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Soil test based fertilizer recommendation under IPNS for vegetable guar in Torripsamments of Rajasthan

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Abstract

Soil test crop response correlation studies were conducted with vegetable guar under integrated plant nutrition system (STCR-IPNS) in Torripsamments of Rajasthan during Kharif 2003. Fertilizer adjustment equations under IPNS were formulated for vegetable guar following Ramamoorthy's inductive-cum targeted yield model. The nutrient requirement for producing one quintal of veg. cluster bean was found to be 6.80, 1.17 and 4.62 kg of N,P_2O_5 and K_2O, respectively. The per cent nutrient utilization efficiencies from soil and fertilizer nutrients were found to be 72.72 and 59.62 for N, 33.93 and 17.73 for P_2O_5 and 45.34 and 50.10 for K_2O, respectively. Like wise the percent nutrient utilization efficiency from farmyard manure (FYM) was 200 for N, 32.66 for P_2O_5 and 137.92 for K_2O, respectively. In STCR-IPNS technology, the fertilizer doses are tailored to the requirements of specific yield targets of veg. cluster bean taking into account the contribution from soil, fertilizers and organics.

Key words: *Vegetables cluster bean, STCR-IPNS, fertilizer adjustment equations, Torripsammennts*

Introduction

Fertilizers with instant ability to refurbish depleted nutrients in necessary quantities and forms have come to be recognized as a key component of soil fertility management. The fertilizer prices have gone up and hence their use in required amounts depends much upon the purchasing ability of the farmers. Accordingly, economic rationality dictates a more compressive approach for fertilizer use, incorporating soils tests, magnitude of crop response to applied nutrients and economic evaluation of the results (Katyal, 2001). In these efforts, soil test based fertilizer recommendation plays a vital role in increasing the soil productivity. Research work done using soil test crop response approach in different parts of the country have shown that vegetable crops respond to the nutrients added through organic and chemical fertilizers. Therefore, in sandy soils of the poor fertility, it becomes pre-requisite to use organic manures along with fertilizers to achieve advancement in productivity of vegetable crops in an economically and ecologically sound manner.

Since, in Rajasthan veg. guar is being cultivated in an area of about 598 hectare with a production of 968 metric tones and average productivity of 16.19qha^{-1} (Anoymous 2010-11). Hence, in order to step up the productivity of the veg. guar in the state, soil test based balanced fertilization is essential. Currently, a general recommendation of 50:60:60 kg N, P_2O_5 and K_2O ha^{-1} with 25 tha^{-1} FYM, respectively is being followed. Fertilization based on blanket recommendation results in either over or under use of fertilizers, so balanced fertilization is must for realizing higher efficiency and economy of fertilizer use (Velayutham and Reddy, 1990). In fertilizing the crop, existing soil fertility and crop requirements should be taken into account (Ramamoorthy *et al.*, 1967). This demands the maintenance of optimum balanced between all essential nutrients as per the crop requirements of the nutrients and their availability in soil and possible recycling of organic sources.

Materials and Methods

A field experiment based on inductive methodology was conducted in Torripsamments of Bikaner during Kharif 2003 with vegetable guar (var. M-83). The soil of the experimental field is loamy sand in texture with pH 8.4 and non- saline (EC_2 0.25 dSm^{-1}). The initial $KMnO_4$-N, Olsen-P and NH_4OAc-K status were 82.40, 18.04 and 189.50 kg ha^{-1}, respectively. The P and K fixing retention capacity of the soil observed 62 and 80 kg ha^{-1}, respectively. Following the inductive methodology of the Ramamoorthy *et al*. (1967), four field gradients were created in the preceding season by dividing the experimental field into four equal strips which were fertilized with $N_0P_0K_0$, $N_{1/2}$ $P_{1/2}$ $K_{1/2}$, N_1 P_1 K_1 and N_2 P_2 K_2 levels. An exhaust crop barley (var. RD-2508) was grown so that the fertilizers could undergo transfomations in the soil with plant microbial agencies.

By growing the exhaust crop, the operational range of the soil fertility was created in the fertility stripes, which was evaluated in terms of variations in yield, uptake and soil test values. After the harvest of the exhaust crop, each strip of the fertility gradient was divided into four eqal blocks across the strip for farmyard manure (FYM) levels. Then each strip was divided into 32 plots and distributed fertilizer treatments in such a manner that every treatment was accommodated in each gradient strip as well as in

FYM block.

Pre-sowing soil samples were collected from each gradient plot before superimposition of the treatments and were analysed for alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen, *et al*., 1954) and neutral N NH_4OAc-K (Hanway and Heidel, 1952). Vegetables guar (var. M-83) crop was grown with usual agronomic practices. The green pod yield and Stover yields of veg. guar were recorded plot wise. The plant samples from each plot were analysed for total N, P and K content (Piper, 1966) and total uptake was computed using veg. guar yield data.

Using the data of veg. guar yield, nutrient uptake, pre sowing soil available nutrients and fertilizer doses applied, the basic parameters viz., nutrient requirement (kgq^{-1}) contribution of nutrients from soil (C_s) and fertilizers (C_f) were calculated as described by Ramamoorthy *et al*.,(1967). The per cent utilization efficiency of nutrients from applied FYM was also estimated in the similar manner. These parameters were used for the formulation of fertilizer adjust equations for deriving fertilizer doses and soil test based fertilizer recommendations were prescribed in the form of a ready reckoner for desired yield target of vegetable guar under INPS.

Results and Discussion

Soil available nutriments and vegetable guar yield

The range and mean values of veg. guar yield, uptake and available soil nutrients of treated and control plots are furnished in table 1.$KMNO_4$-N ranged from 82.40 to 144.70 kg ha^{-1} with a mean of 107.80 kg ha^{-1}, Olsen. P ranged from 18.04 to 40.34 kg ha^{-1} with a mean of 27.28 kg ha^{-1} and NH_4OAc-K ranged from 189.50 to 249.98 kg ha^{-1} with a mean 212.35. The veg. guar yield in fertilizer treated plots ranged from 5.10 to 23.30 q ha^{-1} with and without FYM with a mean value of 13.47 q ha^{-1}, and in control plots ranged from 3.25 to 8.30 q ha^{-1} without FYM with a mean of 25.90 q ha^{-1} with FYM. The above data clearly indicate that a wide variability existed in the soil test values and veg. guar yield of treated and control plots, which is a pre-requisite for calculating the basic parameters and fertilizer adjustment equations for calibrating the fertilizer doses for specific yield targets.

Table 1. Range and mean values of available nutrients in the pre- sowing surface soil, uptake of nutrient and yield of vegetable guar (M-83)

Parameters	Range	Mean
Soil test values (Kg ha^{-1})		
$KMnO_4$-N	82.40-144.70	107.80
Olsen-P	18.04-40.34	27.28
NH_4OAc-K	189.50-249.98	212.35
Vegetable Guar yield (q ha^{-1})		
Treated plots	5.10-23.30	13.47
Control plots	3.25-8.30	5.90
Nutrients uptake (kg ha^{-1})		
Treated plots		
N uptake	33.21-157.00	73.56
P uptake	4.94-25.24	14.45
K uptake	20.68-104.97	58.49
Control plots		
N uptake	20.96-54.20	38.30
P uptake	2.70-8.80	5.62
K uptake	12.80-34.24	23.95

Basic parameters

The basic data viz., nutrient requirement for producing one quintal of veg. guar (M-83) yield, per cent nutrient utilization efficiency for soil, fertilizer and FYM have been calculated and presented in Table 2. For calculation of nutrient requirement of veg. guar, 32 plots (Response based) were selected (Ramamoorthy, 1993) and the uptake of nutrients regressed with the yield to obtain the nutrients requirement in kg q^{-1}. Similarly, for calculating the soil nutrient utilization efficiency (C_s), fertilizer nutrient utilization efficiency (C_f) and nutrient utilization efficiency from FYM (C_{fym}), the uptake of nutrients from all the 32 plots regressed with their respective soil nutrients value, fertilizer dose for particular nutrient and FYM dose for obtaining the respective regression coefficients, identified as Cs, C_f and C_{fym}.

The nutrient requirements of N, P_2O_5 and K_2O were 6.80, 1.17 and 4.62 kg q^{-1} of veg. guar, respectively. The per cent nutrient utilization efficiencies from soil and fertilizer nutrients were found to be 72.72 and 59.62 for nitrogen, 33.93 and 17.73 for phosphorus (P_2O_5) and 45.34 and 50.10 for potassium (K_2O) Similarly, the per cent contribution of N,P_2O_5 and K_2o from FYM was 200, 32.66, 137.92, respectively.

The data presented in Table 2 indicated that application of FYM not only contributes for particular nutrients but also improves the utilization efficiency of soil and fertilizer nutrients. The findings are in close agreement with those repoted by Reddy *et al*. (1994), Rao *et al.* (1997) and Santhi *et al*. (2002).

Table 2. Basic data for Vegetables Guar (M-83)

Parameters	N	P_2O_5	K_2O
Nutrient requirement (kg/qt)	6.80	1.17	4.62
Soil nutrient utilization efficientey (%)	72.72	33.93	45.34
Fertilizer nutrient utilization efficiency (%)	59.62	17.73	50.10
FYM Contribution (%)	200.00	32.66	137.92

Fertilizer adjustment equations for desired yield targets of vegetables guar

Soil test based fertilizer models or equations for targeted yield of vegetables guar were formulated using the basic parameters and are furnished in Table 3.

On the basis of these equations a ready reckoner was prepared for range of soil test values and for a yield target of 35.00 & 40 q ha^{-1} (Table 4) under different fertilization programmes. For producing 35.00 q ha^{-1} of vegetable guar in Torripsamments, the fertilizer doses required for the average soil test values 100, 20 and 190 kg ha^{-1} N, P_2O_5 and K_2O, respectively was found to be 60, 60 and 80 kg N, P_2O_5 and K_2O, respectively with 5 tone FYM. The finding of the above study indicate that in STCR-IPNS technology, the fertilizer doses are tailored to be requirements of specific yield targets of veg. guar taking into account the contribution from soil, fertilizers and organics. Hence, there will be a balanced supply of nutrients coupled with recycling of organic wastes avoiding either under or over uses of fertilizer inputs

Table 3. Soil test based fertilizer equations for targeted yield of vegetables guar (M-83)

FN= 11.40T-1.22SN-3.35FYM
FP=6.60T-1.91SP-1.84FYM
FK=9.22T-0.90SK-2.75FYM
Note: FN,FP and FK- fertilizer N, P_2O_5 & K_2O in kg ha^{-1}, respectively: T-yield target in q ha^{-1}, SN, SP & SK, $KMnO_4$-N, Olsen-P & NH_4OAc-K in kg ha^{-1}, respectively.

Conditions:

The yield targeting equations are valid under the following situation-

1. These should be used for similar soils occurring in a particular agro-climatic zone.
2. Targets chosen should not be unduly high or low and should be with in the range of experimental yields obtained.
3. Adjustment equations must be used within the experimental range of soil test values and cannot extrapolate.
4. Good and recommended agronomic practices need to be followed while raising crops.
5. Other micro and secondary nutrients should not be yield limiting.

Table 4. Estimates of soil test based fertilizer recommendations for 35 and 40 q ha^{-1} green pod yield of vegetable guar (M-83)

Available nutrients in soil (kg ha^{-1})			Quantity of nutrients required for yield targets (kg ha^{-1}) with 5 t ha^{-1} FYM					
			35 q ha^{-1}			40 q ha^{-1}		
N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O5	K_2O
90	20	170	60	60	10(20)	60	60	18(20)
100	25	190	60	60	10(20)	60	60	10(20)
110	30	210	53	52	10(20)	60	60	10(20)
120	35	230	41	43	10(20)	60	56	10(20)
130	40	250	29	33	10(20)	52	46	10(20)
140	45	270	17	24	10(20)	39	37	10(20)
150	50	290	10 (17)	20	10(20)	27	27	10(20)
160	55	310	10(17)	20	10(20)	15(17)	20	10(20)
170	60	330	10(17)	20	10(20)	10(17)	20	10(20)

Note: Values in parentheses indicate the maintenancedose of N, P_2O_5 & K_2O

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