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Yield and Economics of Finger Millet Influenced by Micronutrient Management in Red and Laterite Zone of West Bengal

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ABSTRACT

A field experiment had been conducted during *kharif* and rabi seasons of 2016-17 and 2017-18 at Regional Research Sub-station, Raghunathpur, Bidhan Chandra Krishi Viswavidyalaya, Purulia, West Bengal to study the effect of micronutrient management on yield and economics of finger millet. The grain yield of finger millet was significantly influenced by incorporation of 2.5 t ha^{-1} FYM with 75% RDF (1.78 and 1.92 t ha^{-1} in both *kharif* and *rabi* season respectively). Foliar spray of $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % significantly inspired the grain yield (1.93 and 2.08 t ha^{-1} in both *kharif* and *rabi* respectively). During the present study, in both *kharif* and *rabi* seasons highest gross return, net return, B:C and net return ₹$^{-1}$ invested was recorded with 75% RDF + 2.5 t ha^{-1} FYM application in main plot treatments. In sub plot treatments, highest gross return, net return, B:C and net return ₹$^{-1}$ invested was recorded with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. The results of present study clearly indicated that addition of micronutrients with organic and inorganic combination of NPK proved superiority over application of micronutrient with 100% RDF. So organic and inorganic combination (as sources of NPK) along with foliar application of both the micronutrients (Zn and B) together can boost up the yield, economic returns and could be recommended for the cultivation of direct seeded upland finger millet in Red and Laterite Zone of West Bengal in both the *kharif* and *rabi* seasons.

Keywords Finger Millet, Grain Yield, Net Return, B:C, Micronutrient.

INTRODUCTION

Finger millet (*Eleusine coracana* L.) is an important small millet crop grown in India and has the pride of place in having the highest productivity among millets. It is also known as African millet or bird's foot millet and serves as an important staple food crop in parts of eastern and central Africa and India. The crop is adapted to a wide range of environments and can be grown in variety of soils with medium or low water holding capacity and requires rainfall of at least 800 mm per annum (Thakur *et al.* 2016). It is grown both for grain and fodder purposes and is

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cultivated up to an altitude of 3000 meters above mean sea level. The crop is well adapted to very poor and marginal uplands where other crops cannot be grown successfully (AICSMIP 2014). In West Bengal ragi is cultivated mainly in red and laterite tract with an area of 0.11 m ha only producing 0.13 m tones with the productivity of 1.13 t ha^{-1} (Anonymous 2016). The production and productivity of finger millet is low because of inefficient irrigation and nutrient management, heavy weed infestation, incidence of blast disease. The deficiency of micronutrients may result in stunted growth, shortening of internodes, development of chlorotic and mottled leaves and reduction in seed setting. The deficiency of Zn and B are 36 % and 68 % respectively in West Bengal soils (Singh 2006). Soil fertility is the primary limiting factor which influences production under intensive crop cultivation. Boron deficiency is becoming more pronounced in red and lateritic, acidic, coarse textured alluvial soils of India leading to 33% of grid samples to be deficient altogether [68% of soil samples from West Bengal are deficient] (Singh 2008). Adsorption by aluminium (Al) and iron (Fe) oxide minerals in acid soils of high rainfall areas causes leaching of B, thus decreasing availability of B (Tsadilas and Kassioti 2005).This highlights the urgency of applying B fertilizers in such soils to check further deterioration of agricultural production (Jana and Nayak 2006). Introduction of exhaustive high yielding varieties and hybrids in many crops increasing the use of high analysis chemical fertilizers devoid of micronutrients and inadequate application of organic manures due to scarcity has resulted in wide spread micronutrient deficiency and nutrient imbalance which adversely affected yield of many crops. Therefore, it is essential to supply macro and micro nutrients in a balanced ratio in required quantity for obtaining higher yield.

MATERIALS AND METHODS

Study area

The experiment was carried out at the Regional Research Sub-station, Raghunathpur, Bidhan Chandra Krishi Viswavidyalaya, Purulia, West Bengal (Latitude 23.55°N, Longitude 86.67°E and altitude of 155 m above mean sea level) during *kharif* 2016 and 2017 and *rabi,* 2016-17 and 2017-18. In *kharif* season, the mean maximum temperature was 36.20°C and 37.00°C during 2016 and 2017 respectively. The mean minimum temperature for the corresponding period was 25.02°C and 25.83°C during 2016 and 2017 respectively. A total rainfall of 814.6 mm and 631.2 mm was received during 2016 and 2017, respectively. In *rabi* season, the mean maximum temperature was 33.68°C and 31.32°C during 2016-17 and 2017-18 respectively. The mean minimum temperature for the corresponding period was 16.61°C to and 16.19°C during 2016-17 and 2017-18 respectively.A totalrainfall of 2.7 mm and 3.2 mm was received uring 2016-17 and 2017-18, respectively. The soil was sandy clay loam in texture, moderately acidic in reaction and non-saline. It was low in available nitrogen and available phosphorus and medium in available potassium. The bulk density was found to be slightly higher than ideal bulk density.

Treatments and experimental design

The experiment was laid out in a split plot design with two mainplot treatments (sources of NPK) and six sub plot treatments (method and dose of application) in three replications. The main plot treatments comprised of F_1: 100% Recommended dose of NPK (RDF) i.e., $N:P_2O_5:K_2O$ :: 40:20:20 kg ha^{-1}, F2:75% RDF + 2.5 t ha^{-1} FYM. The sub plot treatments comprised of M_1: $ZnSO_4$ @ 12.5 kg ha-1 as soil application, M_2: $ZnSO_4$ @ 0.5% as foliar spray, M_3: Borax @ 10 kg ha^{-1} as soil application, M_4: Borax @ 0.5% as foliar spray, M_5:$ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1} as soil application and M_6:$ZnSO_4$ @ 0.5% + Borax @ 0.5% as foliar spray. Finger millet variety 'Champavathi' was chosen for the experiment.

Experimental procedures

On the date of sowing half of the recommended dose of nitrogen, entire dose of phosphorus and potassium (40-20-20: N-P_2O_5-K_2O kg ha^{-1}), in the form of urea, single super phosphate (SSP) and muriate of potash respectively, were mixed with soil in respective treatment plots (Plate 3.6). Remaining half dose of nitrogen was top dressed in two equal splits one at the time of tillereing and second one at the time of panicle initiation. Borax ($Na_2B_4O_7 10 H_2O$ containing 11% B) as source of boron and zinc sulfate ($ZnSO_4 7H_2O$, containing 22.35 % Zn as source of zinc) were also mixed with the soil at the required dosage as per treatment set up, one week before sowing. Spraying of borax and zinc sulfate, wherever necessary had been undertaken at the required doses on the 40th and 55th day after sowing. Finger millet crop was harvested by cutting the matured panicles from the net plot area in all experimental plots (Plate 3.15). The panicles were sundried and threshed by beating with sticks to separate the seeds from the panicles and winnowed, cleaned simultaneously and weighed plot wise.The grain yield and straw yield per plot was recorded and expressed as t ha^{-1}.

The cost of cultivation (expenditure on land preparation, seed materials, sowing, weeding, thinning and gap filling, plant protection, irrigation and harvesting) of the finger millet crop under different treatments were taken into consideration. The variable costs included the cost of manures and plant protection inputs depending upon the particulars of treatments. The total cost of cultivation, consisted as the cost of cultivation plus input cost.

The gross returns were calculated by considering the prices of finger millet grain and straw yield, prevailing in the local market.The net returns ha^{-1} was calculated by deducting the cost of cultivation from the gross returns ha^{-1}.

Net return ha^{-1} (₹) = Gross income ha^{-1} (₹) – Cost of cultivation ha^{-1} (₹)

The benefit-cost ratio was worked out by using-gross returns and cost of cultivation. The formula was as follows

$$B : C = \frac{\text{Gross Returns ha}^{-1} (₹)}{\text{Cost of cultivation ha}^{-1} (₹)}$$

It is the measure of how much returns we get from each one rupee invested in the cultivation of finger millet. It can be calculated as follows:

$$\text{Net return ₹}^{-1} \text{ invested} = \frac{\text{Net Returns ha}^{-1} (₹)}{\text{Cost of cultivation ha}^{-1} (₹)}$$

Statistical analysis

The data on grain yield was statistically analyzed, applying the technique of analysis of variance. The performance of crop was varying considerably from season to season as well as year to year due to environmental factors. For this purpose, Bartlett's test for homogeneity of variances (chi-square) had been done, then after testing (if chi-square test is significant then) weighted analyses had been made otherwise un weighted analyses i.e., pooled analysis as described by Gomez and Gomez (1984). Wherever the treatment differences were found significant, ('F' test) critical difference was worked out at five per cent probability level and the values furnished. The treatment differences that were not significant were denoted by "NS".

RESULTS AND DISCUSSION

Grain yield (t ha^{-1})

Grain yield is the functions of several yield attributing characters viz., number of productive tillers m^{-2}, number of filled grains ear $head^{-1}$ and 1000 grain weight (g). The cumulative effect of all growth, physiological and yield attributing characters were reflected on grain yield. From the pooled data, it was perceived that grain yield also followed the similar trend like number of productive tillers m^{-2} and number of filled grains ear $head^{-1}$ and significantly influenced by different sources of NPK and method and doses of micronutrients and their interactions were found to be non-expressive (Table 1).

Regardless of application of micronutrients, incorporation of 2.5 t ha^{-1} FYM with 75% RDF registered significantly higher grain yield (1.78 and 1.92 t ha^{-1}) over 100% RDF (1.56 and 1.70 t ha^{-1}) in both *kharif* and *rabi* seasons. $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % foliar spray significantly inspired the grain yield (1.93 and 2.08 t ha^{-1}) which was at par with soil application of $ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1}(1.83 and 1.96 t ha^{-1}) during *kharif* and *rabi* seasons in both the years of experimentation irrespective of main plot treatments.The interaction effect was statistically at par with respect to grain yield of finger millet and in *kharif* season it ranged

Table 1. Effect of sources of NPK with micronutrient application on grain yield (t ha^{-1}) of finger millet. F_1: 100 % Recommended dose of NPK (RDF) F_2: 75 % RDF + 2.5 t ha^{-1} FYM M_1: $ZnSO_4$ @ 12.5 kg ha^{-1} as soil application M_2: $ZnSO_4$ @ 0.5 % as foliar spray M_3: Borax @ 10 kg ha^{-1} as soil application M_4: Borax @ 0.5 % as foliar spray M_5: $ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1} as soil application M_6: $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % as foliar spray.

	Kharif								
	2016			2017			Pooled		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	1.44	1.56	1.50	1.32	1.45	1.39	1.38	1.51	1.45
M_2	1.68	1.91	1.79	1.57	1.80	1.68	1.62	1.85	1.74
M_3	1.42	1.53	1.48	1.30	1.42	1.36	1.36	1.48	1.42
M_4	1.62	1.82	1.72	1.52	1.69	1.60	1.57	1.75	1.66
M_5	1.74	2.02	1.88	1.63	1.93	1.78	1.69	1.98	1.83
M_6	1.79	2.19	1.99	1.67	2.08	1.88	1.73	2.13	1.93
Mean	1.61	1.84	1.73	1.50	1.73	1.61	1.56	1.78	1.67

	SEm (±)	LSD ($p \leq 0.05$)	SEm (±)	LSD ($p \leq 0.05$)	SEm (±) ($p \leq 0.05$)	LSD ($p \leq 0.05$)
F	0.03	0.21	0.03	0.21	0.02	0.10
M	0.05	0.16	0.05	0.15	0.04	0.11
F×M	0.08	NS	0.07	NS	0.05	NS
M×F	0.08	NS	0.07	NS	0.05	NS

	Rabi								
	2016-17			2017-18			Pooled		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	1.51	1.62	1.56	1.57	1.68	1.62	1.54	1.65	1.59
M_2	1.73	1.97	1.85	1.78	2.03	1.90	1.76	2.00	1.88
M_3	1.48	1.59	1.53	1.53	1.65	1.59	1.50	1.62	1.56
M_4	1.67	1.87	1.77	1.72	1.93	1.83	1.70	1.90	1.80
M_5	1.79	2.08	1.93	1.85	2.14	1.99	1.82	2.11	1.96
M_6	1.85	2.24	2.05	1.91	2.30	2.11	1.88	2.27	2.08
Mean	1.67	1.89	1.78	1.73	1.95	1.84	1.70	1.92	1.81

	SEm (±)	LSD ($p \leq 0.05$)	SEm (±)	LSD ($p \leq 0.05$)	SEm (±) ($p \leq 0.05$)	LSD ($p \leq 0.05$)
F	0.03	0.20	0.03	0.20	0.02	0.09
M	0.05	0.16	0.05	0.16	0.04	0.11
F×M	0.08	NS	0.08	NS	0.05	NS
M×F	0.08	NS	0.08	NS	0.06	NS

from 1.36 to 2.13 t ha^{-1} and in *rabi* season, it ranged from 1.50 to 2.27t ha^{-1} (pooled of two years). Highest grain yield 2.5 t ha^{-1} was recorded by FYM + 75% RDF in combination with $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % foliar spray 2.13 and 2.27 t ha^{-1} in *kharif* and *rabi* seasons respectively.

This may be attributed to the fulfillment of the demand of the crop by higher assimilation and translocation of photosynthates from source (leaves) to sink (grains), through the supply of required nutrients by foliar spray of micronutrients (Tariq *et al*. 2014, Manasa and Devaranavadagi 2015). In the presentexperiment, foliar application was the most beneficial method, because low soil pH decreased the efficiency of soil application of Zn and B.The zinc sulfate foliar application had the positive effect on the growth, yield and yield components of finger millet (Yadavi *et al.* 2014).The conjunctive use of organic and inorganic sources had a beneficial effect on the physiological process of plant metabolism and growth, thereby led to higher grain yield. The easy availability of nitro-

Table 2. Effect of sources of NPK and method of application of micronutrients on cost of cultivation (₹ ha^{-1}) of finger millet F_1: 100 % Recommended dose of NPK (RDF) F_2: 75 % RDF + 2.5 t ha^{-1} FYM M_1: $ZnSO_4$ @ 12.5 kg ha^{-1} as soil application M_2: $ZnSO_4$ @ 0.5 % as foliar spray M_3: Borax @ 10 kg ha^{-1} as soil application M_4: Borax @ 0.5 % as foliar spray M_5: $ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1} as soil application M_6: $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % as foliar spray.

	Kharif 2016 and 2017			*Rabi* 2016-17 and 2017-18		
Treatments	F_1	F_2	Mean	F_1	F_2	Mean
M_1	19470.00	21213.75	20341.88	20438.00	22181.75	21309.88
M_2	19090.00	20828.75	19959.38	20058.00	21796.75	20927.38
M_3	19755.00	21498.75	20626.88	20723.00	22466.75	21594.88
M_4	19185.00	20928.75	20056.88	20153.00	21896.75	21024.88
M_5	20230.00	21973.75	21101.88	21198.00	22941.75	22069.88
M_6	19280.00	21018.75	20149.38	20248.00	21986.75	21117.38
Mean	19501.67	21243.75	20372.71	20469.67	22509.25	21489.46

gen due to mineralization of organics influenced the shoot and root growth favoring absorption of other nutrients. The results were in conformity with the findings of Yakadri and Reddy (2009).

Cost of cultivation (₹ ha^{-1})

The lowest cost of cultivation was recorded in 100% RDF application (₹ 19501.67 ha^{-1}) and (₹ 19959.38 ha^{-1}) was recorded by foliar application of $ZnSO_4$ @ 0.5% during the *kharif* season in both the years of experimentation. During *rabi* season, the lowest cost of cultivation was recorded in 100% RDF application (₹ 20469.67 ha^{-1}) and (₹ 20927.38 ha^{-1}) was recorded by foliar application of $ZnSO_4$ @ 0.5% in both the years of experimentation.

Gross return (₹ ha^{-1})

In *kharif* season, the highest gross return was noticed in 75% RDF + 2.5 t ha^{-1} FYM (40487.70 and 38061.26 ₹ ha^{-1} in 2016 and 2017,respectively) in main plot treatments. Among subplot treatments maximum gross return (43832.58 and 41484.53 ₹ ha^{-1} in 2016 and 2017, respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions highest gross return (48519.29 and 45904.72 ₹ ha^{-1}in 2016 and 2017, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

In *rabi* season, the highest gross return was noticed in 75% RDF + 2.5 t ha^{-1} FYM (41772.63 and 43071.09 ₹ ha^{-1}in 2016-17 and 2017-18, respectively) in main plot treatments. Among subplot treatments maximum gross return (45149.98 and 46474.25 ₹ ha^{-1} in 2016-17 and 2017-18, respectively) was recorded in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions highest gross return (49673.28 and 51001.83 ₹ ha^{-1} in 2016-17 and 2017-18, respectively) was recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

Net return (₹ ha^{-1})

During *kharif,* the notable net return was noticed in 75% RDF + 2.5 t ha^{-1} FYM (19243.95 and 16817.51 ₹ ha^{-1} in 2016 and 2017, respectively) respectively in main plot treatments. Among subplot treatments maximum net return (23683.20 and 21335.15 ₹ ha^{-1} in 2016 and 2017,respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions superlative net return (27500.54 and 24885.97 ₹ ha^{-1} in 2016 and 2017,respectively) had been recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

During *rabi* season, the highest net return was noticed in 75% RDF + 2.5 t ha^{-1} FYM (19560.88 and 20859.34 ₹ ha^{-1} in 2016-17 and 2017-18, respectively) in main plot treatments. Among subplot treatments maximum net return (24032.60 and 25356.88 ₹ ha^{-1} in 2016-17 and 2017-18, respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions noteworthy net

Table 3. Effect of sources of NPK and method of application of micronutrients on gross return (₹ ha^{-1}) and net return (₹ ha^{-1}) of finger millet. F_1: 100 % Recommended dose of NPK (RDF); F_2: 75 % RDF + 2.5 t ha^{-1} FYM; M_1: $ZnSO_4$ @ 12.5 kg ha^{-1} as soil application; M_2: $ZnSO_4$ @ 0.5 % as Foliar Spray M_3: Borax @ 10 kg ha^{-1} as Soil Application; M_4: Borax @ 0.5 % as Foliar Spray; M_5: $ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1} as soil application; M_6: $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % as foliar spray.

	Gross return (₹ ha^{-1})											
	Kharif						*Rabi*					
Treat-	2016			2017			2016-17			2017-18		
ments	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	31666.73	34292.50	32979.62	29153.03	31973.33	30563.18	33220.00	35537.32	34378.66	34466.67	36856.24	35661.46
M_2	36936.97	41958.75	39447.86	34751.95	39715.32	37233.64	38200.41	43262.96	40731.69	39228.89	44582.85	41905.87
M_3	30996.67	33811.76	32404.22	28541.50	31197.40	29869.45	32454.33	35193.93	33824.13	33553.23	36522.01	35037.62
M_4	35493.92	39873.66	37683.79	33480.42	37247.90	35364.16	36813.33	41244.24	39028.79	37913.33	42418.46	40165.90
M_5	38488.80	44470.24	41479.52	35860.00	42328.87	39094.44	39449.27	45724.05	42586.66	40698.13	47045.13	43871.63
M_6	39145.87	48519.29	43832.58	37064.33	45904.72	41484.53	40626.67	49673.28	45149.98	41946.67	51001.83	46474.25
Mean	35454.83	40487.70	37971.26	33141.87	38061.26	35601.56	36794.00	41772.63	39283.32	37967.82	43071.09	40519.45
	Net return (₹ ha^{-1})											
	Kharif						*Rabi*					
	2016			2017			2016-17			2017-18		
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	12196.73	13078.75	12637.74	9683.03	10759.58	10221.31	12782.00	13355.57	13068.79	14028.67	14674.49	14351.58
M_2	17846.97	21130.00	19488.48	15661.95	18886.57	17274.26	18142.41	21466.21	19804.31	19170.89	22786.10	20978.49
M_3	11241.67	12313.01	11777.34	8786.50	9698.65	9242.58	11731.33	12727.18	12229.26	12830.23	14055.26	13442.75
M_4	16308.92	18944.91	17626.91	14295.42	16319.15	15307.28	16660.33	19347.49	18003.91	17760.33	20521.71	19141.02
M_5	18258.80	22496.49	20377.64	15630.00	20355.12	17992.56	18251.27	22782.30	20516.78	19500.13	24103.38	21801.75
M_6	19865.87	27500.54	23683.20	17784.33	24885.97	21335.15	20378.67	27686.53	24032.60	21698.67	29015.08	25356.88
Mean	15953.16	19243.95	17598.55	13640.21	16817.51	15228.86	16324.34	19560.88	17942.61	17498.15	20859.34	19178.74

return (27686.53 and 29015.08 ₹ ha^{-1} in 2016-17 and 2017-18, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

B : C

In *kharif* season, the highest B:C was noticed in 75% RDF + 2.5 t ha^{-1} FYM application (1.91 and 1.79 in 2016 and 2017, respectively) in main plot treatments. Among subplot treatments maximum B:C (2.17 and 2.01in 2016 and 2017, respectively) was perceived in the treatment of foliar application of ZnSO4 @ 0.5% + Borax @ 0.5%. Among interactions highest B:C (2.31 and 2.18 in 2016 and 2017, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

In *rabi* season, the highest B:C was noticed in 75% RDF + 2.5 t ha^{-1} FYM application (1.88 and 1.94 in 2016-17 and 2017-18, respectively) in main plot treatments. Among subplot treatments maximum B:C (2.13 and 2.20 in 2016-17 and 2017-18, respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions highest B:C (2.26and 2.32in 2016-17 and 2017-18, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

Net return ₹ $^{-1}$ invested

During *kharif*, the highest net return ₹$^{-1}$ investedwas noticed in 75% RDF + 2.5 t ha^{-1} FYM application (0.91 and 0.79 in 2016 and 2017, respectively) in main plot treatments. Among subplot treatments maximum net return ₹$^{-1}$ invested (1.17 and 1.05in 2016 and 2017, respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions, highest net return ₹$^{-1}$ invested (1.31 and 1.18 in 2016 and 2017, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

During *rabi* season,the highest net return ₹$^{-1}$

Table 4. Effect of sources of NPK and method of application of micronutrients on B:C and net return ₹$^{-1}$ invested of finger millet. F_1: 100 % Recommended dose of NPK (RDF); F_2: 75 % RDF + 2.5 t ha^{-1} FYM; M_1: $ZnSO_4$ @ 12.5 kg ha^{-1} as soil application; M_2: $ZnSO_4$ @ 0.5 % as foliar spray M_3: Borax @ 10 kg ha^{-1} as soil application; M_4: Borax @ 0.5 % as Foliar Spray; M_5: $ZnSO_4$ @ 12.5 kg ha^{-1} + Borax @ 10 kg ha^{-1} as soil application; M_6: $ZnSO_4$ @ 0.5 % + Borax @ 0.5 % as foliar spray.

						B:C						
		2016/2017			*Kharif*		2016/2017			*Rabi*		2016/2017	
Treatments	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	1.63	1.62	1.62	1.50	1.51	1.50	1.63	1.60	1.61	1.69	1.66	1.67
M_2	1.93	2.01	1.97	1.82	1.91	1.86	1.90	1.98	1.94	1.96	2.05	2.00
M_3	1.57	1.57	1.57	1.44	1.45	1.45	1.57	1.57	1.57	1.62	1.63	1.62
M_4	1.85	1.91	1.88	1.75	1.78	1.76	1.83	1.88	1.86	1.88	1.94	1.91
M_5	1.90	2.02	1.96	1.77	1.93	1.85	1.86	1.99	1.93	1.92	2.05	1.99
M_6	2.03	2.31	2.17	1.92	2.18	2.05	2.01	2.26	2.13	2.07	2.32	2.20
Mean	1.82	1.91	1.86	1.70	1.79	1.75	1.80	1.88	1.84	1.86	1.94	1.90

						Net return ₹-^{1} invested						
			Kharif						*Rabi*			
	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
M_1	0.63	0.62	0.62	0.50	0.51	0.50	0.63	0.60	0.61	0.69	0.66	0.67
M_2	0.93	1.01	0.97	0.82	0.91	0.86	0.90	0.98	0.94	0.96	1.05	1.00
M_3	0.57	0.57	0.57	0.44	0.45	0.45	0.57	0.57	0.57	0.62	0.63	0.62
M_4	0.85	0.91	0.88	0.75	0.78	0.76	0.83	0.88	0.86	0.88	0.94	0.91
M_5	0.90	1.02	0.96	0.77	0.93	0.85	0.86	0.99	0.93	0.92	1.05	0.99
M_6	1.03	1.31	1.17	0.92	1.18	1.05	1.01	1.26	1.13	1.07	1.32	1.20
Mean	0.82	0.91	0.86	0.70	0.79	0.75	0.80	0.88	0.84	0.86	0.94	0.90

invested was noticed in 75% RDF + 2.5 t ha^{-1} FYM application (0.88 and 0.94 in 2016-17 and 2017-18, respectively) in main plot treatments. Among subplot treatments maximum net return ₹$^{-1}$ invested (1.13 and 1.20 in 2016-17 and 2017-18, respectively) was perceived in the treatment of foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%. Among interactions highest net return ₹ $^{-1}$ invested (1.26 and 1.32 in 2016-17 and 2017-18, respectively) recorded under 75% RDF + 2.5 t ha^{-1} FYM with foliar application of $ZnSO_4$ @ 0.5% + Borax @ 0.5%.

Higher level of biomass accumulation and efficient translocation of photosynthates to the reproductive parts due to supply of adequate nutrients might be responsible for the production of elevated yield attributes and yield, which resulted in higher monetary returns and B:C ratio (Rajesh 2012). Maximum benefit-cost ratio was observed in treatments having combination of inorganic and organic sources of nutrients along with micronutrient application which was mainly due to higher grain yield and lesser cost incurred on fertilizers. Hence, it was more profitable than 100% RDF treatments and corroborated the findings of Sridhara *et al.* (2003). Significant increase in gross returns, net returns and B:C were obtained with balanced nutrition treatment. This indicated that applications of Zn and B were economical and this practice could be recommended for large scale adoption where Zn and B deficiency occured. Higher B:C ratio were also obtained with micronutrient application on soils deficient in these nutrients (Srinivasarao *et al.* 2008).Economic analysis of the experiment indicated that application of B and Zn alone or application of both improved the net return and benefit: cost ratio (B:C). However, foliar application of both Zn and B observed to record the maximum gross return, net return and B:C of finger millet which corroborated the findings of Wasaya *et al.* (2017).

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