

# RESPONSE OF CUSTOMIZED FERTILIZER ON WHEAT (*TRITICUM AESTIVUM*) UNDER CHHATTISGARH CONDITION

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## ABSTRACT

A field experiment was conducted to evaluate the effect of customized fertilizer (CF) on wheat grown under clayey soils at IGKV, Raipur during winter season 2010-11 and 2011-12. The application of 150% dose of CF produced highest grain yield of wheat (4.4 t/ha), which was 28.27% higher than that of state recommended dose (120:60:40 kg NPK ha<sup>-1</sup>). The uptake of NPKS and Zn also increased due to application of 150% dose of CF. The highest net returns (Rs. 37,676 /ha) and benefit: cost ratio (2.7) was also obtained due to application of 150% CF, which was followed by application of 125 % CF and 100% CF, respectively.

## INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important source of staple food and in food security of the century. The rice - wheat cropping system involving high yielding varieties even with recommended dose of N, P and K use, impoverishing soils in secondary and micro nutrients specially S, Zn, Mn, B and Fe. Use of high analysis fertilizers and inadequate addition of organic manures was resulting in widespread deficiencies of Zn, S and other micronutrients (Patel and Singh, 2010). The universal deficiency of nitrogen and phosphorus is followed by Zn and nearly 50% of the world soils used for cereal production is Zn deficient (Gibbson, 2006). The results of large number of experiments clearly showed that even recommended rates of NPK application based on soil test basis, the yield of crops or of the cropping system could not be maintained at higher level continuously (Ananda and Patil, 2005). The deficiency of S, Zn and Fe or Mn started emerging and limiting crop yield after different periods (Rekhi *et al.*, 2000). The decrease in productivity was observed to be associated with the new emerging problems of deficiency of micronutrients such as zinc (Zn) and of secondary nutrients such as sulphur (S). The balance nutrient supply to the crops resulted no or minimal deleterious effect on environment as well soil (Hegde *et al.*, 2007). The 'Customized Fertilizer', made up of mixing Nitrogen, Phosphorus, Potassium, Sulphur and Zinc has been tested for enhancing wheat yield. Customized fertilizers are unique and ready to use granulated fertilizers, formulated on sound scientific plant nutrition principles integrated with soil information, extensive laboratory studies and evaluated through field research (Rakshit *et al.*,

2012). The Central Fertilizer Committee has included customized fertilizers in the Fertilizer (Control) Order (FCO) 1985, as a new category of fertilizers that are area/soil/crop specific. The experiment was conducted to find out the optimum dose of customized fertilizer on wheat production by providing required nutrient (NPKS and Zn) in single way to get optimum yield with reference to Chhattisgarh condition where wheat production and productivity is low.

## MATERIALS AND METHODS

Field experiment was carried out during *Rabi* season of 2010-2011 and 2011-12 at Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The experimental soil was clayey (*Vertisols*) with pH 6.95, EC 0.52 ds/m<sup>2</sup> and available N, P and K of 190, 19 and 290 kg /ha, respectively for the year of 2010-11 and with pH 7.0, EC 0.53 ds/m<sup>2</sup> and available N, P and K of 199, 20 and 296 kg /ha, respectively for the year of 2011-12. In all seven treatments comprising of different level of customized fertilizer and quantity added through CF is given in Table 1, field experiments during both the years was laid out in randomized block design (RBD) with three replications. The Customized fertilizer (CF) grade of CF was 11:18:9:5.3:0.7% N, P, K, S and Zn (100% dose of CF), product provided by M/s Nagarjuna Fertilizers and Chemical Limited, Hyderabad. The wheat variety GW 322 during both the years was sown in first fortnight of December. The chemical analysis of the plant sample was carried out by wet digesting with HNO<sub>3</sub>:HClO<sub>4</sub> (4:1) di-acid mixture as per the procedure outlined by Jackson (1973) and to determine concentrations of N, P, K, S and Zn at harvest using procedure described by

Jackson, (1973). The analysis of variance was carried out using the randomized block design (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

The Customized fertilizer (CF) had a statistically significant effect on plant height and yield attributing characters of wheat crop (Table 2). Plant height of wheat at the harvest varied significantly due to application of different level customized fertilizer dose. Significantly highest plant height was observed with the application of 150% dose of CF ( $T_6$ ) (89.4 cm) which was on par with the level of 125% CF ( $T_5$ ) on mean basis. The maximum number of effective tillers/m<sup>2</sup> was also obtained under the treatment of 150% dose of CF ( $T_6$ ) which was statistically significant over all other treatments. The longest spikelet length, highest number of grains/spikelet and test weight were also observed under the treatment in 150% dose of CF ( $T_6$ ). The lowest value of plant height and all above yield attributing characters were recorded with the control treatment *i.e.*  $T_1$  (No fertilization). Zeidan *et al.* (2010) also reported that NPK and Zn is important growth nutrient for efficient growth and production. Similar findings were also reported by Sharma *et al.* (2013).

The application of 150% dose of CF produced the highest yield of grain (4.40 t/ha) and straw (5.56 t/ha) which was significantly superior to other level of CF an RDF. The percent increase in wheat yield over state recommended was to the tune of 8.4 %, 12.8 % and 28.2%, respectively due to application of 100% dose of CF, 125% dose of CF and 150% dose of CF. The higher grain yield may be owing to the application of sufficient nutrients in combination which resulted to greater availability of essential nutrients to plants, improvement of soil environment which facilitate in better root proliferation leading to higher absorption of water and nutrients and ultimately resulting in higher yield. Shekhon *et al.* (2012) also reported that application of higher dose of customized fertilizer produced additional grain and straw yields. The lowest grain and straw yield was observed under control treatment *i.e.*  $T_1$ . The results are in close conformity with findings of Goswami (2007) and Singh *et al.* (2012). They also reported that increasing levels of micronutrient and secondary nutrient increased wheat yield. Reddy *et al.* (2009) and Mandal *et al.* (2004) also reported superiority of combined application of N, P, K, Zn and FYM over recommended fertilizer application. The positive impact of availability of individual

plant nutrients and humic substances from balanced supplement of NPKS and Zn through inorganic fertilizers might have induced cell division, expansion of cell wall, meristematic activity, photosynthetic efficiency and regulation of water intake into the cells, resulting in the enhancement of yield parameters (Singh *et al.*, 2008).

The maximum uptake of N (117.3 kg/ha), P (21.4 kg/ha), K (150.5 kg/ha), S (96.1 kg/ha) and Zn (229.9 g/ha) were observed under 150% dose of CF ( $T_6$ ) which is statistically significant due to different doses of customized fertilizer (Table 4). These results agree with the findings of Sharshar and Said (2000) revealed that the optimum NPK fertilizer enhanced growth and yield and nutrient uptake in wheat. The higher nutrient uptake was mainly due to higher biological (straw + grain) yield. Pandey *et al.* (2007) also reported similar findings. Application of customized fertilizer helps to provide essential nutrient to get the targeted yield. This shows that NPKS and Zn combination is useful for wheat growth and yield. Singh (2006) and Das *et al.* (2003) also reported similar findings for N, P, K, S and Zn

Application gave maximum yield. The combination of NPK with micronutrient enhanced the efficiency of other micronutrient as compared to singly application of nutrient, while over supply of N may cause lodging, disease incidence and lower grain quality (Beuerlein *et al.*, 1992). Therefore, in appropriate combination of NPKS and Zn nutrient application gave maximum yield and production. The minimum uptake of NPKS and Zn was observed under control treatment ( $T_1$ ) due to no application of fertilizer. Nutrient uptake by crop is mainly a function of crop yield and nutrient concentration in grain and straw. The concentration of nutrient also increase due to NPKS and Zn customized fertilizer because of improved nutritional environment in rhizosphere and consequently in plant system (Dewal and Pareek, 2004). Choudhary *et al.* (2014) was also concluded that application of S and Zn should be used for improvement of yield and quality traits of crop.

The economic study of different doses of customized fertilizer showed that the maximum net return (Rs. 37,676 /- /ha) and B:C ratio (2.7) was withered due to 150% dose of CF ( $T_6$ ) owing to the higher yields of grain and straw. This treatment fetched Rs. 5853/- more return over 125% dose of CF ( $T_5$ ), Rs. 6558/- over 100% dose of CF ( $T_4$ ), Rs. 9013/- over RDF ( $T_7$ ). The similar findings have been also reported by Shekhon *et al.*, (2012). The minimum net return and B:C ratio was observed under treatment control due to low yield.

**Table 1: Treatment details**

Treatment	Quantity (kg/ha)	Nutrient supplied through Customized fertilizer and at basal (kg/ha)					N applied in split(kg/ha)		Total N applied (kg/ha)
		N	P	K	S	Zn	I	II	
$T_1$ : Control	0	0	0	0	0	0	0	0	0
$T_2$ : 50% dose of CF	187.5	20.6	33.75	16.9	9.9	1.3	28	28	76.6
$T_3$ : 75% dose of CF	281	30.9	50.6	25.3	14.9	2.0	42	42	114.9
$T_4$ : 100% dose of CF*	375	41.3	67.5	33.8	19.9	2.6	56	56	153.3
$T_5$ : 125% dose of CF	468.75	51.6	84.4	42.2	24.8	3.3	70	70	191.6
$T_6$ : 150% dose of CF	562.2	61.8	101.2	50.6	29.8	3.9	84	84	229.8
$T_7$ : RDF (Nutrient dose recommended for CG state)	50.0	60.0	40.0	0	0	25	25.0	100.0	

(\*100% CF dose- 375 kg/ha Customized fertilizer contains - N:P:K:S:Zn - 11:18:9:5:3:0.7 %)

**Table 3: Effect of customized fertilizer on yield and economics of wheat (*Triticum aestivum*)**

Treatment	Grain yield (t/ha)		Straw yield(t/ha)		Cost of cultivation (Rs/ha)		Net return(Rs/ha)		B:C ratio	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
T <sub>1</sub> : Control	1.70	1.48	2.36	2.02	15083	15776	5194	6241	1.5	1.3
T <sub>2</sub> : 50% CF dose	2.76	2.38	3.98	3.35	17216	17909	19084	17674	2.1	1.9
T <sub>3</sub> : 75% CF dose	3.40	3.33	4.50	3.97	18291	18984	25992	26399	2.4	2.4
T <sub>4</sub> : 100% CF dose	3.85	3.59	5.46	4.88	19349	20042	31119	31118	2.6	2.5
T <sub>5</sub> : 125% CF dose	4.18	3.56	5.58	4.64	20414	21108	34110	31823	2.7	2.4
T <sub>6</sub> : 150% CF dose	4.53	4.26	4.40	5.17	21479	22172	37525	37676	2.7	2.7
T <sub>7</sub> : RDF	3.51	3.35	4.67	4.02	17447	18140	28312	28663	2.6	2.6
SEm ±	0.11	0.18	0.09	0.21	-	-	-	-	-	-
CD at 5%	0.33	0.56	0.30	0.66	0.15	0.47	-	-	-	-

Rate of CF was taken @ Rs. 11.25/kg

**Table 2: Effect of Customized Fertilizer on growth and yield attributing characters of wheat (*Triticum aestivum*)**

Treatment	Plant height at harvest(cm)		Total effective tillers/m <sup>2</sup> (No.)		Spikelet length (cm)		Grains/ spikelet(No.)		Test weight (g)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
T <sub>1</sub> : Control	73.4	68.2	188	215	8.3	8.0	55.7	52.3	36.0	36.3
T <sub>2</sub> : 50% CF dose	81.2	77.1	250	258	8.4	8.4	69.0	61.7	36.5	36.1
T <sub>3</sub> : 75% CF dose	85.0	78.2	245	263	8.7	8.9	67.0	64.0	36.5	36.7
T <sub>4</sub> : 100% CF dose	84.1	82.8	293	315	9.2	9.2	73.3	70.0	37.0	37.8
T <sub>5</sub> : 125% CF dose	86.5	83.7	310	326	9.2	9.5	76.0	71.0	37.4	37.4
T <sub>6</sub> : 150% CF dose	92.0	86.8	371	374	9.9	10.1	78.3	74.0	37.9	37.7
T <sub>7</sub> : RDF	84.6	82.9	269	293	9.0	9.2	71.3	68.0	37.2	36.8
SEm ±	1.29	2.28	1.47	20.52	0.24	0.29	1.17	0.73	0.08	0.51
CD at 5%	4.00	7.03	4.84	63.25	0.76	0.92	3.62	2.25	0.24	1.58

**Table 4: Effect of customized fertilizer on nutrient uptake (NPKS & Zn) of wheat (*Triticum avistivum*) crop (2 year pooled data)**

Treatment	N Uptake (kg/ha)			P Uptake (kg/ha)			K Uptake (kg/ha)			Uptake (kg/ha)			Zn Uptake (g/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T <sub>1</sub> : Control	25.3	6.7	32.0	4.4	1.1	5.5	4.7	36.5	41.2	18.9	2.6	21.5	31.5	15.0	46.5
T <sub>2</sub> : 50% CF dose	43.8	13.8	57.6	7.6	2.4	10.0	8.1	68.2	76.3	32.6	5.0	37.6	66.4	27.5	93.9
T <sub>3</sub> : 75% CF dose	57.9	15.5	73.5	10.3	3.2	13.5	10.9	89.2	100.1	47.3	6.4	53.7	93.5	32.7	126.3
T <sub>4</sub> : 100% CF dose	68.3	20.8	89.1	11.9	4.2	16.2	13.1	114.4	127.5	56.1	8.6	64.8	118.8	42.1	160.9
T <sub>5</sub> : 125% CF dose	68.5	22.1	90.6	12.7	4.9	17.6	14.4	115.4	129.8	63.4	9.1	72.5	141.2	45.3	186.6
T <sub>6</sub> : 150% CF dose	90.8	26.5	117.3	15.2	6.2	21.4	18.2	132.3	150.5	85.2	10.8	96.1	174.9	55.0	229.9
T <sub>7</sub> : RDF	56.5	15.8	72.3	10.1	4.0	14.0	10.4	99.7	110.1	53.8	6.3	60.1	110.6	35.1	145.7
S <sub>Em</sub> ±	2.7	0.7	3.8	0.4	0.3	0.5	0.28	3.13	3.4	2.4	0.3	3.0	3.7	1.6	3.7
CD at 5%	8.2	2.1	11.7	1.3	0.8	1.7	0.86	9.7	10.6	7.4	0.9	9.3	11.3	4.9	11.5

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