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An Evaluation of Chick Pea (*Cicer arietinum*) Crop Yield through Nutrient Management in Dry Land Condition of Bundelkhand, (UP), India

Aditya Kumar Singh[1*] and H.S. Kushwaha[2]

[1]Deendayal Research Institute, Krishi Vigyan Kendra, Chitrakoot (UP), India
[2]Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (MP), India

**Corresponding author*

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A B S T R A C T

The study was conducted at farmer field of Sri Brijraj Singh village Titihara of Karwi block in Chitrakoot district during the year 2016-17, to study the effect of soil test crop response technology on yield and economics of Chick pea. The yield of Chick pea 13.55 q/ha achieved with application of N: P: K as 19:16:13 along with 5.5 t/ha farm yard manure (FYM) and yield of 17.86 q/ha is achieved with application of N: P: K as 40:29:26 along with 5.5 t/ha farm yard manure (FYM). Cultivation of Chick pea under farmers condition B: C ratio is 1.58, under general recommendation of agriculture. On the basis of soil test value condition of Chick pea cultivation B: C ratio is 1.79, and under SRTC for 17.86 q/ha in Chick pea variety test crop condition is B: C ratio is 7.90. 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 maximum yield and maintain the soil fertility status.

Introduction

Chick pea is commonly known as Bengal gram or gram. This is the most important pulse crop in India. Chickpea occupies about 35 percent 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 Chick pea in Uttar Pradesh are 5.05 lakh hectare and 3.78 lakh tonnes respectively. Chick pea productivity in Utter Pradesh region is about 755.50 kg/ha. About 39% of the total production of country is from Uttar Pradesh and maximum in districts of Bundelkhand. 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. Hence, need based estimation of N, P and K correlating their requirement with specific yield depending on their native soil status may fit to balanced application of NPK fertilizers. The 'yield equation' (YE) is considered as a soil and fertilizer based precision farming strategy to meet nutrient demands for a specified yield.

The objective of paper was to study the response of Chick pea to manure and fertilizer application, estimate the nutrient requirement of Chick pea and develop quantitative relationships to estimate fertilizer requirement for targeted yield of Chick pea and also discuss the economics.

Materials and Methods

The on farm testing trails were conducted at farmer field of Sri Brijraj Singh village Titihara of Karwi block in Chitrakoot district, Uttar Pradesh, during year rabi 2016-17. Soil samples (0-15 cm in depth) were collected, dried and passed through 2 mm sieve and analyzed for physico - chemical properties.

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 recommended doses of fertilizers, Soil test crop response (STCR) for 13.55 q/ha and Soil test crop response (STCR) for 17.86 q/ha in Chick pea (gram) variety of test crop was Pusa –1103 (HYV), 13.55 q/ha and 17.86 q/ha yield were taken. The 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); F.N. = Fertilizer N (kg/ha); $F.P_2O_5$ = Fertilizer P (kg/ha); $F.K_2O$ = Fertilizer K (kg/ha); SN = Soil available nitrogen (kg/ha); SP = Soil available phosphorus (kg/ha); SK = Soil available potassium (kg/ha); FYM = Farm yard manure (q/ha); ON = Organic Nitrogen (kg/ha); OP = Organic Phosphorus(kg/ha) and OK = Organic Potassium (kg/ha).

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 30 days after sowing in Chick pea 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 Chick pea variety of test crop was Pusa – 1103 (HYV). The same variety was used in STCR treatment and other treatments.

Results and Discussion

Soil characteristics

The soil was loamy sand 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, medium in available phosphorus 18.50 kg/ha and medium in available potassium 198 kg/ha 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 2016-17 was conducted in farmer's field.

Table. 1 Economics of Verification Trails for chickpea crop at Village-Titihara, Chitrakoot (UP)

Treatments	Fertilizer dose NPK (kg ha) and FYM (t / ha)	Actual mean pulse yield (q / ha)	Actual Mean straw^{-1} yield (q / ha)	Additional yield^{-1} (kg / ha)	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
T_1-Control	0-0-0	7.85	10.50	-	-	-	-	-
T_2-FP	10-20-15	9.10	14.70	125	4375	1693	2682	**1.58**
T_3-GRD	20-40-30	10.55	17.20	270	9450	3386	6064	**1.79**
T_4-13.55 q/ha	19-16-13-5.5	16.65	16.65	880	30800	4072	26728	**6.56**
T_5-17.86 q/ha	40-29-46-5.5	23.21	23.21	1536	53760	6035	47725	**7.90**
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) and FYM (t/ha)	Nutrient uptake by Grain(kg/ha)			Nutrient uptake by Straw (kg/ha)		
		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_4-13.55 q/ha	19-16-13-5.5	5.80	1.36	1.45	2.83	0.41	**2.46**
T_5-17.86 q/ha	40-29-46-5.5	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) and FYM (t/ha)	pH	EC (dSm^{-1})	OC (%)	Available nutrient status (kg/ha)		
					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_4-13.55 q/ha	19-16-13-5.5	7.4	0.34	0.68	215	18.2	**205**
T_5-17.86 q/ha	40-29-46-5.5	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.

From the field experiment the basic data on nutrient requirement for producing one quintal grain yield of Chick pea, 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 targeted yield of Chick pea 13.55 q/ha was achieved with application of NPK based on soil test targeted yield (ST-TY) equation along with 5.5 t/ha of FYM (T_4). The 100% NPK application on T_3- GRD achieved only 87.5% of targeted Chick pea yield. The integration of inorganic with organic (FYM) was ensured the achievement of targeted yield of Chick pea only inorganic N, P and K didn't achieve the targeted 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. 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 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 taken 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.

Nutrition uptake and its status in soil

The higher nutrient uptake (39.42 N, 10.38 P and 9.88 K kg/ha) by Chick pea grain and (3.68 N, 0.56 P, 3.18 K kg/ha) 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 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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