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Effect of integrated nutrient management on growth, yield, nutrient uptake and soil nutrient status of summer green gram (*Vigna radiata* L.) under south Gujarat conditions

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Abstract

A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari (Gujarat) during the summer seasons of the years 2018 and 2019. The soil of the field was clayey in texture, slightly alkaline (pH 7.9), low in organic carbon (0.41%) and available nitrogen (199.86 kg/ha), medium in available phosphorus (39.43 kg/ha) and high in available potassium (302.88 kg/ha). Six treatments were imposed in summer green gram *viz.* absolute control (T₁), 100% RDF (20:40:0) (T₂), 100% RDF + biocompost @ 5 t/ha (T₃), 100% RDF + biocompost @ 5 t/ha + PSB @ 2.5 l/ha (T₄), 50% RDF + biocompost @ 2.5 t/ha (T₅) and 50% RDF + biocompost @ 2.5 t/ha + PSB @ 2.5 l/ha (T₆). These treatments were replicated four times in randomized block design. Treatments T₃, T₄ and T₆ performed equally good and recorded significantly higher growth attributes, yield attributes, seed & stover yield, nutrient uptake (NPK) and available nutrient status in soil.

Keywords: Green gram, integrated nutrient management, yield, nutrient uptake

Introduction

Pulses are an important source of protein for humans but have low productivity. There are numerous reasons behind lower productivity in pulses *viz.* cultivation on mainly marginal and sub-marginal conditions with almost no or low-input management, extreme pressure of population on land, uncertain monsoon and insufficient irrigation facilities, imbalanced use of fertilizers, inability of farmers to get high yielding varieties seeds, susceptibility to abiotic and biotic stresses etc. Efficient and balanced fertilization is one of the factors that can help us in achieving desired productivity in pulses. Among various pulses grown in India, green gram (*Vigna radiata* L.) is the third most important one.

Integrated nutrient management facilitates better utilization of resources. In this approach, all possible organic sources of nutrients are applied based on economic consideration and the balance required for the crop is supplemented with chemical fertilisers. Use of biocompost is an important practice under INM as it is a cost effective and good source of nutrients and also has other benefits like enhancing microbial population in the soil, acting as an absorbent material to hold moisture and soluble minerals etc. Biofertilizers too are one of the important ingredients in INM. Biofertilizers themselves are not really a source of nutrients but their application increases the availability of nutrients to the crops due to enhanced mineralization.

Materials and Methods

A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari (Gujarat) on green gram *cv.* GM-6 during the summer seasons of the years 2018 and 2019. The soil of the experimental field was clayey in texture, low in organic carbon content (0.41%) and available nitrogen (199.86 kg/ha), medium in available phosphorus (39.43 kg/ha) and fairly high in available potassium (302.88 kg/ha). The soil was slightly alkaline in reaction (pH 7.9). A total of six treatments were imposed in summer green gram *viz.* absolute control (T₁), 100% RDF (20:40:0) (T₂), 100% RDF + biocompost @ 5 t/ha (T₃), 100% RDF + biocompost @ 5 t/ha + PSB (Soil application @ 2.5 l/ha) (T₄), 50% RDF + biocompost @ 2.5 t/ha (T₅) and 50% RDF + biocompost @ 2.5 t/ha + PSB (Soil application @ 2.5 l/ha) (T₆).

These treatments were replicated four times in randomized block design. Nitrogen was applied through urea whereas phosphorus was applied through single superphosphate as basal application. The desired quantity of biocompost was worked out as per treatments and bio fertilizer culture was thoroughly mixed with biocompost. It was then uniformly spread and mixed in particular plots before sowing. The biometric observations were recorded on five randomly selected plants from the net plot. These plants were labelled with proper notations and used for recording the observations. Samples for the observations that required destructive sampling were collected from the ring line and not from the net plot area. The mean values of all observations were utilized for statistical analysis by using statistical procedures as described by Panse and Sukhatme (1967) [1]. The treatment effects on all the characters under study were compared by employing 'F' – test and the data was analysed in randomised block design.

Results and Discussion

Growth attributes

All the growth attributes viz. plant height, number of branches/plant, number of root nodules/plant, leaf area index and dry matter accumulation/plant at 40 DAS as well as at harvest (table 1 and 2) were significantly improved by the conjunctive use of organic and inorganic sources as compared to inorganic sources alone. Summer green gram fertilized with 100% RDF + biocompost @ 5 t/ha with PSB @ 2.5 l/ha registered the highest values for all the growth attributes.

However, treatments with 100% RDF + biocompost @ 5 t/ha and 50% RDF + biocompost @ 2.5 t/ha with PSB @ 2.5 l/ha were statistically at par with the highest treatment for majority of growth parameters studied. It is probably due to the improvement in soil conditions under organic matter addition. Integrated use of organic manure and inorganic fertilizers increases the availability of nutrients over a longer period of crop duration owing to their slow release. Better absorption of nitrogen facilitated vegetative growth as it is a major component of chlorophyll and proteins. Further, addition of Phosphate Solubilising Bacteria (PSB) enhanced the availability of soil phosphorus which otherwise remains mostly fixed in the soil. Phosphorus other than being an important constituent of cell's energy currency (ATP), also aids in root nodulation in leguminous crops. Thus, better availability of nutrients from an early stage was reflected in improved growth of crop. Similar findings were reported by Tyagi *et al.* (2014) [2], Sushil *et al.* (2015) [3], Meena *et al.* (2016) [4] and Karnavat *et al.* (2018) [5].

Yield attributes and yield

Various yield attributes viz. number of pods/plant, grains/pod, pod length and test weight (table 3) were significantly influenced by the INM treatments imposed in crop. Among INM treatments, application of 100% RDF + biocompost @ 5 t/ha either with or without PSB @ 2.5 l/ha and 50% RDF + biocompost @ 2.5 t/ha with or without PSB @ 2.5 l/ha were found to be equally good for majority of yield attributes studied.

Table 1: Plant height, number of branches per plant and root nodules per plant in green gram as influenced by different treatments (pooled values)

Treatments	Plant height (cm)		Branches/plant		Root nodules/plant (40 DAS)
	40 DAS	Harvest	40 DAS	Harvest	
T ₁ : Absolute control	9.22	31.10	2.03	3.24	14.37
T ₂ : 100% RDF	10.19	34.50	2.13	3.63	19.38
T ₃ : 100% RDF + 5 t/ha biocompost	11.68	40.37	2.41	3.83	21.44
T ₄ : 100% RDF + 5 t/ha biocompost + PSB (2.5 l/ha)	12.46	43.16	2.66	4.30	22.84
T ₅ : 50% RDF + 2.5 t/ha biocompost	11.30	39.38	2.26	3.68	20.89
T ₆ : 50% RDF + 2.5 t/ha biocompost + PSB (2.5 l/ha)	11.89	41.46	2.55	4.15	21.77
SEm ±	0.37	1.49	0.09	0.16	0.45
CD (P=0.05)	1.06	4.29	0.26	0.45	1.29
CV (%)	10.17	11.89	11.53	11.58	6.12
Interaction (Y × T)	NS				

Table 2: Plant height, number of branches per plant and root nodules per plant in green gram as influenced by different treatments (pooled values)

Treatments	Leaf area index		Dry matter accumulation/plant (g)	
	40 DAS	Harvest	40 DAS	Harvest
T ₁ : Absolute control	1.30	1.03	1.94	13.47
T ₂ : 100% RDF	1.43	1.13	2.15	15.39
T ₃ : 100% RDF + 5 t/ha biocompost	1.58	1.25	2.22	16.60
T ₄ : 100% RDF + 5 t/ha biocompost + PSB (2.5 l/ha)	1.61	1.30	2.32	17.14
T ₅ : 50% RDF + 2.5 t/ha biocompost	1.45	1.20	2.21	16.37
T ₆ : 50% RDF + 2.5 t/ha biocompost + PSB (2.5 l/ha)	1.56	1.28	2.30	16.71
SEm ±	0.04	0.04	0.05	0.44
CD (P=0.05)	0.11	0.10	0.14	1.26
CV (%)	7.38	8.42	6.63	8.25
Interaction (Y × T)	NS			

The increased availability of nutrients due to combined application of organics and inorganics resulted in better absorption, translocation and assimilation of nutrients. Better partitioning of photosynthates between source and sink led to

greater assimilation of dry matter in the reproductive or fruiting parts which resulted on improvement of yield attributing characters. The beneficial effects of integration of organic manures and chemical fertilizers on yield attributes

were also reported by Tyagi *et al.* (2014) [2] and Patil *et al.* (2018) [6].

Both, higher seed and stover yields (table 3) were obtained with the application of 100% RDF + biocompost @ 5 t/ha either with or without PSB @ 2.5 l/ha and 50% RDF + biocompost @ 2.5 t/ha with PSB @ 2.5 l/ha. The magnitude of increase in seed yield over absolute control was 47.32, 41.80, 35.41, 28.16 and 20.10 per cent, respectively under T₄,

T₆, T₃, T₅ and T₂ treatments, whereas the corresponding values for stover yield were 43.77, 39.75, 36.09, 20.29 and 15.34 per cent on pooled basis. The increase in yield is a resultant effect of improved vegetative growth and better expression of yield attributes. These findings are in accordance with the results reported by Acharya and Mondal (2010) [7], Sharma *et al.* (2011) [8], Patel (2012) [9] and Patil *et al.* (2018) [6].

Table 3: Yield attributes and yield of green gram as influenced by different treatments (pooled values)

Treatments	Number of pods/plant	Number of grains/pod	Pod length (cm)	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
T ₁ : Absolute control	11.82	5.91	5.54	37.18	1081	1883
T ₂ : 100% RDF	14.50	7.46	6.41	40.64	1298	2172
T ₃ : 100% RDF + 5 t/ha biocompost	16.27	8.07	7.14	42.84	1464	2563
T ₄ : 100% RDF + 5 t/ha biocompost + PSB (2.5 l/ha)	17.37	8.66	7.88	43.93	1592	2708
T ₅ : 50% RDF + 2.5 t/ha biocompost	15.83	7.73	7.26	42.19	1385	2265
T ₆ : 50% RDF + 2.5 t/ha biocompost + PSB (2.5 l/ha)	17.01	8.36	7.71	43.13	1533	2632
SEm ±	0.65	0.30	0.28	0.69	62	107
CD (P=0.05)	1.87	0.87	0.80	2.00	179	307
CV (%)	12.58	11.94	11.94	4.70	12.59	13.64
Interaction (Y × T)	NS					

Nutrient uptake and soil nutrient status

Among the different treatments studied, treatments with 100% RDF + biocompost @ 5 t/ha either with or without PSB @ 2.5 l/ha and 50% RDF + biocompost @ 2.5 t/ha with PSB @ 2.5 l/ha were found equally effective in improving nutrient content and uptake in majority cases (table 4). The uptake of nutrients by the crop is a function of nutrient content and yield/biomass produced. Higher content of nutrients in grain and stover is due to the addition of nutrients through both organic and inorganic sources. Also, when organic manures

are applied in combination with chemical fertilizers, their nutrient releasing pattern is changed. Normally, they initially release nutrients at a slower rate but on applying fertilizers like urea, the C:N ratio is lowered which results in faster mineralization of nutrients from organic manure. Hence, greater amount of nutrients are available for uptake by the crop in the year of application itself and nutrient use efficiency too is enhanced. The results are in close conformity with the findings of ¹⁰Uppari *et al.* (2011).

Table 4: Total nutrient (NPK) uptake by green gram as influenced by different treatments (pooled values)

Treatments	Total N uptake (kg/ha)	Total P ₂ O ₅ uptake (kg/ha)	Total K ₂ O uptake (kg/ha)
T ₁ : Absolute control	50.97	7.36	50.36
T ₂ : 100% RDF	63.94	9.27	61.84
T ₃ : 100% RDF + 5 t/ha biocompost	75.90	10.99	73.36
T ₄ : 100% RDF + 5 t/ha biocompost + PSB (2.5 l/ha)	83.00	12.26	79.81
T ₅ : 50% RDF + 2.5 t/ha biocompost	68.66	9.91	65.71
T ₆ : 50% RDF + 2.5 t/ha biocompost + PSB (2.5 l/ha)	79.50	11.63	76.01
SEm ±	2.74	0.40	2.87
CD (P=0.05)	7.90	1.16	8.29
CV (%)	11.00	11.09	11.97
Interaction (Y × T)	NS		

Table 5: Available nutrient (NPK) status in soil after harvest of green gram as influenced by different treatments after two years of experimentation

Treatments	Available N (kg/ha)	Available P ₂ O ₅ (kg/ha)	Available K ₂ O (kg/ha)
T ₁ : Absolute control	195.26	39.46	282.89
T ₂ : 100% RDF	206.38	43.05	296.23
T ₃ : 100% RDF + 5 t/ha biocompost	223.99	45.32	312.56
T ₄ : 100% RDF + 5 t/ha biocompost + PSB (2.5 l/ha)	225.57	46.96	319.31
T ₅ : 50% RDF + 2.5 t/ha biocompost	219.82	42.70	302.32
T ₆ : 50% RDF + 2.5 t/ha biocompost + PSB (2.5 l/ha)	222.30	45.57	313.14
SEm ±	5.80	1.27	7.08
CD (P=0.05)	17.48	3.83	21.35
CV (%)	5.38	5.80	4.65

Different INM treatments marked their significant influence on available N, P and K status in soil after the harvest of green gram (table 5) during both the years of experimentation. All treatments of INM were found equally good and appreciably improved soil available N, P and K status over its initial status. This is probably due to the incorporation of

organic manure along with inorganics. Moreover, green gram being a leguminous crop, fixes atmospheric nitrogen in the soil, thus adding available N to soil and addition of PSB mobilized the fixed forms of phosphorus into available forms. These findings are in close conformity with the results of Patel *et al.* (2016) [11] and Meena *et al.* (2016) [4].

Conclusion

Based on the above findings, it can be concluded that under south Gujarat conditions to attain higher yields along with maintaining the soil health, summer green gram should be fertilized with 50% RDF (10:20:0 NPK kg ha/) + biocompost @ 2.5 t/ha with PSB @ 2.5 l/ha.

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