

Short Communication**Impact of Nutrient Management Technologies in Chickpea under Irrigated Condition of Chandauli District, Uttar Pradesh****Y.V. Singh, S.K. Singh, Predip Dey**, Pavan Singh and S.S. Jatav**AICRP on STCR, Department of Soil Science and Agricultural Chemistry,
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Chickpea is commonly known as gram or bengal gram. Chickpea occupies about 35 per cent of area under pulses and contributes about 50 per cent of the total pulse production of India especially in Uttar Pradesh.

Several approaches have been used for fertilizer recommendation based on chemical soil test so as to attain maximum yield per unit of fertilizer use^[1, 3]. Among the various approaches, the target yield approach has found popularity in India. This method not only estimates soil test based fertilizer dose but also the level of yield the farmer can achieve with that particular dose. However, application of N, P and K fertilizer on soil test target yield based may meet the productivity but it has negative impact on soil health, hence, integrated nutrient management *i.e.* combination of inorganic and organic in chickpea crop help to enhance the barley and rice productivity while maintaining the soil health. It gives a real balance between applied nutrients and the available nutrients already present in the soil. The objective of this paper was to study the response of chickpea to manure and fertilizer application, estimate the nutrient requirement of chickpea and develop quantitative relationships to estimate

fertilizer requirement for target yield of chickpea and also discuss the economics.

On farm trials were conducted at village–Hadai, block–Naugarh of Chandauli district, Uttar Pradesh, India during *rabi* 2014-15 on alluvial soil (Inceptisol). The soil of experimental field of chickpea was sandy loam with mean value of pH 7.3, EC 0.22 dSm⁻¹, Organic carbon 2.7 g kg⁻¹ and available N, P₂O₅ and K₂O 115.35, 18.80 and 255.80 kg ha⁻¹, respectively. Quantities of nitrogen, phosphorus and potassium were calculated with the help of fertilizer adjustment equations developed by (Mishra, *et al.* 2015) as following equations.

$$FN = 5.35 T - 0.22 SN - 0.098 ON$$

$$FP_2O_5 = 3.71 T - 1.16 SP - 0.15 OP$$

$$FK_2O = 8.32 T - 0.43 SK - 0.22 OK$$

Where, T= Yield target; FN, FP and FK is fertilizer N, P₂O₅ and K₂O (kg ha⁻¹), respectively; SN, SP and SK are available N P and K of soil (kg ha⁻¹) and ON, OP and OK are available N P and K of farm yard manure (%), respectively.

Five fertilizers treatments viz., Control, Farmers practice, General recommendation dose of fertilizer, Soil test crop response (STCR) for 12 q ha⁻¹ with 5 t ha⁻¹ farm yard manure and Soil test crop response (STCR) for 16 q ha⁻¹

¹with 5 t ha⁻¹ farm yard manure in chickpea (gram) variety of test crop was Pusa-364 (Hybrid), 12 q ha⁻¹ and 16 q ha⁻¹ targeted yield were taken. The targeted yield of crop was decided as per yield potential of varieties. Pre sowing soil samples were analyzed according to the standard procedures. The chickpea (gram) variety of test crop was Pusa-364 (Hybrid) sown in the second week of November, 2014 and harvested of third week of April, 2015. The grain yield in chickpea crop was recorded after harvesting of crop. Nutrient content was determined by analyzing the entire plant sample collected randomly from each plot at harvest. Plant nutrient content were analyzed following the standard methods of N, P, and K analysis. Soil samples collected at harvest were analysed for available nitrogen, by the alkaline permanganate method, available phosphorus, by Olsen method and available potassium, by the ammonium acetate method. The economics in term of benefit cost ratio was also calculated at price prevailing in nearest market. The grain yield of chickpea, and other parameters of nutrient dynamics were subjected to standard analysis of variance (ANOVA) and treatment differences were tested following tests of least significant difference.

Grain and straw yields were found in increasing trend to that of the preceding treatments over T₁ and these were varied from 7.80 to 15.80 and 11.50 to 24.50 q ha⁻¹ respectively, among the judged treatments. Among the treatments remarkable difference was also noticed in above parameters. The extent of increase in grain yield was noted to be 12.35, 25.71, 34.73 and 50.63% over control (T₁). Similarly the increase in straw yield was recorded to be 20.68, 33.14, 41.92 and

53.06% in the preceding treatments over T₁ (control). It was observed from the Table 1 that use of organic FYM along with NPK fertilizers applied through STCR equation in T₅ treatment resulted in greater values for all the parameters under observation followed by T₃ (GRD on soil test basis) and T₁ (blanket dose of NPK without soil test) which is also mirrored by the per cent increase in grain and straw yields of chickpea in which the extent of increase was remarkably higher in the above said treatments. Application of fertilizers based on STCR equation in NPK with organic in T₅ treatment might have facilitated the applied nutrients efficiently according to the need of crop and enriched nutrient reserve in soil which lead to better content of the nutrients by the crop. The results indicate that higher yield target may be achieved through integrated supply of nutrients from different sources. Fertilizers application through STCR technology in T₄ treatment resulted in 11.95 q ha⁻¹ grain yield which was nearly 87.87% of the established target and it was appreciably higher than that of T₃ treatment (GRD). The parameters under study were substantially greater in comparison to T₁ (Blanket application of NPK without soil test) as the soil test based application of nutrients in GRD, and fulfilled the crop need to the considerable extent. The integration of inorganic with organic (FYM) was ensured the achievement of target yield of chickpea only inorganic N, P and K didn't achieve the target yield in the chick pea. Balanced nutrition to solve, through integration of both organic and chemical nutrient sources appears to be essential. It provides adequate nutrients to crop uptake which promotes chickpea growth and subsequent development of yield attributes lead to

higher yield. Target yield was not achieved exactly, showing a slight deviation from the grain yield as might be due to unavailability of the full amount of applied nutrients to plant as estimated to achieve the targeted yield. One possibility is that release of nutrients from applied fertilizer occurs spontaneously; however, subsequent uptake by plant is not taking place concurrently. Thus, entry amount of applied fertilizer could not have been up took due to lack of synchronization of its release with its absorption by plant, accounting for uncontrollable losses.

The data given in table 1 dealt with economics of chickpea cultivation under various treatments and reveal that the net benefit was remarkably higher with the STCR technology treatments. Highest benefit cost ratio was observed in T₅(STCR equation based NPK application

with FYM) with value of an additional yield of Rs.24000 followed by STCR equation based NPK with FYM application only in T₄ (Rs.12450), general recommendation dose in T₃(Rs.8100) and farmer practice T₂(Rs.3300) treatments over(control) respectively. The BC ratio was remarkably higher in STCR treatments viz. T₄ and T₅ in comparison to that of GRD, farmer practice and blanket application of NPK fertilizers. It was also observed that the BC ratio was nearly twofold in the T₄ treatment in comparison to that of farmers' practice which divulges the effective and efficient utilization of the fertilizers through STCR technology^[5]. The benefit cost ratio was significantly 2.06 and 2.98 higher in T₄ and T₅, where FYM was integrated with ST-TY based application of NPK compared to T₁, T₂ and T₃ treatments (table-1).

Table 1: Yield and economics of verification trails for chickpea crop

Treatments	Fertilizer dose NPK (kg ha ⁻¹) and FYM (t ha ⁻¹)	Actual mean yield (q ha ⁻¹)	Actual mean straw yield (q ha ⁻¹)	Additional yield (kg ha ⁻¹)	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
T ₁ -Control	0-0-0	7.80	11.50	-	-	-	-	-
T ₂ - FP	10-20-15	8.90	14.50	110	3300	1693	1607	0.95
T ₃ - GRD	20-40-30	10.50	17.20	270	8100	3386	4714	1.39
T ₄ -12q ha ⁻¹	19-16-13-5	11.95	19.80	415	12450	4072	8378	2.06
T ₅ .16q ha ⁻¹	40-29-46-5	15.80	24.50	800	24000	6035	17965	2.98
LSD (P=0.05)	-	0.120	0.309	-	-	-	-	-

Note: Chickpea@Rs.30.00/kg, N@Rs.17.39/kgP₂O₅@Rs.56.25/kg, K₂O@Rs.26.66/kg, FYM@Rs.0.50/ha.

Aminer modification was made in the ready reckoner, FP: Farmers practice i.e. the fertilizer doses the farmers generally applied in the area, GRD: General recommendation of agricultural department of the district on the basis of soil test value, B: C ratio: benefit cost ratios.

The higher nutrient content (3.60) N, (0.92) P and (1.06) K in chickpea grain and (1.82) N, (0.58) P, (2.30) K in chickpea straw was recorded under T₅ superior than other treatments (table 2). The lowest uptake of nutrients under treatment T₁ it is no application of fertilizer by (NPK nutrients). Available

nutrients status was also higher in T₄ and T₅ where FYM was applied. When we apply FYM in soil the entire amount of its NPK constituents was not made available at a time in one season; rather, a gradual release took place over a period of years. It has been reported that only 25% to 30% N, 16% to 70% P, and 75% K could be made

available from applied FYM in first season rice and the remainder being available in subsequent years. Hence, comparatively less yield deviation under integrated nutrients management was attributed to

slow but sustained release of nutrients and due to improvement in humic substances in soil, which in turn promotes the NPK status.

Table 2: Nutrients content of grain and straw in chickpea after harvest of different treatments

Treatments	Fertilizer dose NPK (kg ha ⁻¹) and FYM (t ha ⁻¹)	Grain Percent content			Straw Percent content		
		N	P	K	N	P	K
T ₁ -Control	0-0-0	1.67	0.43	0.54	1.19	0.14	1.38
T ₂ . FP	10-20-15	2.10	0.54	0.65	1.37	0.27	1.79
T ₃ - GRD	20-40-30	2.54	0.74	0.80	1.52	0.36	1.98
T ₄ -12 q ha ⁻¹	19-16-13-5	2.74	0.87	0.93	1.70	0.43	2.41
T ₅ -16 q ha ⁻¹	40-29-46-5	3.60	0.92	1.06	1.82	0.58	2.30
LSD (P=0.05)	-	0.155	0.021	0.074	0.040	0.016	0.102

Note: A minor modification was made in the ready reckoner, FP: Farmers practice i.e. the fertilizer doses the farmers generally applied in the area, GRD: General recommendation of agricultural department of the district on the basis of soil test value.

The average value of the soil physicochemical properties and fertility parameters (before sowing and after crop harvest) given in table 3 indicates that initially the soils were neutral in reaction with average pH 7.3 and low in soluble salts (0.22 dSm⁻¹) which was observed to be neutral with less soluble salt concentration after chickpea crop in *rabi* season in all the treatments. The organic carbon content which was earlier measured low (0.27%) in the experimental fields before sowing, increased in all the treatments except control in 2014-15. The organic carbon content was noticed to be remarkably high in STCR treatments especially in T₅. The soils were very low in N (115.35 kg ha⁻¹), medium in P₂O₅ (18.80 kg ha⁻¹) and high in K₂O (255.80 kg ha⁻¹) before chickpea sowing. The available N

increased in all the treatments except control, however, the remarkable rise was observed in STCR treatments as it arose in low category from very low and it varied from 180 to 200 kg ha⁻¹. The P and K status also improved in all the treatments except T₂ (farmers' practice) in case of K and T₂ in case of P. Despite higher removal of nutrients, the fertility status was maintained in STCR-INM as compared to the general recommendation and farmer practice. This might be attributed to the prevention of losses of nutrients under INM, even after meeting the crop needs. Greater profit consistent with maintenance of soil fertility status was realized when fertilizer was applied for appropriate yield targets in succession over years using STCR-INM concept^[2,4] established that soil test based fertilizer prescription for beet root was found to be

useful in increasing yield and also maintained soil fertility. The higher values of these parameters were noted in STCR treatments especially in T₅ due to use of FYM which helped in increasing P; however, the availability class in the soil for these parameters remained as such. These results suggest that the specific yield based on STCR equation not only optimizes the T₅ crop yield to the desired level but maintains the better soil health which is a prime factor for sustainable

crop production. The above findings suggest that STCR technology may be the appropriate approach for optimum nutrient supply which improves the soil properties especially the soil health and productivity in a long run in comparison to T₅ over T₂. The results indicated that the integrated nutrient supply with inorganic fertilizers through STCR approach is necessary for both productivity and sustainability and it also results in higher net benefit and BC ratio.

Table 3: Available nutrient status of soil before sowing and after harvest of chickpea crop

Treatments	Physiochemical properties						Fertility status(kg ha ⁻¹)					
	pH		EC(dSm ⁻¹)		OC (%)		N		P ₂ O ₅		K ₂ O	
	BS	AH	BS	AH	BS	AH	BS	AH	BS	AH	BS	AH
T ₁ -Control	7.3	7.4	0.22	0.26	0.27	0.20	115.35	95	18.8	21.0	255.8	224.3
T ₂ . FP	7.3	6.9	0.22	0.29	0.27	0.30	115.35	143	18.8	18.2	255.8	258.4
T ₃ - GRD	7.3	7.1	0.22	0.20	0.27	0.34	115.35	157	18.8	19.6	255.8	247.8
T ₄ -12 q ha ⁻¹	7.3	7.2	0.22	0.17	0.27	0.41	115.35	180	18.8	22.1	255.8	262.2
T ₅ -16 q ha ⁻¹	7.3	6.9	0.22	0.20	0.27	0.50	115.35	200	18.8	24.7	255.8	265.5
LSD (P=0.05)	-	0.01	-	0.002	-	0.01	-	3.50	-	0.75	-	6.59

Note:Aminer modification was made in the ready reckoner, FP: Farmers practice i.e. the fertilizer doses the farmers generally applied in the area, GRD: General recommendation of agricultural department of the district on the basis of soil test value, BT- Before sowing, AH- After crop harvest.

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