Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; 9(1): 293-297
Received: 04-11-2019
Accepted: 08-12-2019

Basant Kumar
Technical Assistant, Department of Soil Science, College of Agriculture Raipur Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dr. VN Mishra
Professor, Department of Soil Science, College of Agriculture Raipur Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Rupesh Deshmukh
Technical Assistant, Department of Agronomy, College of Agriculture Raipur Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Biplab Choudhari
Senior Research Fellow, Department of Soil Science, College of Agriculture Raipur Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Basant Kumar
Technical Assistant, Department of Soil Science, College of Agriculture Raipur Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

To evolve a basis of formulating fertilizer recommendation for a given yield target based on soil test for brinjal crop

Basant Kumar, Dr. VN Mishra, Rupesh Deshmukh and Biplab Choudhari

Abstract
Afield experiment was carried out to formulate the fertilizer recommendation for brinjal crop in inceptisol of (C.G.) during rabi season 2005-06. Mukta Kesi variety of Brinjal was taken as the test crop. Fertilizer (N and P_2O_5) adjustment equations formulated by these models for specific yield target (Y) with the use of FYM are.
FN = 1.30 Y - (0.55 SN + 4.86 t FYM)
FP_2O_5 = 115-(13254.6-58.5Y) $^{1/2}$- (2.99 SP + 6.25t FYM)
FN = 312-0.55SN (For economic and maximum yield)
FP_2O_5 = 89-2.99 SP (For economic and maximum yield)
The recommendation for maximum and economic yield were identical because the plateau defined a realistic maximum yield, reached well before the crop response became un-economic for added N and P.

Keywords: Brinjal, fertilizer, formulation

Introduction
Crop yield is the function of many variables. Among them, fertilizer is an important input required for increasing the production of vegetables, cereals, pulses and other crops. The nutrient deficiency in plant often limit the production of field crops. Fertilizers are normally applied to crops on the basis of general recommendation of fertilizers. However the fertilizer requirement of a crop is a static-factors but it may vary for the same crop from soil to soil and even from field to field on the same soil. By adapting such recommendations, Some-times inadequate or excess quantity of fertilizers may be added which may result in its imbalanced and uneconomic use. Soil test based fertilizer application takes into consideration the fertility status of the soil and ensures balanced fertilizer use adopting the fertilizer prescription. based on soil test values. This minimizes the risk of uneconomic use of chemical. Fertilizer and manure as a component of INM for vegetable crops on the basis of soil test, is not available in Chhattisgarh situations. Brinjal is one of the most popular vegetable crop grown in India and Chhattisgarh in particular. India ranks second for vegetable in the world. Total production of vegetable in India is 71.6 million tones from an area of 5.3 million ha {ICAR,1998}. Brinjal belong to Solanaceae family grown in all part of the country throughout the year mainly due to its better adaptability to varied agro climatic condition and assured market. Brinjal covers 8.14% of total vegetable area and produces 9% of total vegetable production in India. In Chhattisgarh brinjal occupies an area of 13.57 thousand ha. With a productivity of 1.50 tones per ha with a production of 2.03 lake tones (Anonymous, 2004) The average productivity of this crop is Low as compared to the other state. Being a vegetable crop, the nutrient consumption is higher as compared to other agricultural crops. Therefore, it is essential to monitor the nutrient requirement is this crop. Once the nutrient requirement is known and efficiency of the available nutrient is evaluated than requirement based on soil test for a definite yield goal can be estimated. Promotion of the use of chemical fertilizer has become our necessity to meet the increasing demand of food grains as well as vegetables crops. It is apparent that fertilizer use per hectare will increase in future. Further, efficient and economic use of fertilizers would help in increasing the input cast for obtaining maximum returns. It has been proved that unbalanced use of fertilizer causes deterioration in the soil quality. Such adverse effect of fertilizer occurs in situation where unbalanced fertilizers are used. Therefore, it is recommendation to use those nutrients through fertilizers which are deficient in soil. Unnecessary use of nutrients which are already present in excess amount should be avoided.

Soil testing is a specific procedure which provides information regarding the deficiency of particularly nutrients due to which plants may suffers in a particular soil type. The essential nutrients are considered as one of the most important factor limiting plant growth and yield of crop. The targeted yield approach of fertilizer recommendation was first advocated by Truogh (1960) [19]. Then Ramamoorthy *et al*. (1967) [12] established the theoretical basis and experimental proof for the fact that Lie Big"s law of minimum operates equally well for N, P and K. This was later extended to different crops in different soils (Ramamoorthy *et al*. 1975 [11]; Randhawa and Velayutham, 1982). In the targeted yield approach, its assumed that there is linear relationship between grain yield (or economic produce) and nutrient uptake by the crop. This means that giving a particular yield the plant must take up a definite amount of nutrient. Once this requirement is known the fertilizer requirement can be determined taking into consideration the contribution of soil available nutrient and applied fertilizer nutrient to the total uptake of nutrient by the crop. There after adjustment equations are developed for different crops in different soil. One of the important advantages of this approach is that farmers have the option to relate their resources with a desired level of yield target. Choosing the appropriate target and application of required amount of plant nutrient ensure the most judicious and balanced fertilization and also helps to sustain the soil fertility and crop production. Targeted yield concept, thus strikes a balance between "Fertilizing the crop" and "Fertilizing the soil". This approach can be used not only for individual field situations but also as a better approximation for planning the requirement of fertilizers an area basis for a given level of crop production. Fertilizer application and the yield targets chosen can be so manipulated that both high profits from fertilizer investment and maintenance of soil fertility can be achieved (Velayutham, 1979) [20]. The targeted yield approach has been used to formulated fertilizer recommendations across the country (Somvanshi *et al*. 1993; Rao *et al*. 1993; Puri *et al*.1993; Puri *et al*.1994; Verma *et al*. 1995; Jha *et al*.1996; Suri *et al*.1996) [16, 9, 13, 10, 4, 18].

Materials and Methods
This chapter deals with the description of the materials used and the methods or techniques adopted during the course of investigation.

Experimental site
A field experiment was conducted at the Instructional Farm of Indira Gandhi Agricultural University, Raipur (C.G.) during 2005-06, Rabi season for investigation on soil test crop response correlation for N, P and FYM in order to evolve soil test-based fertilizer recommendation for Brinjal crop (variety - Mukta kesi} in Inceptisol.

Geographical situation
Raipur is situated in mid-eastern part of Chhattisgarh state and lies at 21^0 16„ N latitude and 81^0 36" E longitude with an attitude of 298.56 meter above the mean sea level.

Climatic and weather condition
The region comes under sub-humid climatic condition. The average annual rainfall of the area is 1250 mm. Major amount of precipitation occurs between June and September (about 3-4 MonthsWhich is the main rice growing season. The hottest and coolest months are May and December respectively.

Soil
The soil is well drained and belongs to the order of an Inceptisol. The color of soil is yellowish with low clay content and slightly acidic in reaction.

Table 1: Physico-chemical properties of Experimental Soil

Properties	Rating/value
pH (1:2.5)	6.3
EC (dSm^{-1})	0.23
CEC (Cmol (p^+) kg^{-1})	22.61
Organic C (%)	0.45
Available N (kg/h)	260
Available P (kg/h)	22.6
Available K (kg/h)	222
Mechanical analysis	
Sand (%)	47.5
Silt (%)	22.2
Clay (%)	30.3
Textural class	Sandy loam

Table 2: Treatment details

N levels	4 (0, 60,120,180 kg/ha)
P levels	3 (0,40,80 kg/ha)
FYM levels	3 (0, 5,10 t/ha)
Experimental design	Factorial RBD
Treatments	36
Replications	Three
Plot Size	5.5 x 6m
Test crop	Brinjal (Solanum melongena)
Variety	Mukta Kesi
Date of nursery sowing	22^{nd} and 24^{th} October
Date of planting	29-11-2005
Picking	Total 12 pickings at 5-10 days interval.

Field experiment
A special field technique developed by Ramamoothy *et al*. (1961) was used for this experiment. The field was divided into three equal long strips and denoted as L_0, L_1 and L_2. Prior to the current experiment, attempt was made to create the fertility variation with respect to N, P and K among the strips.
The soil samples (0-15cm) were drawn from each plot of the experimental field before taking crop. Mukta kasi variety of Brinjal was taken as test crop. Each strip was divided into 36 plots. Factorial combination of 4 levels of N, 3 levels of P and 3 levels of FYM were applied to each strip in the fields.
There were 35 treatments with one control (i.e one control plot in each strip). Factorial combination four level of N three level of P and three level of FYM were applied to each strip. The potassium level was not included due to non-response of the crop to its application.
Phosphorus as a single super phosphate and potassium as muraite of potash were applied as a basal dose and N was applied as urea in 3 equal splits, half dose of nitrogen were applied at the time of transplanting of seedling and the remaining half of the N was applied in two equal split dose at 30 and 50 days after transplanting. Before application of fertilizer, FYM @ the rate of 0,5 and 10 t/ha were applied and thoroughly mixed in soil.
Mukta kesi variety of brinjal was transplanted on October 24,2005 with spacing of 60 x 60 cm (row x plant) Field was regularly monitored and 12 picking of fruits were done. Fruit and straw samples were collected from each plot for N, P and K uptake. Fruit and straw yields were recorded plot wise and calculated on ha basis.

Field Preparation

The Experiment field was prepared by two cross ploughing followed by one harrowing and leveling by tractor drawn.

Soil Parameter

The experimental soil was analyzed for the following Physicochemical Properties.

1. **PH:** Soil pH was determined in 1:2.5 soil water suspensions after stirring for 30 minutes, by glass electrode pH meter as suggested by piper (1967) [7].
2. **Electrical Conductivity:** The sample soil used for pH determination was allowed to settle down for four hours then conductivity of supernatant liquid was determined by Solubridge as described by Black (1965) [2] using Systronics (1644).
3. **Cation Exchange Capacity:** The cation exchange capacity was determined by leaching the soil with neutral normal ammonium acetate as described by black (1965) [2].
4. **Organic Carbon:** Organic Carbon was determined by Walkley and Blacks rapid titration method (1934) as described by piper (1967) [7].
5. **Available Nitrogen:** Available "N" was determined by alkaline $KMNO_4$ method as suggested by Subbiah and Asija (1956) [17].
6. **Available Phosphorus:** Available soil P was extracted by 0.5 N $NaHCO_3$ as described by Olsen *et al*. (1954) and phosphorus in the extract was determined by ascorbic acid method (Watanable and Olsen, 1965) [23] by using Spectrophotometer.
7. **Available Potassium:** Soil potassium was extracted by neutral normal ammonium acetate and determined with the help of flame photometer as described by Muhr *et al*. (1965) [5].
8. **Mechanical Analysis:** The mechanical analysis of soil was carried out by International Pipette Method as described by piper (1950) [6].

Statistical analysis

Standard regression procedure was used to relate the soil test and fertilizer with crop yield response. The nutrient requirement, soil and fertilizer efficiencies were estimated from regression coefficients using computer IRRISTAT package ver.1.1 for statistical analysis and sigma plot ver.8 for graphica were used.

Result and Discussion

Soil available nutrients

The range and mean values of available nutrients (N, P and K) (Table No. 4) indicate that soil test N did not vary with different fertility strips whereas P increased across the fertility strips and average values ranged from 16.7-31.8 Kg ha^{-1}. The mean values of available K did not reflect with respect to fertility strips (329-351 Kg ha^{-1}). This shows that the experimental field is well supplied with K.

Table 3: Fertilizer doses added to various strips and maize yields during previous kharif season, 2005).

Fertility strips	Soil test values (kg/ha)		
	SN	SP	SK
L0	227	14.16	309
L1	222	25.95	317
L2	232	46.70	336

Table 4: Range and average of available N, P and K in soil Kg ha^{-1}

Available nutrients	Fertility strips		
	L0	L1	L2
Alkaline $KMnO_4$-N (kg/ha)	238 - 272 (258)	247 - 275 (259)	247 - 278 (264)
Olsen P (kg/ha)	11.3-23.9 (16.7)	18.4 - 38.5 (27.0)	19.1 - 43.5 (31.8)
Amm acetate extractable K (kg/ha)	298-358 (329)	282-399 (328)	315 - 410 (351)

Response of added nutrients to fruit yield

4.4 Interpretation of soil test in terms of quantity of fertilizer

The fertilizer adjustment equations were derived from LRP in the form of equation as given by (Goswami, 1986; Randhawa and Velayutham, 1982; Singh, 1983 [15]; Velayutham, 1979 [20] and Velayutham *et al*., 1985) as, and presented in Table 6 and fertilizer adjustment equations derived by the solution of quadratic equation (Pal, 1985) is also given in Table 6.

$$F = \frac{NR}{Ef} Y - \frac{Es}{Ef} S$$

Fertilizer adjustment equations for specific yield target of Brinjal and integrated nutrient management for N from LRP model

1. FN = 1.30 Y - 0.55 SN
2. FN = 1.30 Y - (0.55 SN + 4.86 t FYM)

Fertilizer adjustment equations for given yield target of Brinjal and integrated nutrient management for P from QRP model

1. $FP_2O_5 = 115 - (13254.6 - 58.5\ Y)^{1/2} - 2.99\ SP$
2. $FP_2O_5 = 115 - (13254.6 - 58.5\ Y)^{1/2} - (2.99\ SP + 6.25\ t\ FYM)$

Soil test calibration for economic and maximum fruit yield of Brinjal.

1. FN = 312 - 0.55 SN
2. $FP_2O_5 = 89 - 2.99\ SP$

The derivations for economic and maximum yield were based on the price ratio of one kg of fertilizer nutrient to one quintal of Brinjal fruit as 0.04 for P_2O_5. The LRP and QRP models were used to derive soil test calibration for maximum and economic yield.

The ready reckoners for fertilizer N and P_2O_5 for specific yield targets are presented in Table 7 to 8.

A careful examination of the ready reckonars show that in case of P, for a yield target of 16 q ha^{-1} without FYM, when soil test P is 24 Kg ha^{-1}, 27 Kg ha^{-1} of fertilizer P would be required, but with 2.5 tonnes and 5 tonnes FYM the amount of fertilizer decreases to 6 kg and zero kg respectively, at the same level of soil test and yield target.

Table 5: Ready reckoner of fertilizer N for specific fruit yield of Brinjal without FYM

SN kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
150	48	80	113	145	178	210
175	34	66	99	131	181	196
200	20	53	85	118	162	183
225	6	39	71	104	142	169
250	0	25	58	90	123	155
275	0	11	44	76	103	141
300	0	0	30	63	83	128
325	0	0	16	49	64	114
350	0	0	2	35	44	100

Table 6: Ready reckoner of fertilizer N for specific fruit yield of Brinjal with 5 t FYM

SN kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
150	23	56	88	121	153	186
175	9	42	74	107	157	172
200	0	28	61	93	138	158
225	0	14	47	79	118	144
250	0	0	33	66	98	131
275	0	0	19	52	79	117
300	0	0	6	38	59	103
325	0	0	0	24	39	89
350	0	0	0	11	20	76

Table 7: Ready reckoner of fertilizer N for specific fruit yield of brinjal with 10 t FY

SN kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
150	0	31	64	96	129	161
175	0	18	50	83	133	148
200	0	4	36	69	113	134
225	0	0	23	55	94	120
250	0	0	9	41	74	106
275	0	0	0	28	54	93
300	0	0	0	14	35	79
325	0	0	0	0	15	65
350	0	0	0	0	0	51

Table 8: Ready reckoner of fertilizer P for specific fruit yield of Brinjal without FYM

SP kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
4	17	26	36	48	64	93
8	5	14	24	36	52	81
12	0	2	12	24	40	70
16	0	0	0	12	28	58
20	0	0	0	0	16	46
24	0	0	0	0	4	34
28	0	0	0	0	0	22
32	0	0	0	0	0	10

Table 9: Ready reckoner of fertilizer P for specific fruit yield of Brinjal with 5 t FYM

SP kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
4	0	0	5	17	33	62
8	0	0	0	5	21	50
12	0	0	0	0	9	39
16	0	0	0	0	0	27
20	0	0	0	0	0	15
24	0	0	0	0	0	3
28	0	0	0	0	0	0
32	0	0	0	0	0	0

Table 10: Ready reckoner of fertilizer P for specific fruit yield of brinjal with 10 t FYM

SP kg	Yield target q ha-1					
ha-1	100	125	150	175	200	225
4	0	0	0	0	2	31
8	0	0	0	0	0	19
12	0	0	0	0	0	8
16	0	0	0	0	0	0
20	0	0	0	0	0	0
24	0	0	0	0	0	0
28	0	0	0	0	0	0
32	0	0	0	0	0	0

The charts show that with the use of FYM, the fertilizer requirement reduced resulting in the saving of chemical fertilizer. It is further evident that the fertilizer requirements decrease with increase in soil test values. Therefore, a slightly lower yield target may be considered for a poor-farmers who are interested in maximum profit per rupee spent on fertilizer, whereas, a higher yield target for a rich-farmers who are interested in maximum production per hectare of land. Hence, for maintaining soil fertility, it is necessary to choose appropriate yield targets and fertilizer use practices that achieve the twin objectives of high yield and maintenance of soil fertility. Thus the targeted yield approach of fertilizer recommendation ensures nutrient balancing to suit situations involving different yield goals, soil fertility and resources of the farmer (Dev *et al*., 1985) [3]. Several workers in all over the world have used this approach of fertilizer prescription (Patil *et al*., 1985; Rashid *et al*., 1988; Powelson *et al*., 1989; Yuam *et al*., 1995; Acharya *et al*., 2001 and Arya, 2003) [14, 8, 24, 1].

Reference

1. Arya VM. Fertilizer recommendation based on soil test for rice in Inceptisol and Vertisol of C.G. M.Sc. (Ag.) Thesis, IGKVV, Raipur (CG), India, 2003.
2. Black CA. Methods of Soil Analysis. Amer. Soc. of Agro. Inc. Publ. Madison, Wisconsin, USA, 1965.
3. Dev G, Dillion NS, Brar JS, Vig AC. Soil test-based yield targets for wheat and rice-cropping system. Fert. News. 1985; 30(5):42-50.
4. Jha Sarita, Suri VK. Response of rain fed maize to integrated nutrient management based on target yield concept in Typic hapludalf. J Indian Soc. Sci. 1996; 64:143-145.
5. Muhr GR, Datta NP, Donahue RL. Soil testing in India. United States Agronomy for International development mission on India, New Delhi, 1965.
6. Piper CS. Soil and Plant Analysis. Inter Science Publisher. Inc. New York, 1950, 45-47.
7. Piper CS. Soil and Plant Analysis. Asia Publishing House, Bombay and New Delhi, 1967, 85-102.
8. Powelson AK, Willis WD. Crop response to integrated use of inorganic and organic fertilizer on soil microbial biomass dynamic. Agron. J. 1989; 98:533-539.
9. Puri G, Jaipurkar SA. Predication and optimization of soil test-based fertilizer recommendation for safflower production in vertisols of central India: In: Third International Safflower Conference held on June 14-18 at Institute of Botany at Beijing (China), 1993, 45-51.
10. Puri G, Jaipurkar SA. Evaluating the effects of soil fertility variables on the yield of mustard (Branica compestris) on swell shrink soil (Vertisol) of cental India accepted for presentation. In: 15th International congress

of soil sci. Acapulco. Maxico held on July 10-16th, 1994, 45-49.
11. Ramamoorthy B. Velayuthan M, Mahajan VK. Recent trends in making fertilizer recommendation based on soil test under fertilizer resource constraints in India. In: Proc. FAI/FAO Natt. Seminar, New Delhi, 1975, 335-346.
12. Ramamoorthy B, Dinesh RS. Fertilizer application for specific yield targets of Sonara-64. Indian Farming. 1967; 17:43-45.
13. Rao GS, Singh KD. Effect of single Superphosphate on available soil sulphur in targeted maize wheat green gram cropping system. Indian J Agril. Sci. 1993; 63:112-114.
14. Rashid A, Bugio N, Salim N. Calibration of three test for determining phosphorus fertility of soil to support cereals, legumes and oilseeds. In: Soil test calibration on West Asia and North Africa, Proceeding of the IInd Regional Workshop, 1987, 86-93.
15. Singh SS, Maurya AN. Response of NPK and their combination on yield contribution character of Brinjal var. Pusa Kranti, Haryana Journal of Hort. Sci. 1983; 12(3-4)237-240.
16. Somwanshi RB, Tamboli BP. Soil testing and fertilizer use of sunflower MPKV, Pamphlet, No. 125 (In Hindi), 1993.
17. Subbiah BV, Asija GL. A rapid procedure for estimation of available nitrogen in soils. Curr. Sci. 1956; 25:259-260.
18. Suri VK. Jha S. Complementary use of FYM in rainfed maize based on yield target concept. Annals Agri. Bio. Res. 1996; 1(1-2):1-10.
19. Troug E. Transaction, Seventh International Congress Soil Sci. 1960; 4:46-52.
20. Velayutham M. Fertilizer recommendation based on targeted yield concept problem and prospects. Fertilizer News. 1979; 24(9):12-17.
21. Velayutham M, Reddy KCK, Sankar GRM. All India co-ordinated project on soil test crop response correlation and its impact on agricultural production. Fert. News. 1984; 30:81-85.
22. Verma TS, Bhagat RH. Nitrogen use efficiency as affected by time variant nitrogen application to wetland rice. Oryza. 1995; 32:276-279.
23. Watanable FS, Olsen SR. Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts. Soil Sci. Amer. Proc. 1965; 29:677-678.
24. Yaum L, Haung JG. Dynamic of soil phosphorus in the rhizos phere of hybrid rice plants and its utilization. J South West Agril. Unit. 1995; 17:5:440-442.