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Economics and Productivity of Hybrid Maize as Influenced by Combination of Gypsum and Borax under Different Nutrient Management Practices

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A B S T R A C T

Maize crop was raised in split plot design with different nutrient management practices as main and different levels of gypsum and borax as sub treatment. Main treatments included 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 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}) with 15 % deviation from targeted yield, stover yield (184.25 q ha^{-1}) and higher grass net returns 134758.0 and 90589.0 Rs. ha^{-1} respectively was recorded in M_3. However higher B: C ratio (3.21) was recorded in M_2 over M_1. Among gypsum and borax treatments, S_4 recorded significantly higher grain yield (89.86 q ha^{-1}), stover yield (160.78 q ha^{-1}) and higher grass and net returns 129356.0 and 97999.0 Rs. ha^{-1} respectively and B: C ratio (3.41) compared to S_1 and S_2 and was on par with S_3, S_5 and S_6

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 and also as cattle and poultry feed. 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}(Anon., 2014). The productivity and economics 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. Though the continuous use of fertilizers had significantly improved the crop productivity, heavy fertilizer application on the same plot every year in continuous maize system will drain the soil fertility rapidly and result in a plethora of problems *viz*., decline in crop productivity, deficiency of several micro nutrients, environmental pollution etc. 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 in terms of profit 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.

Therefore in order to sustain the profit and yield level integration or conjunctive use of secondary and micronutrients along with primary nutrients is very much essential.

The present study is proposed to study the economics and productivity of hybrid maize as influenced by combination of gypsum and borax under different nutrient management practices.

Materials and Methods

Field experiment was conducted during the *kharif* season of 2014 at College of Agricultural, V. C. Farm, Mandya, Karnataka. The experimental site was geographically situated at an altitude of 695 m above mean sea level, on 11^o 30' to 13^o 05' North latitude and 76^o 05' to 77^o 45' East longitude. It comes under Southern dry zone (Zone-6) of Karnataka. The soil was sandy loam in texture, neutral in soil reaction (pH 7.4) with normal in electrical conductivity (0.23 dS m^{-1}) and 4.5 g kg^{-1} of organic matter, with low available nitrogen (277 kg ha^{-1}), high available phosphorus (61 kg ha^{-1}) and medium potassium (148 kg ha^{-1}). The analytical values for some other nutrients were available sulphur (11.30 mg kg^{-1}), exchangeable calcium (3.4 cmol kg^{-1}), DTPA extractable Zn (2.15 mg kg^{-1}) and hot water extractable boron (0.4 mg kg^{-1}).

The experiment was laid out in split plot design with three replications. Three main treatments *viz.* package of practices (RDF) 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). Fisher's method of analysis of variance was applied for analysis and interpretation of data to calculate the critical difference. The level of significance used in *f* and *t* test was $p= 0.05$ *or 5 %*.

The quantity of fertilizers required for each treatment was worked out by three approaches such as recommended dose of fertilizer as per package of practices, UAS, Bengaluru, STCR dose of fertilizers for target of 90 and 110 q ha^{-1}. Recommended fertilizer dose for hybrid maize under irrigated condition is 150:75:40 N: P_2O_5:K_2O kg ha^{-1} + zinc sulphate 10 kg ha^{-1}+ 10 t FYM ha^{-1} (package of practice, UAS, Bengaluru).

The following fertilizer adjustment equations developed by AICRP on STCR, UAS, Bengaluru were used to work out the fertilizer dose for 90 and 110 q ha^{-1}yield target.

$$FN = 3.41T – 0.08\ SN\ (KMnO_4 - N)$$

$$FP_2O_5 = 1.94T – 0.41\ SP_2O_5\ (Bray's\ P_2O_5)$$

$$FK_2O = 2.28T – 0.072\ SK_2O\ (NH_4OAC – K_2O)$$

Gross returns (Rs. ha^{-1})

Gross returns were calculated by multiplying the grain and straw yield with their respective prevailing market prices (Perin *et al.*, 1979) and presented as ha^{-1}.

Net returns (Rs. ha^{-1})

The net returns were calculated by subtracting the cost of cultivation from the gross returns and presented as ha^{-1}.

Benefit: cost (B: C) ratio

Benefit cost ratio was worked out by using the following formula

$$\text{Benefit: cost ratio} = \frac{\text{Gross returns (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

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 1).

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 (1994).

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. Muhammad (2013) has 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 and 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.*, (2006).

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. Mohamad (2014) and Sarkaut *et al.*, (2013) 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.

Economics

Economics analysis was carried out by considering the cost prevailed during the cropping period of 2014 and also by considering the cost of FYM, inorganic fertilizers and plant protection chemicals. The cost incurred and profits derived are calculated and presented in table 3.

Cost of cultivation

Economic analysis revealed that, among main plot treatments highest cost of cultivation Rs. 44169.0 ha^{-1} was recorded in M_3 treatment, where fertilizers are applied based on STCR targeted yield of 110 q ha^{-1} and lowest cost of cultivation Rs. 30426.0 ha^{-1} was recorded in treatment M_1 UAS, Bengaluru, package of practice treatment.

Among sub plots highest cost of cultivation Rs. 38908.0 ha^{-1} was recorded in S_6 treatment (200 kg gypsum and 5 kg borax ha^{-1}) and lowest Rs. 37388.0 ha^{-1} was recorded in S_1 (control).

Gross returns

Among different nutrient management practices application of fertilizers by STCR based targeted yield of 110 q ha^{-1} recorded higher gross returns (Rs. 134758.0) followed by STCR based targeted yield of 90 q ha^{-1} (Rs. 128057.0). The cost of cultivation of maize under targeted yield approaches varied from treatment to treatment due to varied amount of fertilizer application and their cost.

The cost of cultivation of maize was high in STCR based targeted yield of 110 q ha^{-1} (Rs. 44169.0 ha^{-1}) followed by STCR based targeted yield of 90 q ha^{-1} (Rs. 39848.0 ha^{-1}) due to application of higher quantity of fertilizers as per requirement.

Among subplot treatments, application of 5 kg of borax recorded higher gross returns (Rs. 129356.0) followed by application of 2.5 kg borax ha^{-1} (Rs. 125648.0).

The cost of cultivation of maize under gypsum and borax application varied from treatment to treatment due to varied amount of application of inputs and their cost.

The cost of cultivation of maize was high in 200 kg gypsum and 5 kg borax ha^{-1} treated plot (Rs. 38908.0 ha^{-1}) followed by 200 kg gypsum and 2.5 kg borax ha^{-1} treated plot (Rs. 38533.0 ha^{-1}) due to application of higher amount of gypsum and borax fertilizer and their cost.

These results are in agreement with the findings of Apoorva *et al.*, (2010) and Ashok and Jayadeva (2013).

Table.1 Cob length, number of rows per cob, number of grains per cob and test weight 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)
M_1		15.12	15.02	433.88	26.99
M_2		16.46	16.63	526.96	31.22
M_3		18.01	16.96	540.77	32.22
S.Em±		0.28	0.35	18.17	0.97
CD (p=0.05)		1.09	1.38	71.35	3.80
S_1		15.73	14.83	408.89	28.24
S_2		15.83	15.37	456.18	28.96
S_3		16.78	16.67	535.79	31.31
S_4		16.85	17.14	573.06	31.87
S_5		17.17	16.23	495.66	30.21
S_6		16.82	16.97	533.65	30.27
S.Em±		0.72	0.46	13.88	0.77
CD (p=0.05)		NS	1.33	40.10	2.33
Interaction M X S	**S.Em±**	0.421	0.81	85.26	4.72
	CD (p=0.05)	NS	NS	NS	NS

Table.2 Grain yield, stover yield and harvest index of maize as influenced by application of gypsum and borax under different nutrient management practices

Treatments		Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index
M_1		66.69	115.82	0.37
M_2		88.78	164.14	0.35
M_3		93.00	184.25	0.34
S.Em±		0.89	1.99	0.01
CD (p=0.05)		6.22	7.82	0.01
S_1		73.01	129.56	0.36
S_2		80.95	149.64	0.35
S_3		87.34	154.69	0.36
S_4		89.86	160.78	0.36
S_5		82.23	168.61	0.33
S_6		81.94	165.14	0.34
S.Em±		1.05	1.95	0.01
CD (p=0.05)		7.30	5.64	0.02
Interaction M X S	**S.Em±**	1.89	11.89	0.04
	CD (p=0.05)	NS	NS	NS

Table.3 Cost of cultivation, gross returns, net returns and benefit cost ratio in irrigated maize as influenced by Different approaches of fertilizer prescriptions

Treatments	Cost of cultivation (Rs. ha^{-1})				Gross returns (Rs. ha^{-1})				Net returns (Rs. ha^{-1})				B: C ratio			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	29666	39088	43409	37388	81690	110941	122506	105046	52025	71853	79097	67658	2.75	2.84	2.82	2.80
S_2	30436	39858	44179	38158	88665	127602	134017	116761	58230	87744	89838	78604	2.93	3.20	3.03	3.06
S_3	30041	39461	43784	37762	104559	134555	137832	125648	74518	95091	94047	87886	3.48	3.41	3.15	3.35
S_4	30416	39838	44159	38138	106130	139781	142157	129356	75714	99942	97998	91218	3.49	3.51	3.22	3.41
S_5	30811	40233	44554	38533	96145	128870	135726	120247	65334	88636	91171	81714	3.12	3.20	3.05	3.12
S_6	31186	40608	44929	38908	97769	126594	136311	120224	66583	85986	91382	81317	3.14	3.12	3.03	3.10
Mean	30426	39848	44169	38147	95826	128057	134758	119547	65401	88209	90589	81399	3.15	3.21	3.05	3.14

Net returns

Among different nutrient management practices application of fertilizers by STCR based targeted yield of 110 q ha^{-1} recorded higher net returns (Rs. 90589.0) followed by STCR based targeted yield of 90 q ha^{-1} (Rs. 88209.0). The cost of cultivation of maize under targeted yield approaches varied from treatment to treatment due to varied amount of fertilizer application and their cost. The cost of cultivation of maize was high in STCR based targeted yield of 110 q ha^{-1} (Rs. 44169.0 ha^{-1}) followed by STCR based targeted yield of 90 q ha^{-1} (Rs. 39848.0 ha^{-1}) due to application of higher quantity of fertilizers as per requirement.

Among subplot treatments, application of 5 kg of borax recorded higher net returns (Rs. 97999.0 ha^{-1}, respectively) followed by application of 2.5 kg borax ha^{-1} (Rs. 87886.0 ha^{-1}). The cost of cultivation of maize under gypsum and borax application varied from treatment to treatment due to varied amount of application of inputs and their cost.

The cost of cultivation of maize was high in 200 kg gypsum and 5 kg borax ha^{-1} treated plot (Rs. 38908.0 ha^{-1}) followed by 200 kg gypsum and 2.5 kg borax ha^{-1} treated plot (Rs. 38533.0 ha^{-1}) due to application of higher amount of gypsum and borax fertilizer and their cost.

These results are in agreement with the findings of Apoorva *et al.*, (2010) and Ashok and Jayadeva (2013).

B: C ratio

Application of fertilizers based on STCR targeted yield 90 q ha^{-1} recorded higher B: C ratio (3.21) then with UAS, Bengaluru, package of practice (3.15) and STCR targeted yield level of 110 q ha^{-1} (3.05).

Among sub plots application of 5 kg of borax (S_4) recorded higher B: C ratio (3.41) compared to other treatments and lowest B: C ratio of 2.80 was recorded in control (S_1) treatment.

Benefit cost ratio is higher in STCR based targeted yield of 90 q ha^{-1} (3.21) followed by STCR based targeted yield of 110 q ha^{-1} (3.05). This is mainly due to low quantity of fertilizers used in the treatment targeted for 90 q ha^{-1} compared to 110 q ha^{-1} targeted yield. Further, it was evidenced by low cost of cultivation (Table 3).

Benefit cost ratio is higher in 5 kg borax ha^{-1} (3.41) followed by 2.5 kg borax ha^{-1} (3.35) and lowest cost of cultivation, gross returns, net returns and B: C ratio was recorded in control plot. The results are in conformity with the findings Apoorva *et al.*, (2010) and Ashok and Jayadeva (2013).

Among interaction between main and sub treatments application of 5 kg of borax with STCR for targeted yield level of 90 q ha^{-1} ($M_2 \times S_4$) recorded higher B: C ratio (3.51) than with STCR targeted yield levels of 110 q ha^{-1} and UAS, Bengaluru, package of practice treatments. Lowest B: C ratio (2.75) was recorded in control treatment with UAS, Bengaluru, package of practice treatment ($M_1 \times S_1$).

References

Anonymous, 2014. Area, production and productivity of major cereals in India. *www.indiastat.com.*

Apoorva, K. B., Prakash, S. S., Rajesh, N. L. and Nandini, B. 2010. STCR approach for optimizing integrated plant nutrient supply on growth, yield and economics of Finger Millet (*Eleusine coracana* L. Garten.). *J. Bio. Sci.,* 4(1): 19-27.

Ashok, B., and Jayadeva, H. M. 2013.

Influence of targeted yield approach on yield, yield attributes, nutrient uptake and economics of maize. *Madras Agricult. J*., 100(1-3): 146-149.

Jayaprakash, T.C., nagalikar, V.P., pujari, B.T. and Shetty, R.A. 2006. Effect of organics and inorganics on growth and yield of maize under irrigation. *Karnataka J. Agricult. Sci.*, 18(3): 794-798.

Mohamed, S.H., 2014. Dynamics of boron in soils and response of maize-cowpea to graded levels of boron in central dry zone of Karnataka. *Ph.D. Thesis.* University of Agricultural Sciences, Bengaluru, India.

Muhammad, A., 2013. Cumulative effect of sulphur and calcium on wheat growth and yield under saline-sodic soils. *Pakistan J. Agricult. Res.*, 26(1): 46-53.

Perin, R.K., Donald. L.W., Edwards, R.M and Jack, R.A. 1979. From Agronomic data for farmer recommendations. *An Economic Training Manual*, CIMMYT Information Bulletin. 27: 15-33.

Sarkaut, S., Salaheddin, M., Kaivan, A. N. and Anvar, R. A. 2013. Growth and yield response of maize (*Zea mays* L.) to different rates of potassium and boron. *Int. J. Agricult. Crop Sci.,* 5(3): 236-240.

Shivashankar, K.A., and Sudhakar Babu S N. 1994. Influence of organic matter, spacing and fertilizer levels on growth and yield of maize. *Proc:* Seminar on technology for sustainable crop production IAT. Bengaluru.

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