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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(12): 957-960

www.thepharmajournal.com
Received: 28-10-2021
Accepted: 30-11-2021

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Effect of integrated nutrient management on content and uptake of summer green gram (*Vigna radiata* L.) under South Gujarat condition

Kalal PH, Virdia HM and Patel KR

Abstract
A field trial was conducted at the College Farm, Navsari Agricultural University, Navsari during the years 2019 and 2020 in summer seasons. The soil of the experimental field was clayey in texture, low in organic carbon (0.40 %) and available nitrogen (213.42 kg/ha), medium in available phosphorus (37.55 kg/ha) and high in available potassium (318.27 kg/ha). The soil was slightly alkaline in reaction (pH-7.96). The treatment consisted of integrated nutrient management *viz*., T_1 - Absolute control, T_2 - 100% RDF (20-40-00 NPK kg/ha), T_3 – 100% RDF + bio-compost @ 2.5 t/ha, T_4 – 100% RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha), T_5 – 50 % RDF + bio-compost @ 2.5 t/ha, T_6 – 50% RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha) to green gram in summer season. These treatments were replicated four times in randomized block design. Treatments T_4 as 100 % RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 t/ha) performed good and recorded significantly higher growth attributes, yield attributes, yield and economics of summer green gram.

Keywords: green gram, economics, bio-compost, integrated nutrient management, growth, yield

Introduction
Pulses are a very important crop for India. They are an important source of protein, grow quickly, generate good profits for farmers and contribute to agricultural and environmental sustainability. The UN Food and Agricultural Organization had declared year 2016 as the "International Year of Pulses." Pulses are an important source of protein for human but have low productivity mainly because their cultivation is limited to marginal and sub-marginal conditions with almost no or low-input management. Efficient and balanced fertilization can help in achieving desired productivity in pulses. Apart from the human diet, pulses form an important fraction of cattle feed and fodder as hay, green fodder and concentrates. Due to their short duration, they can be grown as main, intercrop, catch and green manure crop. Pulses also improve the soil fertility by fixing atmospheric nitrogen and adding residues.

Green gram is an important pulse crop of India as it is the third rank among pulse crops. It is grown on an area of 3.44 million ha with total production of 1.4 million tonnes and productivity of 407 kg/ha (Anon., 2017a) [1]. 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 kg/ha (Anon., 2017b) [2]. Green gram (*Vigna radiata* L.) is an important pulse crop having high nutritive value. It not only plays an important role in human diet but also in improving the soil fertility by fixing the atmospheric nitrogen. Due to short duration nature, it is an excellent crop to fit in intercropping system with different major crops. It is also grown as a green manure crop. Being a close growing and spreading crop, it helps in reducing soil erosion and also checks weed growth. Being a legume, it adds nitrogen in the soil. Also, there is a possibility to intensify the system through introduction of green gram as a catch crop during summer, which is helpful in improving soil nutrient status (Venkatesh *et al*., 2015) [10].

Integrated nutrient management facilitates better utilization of resources. In this process, organic sources of nutrients are applied based on economic consideration and the balance required for the crop is supplemented with inorganic fertilizers. Bio-compost is very useful in 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 are also important ingredients in INM. Biofertilizer application increases the availability of nutrients to the crops due to enhanced mineralization.

Materials and Methods

A field trial was conducted at the College Farm, Navsari Agricultural University, Navsari during the year 2019 and 2020. The soil of the experimental field was clayey in texture, low in organic carbon (0.40 %) and available nitrogen (213.42 kg/ha), medium in available phosphorus (37.55 kg/ha) and high in available potassium (318.27 kg/ha). The soil was slightly alkaline in reaction (pH-7.96). The treatment consisted of integrated nutrient management *viz*., T_1 - Absolute control, T_2 - 100% RDF (20-40-00 NPK kg/ha), T_3 – 100% RDF + bio-compost @ 2.5 t/ha, T_4 – 100% RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha), T_5 – 50 % RDF + bio-compost @ 2.5 t/ha, T_6 – 50% RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha) to green gram in summer season, replicated four times in randomized block design. Nitrogen nutrient was applied through urea whereas phosphorus was applied through SSP as basal application. The desired quantity of bio-compost was worked out as per treatments and bio fertilizer was thoroughly mixed with bio-compost. 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. Samples for the observations that required destructive sampling were collected from the ring line and take 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 (1985) [5]. 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

NPK content in grain

Data on nitrogen, phosphorus and potassium content in seed of green gram are presented in Table 1. It revealed significant influence of different treatments on NPK content in seed during individual years and pooled analysis. Though, application of 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T_4) registered highest N content in seed during both the years and in pooled results, it remained statistically at par with the treatments T_3, T_2 and T_6 in year 2019 and treatments T_3 and T_2 in year 2020, while only with treatment T3 in pooled analysis. The lowest N content in seeds was found with control condition (2.97, 2.94 and 2.96 %, respectively) during individual years and in pooled. The higher content of nitrogen in grain is due to the addition of nitrogen through *Rhizobium*, both organic and inorganic sources. Incorporating organic sources along with chemical fertilizers resulted in the formation of clay-humus complexes in the soil which in turn promotes lower and prolonged availability of nitrogen to the crop. Similar results finding by various researchers like Rao *et al.* (2013) [6], Tyagi *et al.* (2014) [8], Mansuri (2016) [4] and Barkha *et al.* (2020) [3].

Data presented in Table 1. indicated that, P_2O_5 content (%) in seeds of summer green gram significantly influenced by different INM treatments. Among different INM treatment, application of 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T4) registered highest P_2O_5 content (0.89, 0.92 and 0.90 %, respectively) in seed during both the years and in pooled results, it remained statistically at par with the treatments T_3 and T_2 in year 2019 and while, only with treatment T_3 in year 2020 and pooled analysis. The lowest P_2O_5 content in seeds was found with control condition (0.64, 0.62 and 0.63 %, respectively) during individual years and in pooled. Incorporating organic sources along with chemical fertilizers resulted in the formation of clay-humus complexes in the soil which in turn promotes lower and prolonged availability of phosphorus to the crop. Addition of PSB might be play role and increase availability of P_2O_5 to plant resulted in higher content in seeds. Similar effect of INM was also observed on phosphorus availability by various researchers like Upperi *et al.* (2011) [9], Rao *et al.* (2013) [6], Tyagi *et al.* (2014) [8], Mansuri (2016) [4] and Barkha *et al.* (2020) [3].

Result on K_2O content (%) in summer green gram seeds as influenced by different INM practices are presented in Table 1. The data revealed that, K_2O content in seed was significantly increased with application of 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T_4) registered highest K_2O content (1.83, 1.87 and 1.85 %, respectively) in seed during both the years and in pooled results, it remained statistically at par with the treatment T_3 in year 2019 and pooled analysis, while with treatments T_3, T_2, T_6 and T_5 in year 2020. The lowest K_2O content in seeds was found with control condition (1.67, 1.64 and 1.65 %, respectively) during individual years and in pooled. Due to organic sources, potassium availability and absorption may be increase in plant. Such findings also reported by researchers like Tyagi *et al.* (2014) [8], Singh *et al.* (2015) [7] and Barkha *et al.* (2020) [3].

NPK uptake by grain

Data on N uptake by seed of summer green gram as influenced by different INM practices are furnished in Table 4.2. It is evident that, N uptake by seed was significantly highest with application of 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T_4) *i.e*. 38.08, 41.60 and 40.34 kg/ha during first year, second year and pooled data, respectively. Treatments T_2 and T_3 was at par during year 2019 and 2020. While, treatment T_3 was found at par in pooled analysis. Lowest N uptake by seed was registered under control treatment (22.14, 22.71 and 22.43 kg/ha) during individual years and in combined result, respectively. The nutrient uptake is a function of yield and nutrient concentration in plant. This might be due to higher crop biomass production due to better nourishment resulted into higher uptake. These findings are in accordance with Rao *et al*. (2013) [6], Tyagi *et al*. (2014) [8], Singh *et al.* (2015) [7] and Barkha *et al.* (2020) [3] reported higher nutrient uptake with application of organic with bio-fertilizer in green gram.

The result reveled (Table 4.2) that application of 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T_4) recorded significantly higher P_2O_5 uptake by seed (9.85, 10.73 and 10.29 kg/ha) than other treatment, while treatment T_3 noted at par during year 2019 and pooled analysis, treatments T_3 and T_2 during year 2020. The lowest P_2O_5 uptake by seed was recorded with control (T_1) treatment (4.69, 4.77 and 4.73 kg/ha) during both the years as well as in pooled, respectively. The uptake of nutrients by the crop is a function of nutrient content and yield/biomass produced. When organic manures are applied in combination with chemical fertilizers, its 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. This might be due to higher crop biomass production due to better nourishment resulted into higher uptake. These findings are in accordance with Rao *et al.*

(2013) [6], Tyagi *et al*. (2014) [8], Singh *et al.* (2015) [7] and Barkha *et al.* (2020) [3] reported higher nutrient uptake with application of organic with bio-fertilizer in green gram.

Result on K_2O uptake by seed as influenced by different INM practices are presented in Table 4.9. Treatment with 100 % RDF + bio-compost 2.5 t/ha with PSB through soil application 2.5 l/ha (T_4) recorded significantly higher K_2O uptake by seed (20.22, 21.85 and 21.04 kg/ha) than other treatment, while treatments T_3 and T_2 were recorded at par result during year 2019 and 2020 and only with T_3 treatment in pooled analysis. The lowest K_2O uptake by seed was recorded with control (12.17, 12.61 and 12.39 kg/ha) during both the years as well as pooled, respectively. 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. Thus, due to higher yield values and improved nutrient content, uptake of K was also higher with these treatments. The results are in close conformity with the findings of Upperi *et al*. (2011) [9], Singh *et al.* (2015) [7] and Barkha *et al.* (2020) [3].

Table 1: Nutrient content in seed of summer green gram as influenced by different treatments of integrated nutrient management

Treatments	Nutrient content in seed (%)								
	N %			P_2O_5 %			K_2O %		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1: Absolute control	2.97	2.94	2.96	0.64	0.62	0.63	1.67	1.64	1.65
T_2: 100% RDF	3.37	3.25	3.31	0.82	0.82	0.82	1.78	1.75	1.76
T_3: 100% RDF + Bio- compost @ 2.5 t/ha	3.46	3.33	3.40	0.85	0.87	0.86	1.81	1.84	1.82
T_4: 100% RDF + Bio- compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha)	3.52	3.56	3.54	0.89	0.92	0.90	1.83	1.87	1.85
T_5: 50% RDF + Bio- compost @ 2.5 t/ha	3.08	3.18	3.13	0.75	0.73	0.74	1.71	1.72	1.72
T_6: 50% RDF + Bio- compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha)	3.27	3.21	3.24	0.80	0.81	0.80	1.75	1.77	1.76
SEm ±	0.11	0.10	0.07	0.02	0.02	0.02	0.03	0.05	0.02
CD (P=0.05)	0.32	0.31	0.21	0.07	0.06	0.06	0.11	0.15	0.07
CV (%)	6.53	6.30	6.41	6.98	6.74	6.82	4.03	5.46	4.80
Interaction (Y × T)									
SEm ±	0.104			0.02			0.04		
CD (P=0.05)	NS			NS			NS		

Table 2: Nutrient content in stover of summer green gram as influenced by different treatments of integrated nutrient management

Treatments	Nutrient content in stover (%)								
	N %			P_2O_5 %			K_2O %		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1: Absolute control	0.85	0.82	0.84	0.40	0.37	0.39	1.55	1.52	1.54
T_2: 100% RDF	0.96	0.98	0.97	0.45	0.46	0.46	1.77	1.80	1.78
T_3: 100% RDF + Bio- compost @ 2.5 t/ha	1.00	1.00	1.00	0.46	0.47	0.47	1.81	1.82	1.82
T_4: 100% RDF + Bio- compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha)	1.04	1.06	1.05	0.47	0.48	0.48	1.89	1.87	1.88
T_5: 50% RDF + Bio- compost @ 2.5 t/ha	0.92	0.90	0.91	0.43	0.45	0.43	1.67	1.69	1.68
T_6: 50% RDF + Bio- compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha)	0.95	0.97	0.96	0.43	0.46	0.44	1.73	1.74	1.74
SEm ±	0.03	0.04	0.03	0.01	0.02	0.01	0.06	0.06	0.04
CD (P=0.05)	0.09	0.13	0.08	0.03	0.06	0.03	0.17	0.18	0.12
CV (%)	6.42	7.19	6.72	5.56	8.41	7.16	6.63	6.72	6.69
Interaction (Y × T)									
SEm ±	0.03			0.02			0.06		
CD (P=0.05)	NS			NS			NS		

Conclusion

On the basis of experimental results, it can be concluded that maximum content and uptake by grain of summer green gram crop recorded in 100% RDF + bio-compost @ 2.5 t/ha + PSB (soil application @ 2.5 l/ha) (RDF: 20-40-00 N-P2O5-K2O kg/ha) under south Gujarat condition.

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