

Evaluation of Fertilizer Doses for Kharif Brinjal (*Solanum melongena* L.) through Soil Test Crop Response Approach in Mollisols of Uttarakhand

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PB and SS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author PB managed the analyses of the study. Authors LB, PKP and SK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A Field experiment was conducted at N. E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar (Latitude 29°N, Longitude 79°30' E and Altitude 243.84 m above MSL) during kharif season of 2018-19 in Mollisols of Uttarakhand, India for brinjal through Soil Test Crop Response (STCR) to recommend desired fertilizer nutrients. In the Initial phase of the investigation the artificially fertility gradient was setup to create heterogeneity in experimental soil for the test crop. Further, in second phase response of brinjal to selected combinations of three levels of FYM (0, 10 and 20 t ha⁻¹), four levels of nitrogen (0, 60, 120 and 180 kg N ha⁻¹), four levels of phosphorus (0, 30, 60 and 90 kg P₂O₅ ha⁻¹) and four levels of potassium (0, 30, 60 and 90 kg K₂O ha⁻¹) in different soil fertility strips was also worked out in a Fractional Factorial Design (Latin

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Square type). Using the data of soil analysis, nutrient uptake and yield the basic data for fertilizer prescription were computed. Fertilizer adjustment equations were generated with the help of basic data. Fertilizer prescription equation helps in evaluating fertilizer requirement for kharif brinjal at different soil test values and yield targets as per farmers' economic conditions. Before their use by soil testing laboratories/farmers, the equations must be verified at farmer's field.

Keywords: Soil test crop response; kharif brinjal; fertilizer prescription equation.

1. INTRODUCTION

In India, vegetables contribute for about an area of 10.10 million hectares with an annual production of 185.88 million metric tonnes and the productivity of 17.3 metric tonnes per hectare [1]. Due to better response brinjal (*Solanum melongena* L.) is grown in tropical and subtropical region of the world. In Uttarakhand, cultivation of brinjal is carried out in an area of about 2.33 thousand hectares with production of about 27.12 thousand tonnes [2]. Brinjal is the cheapest source of nutrient, as it contains 92.70 g moisture, 1.4 g protein, 0.30 g fat, 0.30 g minerals, 0.30 g fiber, 4.0 g carbohydrates, 18.0 mg calcium, 18.0 mg oxalic acid, 47.0 mg, phosphorus, 2.0 mg potassium, 124 I.U., Vitamin A, 0.11 mg riboflavin and 12.0 mg vitamin C per 100 g of edible portion [3].

Brinjal have high moisture content and is being used widely in countries for making various culinary dishes due to better absorption of oil. Apart from this brinjal contain glycoalkaloid which possess medicinal properties. The glycoalkaloid contents in the Indian commercial cultivars vary from 0.37-4.83 mg 100 g⁻¹ fresh weight [4]. Fertilizer is one of the important resources required for production of vegetables. Fertilizers fulfil the crop need for nutrient in order to carry out the growth and development cycle of crops. With rising population the demand for food is also rising this is creating the pressure on food production, for which farmers are using ample amounts of fertilizer. Application of fertilizer without taking into consideration the fertility status of the soil leads to deterioration of soil health.

Soil test crop response approach helps in assessment of fertilizer dose for a particular season and particular area on the basis of initial soil fertility status and crop response in terms of nutrient uptake and yield. The target yield concept is based on quantitative idea of the fertilizer need in accordance with yield and nutritional requirement of the crop, the percent contribution of the soil available nutrient and that of the applied fertilizer [5]. Keeping in mind above view, the present

investigation was worked out to recommend judicious and economic application of fertilizer under Soil Test Crop Response approach for brinjal crop in kharif season.

2. MATERIALS AND METHODS

2.1 Experimental Site

A field experiment was conducted during kharif season 2018-2019 at N. E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India situated at the foothills of the shivalik range of the Himalayas at 29°N latitude, 79°29' E longitude and an altitude of 243.84 m above the MSL, to investigate the response of soil and applied nutrients for optimization of fertilizer doses in brinjal. The initial soil sampling was done from experimental field and analyzed for various soil parameters and are depicted in Table 1.

2.2 Climate of Area

The climate of this area is humid, sub-tropical with hot and dry summers and cool winters. Monsoon season usually begins from third week of June and extends up to last week of September. Few downpours are generally received during winter season (November to March), of which approximately 70 percent of it is received during rainy season.

2.3 Experimental Design and Soil-plant Analysis

The experiment was conducted in three phases, i.e. Fertility gradient experiment in first phase in which an exhaust crop Oats (*Avena sativa*) was grown during *Rabi* season on November 2017 to stabilize fertility gradient in the field so as to create variation in the experimental field. Fertility gradient was established by applying no fertilizer in first strip and application of 100 kg N, 100 kg P₂O₅ and 100 kg K₂O ha⁻¹ in second strip and 200 kg N, 200 kg P₂O₅ and 200 kg K₂O ha⁻¹ in third strip, respectively.

One month before transplanting, the seedling of brinjal was raised in nursery. When the seedlings reached height of about 10-15 cm at two-three leaf stage, they were transplanted to main field. In second phase, during kharif season 2018-19 test crop brinjal was transplanted on month of august 2018 as per layout and different doses of nutrient were applied (Table 2). The experimental area comprised of three strips with 24 plot in each strip resulting 72 (24x3) total plots in a Fractional Factorial Design (Latin Square type). Before transplanting soil samples were collected from 72 plots upto 0-15 cm depth and were analyzed in the laboratory. All the cultural operations were followed, which are required for cultivation of brinjal. The sources of nutrient applied were urea in two split doses half as basal dose at the time of transplanting and remaining half 30 days after transplanting for nitrogen, whereas for phosphorus and potassium full basal dose was applied during transplanting in form of single super phosphate and muriate of potash. Farm Yard manure was applied as basal prior to transplanting. From all the 72 plots soil samples were collected and analyzed for alkaline KMnO_4 -N [10] Olsen's-P [11] and ammonium acetate extractable-K [12]. At harvesting the plant and fruit samples were also collected, dried and then processed and analyzed for total N, P and K content. The data of these analyzed nutrients

obtained from soil and plant analysis were worked out to calculate the basic data viz., nutrient requirement (NR), per cent contribution from soil (CS), fertilizer (Cf), FYM (Cf_y) and fertilizer and FYM (Cf^f). In third phase verification experiment was conducted to validate the fertilizer prescription equations for brinjal in a particular region.

2.4 Basic Data Calculation

The basic data was calculated with help of data obtained from soil and plant analysis. Using this basic data fertilizer prescription equations [16] were developed for kharif brinjal as follows:

2.4.1 Nutrient requirement for production of one quintal of economic produce

$$\text{Nutrient requirement (NR)} = \frac{\text{Nutrient uptake (Kg)}}{\text{Fruit yield (q)}}$$

The values were reported as kg of nitrogen (N), phosphorus (P) and potassium (K) required for producing one quintal of Brinjal. Nutrient requirements were calculated separately for individual plot and then averages were taken for nutrient in question.

Table 1. Physicochemical properties of soil

S. No	Property	Value obtained	Method employed
1.	Textural analysis		Bouycos Hydrometer method [6]
	Sand (%)	54.42	
	Silt (%)	33.76	
	Clay (%)	11.82	
	Textural class	Sandy loam	USDA textural triangle
2.	pH (1:2.5 soil water suspension)	6.99	Glass electrode pH meter [7]
3.	Electrical Conductivity (dS m^{-1})	0.23	Bower and Wilcox method[8]
4.	Organic carbon (%)	0.79	Walkley and Black method [9]
5.	Available nitrogen (kg N ha^{-1})	147.32	Alkaline KMnO_4 method [10]
6.	Available phosphorus (kg P ha^{-1})	16.97	Olsen's extraction method [11]
7.	Available potassium (kg K ha^{-1})	142.33	Neutral 1 N NH_4OAc extraction method [12]
8.	P fixing capacity (%)	80.08	Waugh and Fits [13]
9.	K fixing capacity (%)	49.10	Waugh and Fits [13]
10.	Zn (ppm)	1.13	DTPA [14]
11.	Cu (ppm)	1.126	DTPA [14]
12.	Fe (ppm)	50.23	DTPA [14]
13.	Mn (ppm)	13.88	DTPA [14]
14.	B (ppm)	1.27	Hot water soluble Boron [15]

Table 2. Levels of N, P₂O₅, K₂O and FYM used for the experiment on Kharif Brinjal

Levels	FYM (t ha ⁻¹)	N (kg ha ⁻¹)	P ₂ O ₅ (kg ha ⁻¹)	K ₂ O (kg ha ⁻¹)
0	0	0	0	0
1	10	60	30	30
2	20	120	60	60
3	-	180	90	90

2.4.2 Contribution of nitrogen, phosphorus and potassium from soil (Cs)

Efficiency of soil nutrients was calculated from soil test values of unfertilized plots (control plots).

$$\text{Percent contribution of available nutrient from soil (Cs)} = \frac{\text{Total uptake of nutrient in control plot}}{\text{Soil test value of that nutrient in control plot}} \times 100$$

2.4.3 Contribution of concerned nutrient from fertilizer without FYM (cf)

The efficiency of fertilizer was calculated from the plots treated without FYM

Percent contribution of nutrient from fertilizer (Cf) =

$$\frac{\text{Total uptake of nutrients (kg/ha) in fertilizer and FYM treated plots} - \text{Soil test values of nutrients in fertilizer and FYM treated plots} \times \text{CS} / 100}{\text{Fertilizer dose (N/P/K) applied (kg/ha)}} \times \frac{\text{Nutrient added (kg/ha) through FYM}}{\text{CfYM}} \times 100$$

2.4.4 Contribution of nitrogen, phosphorus and potassium from FYM (cfym)

The efficiency of FYM for any nutrient was calculated from those plots treated with FYM (6 plots)

Percent contribution of nutrient from FYM =

$$\frac{\text{Total uptake of nutrients (kg/ha) in only organic manure treated plots} - \text{Soil test values of nutrients in only organic plots} \times \text{CS} / 100}{\text{organic manure nutrients dose (N/P/K) applied (kg/ha)}} \times 100$$

2.4.5 Contribution of concerned nutrient from fertilizer with FYM (Cf*)

Percent contribution of nutrients from fertilizer with FYM (Cf*) =

$$\frac{\text{Total uptake of nutrients (kg/ha) in fertilizer and FYM treated plots} - \text{Soil test values of nutrients in fertilizer and FYM treated plots} \times \text{CS} / 100}{\text{Fertilizer dose (N/P/K) applied (kg/ha)}} \times 100$$

2.5 Fertilizer Requirements for Targeted Yield

$$\begin{aligned} \text{FP}_2\text{O}_5 &= (\text{NR}/\text{Cf}^*) \times 100 \text{ T} - (\text{CS}/\text{Cf}^*) \times 2.29 \times \text{SP} - (\text{Cfym}/\text{Cf}^*) \times 2.29 \times \text{M} \\ \text{FK}_2\text{O} &= (\text{NR}/\text{Cf}^*) \times 100 \text{ T} - (\text{CS}/\text{Cf}^*) \times 1.21 \text{SK} - (\text{Cfym}/\text{Cf}^*) \times 1.21 \text{M} \end{aligned}$$

Where,

FN- Fertilizer nitrogen (kg N ha⁻¹), F P₂O₅- Fertilizer phosphorus (kg P₂O₅ ha⁻¹), FK₂O- Fertilizer potassium (kg K₂O ha⁻¹), NR- Nutrient requirement of nitrogen, phosphorus and potassium, Cf- Percent contribution of concerned nutrient from fertilizer without FYM, Cf* - Percent contribution of concerned nutrient from fertilizer with FYM., CS- Percent contribution of concerned nutrient from soil, Cfym- Percent contribution of concerned nutrient from FYM, T-

2.5.1 Fertilizer requirement equations for nutrients through use of chemical fertilizer (Without FYM)

$$\begin{aligned} \text{FN} &= (\text{NR}/\text{Cf}) \times 100 \text{T} - (\text{Cs}/\text{Cf}) \times \text{SN} \\ \text{FP}_2\text{O}_5 &= (\text{NR}/\text{Cf}) \times 100 \text{T} - (\text{Cs}/\text{Cf}) \times 2.29 \times \text{SP} \\ \text{FK}_2\text{O} &= (\text{NR}/\text{Cf}) \times 100 \text{T} - (\text{Cs}/\text{Cf}) \times 1.21 \text{SK} \end{aligned}$$

2.5.2 Fertilizer requirement equations for nutrients through conjoint use of chemical fertilizer and FYM (With FYM)

$$\text{FN} = (\text{NR}/\text{Cf}^*) \times 100 \text{ T} - (\text{CS}/\text{Cf}^*) \times \text{SN} - (\text{Cfym}/\text{Cf}^*) \times \text{M}$$

Targeted yield ($q\ ha^{-1}$), SN-Soil test value for available nitrogen ($kg\ ha^{-1}$), SP- Soil test value for available phosphorus ($kg\ ha^{-1}$), SK- Soil test value for available potassium ($kg\ ha^{-1}$) and M-Concerned nutrient content in organic. The statistical analysis of data was done as per standard design of AICRP on 'Soil Test Crop Response Correlation Project' [17].

3. RESULTS AND DISCUSSION

3.1 Fertility Gradient Experiment (Exhaust Crop)

The findings of soil and plant analysis indicates that there was an increase in soil nutrients and crop response with the maximum increase in strip III > strip II > strip I (Table 3). It was clear from the yield of oats (exhaust crop) that there was proper development of fertility gradient and it was significant with respect to N, P and K levels (Table 4).

The findings are closely accorded with those reported by Pant and Gautam [18], Kumar et al. [19] and Arya [20] in Mollisols of Uttarakhand. From present investigation, it was clear that the soil fertility gradient was very well stabilized. Strip third showed high fertility status and high yield, where maximum doses of nutrient were applied followed by Strip II and Strip I.

3.2 Test Crop Experiment (Kharif brinjal)

3.2.1 Yield and Nutrient content

The yield and nutrient content studies of brinjal in three different strips are illustrated in Table 5. The data from the present investigation indicates that the highest mean yield ($222.40\ q\ ha^{-1}$) was found to be in Strip III, followed by second strip ($194.27\ q\ ha^{-1}$) and being lowest ($193.65\ q\ ha^{-1}$) in third strip. Further, maximum nutrient content in both fruit and straw was obtained from strip III, followed by strip II and lowest in strip I (Table 5). The mean dry matter yield followed the trends: Strip III ($22.24\ q\ ha^{-1}$) > Strip II ($19.42\ q\ ha^{-1}$) > Strip I ($19.36\ q\ ha^{-1}$). Findings clearly established the fact that application of higher doses of nutrients and high fertility status of soil showed increase in yield response of brinjal. Moreover, the highest N, P and K nutrient content in fruit (1.58, 0.55 and 1.01%, respectively) and plant (1.63, 0.54 and 0.93%, respectively) was observed in strip III, which were supplied high nutrient doses, while the least in Strip I receiving low fertilizer doses (1.54, 0.48 and 0.86%,

respectively in fruit and 1.60, 0.48 and 0.81%, respectively in plant).

From above findings, it can be inferred that with the application of high dose of nutrient along with integrated approach have resulted in maximum availability of nutrient under these treatment resulting in more nutrient content. With the application of organic sources of nutrient in the soil, there was increase in microbial population, it resulted in slow breakdown of nitrogenous compounds and its availability in the form of nitrate is steady throughout crop growth. The combined application of nutrient increase the nutrient use efficiency of chemical fertilizer [21]. Similar findings were also reported by Zainub et al. [22] and Mazumdar et al. [23].

3.2.2 Nutrient uptake

The data of nutrient uptake are presented in Table 6. From the nutrient uptake study it was indicated that the total uptake of nitrogen was found to be maximum in strip III ($114.56\ kg\ ha^{-1}$) followed by strip II ($109.58\ kg\ ha^{-1}$) and strip I ($103.95\ kg\ ha^{-1}$). While, phosphorus uptake was found to be maximum in strip III ($38.55\ kg\ ha^{-1}$) and least in the strip I ($31.47\ kg\ ha^{-1}$). Moreover potassium uptake followed the trend Strip III ($67.20\ kg\ ha^{-1}$) > Strip II ($59.58\ kg\ ha^{-1}$) > Strip I ($53.84\ kg\ ha^{-1}$). From above findings, it was evident that higher application of nutrient has resulted in more nutrient uptake. With the integrated use of chemical and organic fertilizer there was increase in nutrient use efficiency of chemical fertilizer that has resulted in increased availability of nutrient in soil. With the increase in nutrient availability there was increase in nutrient uptake which in turn enhanced the yield of crop. The findings clearly indicated that initial soil fertility status and application of chemical and organic nutrients had positive influence on the yield and nutrient uptake by brinjal [24].

3.2.3 Basic parameters to develop a fertilizer prescription equation

The basic data were worked out for determining the fertilizer prescription equation is shown below in the Table 7. The nutrient requirement for production of one quintal of brinjal was 0.54 kg for N, 0.16 kg for P and 0.29 kg for K in soils of Pantnagar. The percent contribution of nutrient through soil was 32.18, 36.17 and 14.44% of nitrogen, phosphorus and potassium, respectively. The percent contribution of applied fertilizer alone was 54.30, 48.11 and 71.17% for N, P and K,

Table 3. Range and average of the soil test values for kharif brinjal under different strips

Particulars	Strip I	Strip II	Strip III	Whole Field
pH (1:2 soil water suspension)	6.32-7.49 (6.88)	6.37-7.42 (6.86)	6.43-7.34 (6.78)	6.32-7.34 (6.75)
Electrical conductivity (dS m ⁻¹)	0.15-0.32 (0.23)	0.16-0.34 (0.25)	0.19-0.37 (0.29)	0.15-0.37 (0.28)
Organic carbon (%)	0.39-1.30 (0.89)	0.51-1.48 (0.94)	0.56-1.53 (1.00)	0.39-1.53 (1.15)
Alkaline KMnO ₄ -N (kg ha ⁻¹)	103.46-191.27 (146.15)	104.85-188.47 (151.18)	142.48-205.20 (178.20)	103.46-205.20 (158.52)
Olsen's -P (kg ha ⁻¹)	16.91-20.88 (19.32)	16.94-21.30 (19.58)	17.47-21.47 (20.21)	16.91-21.47 (19.70)
NH ₄ OAC-K (kg ha ⁻¹)	112.35-181.78 (144.83)	120.48-188.49 (156.26)	133.61-213.44 (179.12)	112.35-213.44 (160.07)

Table 4. Strip wise forage yield of oat in fertility gradient experiment

Strip	Symbol	Fertilizer Dose (N,P ₂ O ₅ &K ₂ O)	Forage yield (q ha ⁻¹)
I	N ₀ P ₀ K ₀	0,0,0	273
II	N ₁ P ₁ K ₁	100,100,100	666
III	N ₂ P ₂ K ₂	200,200,200	716

Table 5. Range and average fresh and dry matter yield and nutrient content of Kharif brinjal

Particulars	Strip I	Strip II	Strip III	Whole field	
Fruit	Fresh yield (q ha ⁻¹)	110.25-266.73 (193.65)	121.22-273.78 (194.27)	132.45-302.01 (222.40)	110.25-302.01 (203.44)
	Dry matter yield (q ha ⁻¹)	11.02- 26.67 (19.36)	12.12-27.37 (19.42)	13.24-30.20 (22.24)	11.02-30.20 (20.34)
	N content (%)	0.35-1.80 (1.54)	0.37-1.83 (1.56)	0.38-1.88 (1.58)	0.35-1.88 (1.56)
	P content (%)	0.20-0.54 (0.48)	0.20-0.65 (0.54)	0.21-0.65 (0.55)	0.20-0.65 (0.52)
	K content (%)	0.48-1.71 (0.86)	0.49-1.17 (0.94)	0.50-1.20 (1.01)	0.48-1.20 (0.94)
Plant	Fresh yield (q ha ⁻¹)	46.1-155.75 (110.83)	56.4-160.1 (117.25)	61.12-162.5 (118.15)	46.1-162.5 (115.41)
	Dry matter yield (q ha ⁻¹)	18.44-62.31 (44.33)	22.56-64.04 (46.90)	24.45-65.00 (47.26)	18.44-65.00 (46.16)
	N content (%)	0.32-1.86 (1.60)	0.40-1.95 (1.61)	0.49-1.99 (1.63)	0.32-1.99 (1.61)
	P content (%)	0.21-0.53 (0.48)	0.22-0.64 (0.49)	0.24-0.65 (0.54)	0.21-0.65 (0.50)
	K content (%)	0.40-0.96 (0.81)	0.42-0.98 (0.84)	0.43-1.07 (0.93)	0.40-1.07 (0.86)

Table 6. Range and average nutrient uptake of kharif brinjal under different strips

Particulars	Uptake (kg ha ⁻¹)	Strip I	Strip II	Strip III	Whole field
Fruit	Nitrogen	5.10-43.63 (30.18)	5.47-46.16 (30.69)	6.23-54.30 (36.16)	5.10-54.30 (32.34)
	Phosphorus	2.35-14.08 (9.44)	2.46-17.44 (10.59)	2.82-19.43 (12.47)	2.35-19.43 (10.84)
	Potassium	6.93-23.71 (16.81)	5.88-26.98 (18.38)	7.19-33.06 (22.68)	6.93-33.06 (19.29)
Plant	Nitrogen	7.71-111.04 (73.77)	9.72-111.94 (78.89)	13.99-115.50 (78.40)	7.71-115.50 (77.02)
	Phosphorus	4.31-30.47 (22.02)	5.19-40.64 (23.68)	6.16-40.42 (26.08)	4.31-40.42 (23.93)
	Potassium	7.38-57.33 (37.03)	10.16-65.41 (41.20)	12.34-66.25 (44.52)	7.38-66.25 (40.92)
Total (Fruit +Plant)	Nitrogen	15.06-144.17 (103.95)	17.09-146.77 (109.58)	20.22-159.76 (114.56)	15.06-159.76 (109.36)
	Phosphorus	6.66-44.56 (31.47)	7.86-49.35 (34.28)	9.74-55.91 (38.55)	6.66-55.91 (34.76)
	Potassium	16.25-73.78 (53.84)	16.04-82.02 (59.58)	19.53-89.69 (67.20)	16.25-89.69 (60.21)

Table 7. Basic data for calculating fertilizer dose with and without FYM for targeted yield of Kharif brinjal

S. No	Particulars	Without FYM			With FYM		
		N	P	K	N	P	K
1.	Nutrient requirement (kg q ⁻¹)	0.54	0.16	0.29	0.54	0.16	0.29
2.	Contribution of available nutrient from soil (%)	32.18	36.17	14.44	32.18	36.17	14.44
3.	Contribution from applied fertilizer (%)	54.30	48.11	71.17	65.68	61.00	93.58
4.	Nutrients contribution from applied FYM (%)	-	-	-	54.13	99.99	80.07

Table 8. Soil test based fertilizer adjustment equations for targeted yield of kharif brinjal

Fertilizer dose (kg ha ⁻¹)	Equation with FYM	Equation without FYM
Nitrogen	FN= 0.830T- 0.489 SN-0.824 ON	FN= 1.004 T-0.592 SN
Phosphorus	FP ₂ O ₅ = 0.634T-1.357 SP- 3.753 OP	FP ₂ O ₅ = 0.803 T-1.721 SP
Potassium	FK ₂ O= 0.379 T-0.186 SK-1.04 OK	FK ₂ O = 0.498 T - 0.245 SK

respectively. The percent contribution of nutrient through fertilizer along with FYM was 65.68, 61.00 and 93.58% for N, P and K, respectively. The applied FYM contributed 54.12% for N, 99.99% of P and 80.07% for K. The data showed that the contribution of nutrient from the soil was less as compared to per cent contribution from fertilizer for nitrogen phosphorus and potassium. The above findings were in accordance with the study of Hedge [25] and Gautam and Pant [26].

3.3 Fertilizer Requirement

The fertilizer requirement was calculated with help of fertilizer prescription equation (Table 8) having the range of soil test values and target yield of kharif brinjal without using farmyard manure and using 10 and 20 tonnes of farm yard manure (Tables 9,10 and Figs. 1, 2 and 3). The results depicted that there was an increase in nutrient doses with an increase in target yield

of brinjal and there was a decrease in the fertilizer doses with an increase in soil test value. From above investigation, it can be inferred that with combine application of FYM along with chemical fertilizer results in an increase in the nutrient use efficiency of fertilizer which lead to saving of fertilizer nutrient. The general fertilizer dose recommended for brinjal is 120:60:60 NPK kg ha⁻¹ along with 20-25 tonne ha⁻¹ of FYM for an average yield of 200-250 q ha⁻¹ in Mollisols of Uttarakhand. However, the doses of fertilizer calculated through soil test crop response study using the fertilizer prescription equation for soil test value of 175, 25 and 200 were obtained as 40:42:02 NPK kg ha⁻¹ along with 20 tonne ha⁻¹ of FYM with target yield of 200 q ha⁻¹. Therefore, there was a saving of fertilizer nutrient under the soil test crop response approach and apart from this a desired yield can be opted as per the economic condition of farmers. The findings of Basavaraja et al., [27], Mishra et al., [28] and Dey and Das [29] was in close conformity.

Table 9. Nutrient requirements for different yield targets of kharif brinjal without using FYM

Soil test values (kg ha ⁻¹)	Yield targets of Brinjal (q ha ⁻¹)		
	150	200	250
Alkaline KMnO₄ N	N requirements (kg ha⁻¹)		
125	76	126	176
150	61	111	162
175	46	97	147
200	32	82	132
Olsen's P	P₂O₅ requirements (kg ha⁻¹)		
15	94	134	174
20	86	126	166
25	77	117	157
30	68	108	149
Amm. Ac.-K	K₂O requirements (kg ha⁻¹)		
100	50	75	100
150	37	62	87
200	25	50	75
250	13	38	63

Table 10. Nutrient requirements for different yield targets of kharif brinjal using 10 t ha⁻¹ FYM

Soil test values (kg ha ⁻¹)	Yield targets of Brinjal (q ha ⁻¹)		
	150	200	250
Alkaline KMnO₄ N	N requirements (kg ha⁻¹)		
125	43	84	126
150	30	72	113
175	18	60	101
200	6	47	89
Olsen's P	P₂O₅ requirements (kg ha⁻¹)		
15	49	81	112
20	42	74	106
25	35	67	99
30	29	60	92
Amm. Ac.-K	K₂O requirements (kg ha⁻¹)		
100	19	38	57
150	10	29	48
200	1	20	39
250	-	10	29

*FYM Content: 0.48 % N, 0.30 % P₂O₅ and 0.42 % of K₂O

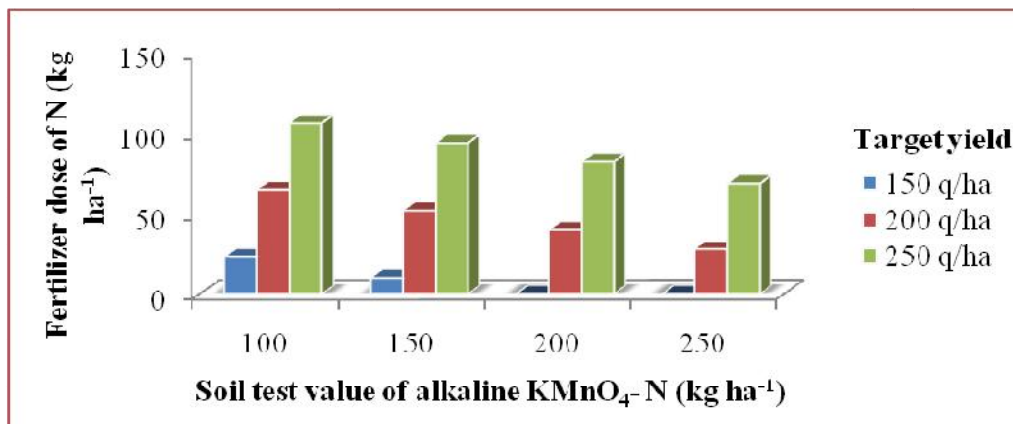


Fig. 1. Nitrogen requirements of Kharif brinjal at different soil test values and yield targets with 20 t FYM

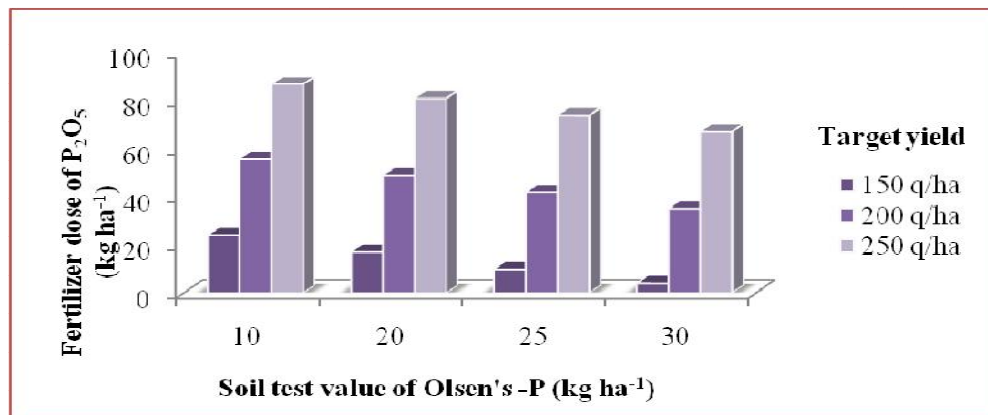


Fig. 2. Phosphorus requirements of Kharif brinjal at different soil test values and yield targets with 20 t FYM

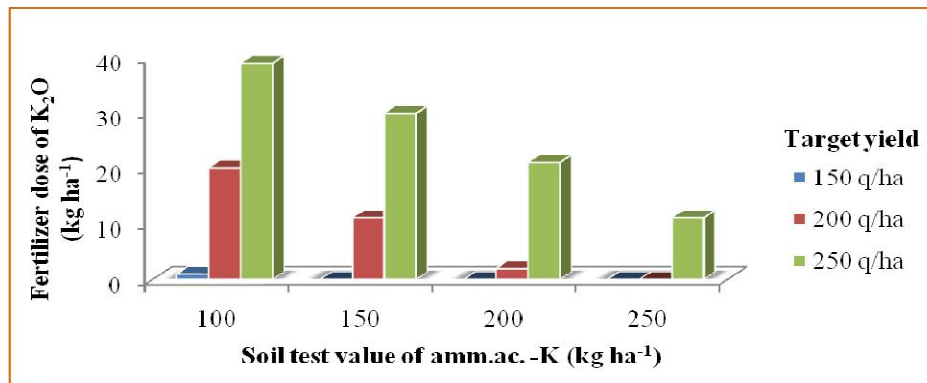


Fig. 3. Potassium requirements of Kharif brinjal at different soil test values and yield targets with 20 t FYM

4. CONCLUSION

From above investigation, a conclusion can be drawn that the recommendation of fertilizer nutrient based on soil test value and crop response resulted in the optimum application of fertilizer for brinjal in tarai soils of Pantnagar. Fertilizer prescription through STCR approach takes into consideration the initial fertility status of soils as well as the response of crop to nutrient in soil and applied through fertilizer. Application of chemical fertilizer in combination with organic fertilizer has resulted in increased availability of nutrient. Apart from saving the fertilizer consumption this approach helps in improving the soil health by ensuring the balanced application of fertilizer. These fertilizer prescription equation needs to be validated by conducting on farm experiment at research station, which can be further used by farmer's / soil testing laboratories.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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