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Research Paper

Response of chickpea (*Cicer arietinum*) to customized fertilizer under Chhattisgarh condition

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 2010–11 and 2011–12 at Raipur, Chhattisgarh, to study the effect of customized fertilizer (11 : 27 : 0 : 6.6 : 0.5% of NPKS and Zn) on performance of chickpea (*Cicer arietinum* L.). Different doses of customized fertilizer were used in the study. The customized fertilizer (CF)–combination of N, P, K, S and Zn mixture–significantly influenced yield attributes, seed yield and nutrient uptake. The highest seed yield (2.2 t/ha), stover yield (2.7 t/ha) and the highest net returns (₹42,883/ha) were obtained with the application of 150% CF dose. The uptake of N P K and Zn was also higher under this treatment. However, in terms of benefit: cost (B:C) ratio, application of 100% CF and 150% CF resulted in equal value, i.e. 2.9. Hence application of 100% CF dose can be considered as optimum, as it gave higher B:C ratio.

***Key words*:** Chickpea, Customized fertilizer, Economics, Nutrient uptake of NPKS and Zn

Chickpea is one of the important pulse crops in Chhattisgarh as well as in India, and cultivated over an area about 8.35 million ha with production of 7.17 million tonnes (www.agricoop.nic.in, and http://eands.dacnet.nic.in 2016). Generally, farmers used imbalanced and suboptimal dose of chemical fertilizers for pulse crop without considering the nutrient requirement based on soil-test value for major and micro-nutrients. As a result, a huge amount of fertilizers are being misused every year in crop cultivation (Noor *et al.*, 2008) and also poor productivity of pulse crops specially chickpea is observed in many parts of country. The importance of micronutrient in limiting crop production in several countries of the world is well recognized. Increased removal of micronutrients as a consequence of adoption of high-yielding varieties and intensive cropping together with a shift towards high-analysis NPK fertilizers has caused decline in the level of micro-nutrients in soil below that required for normal productivity of crops (Dangarwala *et al*., 1994).

The increasing nutrient and fertilizer-use efficiency is most important to decrease fertilizer applications and also to reduce environmental pollution, besides reducing cost and increasing profits from crop production. The results of large number of experiments clearly show 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. The deficiency of S, Zn and Fe or Mn started emerging and limiting crop yield after different periods. Customized fertilizers development process is complex but, is very promising. The cost of customized fertilizers is the same as that of normal fertilizers. The Central Fertilizer Committee has included customized fertilizers in the FCO 1985, as a new category of fertilizers that are area/soil/crop specific. Fertilizer (Control) Order (FCO) recognizes importance of customized fertilizers and defined as Multi-nutrient carriers designed to contain macro, secondary and/or micronutrient both from inorganic sources and/or organic sources. (Rakshit *et al*., 2012). This also calls for innovative fertilizer products, which meet the specific requirement of crop. Customized fertilizers being crop, soil and area specific show a good promise to maintain soil health by ensuring appropriate fertilization (Tiwari, 2010). Customized fertilizers facilitate the application of the complete range of plant nutrients in the right proportion and suit the specific requirements of a crop in different stages of growth and are more relevant under site-specific nutrient-management practices. Hence present investigation was undertaken to work out optimum customized fertilizer dose for chickpea under Chhattisgarh condition.

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MATERIALS AND METHODS

The field experiment was carried out during the winter (*rabi*) seasons of 2010–2011 and 2011–12 at Research-cum-Instructional Farm of the Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Weekly average meteorological data during experimentation was recorded at meteorological observatory, IGKV, Raipur, Chhattisgarh for both the years. The total rainfall of 69.8 and 54.7 mm was received during winter (*rabi*) season of 2010–11 and 2011–12 respectively. The maximum and minimum temperatures ranged in crop seasons 22.8°C to 37.9°C and 9.1°C to 20.1°C during the winter seasons of 2010–11 and 2011–12 respectively. The experimental soil was clayey (Vertisols) with neutral *p*H (6.95), electrical conductivity (EC) 0.52 dS/m^2, being low in organic carbon (0.49%), available N (199 kg/ha), S (14.3 kg/ha) and Zn (0.49 ppm), while medium in available P (19.0 kg/ha) and K (290 kg/ha). The field experiment was laid out in a randomized block design, replicated thrice, to evaluate the effect of a customized fertilizer (CF) product provided by M/s Nagarjuna Fertilizers and Chemical Limited, Hyderabad. The grade of CF (CF-26) was 11 : 27 : 0 : 6.6 : 0.5 ($N : P_2O_5 : K_2O : S : Zn$); 100% Customized fertilizer (CF-26) - 187.5 kg/ha; contains the quantities of N:P:K:S:Zn in 11 : 27 : 0 : 6.6 : 0.5% respectively, and rate of CF was taken @ ₹11.25/kg. Nitrogen was top-dressed at branching stage of crop. The variety 'Vaibhav' was used as test crop. Plant samples were analyzed for uptake of nutrient using standard laboratory procedure. The data were statistically analyzed using analysis of variance (ANOVA) as applicable to randomized block design (Gomez and Gomez, 1984). Experiments consisted of 7 treatments as per the detail in Table 1.

RESULTS AND DISCUSSION

Growth and yield attributes

Application 150% of customized fertilizer (T_6) recorded significantly highest plant height (Table 2). The number of branches was also found maximum with the same treatment (5.6), but it was at par with the treatments receiving 125% CF (T_5), 100% CF (T_4) and RDF (T_7). The minimum plant height and branches were observed with control treatment. Yield attributes were significantly influenced by different doses of customized fertilizer. Application of 150% CF (T_6) resulted in higher number of pods/plant, being at par with 125% CF (T_5) and RDF (T_7). Pod weight and grains/pod were found higher with the application of 150% CF, but in case of grains/pod found these were at par with the treatments receiving 125% CF (T_5), 100% CF (T_4) and RDF (T_7). In case of test weight, no significant differences were observed among treatments. However, the highest yield attributes were recorded with the application of 150% CF and the lowest with the control treatment. Out of 16 essential elements, pulses specially need adequate amount of P, Ca, Mg, S and Mo. Phosphorus is required for proper root growth and growth of rhizobia. Calcium and magnesium are required to stimulate growth and to increase the size of the nodules, pod formation and grain setting. Sulphur is required for nodulation and protein synthesis. Molybdenum is required for nitrogen fixation and assimilation and boron for reproduction. (Thiyagarajan *et al*., 2003). Use of CF with higher dose provides all nutrients during their growth in normal condition (Sekhon *et al.,* 2012).

Yield

Application of 150% CF resulted in significantly higher seed yield than the other treatments. The highest stover yield was also obtained with the application of 150% CF, but it was found at par with the application of 125% CF. The lowest yield was observed with the control. The NPK along with S and Zn was applied in efficient way relatively important for obtaining maximum yield and biomass. The variations in yield due to treatments could be attributed to the variations in the yield-attributing parameters. Results of customized fertilizer revealed that application of nutri-

Table 1. Treatment details with quantity of nutrient supplied in each treatment

Treatment	Quantity (kg/ha)	Nutrient supplied through customized fertilizer and at basal (kg/ha)					N applied as TD (kg/ha)	Total N applied (kg/ha)
		N	P	K	S	Zn		
T_1, Control	0	0	0	0	0	0	0	
T_2 , 50% CF	93.75	10.31	25.31	0	6.18	0.47	4.50	14.81
T_3, 75% CF	140.62	15.46	37.96	0	9.28	0.70	6.75	22.21
T_4, 100% CF	187.5	20.62	50.62	0	12.37	0.94	9.00	29.62
T_5, 125% CF	234.37	25.78	63.27	0	15.46	1.17	11.25	37.03
T_6, 150% CF	281.25	30.93	75.93	0	18.56	1.41	13.50	44.43
T_7, RDF	20.0	50.0	20.0	0	0	0	20.0	

CF, Customized fertilizer; RDF, recommended dose of fertilizer

ent singly is less beneficial than mixed combination in proper ratio which improves production. Singh (2011) also reported that application of S, Zn and other micronutrient with NPK increases the yield in pulse crop.

Nutrient uptake

Higher removal of nutrients from the soil contributed to the higher yields of the crop (Table 3). The maximum total uptake of N, P, K, S and Zn under 150% CF was significantly higher than the other treatments. Fertilization through 100% CF (T_4) resulted in more uptake of nutrients than that through recommended dose of fertilizer (RDF, T_7). The minimum uptakes of NPKS and Zn along with minimum yield were observed with the control due to no application of fertilizer. The extent of nutrient availability of the nutrients in the soil could have determined the removal of nutrients by the crop. Nutrient uptake by the crop is mainly a function of crop yield and nutrient concentration in crops; combination of nutrient (NPKS and Zn) improved nutritional environment in rhizosphere and consequently in plant growth system (Dewal and Pareek, 2004).

Economics

The increasing doses of customized fertilizer gave increasing net returns (Table 2). The maximum net returns (₹42,883/ha) was recorded owing to application of 150% CF because higher yields were recorded under this treatment. An application of 150% CF fetched ₹3,018 more return over 125% CF (T_5), ₹3,418 over 100% CF (T_4) and ₹5,674/ha than the RDF (T_7). Though the maximum dose of CF also increased the cost of cultivation, the additional cost was compensated by higher yields of the crop. Benefit: cost ratio was higher with the application 150% CF, i.e. 2.9; however, same value was computed with the application of 100% CF, hence 100% CF dose was more economical rather than 150% and other CF doses including RDF.

REFERENCES

Dangarwala, R.T., Patel, K.P., Valsamma, G., Patel, M.S., Patel, K.C. and Ramani, V.P. 1994. *Annual Report of AICRP on Micronutrients (ICAR), Gujarat Agricultural University*, Anand Campus, Anand.

Dewal, G.S. and Pareek, R.G. 2004. Effect of phosphorus, sulphur

Table 2. Effect of customized fertilizer on growth and yield-attributing characters, yield and economics of chickpea (pooled data of 2 years)

Treatment	Plant height (cm)	Branches/ plant	Pods/ plant	Pod weight (g)/plant	Grains/ pod	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Cost of cultivation ($\times 10^3$ ₹/ha)	Gross returns ($\times 10^3$ ₹/ha)	Net returns ($\times 10^3$ ₹/ha)	Benefit: cost ratio
T_1, Control	49.6	3.9	32.9	27.9	1.10	29.3	1.59	1.94	11.6	41.7	30.0	2.6
T_2, 50% CF dose	50.3	4.7	35.5	33.2	1.16	29.8	1.81	2.24	12.6	47.3	34.7	2.7
T_3, 75% CF dose	50.9	4.9	37.2	34.2	1.22	29.9	1.93	2.34	13.1	50.0	36.9	2.8
T_4, 100% CF dose	51.9	5.0	38.9	35.9	1.23	30.6	2.04	2.50	13.6	53.1	39.5	2.9
T_5, 125% CF dose	53.1	5.2	40.4	37.7	1.25	31.9	2.07	2.61	14.0	53.8	39.9	2.8
T_6, 150% CF dose	55.4	5.6	43.1	39.6	1.27	32.8	2.21	2.69	14.7	57.5	42.9	2.9
T_7, RDF	52.6	5.0	39.6	36.6	1.24	31.7	2.05	2.51	13.2	50.4	37.2	2.8
SEm±	0.53	0.19	1.28	0.57	0.01	0.75	0.04	0.04	-	-	-	-
CD (P=0.05)	1.65	0.60	3.94	1.76	0.04	NS	0.11	0.12	-	-	-	-

CF, Customized fertilizer; RDF, recommended dose of fertilizer

Table 3. Effect of customized fertilizer on nutrient uptake of chickpea as influenced (pooled data of 2 years)

Treatment	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)			S uptake (kg/ha)			Zn uptake (g/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1, Control	34.6	8.5	43.1	5.4	3.8	9.2	7.1	24.7	31.8	4.1	2.7	6.7	41.2	12.9	54.1
T_2, 50% CF dose	42.8	12.6	55.3	7.2	5.0	12.1	8.7	30.7	39.4	5.3	3.2	8.5	69.5	17.3	86.8
T_3, 75% CF dose	47.1	14.9	62.0	8.9	5.7	14.6	9.9	33.6	43.5	6.0	3.6	9.6	82.9	22.1	105.0
T_4, 100% CF dose	55.3	17.6	72.9	10.2	6.4	16.6	11.0	37.0	48.0	6.8	4.1	10.9	92.8	25.4	118.2
T_5, 125% CF dose	59.9	20.3	80.1	11.8	7.2	19.0	11.7	39.5	51.2	7.4	4.4	11.8	98.4	27.1	125.5
T_6, 150% CF dose	69.4	22.2	91.5	13.6	8.2	21.9	13.3	41.7	54.9	8.0	5.0	13.1	111.4	29.1	140.5
T_7, RDF	51.2	16.2	67.4	9.7	6.2	15.9	10.7	35.5	46.2	6.0	3.8	9.8	88.7	22.6	111.3
SEm±	2.23	0.48	2.23	0.32	0.19	0.40	0.37	0.84	1.07	0.19	0.16	0.33	3.12	0.78	3.52
CD (P=0.05)	6.89	1.50	6.88	1.00	0.60	1.24	1.16	2.61	3.31	0.59	0.51	1.06	9.61	2.40	10.85

CF, Customized fertilizer; RDF, recommended dose of fertilizer

and zinc on growth, yield and nutrient uptake of wheat (*Triticum aestivum*). *Indian Journal of Agronomy* **49**(3): 160–162.

Gomez, K. A. and Gomez, A. A. 1984. *Statistical Procedures for Agricultural Research,* pp. 108–127. A Willey Inter-science Publication-John Willey & Sons, New York, USA

Noor, S., Mahiuddin, M., Shil, N.C. and Talukder, M.R. 2008. Integrated nutrient management for tomato–okra–Indian spinach cropping pattern. (In) *Annual Research Report, 2007–2008*. Division of Soil Science, Bangladesh Agricultural Research Institute, Gazipur, pp. 108–114.

Rakshit, R., Rakshit, A. and Das, A. 2012. Customized fertilizers: Marker in fertilizer revolution. *International Journal of Agriculture Environment and Biotechnology* **5**(1): 67–75.

Sekhon, B.S., Kaur, S, and Singh, P. 2012. Evaluation of a customized fertilizer on wheat. *Indian Journal of Ecology* **39**(1): 71–75.

Singh, A.K. 2011. http://www.isric.org/sites/default/files/AKSingh.pdf.

Thiyagarajan, T.M., Backiyavathy M.R. and Savithri, P. 2003. Nutrient management for pulses – A review. *Agricultural Review* **24**(1): 40–48.

Tiwari, K.N. 2010. Relevance of customized fertilizers in the era of multi-nutrient deficiency. *Indian Journal of Fertilizer* **6**(12): 76–86.

www.agricoop.nic.in & http://eands.dacnet.nic.in. 2016. www.agricoop.nic.in & http://eands.dacnet.nic.in