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Effect of Soil Test Crop Response Technology on Yield and Economics of Chick pea in Chandauli district of Uttar Pradesh

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Abstract

The present study was conducted in five locations of Naugarh block in Chandauli district to study the soil test crop response technology on yield and economics of Chick pea in Jhariyawan village, Chandauli district in an Inceptisoil. Results revealed that targeted yield of chickpea was achieved by using the plant nutrients on the basis of targeted yield concept (soil test crop response technology). The percent increase in yield was 9.24 and 34.54 % at first location, 11.86 and 36.96 % at second location, 10.34 and 34.79 % at third location, 11.57 and 33.40 % at fourth location and 13.55 and 34.61 % at fifth location, over general recommendation dose of fertilizer. Comparatively higher income on all locations was obtained in treatment where plant nutrients were applied as per soil test value (STCR treatment). This technology 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 technology) is essential.

Key words: *Target yield, soil test crop response, B:C ratio*

Introduction

Chickpea is commonly known as Chick pea (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). 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[6, 12]. This method not only estimates soil test based fertilizer dose but also the level of yield the farmer can achieve with that particular dose. The basic data required for formulating fertilizer recommendation using this approach are nutrient requirement for a unit grain yield, nutrient contribution from soil i.e., nutrient supplying capacity of soil and the nutrient contribution from fertilizer *i.e.*, recovery efficiency of fertilizer nutrient. Quantitative fertilizer requirements based on this approach have been estimated for specific yield target of crops like rice and wheat[1,12]. It has potential in modifying the soil physical properties and improving crop yields and has become an important part of integrated nutrient supply system in developing countries. Recommendations based on soil test crop response correlation concept are more quantitative, precise and meaningful because combined use of soil and plant analysis is involved in it. 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 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.

Materials and Methods

The on farm testing trials were conducted in village–Jharigawan, block - Naugarh of Chandauli district, Uttar Pradesh, India during year *rabi* 2014-15 on alluvial soil (Inceptisol). Soil samples (0-15 cm in depth) were collected, dried and passed through 2 mm sieve and analyzed for physico chemical properties using standard methods[2,3,5,11]. Five fertilizers 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 analyszed according to the standard procedures. Soil resource inventory of the study area in given in the table 1. Quantities of nitrogen, phosphorus and potassium were calculated with the help of fertilizer adjustment equations as follow.

$FN = 5.35\ T – 0.22\ SN- 0.098ON$

$FP_2O_5 = 3.71\ T –1.16\ SP- 0.15OP$

$FK_2O = 8.32\ T – 0.43\ SK- 0.22OK$

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})

ON = Amount of Nitrogen thorough FYM (kg ha^{-1})

OP = Amount of Phosphorus thorough FYM (kg ha^{-1})

OK = Amount of Potassium thorough FYM (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 Physico-chemical properties of the experimental area

Locations	Physico chemical properties			Fertility status		
	pH	EC (dSm^{-1})	OC (%)	Av-N (kg ha^{-1})	Av-P (kg ha^{-1})	Av-K (kg ha^{-1})
Location-I	7.0-7.6	0.30-0.39	0.45-0.71	180	16.50	170
Location-II	7.0-7.3	0.30-0.34	0.50-0.71	185	14.50	178
Location-III	7.0-7.5	0.30-0.36	0.40-0.71	182	15.50	180
Location-IV	7.0-7.3	0.29-0.39	0.45-0.71	180	15.50	178
Location-V	7.0-7.5	0.30-0.38	0.50-0.71	182	15.50	180
Location-VI	6.8-7.3	0.30-0.38	0.43-0.71	184	13.50	180

***** Av = Available

Table 2 Economics of Verification Trails for chickpea crop

Treatments	Fertilizer dose NPK (kg ha^{-1}) and FYM (t ha^{-1})	Actual mean yield (kg ha^{-1})	Actual mean straw yield (kg/ha)	Additional yield (kg ha^{-1})	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
	Location - I: Name and Tribe – Smt.Govind H/O.Shiv charan and Kharwar, Village-Jhariyawan							
T_1-Control	0-0-0	790	1160	-	-	-	-	-
T_2 - FP	10-20-15	920	1350	130	3900	1693	2207	1.30
T_3 - GRD	20-40-30	1080	1660	290	8700	3386	5314	1.57
T_4 – 12q/ha	19-16-13-5	1190	1900	400	12000	4072	7928	1.95
T_4 - 16q/ha	40-29-46-5	1650	2300	860	25800	6035	19765	3.28
	Location - II: Name and Tribe – Smt.Rinjar and Chero, Village-Jhariyawan							
T_1-Control	0-0-0	780	1150	-	-	-	-	-
T_2-FP	10-20-15	890	1350	110	3300	1693	1607	0.95
T_3-GRD	20-40-30	1040	1620	260	7800	3386	4414	1.30
T_4-12 q ha^{-1}	19-16-13-5	1180	1880	400	12000	4072	7928	1.95
T_4-16 q ha^{-1}	40-29-46-5	1630	2350	850	25500	6035	19465	3.23
	Location - III: Name and Tribe – Smt.Ramshakhi and Kharwar, Village-Jariyawan							
T_1-Control	0-0-0	760	1140	-	-	-	-	-
T_2-FP	10-20-15	890	1400	130	3900	1693	2207	1.30
T_3-GRD	20-40-30	1040	1790	280	8400	3386	5014	1.48
T_4-12 q ha^{-1}	19-16-13-5	1160	1900	400	12000	4072	7928	1.95
T_4-16 q ha^{-1}	40-29-46-5	1595	2310	835	25050	6035	19015	3.15
	Location - VI: Name and Tribe – Sri.Ghurbhari Singh and kharwar, Village - Jariyawan							
T_1-Control	0-0-0	740	1100	-	-	-	-	-
T_2-FP	10-20-15	890	1320	150	4500	1693	2807	1.66
T_3-GRD	20-40-30	1070	1620	330	9900	3386	6514	1.92
T_4-12 q ha^{-1}	19-16-13-5	1210	1950	470	14100	4072	10028	2.46
T_4-16 q ha^{-1}	40-29-46-5	1610	2320	870	26100	6035	20065	3.32
	Location – V: Name and Tribe –Smt. Devraj and Kharwar, Village - Jariyawan							
T_1-Control	0-0-0	790	1050	-	-	-	-	-
T_2-FP	10-20-15	890	1250	100	3000	1693	1307	0.77
T_3-GRD	20-40-30	1020	1620	230	6900	3386	3514	1.04
T_4-12 q ha^{-1}	19-16-13-5	1180	1880	390	11700	4072	7628	1.87
T_4-16 q ha^{-1}	40-29-46-5	1560	2250	770	23100	6035	17065	2.83

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, B: C ratio: benefit cost ratios.

Results and Discussion

Yield targeting of* chickpea *based on soil test

Experimental data on follow up trails as frontline demonstration, for each location during the period 2014-15 were conducted in farmers field and are given in Table 2. From the field experiment the basic data on nutrient requirement for producing one quintal grain yield of chickpea, per cent 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 nutrient requirement of N, P_2O_5 and K_2O were 6.26, 1.12 and 3.78 kg q^{-1} of grain yield, respectively. The per cent contribution of nutrients from soil and fertilizers were found to be 25.41 and 117.03 for N, 40.99 and 35.42 for P_2O_5 and 19.67 and 45.47 for K_2O, respectively. It was noted that contribution of potassium from fertilizer for wheat was higher in comparison to soil. This high value of potassium could be to the interaction effect of higher doses of N, P coupled with priming effect of starter K doses in the treated plots,

which might have caused the release of soil potassium form, resulting in the higher uptake from the native soil sources by the crop[1,7].

Target yield of 12 and 16 q ha^{-1} has been achieved with comparatively lower application of N and P_2O_5 fertilizers but higher application of K_2O, in comparison to doses applied in farmer's practice and soil based recommendations. As for example in the alluvial soil of West Bengal, In the winter season highest rice yield was 6.0 t/ha regardless of the N level used but could be raised to 7.4 t/ha with increased application of K fertilizers[13]. This is probably due to the higher N use efficiency as well as increased N recovery by crop under increased K application[4]. Yield targets of 12 and 16 q ha^{-1} for Chickpea Pusa – 364 (Hybrid) were achieved in table 2 from the expected yield targets in all the cases. In all sites, grain yields of chickpea through general recommendation (GRD) of fertilizers lagged behind the yield obtained at 12 and 16 q ha^{-1} fixed target. These results accorded with the findings of Singh *et al.,* (2014)[8] and Singh *et al.,* (2015)[9]. Between the two targets tried, targeting for 45 q ha^{-1} recorded relatively higher response ratio than with 35 q ha^{-1} though it has also recorded higher yields. This might be due to the better use efficiency of applied NPK fertilizers at low yield target levels[4,9,10].

However for efficient utilization of applied fertilizer some other parameters like soil pH, organic carbon status status etc. should also be considered, since these are the major determining factors of soil nutrient retention. This is for the development of an effective fertilizer schedule as well as nutrient supply source in view of the better nutrient absorption and assimilation by the plants.

The study will help to make guidelines for the amount of fertilizer used in chickpea cultivation. The specific yield equation based on soil health will not only ensure sustainable crop production but will also steer the farmers towards economic use of costly fertilizer inputs depending on their financial status and prevailing market price of the crop under consideration.

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References

1. Ahmed, S., Raizuddin, M. and Krishna Reddy, P.V. (2002). Optimizing fertilizer doses for rice in alluvial soils through chemical fertilizers, farm yard manure and green manure using soil test values. Agropedology, 12, 133-140.
2. Hanway, J.J. and Heidal, H. (1952). Soil analysis methods asused in Iowa state college soil testing laboratory. Lowa State College of Agriculture Bulletin, 57, 1-31.
3. Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi.
4. Marschner, H. (1995). Mineral nutrition of higher plants. Academic Press. London.
5. Olsen, S.R., Cole, C.V., Frank, S.W. and Dean, L.A. (1954) Estimation of available phosphorus by extraction with sodium bicarbonate. United States Department of Agriculture Circular number, 939.
6. Ramamoorthy, B., Narasimham, R.L. and Dinesh, R.S. (1967). Fertilizer application for specific yield targets of sonora - 64 wheat. Indian Farming, 17, 43-45.
7. Ray, P. K., Jana, A. K., Maitra, D. N., Saha, M. N., Chaudhury, J., Saha, S. and Saha, A. R. (2000). Fertilizer prescriptions on soil test basis for jute, rice and wheat in a typic ustochrept. Journal of Indian Society of Soil Science, 48, 79-84.
8. Singh, Y.V. and Singh, S.K. (2014). Fertilizer prescription for targated yield of rice (Oryaza Sativa L var. Saryu-52) in and Inceptisol of Varanasi. Indian Journal of Ecology, 41(2),282-285.
9. Singh, Y.V., Dey, Pradip., Singh, S.K. and Kumar, Mukesh. (2015). Impact of soil

test crop response technology on yield and economics of wheat in Chandauli district of Uttar Pradesh. Technofame - a journal of multidisciplinary advance research, 1, 52 - 56.

10. Singh, Y.V., Sharma P.K. and Meena, R. (2014). Effect of Soil Test Crop Response Technology on Productivity and Economics of Rice crop of Varanasi district of Uttar Pradesh. Journal of Rural and Agricultural Research, 14(01), 77-80.
11. Subbiah, B.V. and Asija, G.I. (1956). A rapid procedure for determination of available nitrogen in soils. Current Science, 31, 196-198.
12. Subba Rao, A., Srivastava, S. and Singh, K. N. (2002) Proceedings of the symposium on statistical modals for optimizing nutrients recommendations for cropping system. Journal of Indian Society of Agriculture Statistics, 55 (2), 232-250.
13. Tiwari, K.N. (2002). Nutrient management for sustainable agriculture. Journal of Indian Society of Agriculture Statistics, 50, 374-397.