e- ISSN: 2394-5532
p- ISSN: 2394-823X

Scientific Journal Impact Factor: 3.762

International Journal of Applied And Pure Science and Agriculture

www.ijapsa.com

NUTRIENT MANAGEMENT IN SUMMER GREEN GRAM (*Vigna radiata* L.)

A. R. Patel[1], D.D. Patel[2], T. U. Patel[3] and H. M. Patel[4]

N. M. College of Agriculture,Navsari Agricultural University, Navsari-396 450, Gujarat (India)

ABSTRACT

The field experiment was conducted during the summer season of the year 2013 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat (India). The experimental soil was clay in texture, low in available nitrogen, medium in available phosphorus, medium in available sulphur and slightly alkaline in reaction. Total twelve treatment combinations consisting of three levels of inorganic fertilizer (R_1: 50 per cent RDF, R_2: 75 per cent RDF and R_3: 100 per cent RDF i.e. 20-40-00 kg NPK/ha), two sources of organic manure (O_1:FYM @ 5t/ha and O_2:Biocompost @ 5t/ha) and two treatments of biofertilizers (B_1: no seed inoculation, B_2:rhizobium + Phosphate solubilizing bacteria (PSB) seed inoculation) were evaluated in factorial randomized block design with three replications. The results revealed that application of 100 % RDF (20-40-00 kg/ha NPK) + biocompost (5 t/ha) + dual inoculation of rhizobium and PSB is the best nutrient management option for harvesting economic seed yield of green gram.

KEY WORDS: Economics, Green gram, Growth parameters, Integrated nutrient management, Nutrient content and uptake, Yield

I. INTRODUCTION

Green gram is an important pulse crop of Indian as it is grown an area of 3.44 million hectares with total production of 1.4 million tonns and productivity of 406.98 kg/ha. India, major green gram producing states are Odissa, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar. In Gujarat, it is cultivated in about 2.3 lakh hectares with an annual production of 1.21 lakh tonnes and average productivity of 526.09 kg /ha (Anonymous, 2011).

The unprecedented like in cost of chemical fertilizers in the recent past has adversely affected consumption of chemical fertilizers and has aggravated the problems. Moreover injudicious use of chemicals enhanced the soil and plant health problems. In this context use of alternative sources of plant nutrients such as bio-fertilizers and organic manures are the need of the time.

Among various bio-fertilizers, *rhizobium* inoculation is a cheapest, easiest and safest way of supplying nitrogen to green gram through well known symbiotic nitrogen fixation process. Phosphate solublizing bacteria (PSB) have the consistent capacity to increase the availability of phosphate to plant by mineralizing organic phosphorus compounds. Manures contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen, that are trapped by bacteria in the soil. FYM and Biocompost helps for better crop yield by improving soil fertility and soil structure. Hence adoptions of appropriate nutrient management strategies hold a great potential in boosting the green gram yield in a suitable manner. Therefore, integrated nutrient management is crucial not only for increasing the yield but also for the improvement of soil health. Keeping all these factors in view, the present research

work entitled "Nutrient management in summer green gram (*Vigna radiata* L.)" planned to conduct at College Farm, N.A.U., Navsari.

II. MATERIALS AND METHODS

The field experiment was conducted during the summer season of the year 2013 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. The experimental soil was clay in texture, low in available nitrogen (237.15 kg/ha), medium in available phosphorus (15.78 kg/ha), medium in available sulphur (24.01 kg/ha) and slightly alkaline in reaction (pH 7.7). Total twelve treatment combinations consisting of three levels of inorganic fertilizer (R_1: 50 per cent RDF, R_2: 75 per cent RDF and R_3: 100 per cent RDF i.e. 20-40-00 kg NPK/ha), two sources of organic manure (O_1:FYM @ 5t/ha and O_2:Biocompost @ 5t/ha) and two treatments of biofertilizers (B_1: no seed inoculation, B_2:*rhizobium* + Phosphate solubilizing bacteria (PSB) seed inoculation) were evaluated in factorial randomized block design with three replications.

Greengram cv. Meha was sown with spacing of 30 cm x 10 cm on 5th March and harvested on 3rd June, 2013. Other cultural practices and plant protection measures were taken as per recommendations. The data on seed and stover yield recorded from net plot and converted on hectare basis. The nitrogen content in green gram seed was estimated by micro kjeldahl's method as described by Jackson (1967). The protein content of seed was computed by multiplying the nitrogen percentage with 6.25 for each treatment. Chemical studies pertaining to nitrogen, phosphorus and sulphur content and their uptake by seed and stover and available nitrogen, phosphorus and sulphur status in soil after harvest of crop were determined as per different methods viz., Modified Kjeldahl's method (For N), Wet digestion (Diacid) Vanadomolybdo phosphoric acid yellow colour method (for P) and Turbidiometric method (for K). The data related to each parameter of the experiment were statistically analyzed using MSTATC software. The purpose of analysis of variance was to determine the significant effect of treatments on greengram. LSD test at 5% probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1980). The net realization was calculated by deducting the total cost of cultivation from the gross realization for each treatment. The benefit cost ratio (BCR) was calculated on the basis of the formula given below:

BCR = Net realization (₹ /ha) / Cost of cultivation (₹ /ha)

III. RESULTS AND DISCUSSION

Effect of inorganic fertilizer

The treatment R_3 i.e. 100 % RDF recorded significantly higher seed yield, stover yield, harvest index (1000 kg/ha, 2668 kg/ha, 27.41 %) which was comparable with the treatment R_2 i.e. 75 % RDF (896 kg/ha, 2555 kg/ha, 26.08 %). The results were supported by the findings of Singh *et al.* (2011) and Patel (2012).

Protein content in seed as well as N, P and S contents in seed and stover were not differed significantly due to different doses of inorganic fertilizer. However, significantly higher protein yield as well as uptake of these nutrients by seed and stover were recorded under the inorganic fertilizer treatment R3 i.e.,100% RDF followed by the R2 i.e.,75% RDF. Similar results found by Dekhane, *et al.* (2011), Chesti *et al.* (2012) and Patel (2012).

Significantly higher values of available nitrogen, phosphorus and sulphur were recorded with 100 per cent RDF. The status of the soil after harvest was also improved and this might be due to residual effect of fertilizer. Almost similar findings were also reported by Tanwar *et al.* (2010) and Patel (2012).

Effect of organic manure

Plot treated with bicompost @ 5t/ha (O_2) recorded significantly the highest seed yield (929 kg/ha) and stover yield (2575 kg/ha) as compared to the treatment having application of FYM @ 5 t/ha (O_1). This might be due to the favourable effect of biocompost on chemical physical and biological properties of soil leads to easy availability of nutrients might have reflected in higher growth parameter and yield attributes. Data revealed that the harvest index was not influenced by different organic manures.

Protein content as well as N, P and S content in seed and stover were found non significant due to different sources of organic manure. However, protein yield as well as uptake of nutrients was recorded significantly higher under the treatment biocompost @ 5 t/ha as compared to application of FYM @ 5 t/ha.

Significantly higher values of available nitrogen, phosphorus and sulphur were recorded with biocompost (5 t/ha). However, both the sources of organic manures increased the nutrient status of soil as compared to the initial nutrient status of soil. This was due to the application of organic manures increased organic matter in soil ultimately enhancing microbial activity which reflected in the possible increase of nutrient status of soil. These results are in conformity with those reported by Vyas *et al.* (2003) and Reddy *et al.* (2007).

Effect of biofertilizer

Seed treated with *rhizobium* + PSB (B_1) recorded significantly the highest seed yield (901 kg/ha) and stover yield (2517 kg/ha) as compared to no seed inoculation with biofertilizer. This might be due to dual inoculation benefited the plants by providing atmospheric N and rendering the insoluble phosphorus into available form. The enhanced availability of P favoured N fixation and rate of photosynthesis and consequently led to better plant height and branches per plant. Almost similar findings were also reported by Sahay *et al.* (2011) and Patel (2012) in mungbean. The harvest index did not reach to the level of significance due to the effect of various biofertilizers treatments.

Protein content as well as N, P and S content in seed and stover were not differed significantly due to different treatments of biofertilizers. However, protein yield as well as uptakes of nutrients (NPS) were influenced significantly due to different biofertilizer treatments. Significantly the highest protein yield (190.20 kg/ha) and nutrient uptake were recorded under treatment B_1 (*rhizobium* + PSB seed inoculation).

Rhizobium and PSB seed inoculation in combination significantly increased available nitrogen, phosphorus and sulphur in soil. This could be due to higher mobilization of N, P and S. This indicates that crop might not have been utilised all the available nutrients native to the soil. These findings lend support to the report of Sahay *et al.* (2011) and Patel (2012).

Interaction effect.

Interaction effects of inorganic fertilizers, organic manure and biofertilizer were found to be absent on stover yield and harvest index, while seed yield found significant due to interaction.

Data presented in Table 2 revealed that the treatment combination $R_3O_2B_1$ (100 per cent RDF along with biocompost @ 5t/ha and seed inoculation with *rhizobium* + PSB) recorded significantly higher seed yield (1071 kg/ha) and it was found statistically at par with the treatment combinations $R_3O_2B_0$, $R_3O_1B_1$, $R_3O_1B_0$ and $R_2O_2B_1$. The lowest seed yield (626 kg/ha) was recorded with treatment combination $R_1O_1B_0$ (50 per cent RDF along with FYM 5t/ha and without biofertilizer inoculation). Similar findings were also reported by Beg and Singh (2009), Tanvar *et al* (2010) and Patel (2012) with respect to seed yield. The treatment combination $R_3O_2B_1$ (100% RDF with Biocompost @ 5 t/ha with *rhizobium* + PSB seed inoculation) recorded the highest P uptake by seed (7.98) as compared to rest of all the interactions.

Economics

A perusal of data presented in Table 1 revealed that the highest net realization (₹ 66284/ha) was obtained under the treatment R_3 (100% RDF) with the BCR value of 3.86. followed by the treatment R_2 (75% RDF) which recorded the net realization of ₹ 57977/ha with the BCR value of 3.46. Similar results were also reported by Saini *et al.* (2011) and Patel (2012) with respect to higher net income and BCR. The highest net realization (₹ 60223/ha) was recorded under the treatment O_2 (Biocompost @ 5t/ha) with the BCR value of 3.49 followed by the treatment O_1 (FYM @ 5t/ha) with lower net realization of ₹ 51250/ha and BCR value of 3.15. A perusal of data presented in Table 3 also revealed that the highest net realization (₹ 58294/ha) was obtained under the treatment B_1 (*rhizobium* + PSB) with the BCR value of 3.45 which was higher as compared to control. Similar results were obtained by Beg and Singh (2009) and Patel *et al.* (2010).

Based on the results of the field experimentation, it is concluded that potential seed yield and economic nutrient management can be achieved in greengram by

application of 100 % RDF (20-40-00 kg/ha NPK) + biocompost (5 t/ha) + dual inoculation of *rhizobium* and PSB.

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Table 1. Economics of summer green gram as influenced by inorganic fertilizer, organic manure and biofertilizers

Treatment	Yield (kg/ha)		arvest index (%)	Gross realization (₹/ha)	st of production(₹ /ha)	Net realization (₹/ha)	B:C ratio
	Seed	Stover					
Inorganic fertilizer							
R_1 (50 % RDF)	711	2088	25.41	59313	16364	42949	2.62
R_2 (75 % RDF)	896	2555	26.08	74728	16751	57977	3.46
R_3 (100 % RDF)	1000	2668	27.41	83422	17138	66284	3.86
S.Em.±	18.44	97.53	0.54				
C.D. (P=0.05)	54.11	286.07	1.59				
Organic manure							
O_1 (FYM 5t/ha)	809	2299	26.00	67501	16251	51250	3.15
O_2 (Biocompost 5t/ha)	929	2575	26.61	77474	17251	60223	3.49
S.Em.±	15.06	79.63	0.44				
C.D. (P=0.05)	44.18	233.57	NS				
Biofertilizer							
B_0 (No biofrtilizer)	837	2357	26.16	69811	16631	53180	3.19
B_1 (*Rhizobium*+ PSB)	901	2517	26.44	75165	16871	58294	3.45
S.Em.±	15.06	79.63	0.44				
C.D. (P=0.05)	44.18	NS	NS				
Interaction effect							
RXO	NS	NS	NS				
RXB	NS	NS	NS				
OXB	NS	NS	NS				
VXFXB	S	NS	NS				
CV%	7.35	13.86	7.14				

A = Selling rate of product Greengram Seed : ₹ 50 kg^{-1} (Meha) Greengram Stover : ₹ 2 kg^{-1}

Table 2: Seed yield (kg/ha) as influenced due to RXOXB interaction

Treatments	B_0	B_1
R_1O_1	626	628
R_1O_2	708	880
R_2O_1	775	886
R_2O_2	957	965
R_3O_1	964	975
R_3O_2	991	1071
S.Em.±	36.89	
C.D. (P=0.05)	108.22	

Table 3. N, P and S content (%) in seeds and stover of summer greengram as influenced by various treatments.

Treatment	rotein content (%)	rotein yield (kg/ha)	N content (%)		P content (%)		S content (%)	
			Seed	Stover	Seed	Stover	Seed	Stover
rganic fertilizer								
R_1 (50 % RDF)	20.50	146.03	3.280	0.694	0.688	0.226	0.389	0.316
R_2 (75 % RDF)	20.99	187.95	3.358	0.709	0.708	0.232	0.398	0.319
R_3 (100 % RDF)	21.25	212.63	3.400	0.716	0.714	0.231	0.413	0.327
S.Em.±	0.26	3.96	0.041	0.009	0.009	0.003	0.007	0.004
C.D. (P=0.05)	NS	11.63	NS	NS	NS	NS	NS	NS
ganic manure								
O_1 (FYM 5t/ha)	20.83	168.98	3.333	0.700	0.693	0.229	0.397	0.316
O_2 (Biocompost 5t/ha)	21.00	195.42	3.359	0.713	0.714	0.23	0.403	0.32
S.Em.±	0.21	3.23	0.033	0.007	0.007	0.003	0.005	0.003
C.D. (P=0.05)	NS	9.50	NS	NS	NS	NS	NS	NS
fertilizer								
B_0 (No biofrtilizer)	20.76	174.21	3.321	0.700	0.695	0.22	0.398	0.31
B_1 (*Rhizobium*+ PSB)	21.07	190.20	3.371	0.713	0.712	0.23	0.401	0.32
S.Em.±	0.21	3.23	0.033	0.007	0.007	0.003	0.005	0.003
C.D. (P=0.05)	NS	9.50	NS	NS	NS	NS	NS	NS
Interaction effect								
RXO	NS	NS	NS	NS	NS	NS	NS	NS
RXB	NS	NS	NS	NS	NS	NS	NS	NS
OXB	NS	NS	NS	NS	NS	NS	NS	NS
VXFXB	NS	NS	NS	NS	NS	NS	NS	NS
CV%	4.28	7.54	4.28	4.52	4.46	5.5	6.08	4.46

Table 4. N, P and S uptake (kg/ha) in seeds and stover of summer green gram as influenced by various treatments

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		S uptake (kg/ha)	
	d	ver	d	ver	d	ver
rganic fertilizer						
R_1 (50 % RDF)	23.36	14.47	4.90	4.72	2.77	6.59
R_2 (75 % RDF)	30.07	18.09	6.34	5.91	3.56	8.14
R_3 (100 % RDF)	34.02	19.12	7.15	6.15	4.13	8.70
S.Em.±	0.6	0.62	0.14	0.22	0.10	0.27
C.D. (P=0.05)	1.86	1.82	0.42	0.65	0.29	0.82
ganic manure						
O_1 (FYM 5t/ha)	27.03	16.09	5.62	5.27	3.22	7.27
O_2 (Biocompost 5t/ha)	31.26	18.37	6.65	5.92	3.75	8.35
S.Em.±	0.51	0.50	0.11	0.18	0.08	0.22
C.D. (P=0.05)	1.52	1.48	0.34	0.53	0.24	0.66
fertilizer						
B_0 (No biofrtilizer)	27.87	16.47	5.83	5.39	3.34	7.52
B_1 (*Rhizobium*+ PSB)	30.43	17.98	6.44	5.79	3.63	8.11
S.Em.±	0.51	0.50	0.11	0.18	0.08	0.22
C.D. (P=0.05)	1.52	1.48	0.34	NS	0.24	NS
Interaction effect						
RXO	NS	NS	NS	NS	NS	NS
RXB	NS	NS	NS	NS	NS	NS
OXB	NS	NS	NS	NS	NS	NS
VXFXB	NS	NS	S	NS	NS	NS
CV%	7.54	12.48	8.15	9.87	10.15	12.39

Table 5. Available N, P and S (kg/ha) in soil after harvest of summer greengram as influenced by various treatments

Treatment	Available N (kg/ha)	Available P (kg/ha)	Available S (kg/ha)
›rganic fertilizer			
R_1 (50 % RDF)	235.66	15.31	23.70
R_2 (75 % RDF)	258.50	17.38	26.41
R_3 (100 % RDF)	271.25	18.13	27.41
S.Em.±	3.22	0.27	0.43
C.D. (P=0.05)	9.45	0.79	1.26
ganic manure			
O_1 (FYM 5t/ha)	249.83	16.18	24.86
O_2 (Biocompost 5t/ha)	260.44	17.63	26.83
S.Em.±	2.63	0.21	0.35
C.D. (P=0.05)	7.72	0.64	1.03
fertilizer			
B_0 (No biofrtilizer)	251.22	16.47	25.58
B_1 (*Rhizobium*+ PSB)	259.05	17.34	26.11
S.Em.±	2.63	0.22	0.35
C.D. (P=0.05)	7.72	0.64	NS
eraction effect			
RXO	NS	NS	NS
RXB	NS	NS	NS
OXB	NS	NS	NS
VXFXB	NS	NS	NS
CV%	4.38	5.5	5.77