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Grain Setting and Productivity of Wheat (*Triticumaestivum*) as Influenced by FYM, Zinc and Boron Application

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ABSTRACT: *A field experiment consisting FYM, zinc and boron combined with RDF was conducted during two consecutive rabi season of 2012-13 and 2013-14 at Purnea to study the effect of FYM, boron and Zinc on grain setting and productivity of wheat. The maximum yield attributing character, grain yield (27.23 q/ha) and nutrient uptake were obtained with recommended dose of fertilizer along with FYM at 5 ton /ha, borax 10 kg/ha and $ZnSO_4$ 25 kg/ha, which was at par with RDF+ FYM 5 t/ha + borax 10 kg/ha or $ZnSO_4$ 25 kg/haand RDF + FYM at 5 t/ha. Combine application of RDF and FYM either boron or zinc gave significantly higher yield attributing character, grain yield and nutrient uptake by grain over recommended dose of fertilizer application. Higher net return and B:C ratio(Rs 25383 and 1.54) was obtained in RDF+ FYM 5t/ha + borax 10 kg/ha + $ZnSO_4$25 kg/ha followed by RDF + FYM 5 t/ha + borax 10 kg/ha and lowest in control. Fertility status of soil after harvest of crop was more in treatment inorganic with organic fertilizer combined with micronutrients than control or only inorganic fertilizer application.*

Keywords: *Wheat, grain setting, productivity, nutrient uptake, economics and fertility*

INTRODUCTION

Intensive cereal cropping with application of major nutrient fertilizer depleted the micronutrient status of soil cause many problem in wheat of Kosiregion.Only N,P and K application leads to deficiency of micronutrient in this region particularly zinc and Boron. The status zinc and boron is too much lower than optimum, whereas Iron is in toxic amount and copper is reliable amount. Integrated nutrient management is reliable way for obtaining higher productivity (Sharma *et al*, 2007). Soil organic matter is known to serve as soil conditioner, nutrient source and substratefor microbial activity preserver of environment and major determinant for sustaining agricultural productivity (Tolanur and Badanur, 2003). Khaira disease in rice and poor grain setting in spikelet of wheat is the major problem in Purnea district. Boron (helps in pollination), zinc (help in growth promoting hormone) and organic carbon are deficient in this soil may cause khaira disease in rice and poor grain setting in spikelet of wheat. So, B, Zn and FYM are taken for consideration of study.

MATERIALS AND METHODS

A field experiment was conducted during winter season of 2011and 2012 at research farm of Bhola Paswan Shastri Agricultural College, Purnea, Bihar Agricultural University, (Sabour) Bhagalpur, Bihar. The field is situated 25.48 °N and 87.30 °L at an altitude of 31meter above MSL in inceptisol. Soil of experimental site is sandy loan in texture, neutral in pH (6.5), low in organic carbon (0.48%), available nitrogen (180 kg/ha), medium in phosphorus (30 kg/ha), medium in available potassium (270 kg/ha), medium in available S (19.5 kg/ha), medium in available Mn (6.8 ppm), low in available Zn (0.2 ppm), high in available Fe (114.4 ppm), medium in available Cu (2.6 ppm) and low in available B (0.1 ppm) of soil status. The treatment comprises control ($N_0P_0K_0$), RDF ($N_{125}P_{60}K_{25}$), RDF + FYM 5 t/ha, RDF+ Borax 10 kg/ha, RDF + $ZnSO_4$25 kg/ha, RDF+ Borax 10 kg/ha + $ZnSO_4$25 kg/ha, RDF + FYM 5 t/ha+ Borax 10 kg/ha, RDF + FYM 5 t/ha + $ZnSO_4$25 kg/ha, RDF + FYM 5 t/ha+ Borax 10 kg/ha + $ZnSO_4$25 kg/ha in randomized block design having three replication.The

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FYM was applied 15 days before sowing of wheat. The maximum and minimum temperature in wheat season during 2011-12 range from 35 °C to 26 °C with mean value 30 °C. The recommended dose of fertilizer 100:50:25 kg NPK/ha applied as urea, DAP and murate of potash. The half of nitrogen and full dose of phosphorus and potash, borax 10 kg/ha and $ZnSO_4$ 25 kg/ha were applied as basal and rest of nitrogen applied in two split at 23 and 45 DAS of crop. Irrigations were applied at critical stage of wheat production. Wheat was sown (var-HD 2733) of seed rate 125 kg/ha with 20 cm row spacing continuous in line. The experiment was conducted for two consecutive years in fixed plots in the same field without disturbing the layout. The crop was harvested at physiological maturity. The observation on length of spikelet, number of spikelet/spike, number of grain/spike and 1000 grain wt. parameter of crop was recorded after harvest.

The grain and straw sample were collected and dried in oven at 65±5 °C ground, digested and N determined by Kjeldhal methods with titration of absorbed ammonia by sulphuric acid and P content by yellow colour developed by vandomolybedate and reading by spectrophotometre and K concentration were estimated by flamephotometer, respectively. Plant material was digested in di-acid mixture HNO_3 and $HClO_4$ in 9:1 ratio and Zn content determined by atomic absorptionspectrophotometre. For boron estimation, the powdered plant material was dry-ashed at 550 °C for 6 hours and ash was digested in 6N HCl. The boron content determined by colour developed with help of carmine method (Hatcher and Wilcox, 1950) and colour determined by spectrophotometre. The per cent of nutrient content multiplied with biomass of crop yield for calculating of nutrient uptake. The available N (alkaline $KMNO_4$), available P (Olsen P), available K (1N NH_4OAC-K), pH, Organic carbon (Jakson 1973), Available micronutrients (Fe, Mn, Cu and Zn)by method described by Lindsayand Norvell (1978) and available boron by hot water method. The cost of cultivation was calculated by taking into account of prevailing market price of inputs and outputs. Economics was computed based on the prevailing market price of inputs.

RESULTS AND DISCUSSION

Yield Attributing Character

As perusal of data (Table 1) revealed that the maximum yield attributing character plant height (99.67 cm), length of spikelet (10.89 cm), number of spikelets/spike (17.70), number of grain/spike (34.04) and 1000 grain wt. (44.23 g) of wheat were observed with RDF application along with FYM combined with zinc and boron and minimum in over control. The yield attributing characters (length of spikelet, number ofspikelets/spike, number of grains/spike and 1000 grain wt.) of wheat was significantly higher in treatments where RDF application separately or in combination withFYM, zinc and boron over control. Similar beneficial effect of fertilizer on yield attributes of wheat has been reported by Sharma *et al* (2007). Zinc,boron and FYM application along with RDF separately could be significantly higher yield attributing characters over in RDF. This increment in yield attributing characters in term of high plant height, dry matter accumulation various root system resulted in more length of spikelet, number of spikelets/spike, number of grains/spike (grain setting) and 1000 grain wt. significantly by combined application of RDF along with FYM, zinc and boron. The increased of biological yield of wheat might be due to increased availability of essential nutrients which influenced the physical function like fertilization, grain setting, grain filling in the sikelets/ spike of wheat crop.

Grain Yield of Crop

Data of table 1 revealed that the maximum grain yield of wheat (27.23 q/ha) was obtained with recommended dose of fertilizer along with FYM, borax 10 kg/ha and $ZnSO_4$ 25 kg/ha, which was at par with RDF+ borax 10 kg/ha + $ZnSO_4$ 25 kg/ha. The combined application of RDF along with FYM (24.83 q/ha) produce 4.03q/ha more yield than obtained in RDF,which was due to that organic manure has properties to enhance soil quality by the way of increasing soil organic carbon, microbial activitymicronutrient availability and other growth promoter resultedbetter plant growth which tune make good source sink relationship and enhanced economic yield of crop.Our results confirm the finding of Nambir and Abrol (1989); Bisht (1990); Hegde and Dwivedi (1992); Sharma *et al.* (2007) and Yadav and Kumar (2009). Combination application RDF and FYM with either zinc or boron gave significantly higher by grain yield over recommended dose of fertilizer application only. The use of borax 10kg/ha and $ZnSO_4$ 25 kg/ha along with RDF produced 1.53 and 1.87 q/ha more yield than yield in RDF and response 54.0 and 56.3 per cent over control. This might be due to that boron help in pollination and interpreted in term of manufacturing more

carbohydrate and protein along with role in enhancing their translocation from the site of synthesis to the storage organ and zinc help in influencing metabolic activity by controlling auxin level, nucleic acid in growth and development of plant.

Nutrient Uptake and Economics

The maximum nutrient (Table 2) N, P K, Zn and Buptake by wheat 58.76, 12.10,57.05 kg/ha and 279.9 and 48.7 g/ha, respectively were obtained with RDF along with FYM 5 t/ha, borax 10 kg/ha and $ZnSO_4$ 25 kg/ha followed by RDF+ FYM 5 t/ha + $ZnSO_4$ 25 kg/ha application and minimum in case of control (28.40, 5.68 24.16 kg/ha and 128.9, 20.4 g/ha, respectively). The N,P,K,Zn and B uptake by grain of wheat were significantly higher in treatments where recommended dose of fertilizer application in combination with FYM, zinc and boron over RDF.

Combined application of RDF and FYM either zinc or boron gave significantly higher nutrient uptake by grain over recommended dose of fertilizer application only. Recommended dose of fertilizer application along with organic manure gave significantly higher nutrient uptake by grain of wheat than RDF,This was only due to the application of organic matter enhancedmicronutrient activity that released different organic acid which help in substitution of native soil nutrient and make available for the uptake by plant. Highest net return (Rs. 25383) was obtained in RDF + FYM 5 t/ha + borax 10 kg/ha + $ZnSO_4$ 25 kg/ha followed by RDF + FYM 5 t/ha + borax 10 kg/ha and lowest in control. Inorganic plus organic fertilizer combined with micronutrients produced more net return than only inorganic fertilizer. These results are in conformity with Bisht (1990) who reported that nutrient uptake was higher with the application of NPK along with organic manure. Highest B:C ratio (1.54) was obtained in RDF + FYM 5 t/ha followed by RDF + FYM 5 t/ha + borax 10 kg/ha and lowest in control.

Soil Properties after Harvest of Crop

Soil analysis after harvest of wheat (Table 3) revealed that combinedapplication of RDF with FYM showed significantly increase in soil organic carbon over control. The highest organic carbon in soil (0.54%) was observed under RDF with FYM, boron and zinc treatment. This may attributed to high addition of root biomass in soil as their beneficial effect on crop roots and total microbial biomass (Tolanur and Badanur, 2003). Available N content was significantly increased the soil amended with FYM, this indicate that available N was directly correlated with organic carbon build up in the soil. Available P content was significantly increased the soil amended with RDF and FYM, this indicate that available P was govern by residual effect of applied organic manure and phosphate to soil. Application of FYM, zinc and boron with RDF to wheat increased significantly available K, zinc and boron content in soil over control, this maybe due to residual effect of applied nutrient in soil and also governed positive correlation to organic carbon build up in the soil.

Table 1
Effect of FYM, Boron and Zinc on Yieldattributes and Yield of Wheat (Pool Data of Two Years)

Treatment	*Yield attributes*						
	Plant Height at maturity (cm)	*Length of spikelet (cm)*	*No of spikelet/ Spike*	*No of grain/ spike*	*1000 Grain wt. (g)*	*Grain yield (q/ha)*	*Response over RDF*
Control	79.40	5.80	9.43	21.75	40.80	14.50	-
RDF	88.83	8.32	13.52	29.12	41.83	20.80	43.4
RDF+ FYM 5 t/ha	92.50	9.93	16.14	33.53	43.00	24.83	71.3
RDF+ Borax 10 kg/ha	91.33	8.93	14.52	30.15	42.27	22.33	54.0
RDF+ $ZnSO_4$ 25 kg/ha	91.67	9.07	14.73	30.60	42.33	22.67	56.3
RDF+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	93.33	9.63	15.64	31.29	43.00	24.07	66.0
RDF+ FYM 5 t/ha+ Borax 10 kg/ha	92.90	10.33	16.77	32.25	43.17	25.80	77.9
RDF+ FYM 5 t/ha + $ZnSO_4$ 25 kg/ha	97.20	19.57	17.18	34.36	43.57	26.43	82.3
RDF+ FYM 5 t/ha+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	99.67	10.89	17.70	34.04	44.23	27.23	87.8
CD (P=0.05)	13.60	1.62	2.67	5.44	NS	4.11	-

Table 2
Effect of FYM, Boron and Zinc on Nutrient Uptake and Economics of Wheat (Pool of Two Years)

Treatment	*Uptake (kg/ha)*			*Uptake (g/ha)*		*Net return*	*B: C*
	Nitrogen	*Phosphorus*	*Potassium*	*Zinc*	*Boron*	*(Rs/ha)*	*ratio*
Control	28.40	5.68	24.16	128.9	20.4	13483	1.12
RDF	42.29	8.74	38.11	179.8	29.5	22433	1.45
RDF+ FYM 5 t/ha	50.65	10.50	48.18	195.8	33.1	24817	1.52
RDF+ Borax 10 kg/ha	45.72	9.39	44.19	180.0	31.1	24133	1.45
RDF+ $ZnSO_4$ 25 kg/ha	45.09	9.52	44.05	199.2	32.0	23267	1.29
RDF+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	48.13	10.10	45.92	228.0	39.1	24700	1.29
RDF+ FYM 5 t/ha+ Borax 10 kg/ha	53.65	10.81	48.49	225.4	44.2	25333	1.45
RDF+ FYM 5 t/ha + $ZnSO_4$ 25 kg/ha	54.33	11.23	53.50	255.9	43.1	25117	1.35
RDF+ FYM 5 t/ha+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	58.76	12.10	57.05	279.9	48.7	25383	1.28
CD (P=0.05)	9.73	1.88	11.54	42.7	7.0	-	-

Table 3
Nutrient Status of Soil after Harvest of Wheat (Pool Data of Two Years)

Treatment	*Organic carbon (%)*	*Available nutrient (kg/ha)*			*Available nutrient (ppm)*	
		Nitrogen	*Phosphorus*	*Potassium*	*Zinc*	*Boron*
Control	0.48	175.0	29.0	295.0	0.19	0.09
RDF	0.47	185.0	29.5	298.0	0.20	0.10
RDF+ FYM 5 t/ha	0.52	205.0	30.4	305.0	0.20	0.10
RDF+ Borax 10 kg/ha	0.49	180.0	29.7	295.0	0.23	0.12
RDF+ $ZnSO_4$ 25 kg/ha	0.50	190.0	29.8	300.0	0.22	0.09
RDF+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	0.51	185.0	30.0	299.0	0.21	0.11
RDF+ FYM 5 t/ha+ Borax 10 kg/ha	0.54	200.0	30.4	297.0	0.21	0.10
RDF+ FYM 5 t/ha + $ZnSO_4$ 25 kg/ha	0.54	205.0	30.6	295.0	0.23	0.10
RDF+ FYM 5 t/ha+ Borax 10 kg/ha + $ZnSO_4$ 25 kg/ha	0.54	210.0	30.7	305.0	0.24	0.13
CD (P=0.05)	0.02	9.4	1.7	4.1	0.02	0.02

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