

## Original Research Article

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## Stimulus Effect of Nutrient Management Techniques with STCR in Field Pea Crop Cultivation under Irrigated Condition of Chandauli District, Uttar Pradesh, India

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### ABSTRACT

A study is conducted through Soil test Crop Response based (STCR) for the desired yield targets of pea in an alluvial soil of two different locations of a village- Persiya, block- Naugarh in Chandauli district during Rabi season 2017. For testing of developed fertilizer prescription equation is necessary to demonstrate the effectiveness of technology delivery to the farmers field. To evaluate the validation of fertilizer prescription, experiment was set-up in two locations of Chandauli district, Uttar Pradesh. Soil samples of the selected crop field locations are studied initially for analyzing available N, P, K, EC, pH and organic matter status. Treatments were included as control, farmer practices, general recommended dose of fertilizer and STCR based fertilizer dose with 5 t ha<sup>-1</sup> FYM for targeting yield 15 and 20 quintal per hectare (q ha<sup>-1</sup>). The treatments were applied and cultivation practices were carried out periodically and the grain yield was recorded after harvest. With using data on grain yield and fertilizer doses applied, percent increment in yield and benefit cost (B:C) ratio were determined. The results of the experiments indicated that in two locations, the percent achievement of the targeted yield was within ±10% variation proving the validity of the equations for prescribing integrated fertilizer doses for pea. The highest percent increment in yield was recorded in the yield target of 20 q ha<sup>-1</sup> (39.43 percent) followed by 15 q ha<sup>-1</sup> (9.59 percent) over recommended dose of fertilizers (RDF). The highest mean grain yield recorded in STCR with 5 t ha<sup>-1</sup> FYM was 20 q ha<sup>-1</sup> (1962.5 kg ha<sup>-1</sup>). The highest benefit: cost ratio recorded in T<sub>5</sub> treatment (20 q ha<sup>-1</sup>) was 5.45 followed by T<sub>4</sub> treatment (15 q ha<sup>-1</sup>) was 4.32. The fertilizer prescription equations developed for pea can be recommended for alluvial soil (Inceptisol) of eastern Uttar Pradesh for achieving a yield target of 20 q ha<sup>-1</sup> with higher economic return.

#### Keywords

STCR, Fertilizer,  
Pea, B:C ratio,  
Yield target

#### Article Info

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## Introduction

Field pea (*Pisum sativum* L.) is a leguminosae family crop and commonly known as 'Matar' in India. It is widespread pulse crop in the world as like in India. It is consumed as green and yellow pea as a vegetable and pulse respectively. It contributes in human diet with protein (27.8%), complex carbohydrates (42.65%), vitamins, minerals, dietary fibers and antioxidant compounds (Urbano *et al.*, 2003). The field peas are distributed in Asia, Africa, Europe, North America, Australia, China, Russian Fed, Ukraine, India, Ethiopia, France, Canada and USA, these are the leading field Pea producing countries contributing approximately 75% to the total global production. India is the second largest producer of pea in the world after Russia (Negi *et al.*, 2004). The pea is full of nutrition because its grain is Pea is the third most important pulse crop at global level, after dry bean and chickpea and third most popular rabi pulse of India after chickpea and lentil. Uttar Pradesh is the major field pea growing state producing 60 % of country's produce. There is no doubt, for increasing the crop production, fertilizer is one of the most essential agricultural inputs. Soil testing is now being accepted as a technique for recommending the fertilizer doses for various crops in India. But it would be beneficial only when it is based on right knowledge about the management practices with the interactions of these factors like soil, crop-variety, fertilizer and climate. (Kanwar, 1971). Use of plant nutrients based on soil test helps to get higher response ratio and benefit-cost ratio as the nutrient are applied in proportion to the magnitude of the deficiency of particular nutrient and the correction of the nutrients imbalance in soil helps to connect the synergistic effects of balanced fertilization (Rao and Srivastava, 2000). Soil test and crop response (STCR) method is created on soil contribution and yield level and used for

recommending fertilizer dose. In 1967, All India Co-ordinated Research Project on STCR, the targeted yield concept is being widely followed. Targeted yield approach was first developed by (Trough, 1960) and (Ramamurthy *et al.*, 1967). The IPNS based STCR equations are useful and decisive step towards appropriate dose of chemical fertilizers in combination with the decomposed manures.

## Materials and Methods

To assess the validation of fertilizer prescription equation for pea developed by STCR model, field experiments were carried out in two different location of two farmers field of alluvial soil of Utter Pradesh. Experiments were set up at two locations in Persiya village, Naugarh block of Chandauli district, Utter Pradesh. Initial soil samples were collected from each location and analyzed for pH determination through 1:2.5 soil-water suspensions by potentiometer method (Jackson, 1973). Electrical conductivity was determined by using Conductivity Bridge (EC meter) and expressed in  $\text{dSm}^{-1}$  (Jackson, 1973). Organic carbon through titration method (Walkley and Black, 1934), available nitrogen (N) by alkaline permanganate method (Subbiah and Asija, 1956), phosphorus by Olsen-P reagent (Olsen *et al.*, 1954), potassium (K) by normal ammonium acetate method (Hanway and Heidal, 1952). The initial soil fertility status for different locations is shown in Table 1. Fertilizer prescription equations developed for pea under STCR- IPNMS on eastern plain zone of Utter Pradesh by (Kumar *et al.*, 2018), are given below:

$$\text{Nitrogen dose (kg ha}^{-1}\text{)} = \text{FN} = 4.15 \text{ T} - 0.27 \text{ SN} - 0.09 \text{ ON}$$

$$\text{Phosphorus dose (kg ha}^{-1}\text{)} = \text{FP} = 3.18 \text{ T} - 2.08 \text{ SP}_2\text{O}_5 - 0.12 \text{ OP}_2\text{O}_5$$

Potassium dose ( $\text{kg ha}^{-1}$ ) =FK=  $4.31 T - 0.32 \text{SK}_2\text{O} - 0.14 \text{OK}_2\text{O}$

Where, T=Grain yield target in  $\text{q ha}^{-1}$ ; SN, SP and SK are available N, P and K through soil in  $\text{kg ha}^{-1}$  whereas ON, OP and OK are N, P and K supplied through FYM in  $\text{kg ha}^{-1}$  respectively. The treatments executed were as follows: (i) Control( $T_1$ ), (ii) Farmer's Practices( $T_2$ ), (iii) General Recommended Dose( $T_3$ ), (iv) STCR based fertilizer dose with  $5 \text{ t ha}^{-1}$  FYM for an yield target of  $15 \text{ q ha}^{-1}$ ( $T_4$ ) and (v) STCR based fertilizer dose with  $5 \text{ t ha}^{-1}$  FYM for an yield target of  $20 \text{ q ha}^{-1}$ ( $T_5$ ). Based on the initial soil test values of available N, P and K and the quantities of N,  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  supplied fertilizer doses were calculated and suggested for STCR treatments for various yield targets.

Full dose of N,  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  were applied initially and other packages of practices were carried out periodically. Using the data on grain yield and fertilizer doses applied, the parameters viz., B:C ratio was worked out based on the price of the produce and cost incurred for the cultivation as per the standard procedure.

### Results and Discussion

The highest mean grain yield between the two farmers field were recorded in the treatment

STCR20q  $\text{ha}^{-1}$ ( $1962.5 \text{ kg ha}^{-1}$ ) followed by STCR15q  $\text{ha}^{-1}$ ( $1542.5 \text{ kg ha}^{-1}$ ), GRD ( $1407.5 \text{ kg ha}^{-1}$ ) and farmer practices ( $1075 \text{ kg ha}^{-1}$ ) indicating that the STCR treatment with  $5 \text{ t ha}^{-1}$  FYM was recorded relatively higher yield over GRD and Farmer's practices (Table 3). Lowest yield recorded in controlled ( $965.0 \text{ kg ha}^{-1}$ ) compare to all other treatments. STCR20q  $\text{ha}^{-1}$  recorded a yield increase of 39.43% over general recommendation dose of fertilizer. All the treatments are significantly different in which STCR 20q  $\text{ha}^{-1}$  receive highest mean yield. In the two verification trials, the per cent achievement of the targeted yield was within  $\pm 10\%$  variation proving the validity of the equations for prescribing integrated fertilizer doses for pea. In STCR 20 q  $\text{ha}^{-1}$  (Rs.33718), which was highest net benefit found followed by STCR 15q $\text{ha}^{-1}$  (Rs.18760), GRD (Rs.14314) and farmer practices (Rs.3507). Highest B:C ratio was recorded in STCR 20 q  $\text{ha}^{-1}$  (5.45) followed by STCR 15 q  $\text{ha}^{-1}$  (4.32). So STCR treated field performed best overall viz., higher yield, net benefits and B:C ratio compare to others treated field due to balanced supply of nutrients from fertilizer, efficient utilization of applied fertilizer nutrients in the presence of organic sources and the synergistic as well as beneficial effect of the conjoint addition of several sources of nutrients (Singh, 2019 and Singh *et al.*, 2017).

**Table.1** Initial soil fertility status of the different locations of Village-Persiya, Naugarh block in district Chandauli

Locations	Farmers Name	pH	E.C. ( $\text{dSm}^{-1}$ )	OC (%)	Avai. N ( $\text{kg ha}^{-1}$ )	Avai. P ( $\text{kg ha}^{-1}$ )	Avai. K ( $\text{kg ha}^{-1}$ )
1.	Smt. Kishmati Devi w/o Shri Ramlakhan	7.28	0.41	0.71	182.00	20.90	179.90
2.	Smt. Prabhawati w/o Shri Ganesh	7.30	0.42	0.68	178.20	21.20	181.00

**Table.2** Treatments of fertilizer doses ( $\text{kg ha}^{-1}$ ) imposed under different locations of Village-Persiya, Naugarh block in district Chandauli

Treatments	Location 1			Location 2		
	N	P	K	N	P	K
<b>Control</b>	0	0	0	0	0	0
<b>Farmer's practice</b>	10	20	15	10	20	15
<b>GRD</b>	20	40	30	20	40	30
<b>STCR15 q ha<sup>-1</sup></b>	19	27	20	19	27	20
<b>STCR20 q ha<sup>-1</sup></b>	40	43	41	40	43	41

Where: GRD – General Recommended Dose and STCR-Soil Test Crop Response

**Table.3** Grain yield, net benefits and B: C ratio of pea crop under different locations of Village-Persiya, Naugarh block in district Chandauli

Treatments	Grain yield ( $\text{kg ha}^{-1}$ ) Locations		Mean ( $\text{kg ha}^{-1}$ )	Increment in yield over $T_1$ ( $\text{kg ha}^{-1}$ )	Value of additional yield (Rs.)	Cost of fertilizer (Rs.)	Net benefit (Rs.)	B/C ratio
	1	2						
<b>T<sub>1</sub>-0-0-0</b>	985	945	965.0	-	-	-	-	-
<b>T<sub>2</sub>-10 -20 - 15</b>	1,115	1075	1095.0	130	5200	1693	3507	2.07
<b>T<sub>3</sub>-20 - 40 - 30</b>	1,415	1400	1407.5	442.5	17700	3386	14314	4.23
<b>T<sub>4</sub>- 19 - 27- 20-5</b>	1,555	1530	1542.5	577.5	23100	4340	18760	4.32
<b>T -40 - 43 - 41-5</b>	1,995	1930	1962.5	997.5	39900	6182	33718	5.45
<b>C.D at 5%</b>	3.989	4.223		-	-	-	-	-

**Note:** Pea @Rs.40.00/kg, N@Rs.17.39/kg, P<sub>2</sub>O<sub>5</sub>@Rs.56.25/kg, K<sub>2</sub>O@Rs.26.66/kg

T<sub>1</sub> – Control, T<sub>2</sub>- Farmer's Practices, T<sub>3</sub>- GRD (General recommended Dose)

T<sub>4</sub>- Target yield ( $1500 \text{ kg ha}^{-1}$ ) with FYM  $5 \text{ t ha}^{-1}$  and T<sub>5</sub>- Target yield ( $2000 \text{ kg ha}^{-1}$ ) with FYM  $5 \text{ t ha}^{-1}$

**Table.4** Post-harvest soil fertility status of various treatments under different locations of village-Persiya, Naugarh block in district Chandauli

Treatments	Location 1			Location 2		
	N	P	K	N	P	K
<b>Control</b>	211	16.2	192	209	16.5	190
<b>Farmer's practice</b>	224	18.3	201	223	17.2	198
<b>GRD</b>	237	19.1	203	228	18.4	203
<b>STCR 15 q ha<sup>-1</sup></b>	241	19.7	211	233	19.8	211
<b>STCR 20 q ha<sup>-1</sup></b>	246	21.9	214	241	21.5	213
<b>CD at 5%</b>	3.97	2.07	4.23	6.47	1.56	4.78

Where: GRD – General recommended dose and STCR-Soil test crop response

Post-harvest soil values revealed that a sufficient build up and maintenance of SN, SP and SK are found under STCR study compare to farmer practices and general recommended dose. Despite removal of higher amount of nutrient in STCR treatment due to getting a higher yield, higher post-harvest soil fertility was observed in STCR plot. The highest post-harvest soil nitrogen, phosphorus and potassium found in STCR for 20 q ha<sup>-1</sup> were 246.00 kg ha<sup>-1</sup>, 21.90kg ha<sup>-1</sup> and 214 kg ha<sup>-1</sup> in location-1, respectively shown in table 4. Higher consistent profit with maintaining soil fertility status was realized when fertilizer was applied for suitable yield targets in succession over years using STCR concept (Singh *et al.* 2015). The greater buildup of nutrient in STCR treated field was due to balance application of chemical fertilizer in conjoint with organic manure source. Combination of FYM organic source with fertilizers improved the chemical and physical properties, which led to enhance and sustainable crop production.

On the basis of results of experiment which we found, we can say that the study will help to make guidelines for the amount of fertilizer used in field pea 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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