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Nutrient Management for Chick pea Using Soil Test Target Yield Equation

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Abstract

The present study was conducted at farmer field of Sri Vinod Kumar Kharwar in Hadai village of Naugarh block in Chandauli district during the year 2014-15, to study the effect of soil test crop response technology on yield and economics of Chick pea. The target yield of chickpea 12 q ha^{-1} achieved with application of N:P:K as 19:16:13 along with 5 t ha^{-1} farm yard manure (FYM) and target yield of 16 q ha^{-1} is achieved with application of N:P:K as 40:29:26 along with 5 t ha^{-1} farm yard manure (FYM). Under farmers condition of chick pea cultivation B:C ratio is 1.84, under general recommendation of agriculture. Department of the district. On the basis of soil test value condition of chick pea cultivation B:C ratio is 1.57, and under STCR for 16 q ha^{-1} in chick pea variety test crop condition is B:C ratio is 3.37. The nutrient uptake by crop and soil nutrients status was higher after harvest of chickpea cultivation when NPK were applied with FYM. Hence combination of organic (FYM) and inorganic fertilizer could achieve target yield and maintain the soil fertility status.

Key words: *Chickpea, target yield, soil test crop response, Nutrient uptake, FYM and Economics etc.*

Introduction

Chickpea is commonly known as gram or Bengal gram. This is the most important pulse crop in India. Chickpea is grown by 22 states and 02 union territories of Dadar & Nagar Haveli and Delhi. 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 Utter Pradesh after Madhya Pradesh and Rajasthan. The area and production of chickpea in Uttar Pradesh are 5.05 lakh hectare and 3.78 lakh tonnes respectively. Chickpea productivity in Utter Pradesh region is about 748.51 kg ha^{-1}. About 38% of the total production of country is from Uttar Pradesh and maximum in Kanpur district (Agriculture and Cooperation Report, Ministry of Agriculture, Government of India 2011 - 12). With the development of high yielding and fertilizer responsive varieties of almost all crops escalated the indiscriminate use of fertilizer thus increases cost of cultivation and environmental pollution. Balanced fertilizer application in a cropping system is pre-requisite for sustainable production system as well as appropriate soil nutrient resilience. With the development of high yielding and fertilizer responsive varieties of almost all crops escalated the indiscriminate use of fertilizers thus increases cost of cultivation and environment pollution. Hence, need based estimation of N, P and K correlating their requirement with specific target yield depending on their native soil status may fit to balanced application of NPK fertilizers. The 'target yield equation' (TYE) is considered as a soil and fertilizer based precision farming strategy to meet nutrient demands for a specified yield.

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.

Materials and Methods

The on farm testing trials were conducted at farmer field of Sri. Vinod Kumar Kharwar in village – Hadahi, block - Naugarh of Chandauli district, Uttar Pradesh, India during year *rabi* 2014-15. Soil samples (0-15 cm in depth) were collected, dried and passed through 2 mm sieve and analyzed for physico-chemical properties. Available nitrogen, by the alkaline permanganate method, available phosphorus, 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 fibre yield of barley, grain yield of rice, 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 (LSD) at statistical significance level of $P \leq 0.05$.

Five fertilizer treatments viz. Control, Farmers practice, General recommendation dose of fertilizer, Soil test crop response (STCR) for 12 q ha^{-1} and Soil test crop response (STCR) for 16 q ha^{-1} 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 analysed according to the standard procedures. Quantities of nitrogen, phosphorus and potassium were calculated with the help of fertilizer adjustment equations developed as follows:

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

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

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

Where - T = Yield target (t ha^{-1}); F.N. = Fertilizer N (kg ha^{-1}); $F.P_2O_5$ = Fertilizer P (kg ha^{-1}); $F.K_2O$ = Fertilizer K (kg ha^{-1}); SN = Soil available nitrogen (kg ha^{-1}); SP = Soil available phosphorus (kg ha^{-1}); SK = Soil available potassium (kg ha^{-1}); FYM = Farm yard manure (q/ha^{-1}); ON = Organic Nitrogen (kg ha^{-1}); OP = Organic Phosphorus(kg ha^{-1}) and OK = Organic Potassium (kg ha^{-1})

The crop received one third N and full dose of P_2O_5 and K_2O as basal application and remaining half N were applied and 27 days after sowing in chickpea (gram) crop. Remaining nitrogen was applied at panicle initiation stage. Nitrogen was applied through urea and phosphorus through single super phosphate and potassium through muriate of potash. The chickpea (gram) variety of test crop was Pusa – 364 (Hybrid). The same variety was used in STCR treatment and other treatments.

Table 1 Economics of Verification Trails for chickpea crop at Village-Hadahi, Naugarh Chandauli (U.P.)

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	Actual mean pulse 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	7.60	10.50	-	-	-	-	-
T_2-FP	10-20-15	9.20	14.20	160	4800	1693	3107	1.84
T_3-GRD	20-40-30	10.50	17.20	290	8700	3386	5314	1.57
T_4-12 q ha^{-1}	19-16-13-5	18.65	18.65	450	13500	4072	9428	2.32
T_5-16 q ha^{-1}	40-29-46-5	123.60	23.60	880	26400	6035	20365	3.37
LSD (P=0.05)		0.206	0.245					

Note: Chickpea@Rs.30.00/kg N@Rs.17.39/kg P_2O_5@Rs.56.25/kg, K_2O@Rs.26.66/kg, FYM@Rs.0.50/ha

A miner 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, FYM: Farm yard manure, B: C ratio: benefit cost ratios

Table 2 Nutrients Uptake by Grain and straw in chickpea crop after different treatments.

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	Nutrient uptake by Grain(kg ha^{-1})			Nutrient uptake by Straw (kg ha^{-1})		
		N	P	K	N	P	K
T_1-Control	0-0-0	1.59	0.42	0.53	1.45	0.13	1.26
T_2 _ FP	10-20-15	2.15	0.56	0.68	2.03	0.26	1.76
T_3 - GRD	20-40-30	2.52	0.74	0.80	2.52	0.36	2.18
T_4 – 12q/ha	19-16-13-5	5.80	1.36	1.45	2.83	0.41	2.46
T_5 _ 16q/ha	40-29-46-5	39.42	10.38	9.88	3.68	0.56	3.18
LSD (P=0.05)		0.230	0.027	0.034	0.010	0.013	0.015

Note: A miner 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, FYM: Farm yard manure, B: C ratio: benefit cost ratios

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

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	pH	EC (dSm^{-1})	OC (%)	Available nutrient status (kg ha$^{-1)}$		
					N	P	K
Initial soil status		7.2	0.32	0.55	202	18.50	198
T_1-Control	0-0-0	7.0	0.31	0.53	192	16.50	186
T_2 _ FP	10-20-15	7.3	0.30	0.58	198	17.2	190
T_3 - GRD	20-40-30	7.2	0.33	0.64	209	17.5	197
T_4 – 12q/ha	19-16-13-5	7.4	0.34	0.68	215	18.2	205
T_5 _ 16q/ha	40-29-46-5	7.4	0.36	0.72	233	19.5	216
LSD (P=0.05)		0.168	0.015	0.018	0.214	0.157	0.734

Note: A miner 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, FYM: Farm yard manure, B: C ratio: benefit cost ratios

Results and Discussion

Soil characteristics

The soil was alluvial (Inceptisol) in reaction with initial nutrient status before chick pea sowing that are pH 7.2, organic carbon content 0.55% and Electrical conductivity is 0.32 dSm^{-1} soil is medium in available nitrogen 202 kg ha^{-1}, medium in available phosphorus 18.50 kg ha^{-1} and medium in available potassium 198 kgha^{-1} in Table 3. Though these soils are considered to be most fertile, they are medium in nitrogen and humus but moderately supplied with phosphorus and potassium.

Yield targeting of chickpea based on soil test

Experimental data on follow up trail as frontline demonstration, for the location during the period 2014-15 was conducted in farmer's field. From the field experiment the basic data on nutrient requirement for producing one quintal grain yield of chickpea, percent contribution of nutrients from soil (%CS) and fertilizer (%CF) were evaluated. These basic parameters were used for developing the fertilizer prescription equations under NPK alone. The target yield of chick pea 12 qha^{-1} was achieved with application of NPK based on soil test target yield (ST-TY) equation along with 5 t/ha of FYM (T_4). The 100% NPK application on T_3- GRD achieved only 87.5% of target chick pea yield. The

integration of inorganic with organic (FYM) was ensured the achievement of target yield of chick pea only inorganic N, P & 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 chick pea growth and subsequent development of yield attributes lead to higher yield[1,2]. Target yield was not achieved exactly, showing a slight deviation from the grain yield was 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 benefit cost ratio was significantly 2.32 and 3.37 higher in T_5 and T_4, where FYM was integrated with ST-TY based application of NPK compared to T_1, T_2 and T_3 treatments (table-1). The combination of inorganic and organic resulted in higher productivity of chick pea was also reported earlier[3,4,5,6].

Nutrition uptake and its status in soil:

The higher nutrient uptake (39.42 N, 10.38 P and 9.88 K kg ha^{-1}) by chick pea grain and (3.68 N, 0.56 P, 3.18 K kg ha^{-1}) by chick pea straw was recorded under T_5 superior than other treatments (table-2). The lowest uptake of nutrients under T_1 it is no application of nutrients. Available nutrients status was also higher in T_5 and T_4 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 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

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