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EFFECT OF SOIL TEST BASED FERTILIZER APPLICATION ON YIELD AND ECONOMICS OF CHICK PEA IN INCECTISOL

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ABSTRACT

Field experiments were conducted during rabi 2014-15 on farmer's fields in Jharigawan (Chandauli) village in Uttar Pradesh to study the response of soil test based fertilizer application. The treatment included control, general recommendation dose, FP (farmer practice), soil test crop response (STCR) based fertilizer dose for a target yield of 12 and 16 q ha^{-1}. Results indicated that the achievement of the targeted yield were obtained within more or less 5% variation proving the validity of the equation for prescribing fertilizer dose for chick pea. At all locations, mean highest achievement was recorded in the yield target of 16 q ha^{-1} (82.2%) followed by 12 q ha^{-1} (37.2%) over farmer's practise. The maximum benefit: cost ratio (2.54 and 2.98) at first location, (2.13 and 3.20) at second location and (2.13 and 3.20) at third location were obtained obtained with soil test value (STCR treatments T_4 and T_5). STCR also maintained the soil available plant nutrients. Thus, for obtaining maximum gain and sustain the soil fertility, application of plant nutrients as per soil test value (STCR) is essential.

***Key words*:** Target yield, chickpea, economics, soil fertility

INTRODUCTION

Chickpea (*Cicer arietinum*) 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. The area and production of chickpea in Uttar Pradesh are 5.25 lakh hectare and 3.98 lakh tonnes respectively. Chickpea productivity in Utter Pradesh is about 756.51 kg ha^{-1}. About 38.25% of the total production of country is from 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. Among the various approaches, the target yield approach has been found to be beneficial which recommends balanced fertilization considering available nutrients status in the soil and the crop needs. 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 organics helps to enhance the crop productivity while maintaining the soil health (Ghosh, 2008, Sharma *et al.,* 2015). It gives a real balance between applied nutrients and the available nutrients already present in the soil. Keeping the above facts in view and non availability of quantitative study of fertilizers requirements based on target yield for chickpea in Indo-Gangetic plains of Uttar Pradesh this study was conducted. The objective of this study was to assess 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.

MATERIALS AND METHODS

On farm trials were conducted at village–Jharigawan, block - Naugarh of Chandauli district, (Uttar Pradesh) during *rabi* 2014-15 on alluvial soil (Inceptisol). The soil of experimental field was sandy loam with pH 7.9, EC 0.28 dSm^{-1}, organic carbon 3.2 g kg^{-1} and available N, P and K 157, 16 and 134 kg ha^{-1}, respectively. Quantities of nitrogen, phosphorus and potassium were calculated with the help of fertilizer adjustment equations developed by (Singh *et al.,* 2014). 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}),

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FYM = Farmyard manure (q ha^{-1}), ON = Organic nitrogen (kg ha^{-1}), OP = Organic phosphorus (kg ha^{-1}) and OK = Organic potassium (kg ha^{-1}).Five fertilizers treatments viz., control, farmers practice, general recommendation dose of fertilizer, soil test crop response (STCR) for 12 q ha^{-1} and STCR for 16 q ha^{-1} in chickpea 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. The chickpea Pusa – 364 (Hybrid) was sown in the second week of November, 2014 and harvested in third week of April, 2015. The grain yield of chickpea crop was recordedat harvest. Soil samples were collected at harvest and analyzed for available N by alkaline permanganate method, available P by Olsen's method and available K by flame photometer (Jackson, 1973). The economics in term of benefit cost ratio was also calculated at price prevailing in nearest market.The data 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≤ 0.05 (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Target Yield

. The treatment T_1 produced lowest yield (740, 735 and 735) kg ha^{-1} at all three sites as compared to STCR fertilizer treatments. At all the sites, the actual yield obtained was around ±5% from targeted yield. The use of fertilizer and organic manure on the basis of soil test value produced significantly higher yield as compared to blanket application. Combination of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining better soil fertility. These finding clearly indicated that the highest crop response in term of yield was obtained with the application of sub optimal dose of NPK and farmyard manure and it was superior than other treatments. Thus, the balanced use of fertilizer either alone or in combination with FYM is necessary for sustaining soil fertility and productivity of crop. Singh *et al.,* (2014) and Sharma *et al.,* (2015) also reported that integrated nutrient management showed significant influence on productivity of crops.

Economics

The results (Table 1) showed that the yield targets of 12 and 16 q ha^{-1} were achieved. The higher yield and profits were observed under 16q ha^{-1} yield target of chickpea followed by 12q ha^{-1} target yield treatment. On an average, highest net profits of Rs 17965, Rs 19315 and Rs 19315 ha^{-1} were recorded at site 1, 11, 111, respectively under 16q ha^{-1} yield target of chickpea.

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

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	Actual mean grain yield (kg ha^{-1})	Actual mean straw yield (kg ha^{-1})	Additional yield (kg ha^{-1})	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
			Location - I					
T_1-Control	0-0-0	740	1180	-	-	-	-	-
T_2-FP	10-20-15	880	1440	140	4200	1693	2507	1.48
T_3-GRD	20-40-30	1070	1750	330	9900	3386	6514	1.92
T_4-12 q ha^{-1}	19-16-13-5	1220	1960	480	14400	4072	10328	2.54
T_5-16 q ha^{-1}	40-29-46-5	1540	2350	800	24000	6035	17965	2.98
			Location - II					
T_1-Control	0-0-0	735	1150	-	-	-	-	-
T_2-FP	10-20-15	850	1350	115	3450	1693	1757	1.04
T_3-GRD	20-40-30	1050	1720	315	9450	3386	6064	1.79
T_4-12 q ha^{-1}	19-16-13-5	1160	1880	425	12750	4072	8678	2.13
T_5-16 q ha^{-1}	40-29-46-5	1580	2420	845	25350	6035	19315	3.20
			Location – III					
T_1-Control	0-0-0	755	1180	-	-	-	-	-
T_2-FP	10-20-15	850	1420	115	3450	1693	1757	1.04
T_3-GRD	20-40-30	1050	1620	315	9450	3386	6064	1.79
T_4-12 q ha^{-1}	19-16-13-5	1160	1780	425	12750	4072	8678	2.13
T_5-16 q ha^{-1}	40-29-46-5	1580	2250	845	25350	6035	19315	3.20

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

The corresponding B:C ratios were 2.98, 3.20 and 3.20. Fertilizer application based on targeted yield approach was found to be superior to as per soil test treatment and farmer practice. An increase in profits over control was observed with increasing yield targets from 12 to 16q ha^{-1} which might be due to efficiency factor tended to increase with with increase in crop yields. Thus targeted yield 16 q ha^{-1} was found most economic treatment as compared to farmer practices and general recommendation. Similar results were also reported by Singh *et al.,* (2014); Ramakrishna *et al.,* (2005) and Sharma and Singhal (2014). 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, B: C ratio: benefit cost ratios

Soil fertility

In general, the p^H of soil decreased from initial mean value of 7.9 at all the three sites. The p^H of soil of all the locations ranged between 7.5 and 7.8 (Table 2). The lowest soil p^H value was observed under soil test crop response (STCR) for 16 q ha^{-1} at all experiment sites. On the otherhand, the highest soil p^H value was recorded in control. This may be due to the production of organic acids during decomposition of organic matter. Similar views were expressed by Singh *et al.,* (2014). The effect of treatment on EC was found to be non significant but it increased slightly with increasing doses of fertilizer. The electrical conductivity ranged between 0.24 and 0.45 dSm^{-1}. The highest soil electrical conductivity was observed under soil test crop response (STCR) for 16 q ha^{-1}. Similar results were expressed by Thakur *et al.,* (2011).The organic carbon content increased in all the treatments except control. The organic carbon content was noticed to be remarkably high in STCR treatments and lowest in the T_1 (Table 2). The organic carbon content of soil increased significantly and attained maximum value in treatment T_5 at all farmer's plot. Contribution from root stubble could also be expected to follow the same trend. Similar resilts were expressed by Thakur *et al.,* (2011).

Table 2: Post harvest soil fertility by various treatments for Chickpea of Jhariyawan Village

Treatments	pH	EC (dSm^{-1})	OC (g kg^{-1})	Fertilizer (kg ha^{-1})		
				N	P	K
Location - I						
Initial status	7.90	0.29	3.2	157	17	135
T_1-Control	7.80	0.30	3.0	160	20	140
T_2-FP	7.70	0.33	4.5	163	22	145
T_3-GRD	7.65	0.32	5.8	175	29	155
T_4-12 q ha^{-1}	7.73	0.39	5.4	180	32	170
T_5-16 q ha^{-1}	7.63	0.45	5.9	200	35	185
LSD (P=0.05)	0.04	0.003	0.05	0.81	0.25	0.67
Location - II						
Initial status	7.85	0.28	3.1	155	15	130
T_1-Control	7.65	0.27	2.9	157	19	135
T_2-FP	7.75	0.25	3.4	162	22	145
T_3-GRD	7.63	0.26	4.0	174	25	165
T_4-12 q ha^{-1}	7.70	0.28	4.5	180	29.5	170
T_5-16 q ha^{-1}	7.63	0.30	4.9	195	32	180
LSD (P=0.05)	0.07	0.005	0.03	0.77	0.48	0.56
Location – III						
Initial status	8.00	0.27	3.3	159	16	138
T_1-Control	7.77	0.25	3.1	165	20	145
T_2-FP	7.75	0.27	3.7	170	22	155
T_3-GRD	7.66	0.26	3.6	190	25	175
T_4-12 q ha^{-1}	7.74	0.33	4.4	200	32	180
T_5-16 q ha^{-1}	7.60	0.37	4.5	211	38	195
LSD (P=0.05)	0.05	0.006	0.0.2	0.66	0.45	0.65

Though, these soils are considered to be most fertile, they are deficient in nitrogen and humus but moderately supplied with phosphorus and potassium. In post harvest soil available N, P and K status was build up and maximum amount of available NPK were noted under soil test based fertilizer recommendation. The higher amounts of available N at all the three sites were recorded under 16q ha^{-1} yield target treatment followed by 12q ha^{-1} target yield treatment. The minimum amounts of available N were recorded under control. Application of STCR (16 and 12q ha^{-1}) based fertilizer significantly increased the amounts of available P in soils of all the three sites over control. This increase in available P may be attributed to increased availability of P in soil under 16q ha^{-1} target yield treatment.

From these studies, it is possible to make fertilizer recommendation for chickpea to the farmers considering their financial conditions. Thus targeted yield approach is superior to the present method based on soil testing for chickpea in inceptisol.

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