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Original Research Article

Effect of Various Sources of Nitrogen and Phosphorus on Seed Quality, Soil Nutrient Status and Plant Nutrient Contents and Uptake in Summer Green Gram (*Vigna radiata* L. Wilczek)

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Keywords

Green gram, Nitrogen, Phosphorus, *rhizobium*, PSB and vermicompost

A B S T R A C T

A field experiment was conducted at the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand to evaluate the effect of various sources of nitrogen and phosphorus on growth and yield attributes of summer green gram (*Vigna radiata* L. Wilczek) during summer season of 2018-19. The experiment consists of fifteen treatment combinations comprised of five levels of nitrogen sources (N_1: only inoculation with *rhizobium*, N_2: 20 kg N/ha through vermicompost, N_3: 10 kg N/ha through vermicompost + inoculation with *rhizobium*, N_4: 20 kg N/ha through neem cake and N_5: 10 kg N/ha through neem cake + inoculation with *rhizobium*) and three levels of phosphorus sources (P_1: 20 kg P_2O_5/ha + inoculation with PSB, P_2: 40 kg P_2O_5/ha and P_3: 40 kg P_2O_5/ha + inoculation with PSB). The results revealed that application of vermicompost @ 20 kg N/ha recorded significantly higher seed protein content among the various sources of nitrogen applied; while application of various sources of phosphorus don't give significant response on seed protein content. The application of 20 kg N/ha through vermicompost and 40 kg P_2O_5/ha + inoculation with PSB resulted into better soil and plant health after harvesting of crop.

Introduction

The production of pulses however, does not commensurate with the demand in the country. The per capita availability of pulses in India has been continuously decreasing which is at present 55.90 g/day/capita against the minimum requirement of 85 g/day/capita for balanced diet as recommended by World Health Organization (WHO) and Food and Agricultural Organization (FAO). It is the high time to cultivate pulses crops scientifically with increasing area (Patel *et al.,* 2013).

Green gram [*Vigna radiata* L. Wilczek] is one of the most ancient and extensively grown leguminous crops of India. It is the third important pulse crop after chickpea and pigeon pea, cultivated throughout India for its multipurpose uses as vegetable, pulse, fodder and green manure crop (Karpechenko, 1925). Its seed is more palatable, nutritive, digestible and non-flatulent than other pulses grown in world. It is a good source of protein (20-24%), carbohydrates (60-62%), water (10%), fat (1.0%), fiber (4.0%) and ash (3.0%). Owing to all these characteristics, it is considered a good substitute of animal protein and forms a balanced diet when it is taken with cereals (Delice *et al.,* 2011).

Among the various factors of crop production, fertilizer management as one of the parameter to use optimum fertilizer with optimum considerations of soil health. At present, the latest concept is integrated nutrient management.

Integration of organic manures and inorganic fertilizer materials has been found to be promising not only in maintaining higher productivity of crops and for providing stability in crop production, besides improving soil physical conditions (Hati *et al.,* 2007). Biofertilizers, a component of integrated nutrient management and are considered to be cost effective, eco-friendly and renewable source of non-bulky, low cost plant nutrient supplementing fertilizers in sustainable agriculture system in India (Rao, 2007).

Materials and Methods

A field experiment was carried out at the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand to elicit the effect of various sources of nitrogen and phosphorus on growth and yield attributes of summer green gram (*Vigna radiata* L. Wilczek) during summer season of 2018-19. The experiment was laid out in randomized block design (Factorial) with four replications. There were 15 treatment combinations comprising 5 levels of nitrogen sources (N_1: only inoculation with *rhizobium*, N_2: 20 kg N/ha through vermicompost, N_3: 10 kg N/ha through vermicompost + inoculation with *rhizobium*, N_4: 20 kg N/ha through neem cake and N_5: 10 kg N/ha through neem cake + inoculation with *rhizobium*) and 3 levels of phosphorus sources (P_1: 20 kg P_2O_5/ha + inoculation with PSB, P_2: 40 kg P_2O_5/ha and P_3: 40 kg P_2O_5/ha + inoculation with PSB). The entire quantity of vermicompost, neem cake and SSP fertilizers were applied as basal application before sowing of crop. *Rhizobium* and PSB were applied as seed treatment (5 ml/kg seed) and at 30 DAS as soil drenching (1 lit./ha). The soil of experimental field was loamy sand in texture, low in nitrogen (240.4 kg N/ha), medium in available phosphorus (46.37 kg P_2O_5/ha) and high in available potash (303.4 kg K_2O/ha). For the plot observation, selected five random plants in net plot area and tagged it for further observation. For soil chemical analysis (before and after harvesting of crop), plant chemical analysis and organic manure analysis used prescribed methods.

Results and Discussions

Effect on seed quality

The data presented in Table 1 showed that the significantly higher protein content of seed (22.47%) was obtained with application of 20 kg N/ha through vermicompost (N_2) and was remained at par with treatments N_4 & N_3. The increase in protein content of seed was might be due to efficient and effective working of N fixing bacteria, ultimately it results into more nitrogen absorption by plant. It led to more protein synthesis in plant and its more concentration in seed. Similar results are in accordance with those reported by David and David (2017) in green gram.

Phosphorus applied through different sources were failed to express its significant effect on protein content of seed.

Interactions of various sources of nitrogen and phosphorus did not exert any significant effect on seed quality of green gram.

Effect on soil health after harvest

Available N in soil after harvest (257 kg/ha) showed significant effect under N_2 treatment

(20 kg N/ha through vermicompost) and was remained at par with N_4 & N_3 treatments. The prolonged availability of nutrients from vermicompost and enhanced mineralization of native soil nutrients by creating better soil environment, led to more nutrient concentration in soil after harvest of crop. These results are conformity to those reported by Prajapati (2014) and David and David (2017) in green gram.

Significantly higher available phosphorus (51.69 kg/ha) retained in soil after harvest under treatment P_3 (40 kg P_2O_5/ha + inoculation with PSB) and was remained at par with P_2 treatment. Application of inorganic phosphatic fertilizer along with PSB solubilise the insoluble phosphorus fractions through release of various organic acids and increased the available phosphorus status in soil after harvest of crop. These results are in close agreement with the findings of Patel *et al.*, (2017) in green gram.

While other soil status contributing parameters *viz.*, EC, pH, organic carbon and available potassium after harvest were non significant with application of nitrogen and phosphorus through varying sources (Table 1).

Interactions of various sources of nitrogen and phosphorus did not exert any significant effect on soil health after harvest (Table 1).

Effect on plant health after harvest

Application of 20 kg N/ha through vermicompost (N_2) registered significantly higher nitrogen content in seed (3.60%) and haulm (0.65%), but it was also remained at par with N_4 & N_3 treatments. While phosphorus content in seed and haulm remained unaltered with application of nitrogen through different sources. Significantly higher nitrogen uptake by seed (49.79 kg/ha) and haulm (12.84 kg/ha) was obtained with application of 20 kg N/ha through vermicompost (N_2) and was also remained at par with N_4 treatment. The higher phosphorus uptake by seed (6.95 kg/ha) and haulm (3.09 kg/ha) was obtained with application of 20 kg N/ha through vermicompost (N_2) and was remained at par with N_4 treatment (Table 2). As vermicompost adds organic matter to soil, improves the physical and biological properties of soil. Vermicompost also releases nutrients gradually and remained readily available to plants throughout the crop growth period, resulted into higher nutrients uptake by plants. Similar results were also obtained by Kachariya (2015) and shariff *et al.*, (2017) in green gram.

Application of 40 kg P_2O_5/ha + inoculation with PSB (P_3) produced significantly higher phosphorus content in seed (0.50%) and haulm (0.161%), but it was also remained at par with P_2 treatment. While nitrogen content in seed and haulm remained non significant with application of phosphorus through different sources. Significantly highest nitrogen uptake by seed (45.84 kg/ha) and haulm (11.32 kg/ha) was observed with application of 40 kg P_2O_5/ha + inoculation with PSB (P_3). Application of 40 kg P_2O_5/ha + inoculation with PSB (P_3) recorded significantly higher phosphorus uptake by seed (6.62 kg/ha) and haulm (3.02 kg/ha) in green gram. However, it was also remained at par with P_2 treatment (Table 2). It might be due to application of higher dose of phosphorus along with PSB increased the availability of nutrients over a long period of time and ultimately led to uptake of more nutrients by seed and haulm. These results are in close agreement with research findings reported by Rathour *et al.*, (2015) and Rekha *et al.*, (2018).

Interactions of various sources of nitrogen and phosphorus did not exert any significant effect on plant health after harvest (Table 2).

Table.1 Effects of various sources of nitrogen and phosphorus on seed quality and soil health after harvesting of summer green gram

Treatments	Protein (%) in seed	EC (dS/m)	pH	O.C. (%)	Soil nutrient content (kg/ha)		
					N	P_2O_5	K_2O
Sources of nitrogen (N)							
N_1	20.07	0.29	8.12	0.35	229.4	45.82	302.7
N_2	22.47	0.30	8.05	0.39	257.1	48.80	306.7
N_3	21.31	0.30	8.07	0.37	244.1	48.16	304.6
N_4	21.84	0.32	8.04	0.38	251.3	47.56	305.1
N_5	20.64	0.32	8.06	0.36	241.0	46.84	303.6
S.Em. ±	**0.51**	**0.01**	**0.12**	**0.01**	**4.96**	**1.14**	**5.36**
C.D. at 5 %	**1.47**	**NS**	**NS**	**NS**	**14.2**	**NS**	**NS**
Sources of phosphorus (P)							
P_1	20.95	0.29	8.10	0.35	239.6	41.25	302.8
P_2	21.29	0.31	8.06	0.37	245.4	49.38	304.7
P_3	21.56	0.32	8.05	0.38	248.8	51.69	306.1
S.Em. ±	**0.40**	**0.01**	**0.09**	**0.01**	**3.84**	**0.88**	**4.15**
C.D. at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**2.52**	**NS**
N × P interaction							
S.Em. ±	**0.89**	**0.02**	**0.21**	**0.02**	**8.59**	**1.98**	**9.28**
C.D. at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
C.V. %	**8.38**	**11.90**	**5.25**	**11.76**	**7.02**	**8.33**	**6.10**
Initial value		0.27	8.21	0.34	240.4	46.37	303.4

Table.2 Effects of various sources of nitrogen and phosphorus on plant health after harvesting of summer green gram

Treatments	N content (%)		P content (%)		N uptake (kg/ha)		P uptake (kg/ha)	
	Seed	Haulm	Seed	Haulm	Seed	Haulm	Seed	Haulm
Sources of nitrogen (N)								
N_1	3.21	0.48	0.45	0.150	27.82	6.61	3.98	2.05
N_2	3.60	0.65	0.49	0.156	49.79	12.84	6.95	3.09
N_3	3.41	0.61	0.47	0.153	44.34	11.16	6.16	2.80
N_4	3.49	0.63	0.48	0.154	46.17	11.75	6.54	2.90
N_5	3.30	0.52	0.46	0.151	37.32	8.05	5.29	2.37
S.Em. ±	**0.08**	**0.01**	**0.01**	**0.003**	**1.55**	**0.46**	**0.25**	**0.11**
C.D. at 5 %	**0.23**	**0.04**	**NS**	**NS**	**4.42**	**1.30**	**0.70**	**0.33**
Sources of phosphorus (P)								
P_1	3.35	0.56	0.44	0.139	35.17	8.67	4.62	2.13
P_2	3.41	0.58	0.49	0.157	42.26	10.25	6.10	2.78
P_3	3.45	0.60	0.50	0.161	45.84	11.32	6.62	3.02
S.Em. ±	**0.06**	**0.01**	**0.01**	**0.003**	**1.20**	**0.35**	**0.19**	**0.09**
C.D. at 5 %	**NS**	**NS**	**0.03**	**0.007**	**3.42**	**1.01**	**0.54**	**0.25**
N × P interaction								
S.Em. ±	**0.14**	**0.03**	**0.02**	**0.01**	**2.68**	**0.79**	**0.43**	**0.20**
C.D. at 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
C.V. %	**8.38**	**8.97**	**9.34**	**7.35**	**13.06**	**15.67**	**14.74**	**15.05**

In light of results obtained from the field experiment, it could be concluded that the crop should be fertilized with 20 kg N/ha through vermicompost and 40 kg P_2O_5/ha through SSP + PSB inoculation. *Rhizobium* (GMBS 1 strain) and PSB (PBA 17 strain) should be applied as seed treatment (5 ml/kg seed) and soil drenching (1 lit./ha) at 30 DAS for retaining the better seed quality, soil and plant health after harvesting of summer green gram under middle Gujarat condition.

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