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## Integrated nutrient management in summer greengram (*Vigna radiata* L.) under south Gujarat condition

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**Abstract**

A field experiment entitled “Integrated nutrient management in summer greengram (*Vigna radiata* L.) under south Gujarat condition” was conducted during summer season of 2019 at the college farm, Navsari Agricultural University, Navsari (Gujarat). Individual application of 100% RDF, vermicompost @ 2.5 t/ha and biofertilizer (Rhizobium + PSB) recorded significantly highest growth and yield attributes, seed and stover yields as well as net realization of greengram. The treatment combination of 100% RDF, vermicompost 2.5 t/ha and biofertilizer (Rhizobium + PSB) (F<sub>3</sub>O<sub>2</sub>B<sub>2</sub>) obtained significantly higher seed yield (1370 kg/ha) and it was found statistically at par with treatment combination of F<sub>3</sub>O<sub>2</sub>B<sub>1</sub>, F<sub>3</sub>O<sub>1</sub>B<sub>2</sub> and F<sub>2</sub>O<sub>2</sub>B<sub>2</sub>. Looking to the economics, the maximum net return (63234 Rs/ha) and B: C ratio (3.25) were obtained under treatment combination of 100% RDF, FYM @ 2.5 t/ha and biofertilizer (Rhizobium + PSB) (F<sub>3</sub>O<sub>1</sub>B<sub>2</sub>) followed by F<sub>3</sub>O<sub>2</sub>B<sub>2</sub> (100% RDF + vermicompost 2.5 t/ha + biofertilizer (Rhizobium + PSB)).

**Keywords:** Greengram, FYM, vermicompost, bio-fertilizers

**Introduction**

Greengram is the third important pulse crop cultivated through India. Pulses from an integral part of vegetarian diet of large population of India. Besides being rich source of protein and amino acids, they maintain soil fertility through the process of nitrogen fixation in symbiotic association with *Rhizobium* bacteria present in their nodules. Thus, they play a vital role as nitrogen fixation manufactories, which help in sustain productivity of agricultural soil (Jat *et al.*, 2012) [6].

Recently, integrated nutrient management has emerged as a sustainable practice which is able to boost up production, productivity and quality of the product as well as without causing any negative hazardous effect on crop and environment. The integrated nutrient management is one of the most important component of the production technology to sustain soil fertility and crop productivity in the future. Plant nutrients can be supplied from different sources i.e. organic manures, vermicompost, crop residues, green manure, bio-fertilizers and chemical fertilizers. The combined use of organic and inorganic sources of plant nutrient not only pushed the production and profitability of field crops, rather it helps in maintaining the permanent fertility status of soil (Dubey and Gupta, 1996; Kumar and Singh, 2010) [4, 6].

Among different plant nutrients, nitrogen is the most important nutrient for plant growth and development. Nitrogen as chief constituents of plant nutrition plays an important role in synthesis of chlorophyll and amino acid (Masclaux *et al.*, 2006) [10]. Insufficient nitrogen may reduce yield drastically and deteriorates the quality of produce specially protein content.

Phosphorus plays a key role in the balance nutrition of plants. The beneficial effects of phosphorus have been observed on nodulation, aerial growth, root development, synthesis and breakdown. Potassium is the third most important essential nutrient after nitrogen and phosphorus. The potassium activates more than 60 enzymes and enzymatic catalyst in system involved in photosynthesis, metabolism and translocation of carbohydrate and proteins, membrane permeability, stomatal regulation and water utilization. Generally, there is no need to apply potassium where high K<sub>2</sub>O status of soil.

Farm yard manure (FYM) is though not useful as a sole source of nutrients but a good complimentary and supplementary source with mineral fertilizers. Farmyard manure is good source of all the essential nutrients which supplies nitrogen, phosphorus, potassium and micronutrients like Fe, S, Mo and Zn etc.

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The application of FYM not only provides nutrition to crop on decomposition but it also improves physical and chemical properties and health of soil such as aggregation, aeration, permeability, water holding capacity, stimulation of soil flora and fauna. Addition of FYM also restricts the phosphate depletion from soil and maintains phosphate balance by reducing its fixation. The use of farmyard manure (FYM) along with inorganic fertilizer increases the nutrient use efficiency (Shrotri *et al.*, 2018) [18].

Vermicompost enhances soil biodiversity by promoting beneficial microbes, which enhances plant growth directly by production of plant growth regulating substances (hormones and enzymes) and indirectly by controlling plant pathogens, nematodes and other pests, thereby enhancing plant health and minimizing the yield loss (Pathama and Sakthivel, 2012) [14].

Bio-fertilizer have come up as relatively inexpensive nitrogen and supplement for crop production during the recent year, which provide scope for nitrogen economy. They help in improving soil fertility by way of accelerating biological nitrogen fixation from atmosphere, solubilization of insoluble nutrients present in the soil, stimulating plant growth and development, maintaining soil reaction and improving physical and biological properties of soil and thereby making nutrient easily available to the plant (Desai *et al.*, 2020) [2].

## Materials and Methods

A field experiment was conducted in summer season of 2019 at the college farm, Navsari Agricultural University, Navsari, Gujarat. The soil of the experimental field was clayey in texture having medium to poor drainage, soil pH 7.35, EC 0.35 ds/m and organic carbon content 0.40%. The soil is low in available nitrogen (141.74 kg/ha), medium in available phosphorus (53.57 kg/ha) and high in available potassium (358.17 kg/ha) were determined by Kjeldahl's method, Olsen's method and Flame photometric method, respectively. An experiment was laid out on a factorial randomized block design with twelve treatment combinations replicated thrice. The factors consisted of three levels of fertilizers (F<sub>1</sub>: 50% RDF, F<sub>2</sub>: 75% RDF and F<sub>3</sub>: 100% RDF *i.e.* 20-40-00 NPK kg/ha), two sources of organic manures (O<sub>1</sub>: FYM @ 2.5 t/ha and O<sub>2</sub>: vermicompost @ 2.5 t/ha) and two treatments of bio-fertilizers (B<sub>1</sub>: no inoculation and B<sub>2</sub>: *Rhizobium* + PSB inoculation). Greengram variety "GM 6" seeds were sown on 18 February 2019 using seed rate 20 kg/ha with row spacing 30 cm and plant spacing 10 cm spacing. All other operation was performed as per recommendations of the crops. The crop was harvested on 15 May 2019. The data on growth and yield attributes were recorded from randomly selected five plants in each plot and seed yield and stover yield recorded from net plot and converted on hectare basis. The results were analysis statistically to draw suitable interference as per the standard ANOVA techniques suggested by Gomez and Gomez (1984) [5].

## Results and Discussion

### Effect of inorganic fertilizers

The periodical plant height, number of branches per plant and dry matter accumulation per plant were significantly highest under the application of 100% RDF. All above parameters except dry matter accumulation per plant were statistically at par with 75% RDF. This might be due to nitrogen application increased growth of the plant, since nitrogen as major component of protoplasm helps in photosynthesis and enhances metabolic rate, cell division and cell elongation

which thereby, allow the plant grow to faster and phosphorus enhances the root elongation, leaf expansion and helps in cell elongation. The present findings are in close agreement with those reported by Priyadarshini *et al.* (2017) in clusterbean, Pargi *et al.* (2018) [13] in cowpea, Beniwal and Ajay (2019) [11] in blackgram and Desai *et al.* (2020) [2] in Indian bean. Significantly the highest pod length, number of pods per plant, number of seeds per pod and seed and stover yields were found superior under application of 100% RDF. All the parameters, except number of pods per plant were statistically at par with 75% RDF. The increase in the seed yield ha<sup>-1</sup> of greengram owing to increase in the fertility level was due to the fact that application of adequate of nutrients in the balanced proportion enhanced the growth of the crop and better utilization of soil moisture and other resources led to better development of the yield attributes. Moreover, the improvement in yield attributes and consequent to higher yield might possibly be due to the enhanced synthesis of carbohydrates and proteins and their transport to the sink through efficient physiological activities in plants, as evident from improved physiological parameter like LAI and CGR. The increase in stover yield with application of RDF might have attributed to the higher photosynthetic activity in greengram plant leading to a better supply of carbohydrates resulted in more number of branches and dry matter. Similar findings were also reported by Singh *et al.* (2016) [12] in black gram, Joshi *et al.* (2018) [7] in cowpea, Mehetre *et al.* (2019) [11] in soybean and Desai *et al.* (2020) [2] in Indian bean. The maximum net realization (57664 Rs/ha) and BCR (2.81) were obtained under the treatment 100% RDF. Increase in the gross and net realization might be due to higher yields and low cost of cultivation. These results are in conformity with the findings of Singh *et al.* (2016) [12] in blackgram and Joshi *et al.* (2018) [7] in cowpea.

### Effect of organic manures

Significantly the highest growth and yield attributes were recorded under the application of vermicompost @ 2.5 t/ha as compared to the application of FYM @ 2.5 t/ha. Similarly, the highest seed and stover yields were recorded under the application of vermicompost @ 2.5 t/ha. The positive response of vermicompost may probably due to enhanced supply of macro as well as micro nutrients which leads to high assimilation of food and its subsequent portioning in sink. It improved yield components due to vegetative and reproductive growth led to higher seed and stover yield. Similar findings were also reported by Sharma and Abraham (2010) [17] in blackgram and Yadav *et al.* (2017) [23] in chickpea. Maximum net realization (45842 Rs/ha) was secured with the application of vermicompost @ 2.5 t/ha over FYM @ 2.5 t/ha. Whereas, maximum BCR (2.40) was secured with the application of FYM @ 2.5 t/ha. This was due to the cost of cultivation of FYM is less as compared to vermicompost. Similar finding was observed by Kumavat *et al.* (2009) [9] in mungbean and Verma *et al.* (2017) [22] in fenugreek.

### Effect of bio-fertilizers

An application of bio-fertilizer (*Rhizobium* + PSB) was resulted in significantly the highest growth and yield attributes and seed and stover yields over without bio-fertilizer application. This might be due to the provision of fixation of nitrogen by *Rhizobium* and possible solubilisation of fixed P as well as applied P besides synthesis of growth promoting substances like auxins and gibberellins and

produce vitamins which augmented plant growth by phosphorus solubilising species might have improved vigour and resulted in recording higher values of morphological parameters and ultimately increased N and P uptake which enhanced the yield of the crop. These findings corroborate the results of Dongare *et al.* (2016) [3] in greengram, Nadeem *et al.* (2016) [12] in cowpea, Pargi *et al.* (2018) [13] in cowpea and Desai *et al.* (2020) [2] in Indian bean. Seed treatment of bio-fertilizers like Rhizobium + PSB at the time of sowing was obtained maximum net realization (44656 Rs/ha) with BCR (2.41) over without seed treatment. These results are in conformity with the findings of Singh *et al.* (2016) [12] in blackgram.

### Interaction effect

Interaction effect of inorganic fertilizers, organic manures and bio-fertilizers were found to be significant for seed yield of greengram. The treatment combination involving 100% RDF along with vermicompost 2.5 t/ha and seed inoculation of *Rhizobium* + PSB(F<sub>3</sub>O<sub>2</sub>B<sub>2</sub>) obtained significantly the higher seed yield (1370 kg/ha) and it was found statistically at par

with treatment combination of 100% RDF along with vermicompost @ 2.5 t/ha and without seed inoculation of *Rhizobium* + PSB (F<sub>3</sub>O<sub>2</sub>B<sub>1</sub>), 100% RDF along with FYM @ 2.5 t/ha and seed inoculation of *Rhizobium* + PSB (F<sub>3</sub>O<sub>1</sub>B<sub>2</sub>) and 75% RDF along with vermicompost @ 2.5 t/ha and seed inoculation of *Rhizobium* + PSB (F<sub>2</sub>O<sub>2</sub>B<sub>2</sub>). Prajapati (2014) [15] in greengram, Tyagi *et al.* (2015) [21] in greengram and Tyagi and Singh (2019) [20] in blackgram also noted similar results. Treatment combination of F<sub>3</sub>O<sub>1</sub>B<sub>2</sub> (100% RDF along with FYM @ 2.5 t/ha and seed inoculation of *Rhizobium* + PSB) fetched maximum net realization (63234 Rs/ha) and BCR (3.25) followed by the treatment combination of F<sub>3</sub>O<sub>2</sub>B<sub>2</sub> (100% RDF along with vermicompost @ 2.5 t/ha and seed inoculation of *Rhizobium* + PSB). The increase in net return and BCR might be due to higher production because more availability of nutrient with combined application of nutrient sources and also due to the cost of FYM (2 Rs/kg) is less as compared to vermicompost (5 Rs/kg). These results are also reported by Prajapati (2014) [15] in greengram and Tyagi and Upadhyay (2015) [21] in greengram.

**Table 1:** Effect of inorganic fertilizers, organic manures and bio-fertilizers on growth and yield attributes of summer greengram

Treatments	Plant height (cm)		Number of branches per plant		Dry matter accumulation per plant (g)	Pod length (cm)	Number of pods per plant	Number of seeds per pod	Test weight (gm)
	At 30 DAS	At 60 DAS	At 30 DAS	At 60 DAS					
<b>Inorganic fertilizers (F)</b>									
F <sub>1</sub> : 50% RDF	21.07	50.85	2.22	3.10	13.05	7.56	13.53	10.70	51.36
F <sub>2</sub> : 75% RDF	22.54	53.29	2.28	3.27	15.07	8.23	14.77	11.43	53.31
F <sub>3</sub> : 100% RDF	23.54	55.27	2.52	3.40	16.70	8.70	16.42	11.73	54.16
S.Em±	0.37	0.92	0.05	0.06	0.37	0.19	0.42	0.21	0.82
CD at 5%	1.09	2.70	0.15	0.17	1.07	0.55	1.22	0.60	NS
<b>Organic manures (O)</b>									
O <sub>1</sub> : FYM 2.5 @t/ha	21.82	52.03	2.24	3.14	14.31	7.83	13.97	10.93	52.04
O <sub>2</sub> :Vermicompost @ 2.5 t/ha	22.95	54.24	2.43	3.37	15.57	8.49	15.84	11.64	53.84
S.Em±	0.30	0.75	0.04	0.05	0.30	0.15	0.34	0.17	0.67
CD at 5%	0.89	2.20	0.12	0.14	0.88	0.45	0.99	0.49	NS
<b>Bio-fertilizers (B)</b>									
B <sub>1</sub> : No bio-fertilizer	21.94	52.01	2.28	3.18	14.46	7.90	14.32	11.03	51.99
B <sub>2</sub> : <i>Rhizobium</i> +PSB	22.82	54.26	2.40	3.33	15.42	8.42	15.49	11.54	53.89
S.Em±	0.30	0.75	0.04	0.05	0.30	0.15	0.34	0.17	0.67
CD at 5%	NS	2.20	NS	0.14	0.88	0.45	0.99	0.49	NS
<b>Significant interaction</b>	--	--	--	--	--	--	--	--	--
CV%	5.74	6.00	7.72	6.09	8.49	7.89	9.65	6.33	5.36

**Table 2:** Effect of inorganic fertilizers, organic manures and bio-fertilizers on yield and economics of summer greengram

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B:C ratio
<b>Inorganic fertilizers (F)</b>							
F <sub>1</sub> : 50% RDF	798	1694	32.08	56969	30548	26421	1.86
F <sub>2</sub> : 75% RDF	1033	2153	32.44	73621	31122	42499	2.36
F <sub>3</sub> : 100% RDF	1258	2525	33.21	89361	31697	57664	2.81
S.Em±	21.55	54.57	0.72	-	-	-	-
CD at 5%	63.20	160.07	NS	-	-	-	-
<b>Organic manures (O)</b>							
O <sub>1</sub> : FYM 2.5 @t/ha	926	1910	32.61	65921	27372	38549	2.40
O <sub>2</sub> :Vermicompost@ 2.5 t/ha	1134	2338	32.54	80714	34872	45842	2.31
S.Em±	17.59	44.56	0.58	-	-	-	-
CD at 5%	51.60	130.70	NS	-	-	-	-
<b>Bio-fertilizers (B)</b>							
B <sub>1</sub> : No bio- fertilizer	954	2024	32.02	68071	31022	37049	2.19
B <sub>2</sub> : <i>Rhizobium</i> + PSB	1106	2224	33.14	78564	31222	47342	2.51
S.Em±	17.59	44.56	0.58	-	-	-	-
CD at 5%	51.60	130.70	NS	-	-	-	-
<b>Significant interaction</b>	FxOxB	--	--	-	-	-	-
CV%	7.25	8.90	7.62	-	-	-	-

**Table 3:** Economics of various treatment combination of inorganic fertilizer, organic manure and bio-fertilizer

Treatment	Yield (kg/ha)		Cost of cultivation (Rs/ha)			Gross realization(Rs/ha)			Net return (Rs/ha)	B:C
	Seed	Stover	Fixed	Variable	Total	Seed	Stover	Total		
F <sub>1</sub> O <sub>1</sub> B <sub>1</sub>	683	1407	20548	6150	26698	44395	4221	48616	21918	1.82
F <sub>1</sub> O <sub>1</sub> B <sub>2</sub>	760	1577	20548	6350	26898	49400	4731	54131	27233	2.01
F <sub>1</sub> O <sub>2</sub> B <sub>1</sub>	800	1803	20548	13650	34198	52000	5409	57409	23211	1.67
F <sub>1</sub> O <sub>2</sub> B <sub>2</sub>	950	1990	20548	13850	34398	61750	5970	67720	33322	1.96
F <sub>2</sub> O <sub>1</sub> B <sub>1</sub>	817	1713	20548	6724	27272	53105	5139	58244	30972	2.13
F <sub>2</sub> O <sub>1</sub> B <sub>2</sub>	983	2037	20548	6924	27472	63895	6111	70006	42534	2.57
F <sub>2</sub> O <sub>2</sub> B <sub>1</sub>	1050	2290	20548	15224	34772	68250	6870	75120	40348	2.16
F <sub>2</sub> O <sub>2</sub> B <sub>2</sub>	1283	2573	20548	15424	34972	83395	7719	91114	56142	2.60
F <sub>3</sub> O <sub>1</sub> B <sub>1</sub>	1023	2250	20548	7299	27847	66495	6750	73245	45398	2.63
F <sub>3</sub> O <sub>1</sub> B <sub>2</sub>	1290	2477	20548	7499	28047	83850	7431	91281	63234	3.25
F <sub>3</sub> O <sub>2</sub> B <sub>1</sub>	1350	2680	20548	14799	35347	87750	8040	95790	60443	2.70
F <sub>3</sub> O <sub>2</sub> B <sub>2</sub>	1370	2693	20548	14999	35547	89050	8079	97129	61582	2.73

## Conclusion

On the basis of one year experimental results, it is concluded that to obtain higher and profitable yield of summer greengram (cv. GM 6) as well as to maintain soil fertility the crop should be fertilized with 100% RDF along with FYM @ 2.5 t/ha and seed inoculation of Rhizobium + PSB (F<sub>3</sub>O<sub>1</sub>B<sub>2</sub>). To curtailed 25% chemicals in the soil, 75% RDF along with vermicompost @ 2.5 t/ha and seed inoculation of Rhizobium + PSB (F<sub>2</sub>O<sub>2</sub>B<sub>2</sub>) is also found comparable with 100% RDF along with FYM @ 2.5 t/ha and seed inoculation of Rhizobium + PSB (F<sub>3</sub>O<sub>1</sub>B<sub>2</sub>).

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