	84.08	204.84	236.43
S_1		17.07	45.42	62.49	686.87	407.66	1094.45
S_2		30.29	84.33	114.62	758.84	504.50	1263.35
S_3		22.84	61.56	84.40	1748.55	918.39	2666.94
S_4		25.87	70.91	96.79	1837.30	1030.16	2867.46
S_5		34.68	103.77	138.45	1580.07	743.06	2323.13
S_6		35.56	98.91	135.13	1651.29	686.11	2337.39
S.Em±		0.67	2.55	2.63	47.22	48.72	65.04
CD (p=0.05)		1.94	7.35	7.58	136.39	140.72	187.85
Interaction M X S	**S.Em±**	4.08	15.30	15.76	284.16	296.94	394.87
	CD (p=0.05)	NS	NS	NS	NS	NS	NS

CONCLUSION

Combined application of gypsum and boron may have antagonistic effect on yield and boron uptake of maize and the same trend has been reflected in the present investigation. Further calcium and boron ratio should worked out for optimization of maize yield and finally it can be concluded that application of gypsum alone and in combination with borax did not contribute to significant increase in yield, nutrient content and nutrient uptake of maize crop. Where as borax tried individually at two levels (2.5 and 5 kg ha^{-1}) along with different nutrient management practises (STCR targeted yield equation) attributed to significant increase in grain yield, nutrient content and nutrient uptake of maize crop.

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