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Research Article

Integrated Fertiliser Prescriptions for Bhendi Through Inductive Cum Targeted Yield Model in Bahour Soil Series (Topic Stropped) of Pondicherry

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ABSTRACT

A field experiments were conducted on a topic Stropped soils of Pondicherry by adopting the inductive cum targeted yield model, and fertiliser requirements were quantified for bhendi based on soil test and yield target. The basic parameters viz. Nutrient Requirement (NR), contribution of nutrients from soil (Cs), fertilizer (Cf) and farmyard manure (Cfym) were computed from field experimental data. Using these basic parameters, the fertiliser prescription equations were developed under Integrated Plant Nutrition System (IPNS) and nomograms were formulated for the desired yield target of bhendi for a range of soil test values. The quantity of fertilizers that could be contributed for bhendi were evaluated as 50, 28 and 43 kg fertilizer N, P and K respectively, when applied along with the NPK fertilizers as per soil test and desired yield target.

Keywords: Soil series; Bhendi; Fertiliser prescription; IPNS

INTRODUCTION

The demand for high-value commodities (such as horticulture, dairy, livestock and fish) is increasing faster than food grains and for most of the high-value food commodities, demand is expected to increase.

To meet the vegetable requirement for ever increasing population of our country, the best way is to produce more from limited land resources. Further, the escalation in fertiliser prices has caused a serious setback for balanced fertilization. Hence, exclusive dependence on either inorganic fertilizers or organic sources is neither economically viable nor environmentally acceptable [1].

Okra (*Abelmoschus esculentum L.)* is one of the important vegetable grown through the troics and warm temperate zones. It is widely cultivated as a summer season crop in North India as a kharif and summer crop in Gujarat, Andra Pradesh, Karnataka and Tamil Nadu. Okra fruit is good source vitamin A, B and C. The content of calcium in its fruits is very high (66 mg/100 g of edible portion) compared to that of other fruit vegetables. It is an excellent source of iodine. It is also rich in protein and mineral nutrients. Among fruit vegetables, okra fruits have good demand of throughout the year. India is the largest producer of okra in the world. In Tamil Nadu, it is cultivated in area of about 26,120 with a production of 5.19 lakh tonnes and an average productivity of 19.9 tonnes per hectare [2].

The present consumption of vegetables per capita per day is 135 g against the requirement of 285 g per capita per day emphasising the necessity to enhance production of vegetables which can be achieved by bringing more land under vegetables cultivation and increasing the productivity of the vegetables as well.

At this juncture, the prescription procedure outlined by trough and modified by Ramamurthy as Inductive cum Targeted yield model strikes a balance between 'fertilizing the crop' and 'fertilizing the soil'. This model provides a scientific basis for balanced fertilization and balance between applied nutrients and soil available nutrients.

MATERIALS AND METHODS

The present study consisted of two field experiments in two phases viz., fertility gradient experiment with Hybrid maize (Kavery super 244) (Phase I) and the test crop experiment with

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Hybrid Bhendi (Green Gold Plus) (phase II). The experiments were conducted on Bahour soil series (topic Stropped) at farmer's holding of Karikalampakkam village in U.T of Pondicherry. The study area comes under coastal alluvial plain (PC1) classified as fine, mixed isohyperthermic, topic Stropped with an area of 12.72 per cent. According to agro climatic zonal classification, the study area is located at 11°56' North latitude and 79°66' East longitude [3].

The surface soil (0-15 cm deep) of the experimental field is sandy clay loam in texture. The pH, electrical conductivity and cation exchange capacity of the soil were 7.95, 0.81 dS and 36.5 cmol kg, respectively. The initial soil available alkaline potassium permanganate nitrogen (N), Olsen phosphorus (P) and ammonium acetate potassium (K) were 187.2 kg, 64.42 kg and 230 kg, respectively. The P and K fixing capacities of the soil were 150 and 100 kg respectively.

In gradient experiments, the variation in soil fertility was created by adopting the Inductive Methodology developed by Ramamurthy. For this purpose, the experimental field was divided into three equal strips, the first strip received no fertilizer, the second and third strips received one and two times the standard dose of N, P and K respectively and a gradient crops of Hybrid maize (Kavery super 244) was grown. The pre-sowing and post-harvest soil samples from each fertility strips were collected thus making a total of 24 samples and analysed for alkaline [4].

After the harvest of Hybrid maize, each strip was divided into 24 plots, and pre-sowing soil samples were collected from each plots and analysed for alkaline N, P and K. The experiments was laid out in a fractional factorial design comprising twenty four treatments each for Bhendi, the treatments consisted of four levels of N, P and K viz., 0, 100, 200 and 300 kg and viz., 0, 50, 100, and 150 kg respectively and three levels of FYM (0, 12.5 and 25.00 t). The IPNS treatments (NPK alone, FYM 6.25 t and 12.5 t) were superimposed across the strips. There were 21 fertilizer treatments along with three controls which were randomized in each strip in such a way that all the treatments occurred in both directions. The treatments structure is given in the test crop Bhendi was planted with a spacing of 45 cm x 60 cm. After planting Routine cultural operations were followed periodically. The crop was grown to maturity, harvested and plot wise yields were recoded. The fruit, plant and post-harvest soil samples were collected from each plot and processed and analysed for N, P and K contents, and NPK uptake by Bhendi was computed using the dry mater yield (Table 1) [5].

Sl. No	Treatment combinations			Levels of nutrients (kg)		
	N	P	K	N	P	K
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	2	2	0	100	100
5	1	1	1	100	50	50
6	1	2	1	100	100	50
7	1	1	2	100	50	100
8	1	2	2	100	100	100
9	2	1	1	200	50	50
10	2	0	2	200	0	100
11	2	1	2	200	50	100
12	2	2	2	200	100	100
13	2	2	1	200	100	50
14	2	2	0	200	100	0
15	2	2	3	200	100	150
16	2	3	2	200	150	100
17	2	3	3	200	150	150
18	3	1	1	300	50	50
19	3	2	1	300	100	50
20	3	2	2	300	100	100
21	3	3	1	300	150	50
22	3	3	2	300	150	100
23	3	2	3	300	100	150
24	3	3	3	300	150	150

Table 1: Treatment structure for bhendi.

Making use of data on the yield of Bhendi, total uptake of N, P and K, initial soil test values for available N, P and K and doses of fertilizer N, P and K and applied, the basic parameters viz., nutrient requirement (NR), contribution of nutrients from soil (Cs), fertilizer (Cf) and farmyard manure (Cfym).

- Nutrient Requirement (NR) kg
- Per cent nutrient contribution of nutrients from soil to total nutrient uptake (Cs)
- Per cent nutrient contribution of nutrients from fertilizer to total uptake (Cf)
- Percent nutrient contribution of nutrients from organics to total uptake (Co)
- Percent contribution from FYM (Cfym)

These parameters were used for developing fertilizer prescription equations for deriving fertilizers doses, and the soil test based fertiliser recommendations were prescribed in the form of a

ready table for desired yield target of Bhendi under NPK alone as well as under IPNS [6].

Targeted yield equations

Making use of these parameters, the fertilizer prescription equations (FPEs) were developed for Bhendi as furnished below.

- Fertilizer Nitrogen (FN)
- Fertilizer Phosphorus (FP)
- Fertilizer Potassium (FK)

where, FN, and are fertilizer N, and in kg, respectively, NR is Nutrient requirement N, P and K kg, Cs is Per cent nutrient contribution of nutrients from soil, Cf is Per cent nutrient contribution of nutrients from fertilizer, Cfym is Percent contribution from FYM, T is the yield target in q, SN, SP and SK respectively are alkaline N, P and K in kg and ON, OP and OK are the quantities of N, P and K supplied through FYM in kg (Table 2) [7].

Parameters	Bhendi		
	Strip-I	Strip-II	Strip-III
N	158.3	214.4	235.1
P	55.6	57.1	59.6
K	205	225	265
Fruit yield	10765	13181	14379
N Uptake	71.7	79.9	81.1
P Uptake	15.5	16.5	17.7
K Uptake	61	78.7	84.1

Table 2: Mean values of available nutrients in the pre-sowing surface soil samples yield and nutrient uptake by Bhendi.

These equations serve as a basis for predicting fertilizer doses for specific yield targets of hybrid Bhendi for varied soil available nutrient levels.

RESULTS AND DISCUSSION

The mean fruit yields of bhendi were 10,765: 13,181 and 14,379 kg, respectively in strip I, II and III. The N uptake bhendi varied from 71.7 kg to 81.1 kg, P uptake varied from 15.5 kg to 17.7 kg and K uptake 61.0 kg to 84.1 kg in strips I-III, respectively.

The data on initial soil test values of bhendi revealed that, the mean N values were 158.3 kg, 214.4 kg, and 235.1 kg, the mean Olsen-P values was 55.6 kg, 57.1 kg, and 59.6 kg, the mean K was 205, 225 and 265 kg in strips I, II, III, respectively.

The existence of operational range of soil test values for available N, P and K status in the present investigation was clearly depicted from the initial soil available nutrient status and variations in the fruit yield of bhendi and NPK uptake, which is a prerequisite for calculating the basic parameters and fertilizer prescription equation for calibrating the fertiliser doses for specific yield target. Uma devi reported similar existence of operational ranges of available N, P and K for carrot on Ultisols.

Basic parameters

In the targeted yield model, making use of data on the yield of bhendi, total uptake of N, P and K, initial soil test values for available N, P and K and doses of fertilizer and applied, the basic parameters were computed. The basic parameter for developing fertilizer prescription equations for bhendi are nutrient requirement kg per quintal of bhendi (NR), contribution of available nutrients from soil (Cs), fertilizer nutrients (Cf) and farmyard manure (Cfym) (Table 3) [8].

Crop	Parameters	Basic Data		
		N	P	K
Bhendi	Nutrient requirement (kg)	0.6	0.29	0.71
	Per cent contribution from soil (Cs)	11.7	11.75	10.05
	Per cent contribution from fertilizers (Cf)	30.2	25.73	77.03
	Per cent contribution from FYM (Cfym)	33.78	11.41	41.08

Table 3: Nutrient requirement, per cent contribution of nutrients from soil, fertilizer and FYM for bhendi.

Nutrient requirement

To produce one quintal of bhendi fruit 0.60 kg of N, 0.29 kg of p and 0.71 kg of k were required. Among the three nutrients, the requirement of K_2O was the highest followed by N and P. The requirement of K was 1.18 times higher than N and 2.45 times higher than P. Similar trend of nutrient requirement for N, P and K was also reported by Muralidharudu for tomato and Smitha Johnfor cabbage [9].

Per cent contribution of nutrients from soil (Cs) to total uptake

The per cent contribution of nutrients from soil (Cs) to the total uptake was computed from the absolute control plots and it expresses the capacity of the crop to extract nutrients from the soil. In the present study, it was found that the soil has contributed 11.70 per cent of available N, 11.75 per cent of available P and 10.05 percent of available K respectively towards

the total N, P and K uptake by bhendi. Among the three nutrients, the per cent contribution from soil was higher for P followed by N and K. With regard to N and K, comparatively lower Cs was recorded which might be due to the preferential nature of bhendi towards the applied N and K than the native N and K. the above findings are in accordance with Muralidharudu for tomato [10].

Per cent contribution of nutrients from fertilizers (Cf) to total uptake

The contribution from fertilizer nutrients (Cf) of bhendi, the values were 30.20, 25.73 and 77.03 per cent, respectively for N, P and K and followed the order of K>N>P. The response yardstick recorded was 24.62 kg. The estimated Cf clearly revealed the fact that the magnitude of contribution by fertilizer K was 2.99 times higher than P and 2.55 times as that of N. With regard to N and K, comparatively more contribution was recorded from fertilizers than from the soil. The findings are in accordance with Santhi. For beetroot on Alfisol. However, in the case of P, the contribution was more from soil than from fertiliser. The results observed in the present study corroborated with the findings of Muralidharudu for tomato.

Contribution of nutrients from FYM for bhendi

The estimated per cent contribution of N, P and K from FYM (Cfym) were 33.78, 11.41 and 41.08 respectively for bhendi which indicated that relatively higher contribution was recorded for K followed by N and P for bhendi.

Growth parameter of bhendi

The mean plant height of bhendi were 144.9 cm, 160.8 cm and 162.7 cm respectively in strip I, II and III. The number of branches per plant of bhendi varied from 3.2 to 3.6. The mean Number of fruit per plant of bhendi was 13.8, 14.8 and 15.5 respectively in strip I, II and III. The fruit length of bhendi varied from 13.90 cm to 15.7 cm and fruit grith from 4.9 cm to 5.65 cm in strips I-III, respectively. The fruit weight of bhendi were 12.8 g, 14.9 g and 15.1 g respectively in strip I, II and III.

Quality parameter of bhendi

The mean crude fibre content of bhendi was 12.3 cm, 11.5 cm and 11.5 cm, respectively in strip I, II and III. The crude protein of bhendi varied from 1.55 per cent to 1.70 per cent and starch content from 3.85 per cent to 4.28 per cent in strips I-III, respectively.

Fertilizer prescription equations

Soil test based fertilizer prescription equations for desired yield target of bhendi were formulated using the basic paramerters.

Fertilizer prescription under IPNS for desired yield target of bhendi

A ready table was prepared based on these equations for a range of soil test values and for yield targets of 180 q for bhendi the data clearly revealed the fact that the fertilizer N, P and K requirements decreased with increase in soil test values.

For achieving a yield target of 180 q of bhendi, for a soil test value of 200 kg of N the fertiliser N doses required were 283,258 and 232 kg respectively for NPK alone, NPK+FYM 6.25 t and NPK+FYM 12.5 t. The per cent N, P and K reduction of 8.8 and 18.0 was observed by addition of FYM 6.25 t and 12.5 t respectively over NPK alone.

For a soil test value of 20 kg of Olsen P, the dose of fertilizer P required for the yield target of 180 q was 183 kg, when NPK alone were applied, whereas the dose was 169 kg for combined addition of NPK+FYM 6.25 t recording 7.6 per cent reduction in fertilizer P over NPK alone. When NPK were applied along with 12.5 t the dose were 154 kg with per cent reduction of 15.8 over NPK alone for the soil test value of 20 kg of Olsen P (Table 4) [11].

Parameters	Bhendi		
	Strip-I	Strip-II	Strip-III
Plant height (cm)	144.9	160.8	162.7
No. of branches/Plant	3.2	3.6	3.6
No. of fruits/ plant	13.8	14.8	15.5
Fruit length (cm)	13.9	14.2	15.7
Fruit grith (cm)	4.9	5.57	5.65
Fruit weight (gm)	12.8	14.9	15.1

Table 4: Mean values of growth and yield attributes of bhendi crop in various strips

Similarly for achieving a yield target of 180 q of bhendi, for a soil test value of 200 kg of K the fertiliser K doses required were 135,114 and 92 kg respectively for NPK alone, NPK+FYM 6.25 t and NPK+FYM 12.5 t. The per cent N reduction of 15.5 and 32.5 was observed by addition of FYM 6.25 t and 12.5 t respectively over NPK alone.

Using the fertilizer prescription equations under IPNS, the extent of saving of inorganic fertilizers for bhendi was computed. The results showed that with the application of FYM 6.25 t with 28 per cent moisture and 0.56, 0.32 and 0.48 per cent N, P and K, respectively, there was a saving of 25, 15 and 22 kg of fertilizer N, P and K, respectively. If FYM 12.5 t was applied with above quality, the saving of fertilizer N, P and K was 51, 29 and 44 kg, respectively.

The per cent reduction in NPK fertilisers under IPNS also increased with increasing soil fertility levels with reference to NPK and decreased with increase in yield targets. Similar trend

of results were also reported by Balamurugan in wheat, Smitha John in cabbage and Santhi in beetroot.

Therefore, in the present investigation, soil test based fertilizer prescription for bhendi was developed on Typic Ustropept soils (Bahour soil series) of Union Territory of Puducherry taking into account the nutrient requirement and contribution of NPK from the nutrient sources (soil, fertilizer and FYM). This allows a balanced supply of nutrients through IPNS (Table 5) [12].

Parameters (per cent)	Bhendi		
	Strip-I	Strip-II	Strip-III
Crude fibre	12.3	11.5	11.5
Protein	1.55	1.71	1.7
starch	3.85	4.3	4.28

Table 5: Mean values of quality parameters of bhendi fruit.

CONCLUSION

This robust methodology seems to be applicable in diverse climatic conditions and effective for meaningful and sensitive interpretation of Eco toxicological risk to receptors. By concerted further evaluation of pore water from a wider range of soils, over a longer time series, trace element concentrations in soil solution under real-world field conditions may be in corporated into the more accurate assessment of environmental risk.

REFERENCES

1. Humphries EC. Mineral components and ash analysis. Springer. 1956;1:468-502.
2. Santhi R, Bhaskaran A, Natesan R. Integrated fertilizer prescriptions for beetroot through Inductive cum targeted yield model on an Alfisol. Commun Soil Sci Pl Analysis. 2011;1905-1912.
3. Santhi R, Sellamuthu KM, Maragatham S, Dey P. Soil test and yield target based balanced fertilizer prescription for rainfed maize on an alfisol. Res Crops. 2010;17(2):225-231.
4. Saxena AK, Singh S, Srivastava A, Gautam P. Yield target approach under integrated nutrient management for assessing fertilizer requirement of onion in Mollisol of Uttarakhand. Indian J Hort. 2008;65(3):121-125.
5. John KS, Santhi R, Boopathi PM, Natesan R, Gayathri A. Soil test based fertiliser prescription under integrated plant nutrition system for cabbage on inceptisol of Tamil Nadu. Ad Plant Sci. 2010;23(1):155-157.
6. Subbiah BV, Asija GL. A rapid procedure for estimation of available nitrogen in soils. Curr Sci. 1956;25:259-260.
7. Nazir G, Sharma U, Kumar P. Boron its importance in crop production, status in Indian soils and crop responses to its application. Int J Adv Res. 2016;4(5): 654-660.
8. Sharma U, Kumar P. Micronutrient Research in India: Extent of deficiency, crop responses and future challenges. Int J Adv Res. 2016;4(4):1402-1406.
9. Khabla M, Dixit SP. Effect of prescription based fertilizer application on different fractions of phosphorus under wheat in an acid Alfisol. J In Soc Soil Sci. 2017;65(4):447-451.
10. Kumari K, Nazir G, Singh A, Kumar P. Studies on boron fractions with different physico-chemical properties of cultivated soils of Himachal Pradesh. Int J Curr Microbiol Appl Sci. 2017;6(6): 1547-1555.
11. Dasila B, Singh V, Kushwaha HS, Srivastava A, Ram S. Water Use efficiency and yield of cowpea and nutrient loss in Lysimeter experiment under varying water table depth, irrigation schedules and irrigation method. SAARC J Agric. 2016;14(2): 46-55.
12. Kumar S, Singh S. Calibration of Potassium requirements for maximum and economic yields of turmeric (Curcuma longa L.) in a Mollisol of Uttarakhand. Int J Basic Appl Agricul Res. 2016;14(3): 301-304.