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Response of inorganic and organic fertilizers on yield of green gram (*Vigna radiata* L.)

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Abstract

The present investigation entitled “Response of inorganic and organic fertilizers on yield of green gram (*Vigna radiata* L.)” was carried out in the Research farm of Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.) during *Rabi* season of year 2023-24. The observations related to quantity (growth and yield) and quality parameters of green gram recorded periodically under 12 treatments were analyzed statistically to test their significance by using randomized block design. By the one-year based experiment, it is concluded that amongst all 12 treatments the greater seed yield (14.33 q ha⁻¹), net income (71984.33 ₹ ha⁻¹) and B:C ratio (3.33) was realized under T4 (NPK @ 20:40:20 kg/ha). Thereupon, the utilization of NPK @ 20:40:20 kg/ha in green gram crop is beneficial.

Keywords: Inorganic, organic fertilizers, branches, grains, pod, seed index, straw yield

Introduction

Pulses play a pivotal role in Indian agriculture and the human diet since these are excellent sources of protein, vitamins and several other minerals namely, magnesium, iron and zinc. Due to their high protein content, these have paramount importance in Indian meals as vegetarians form the major population of India. India is the world's largest producer and consumer of pulses. The ability of pulses to use atmospheric nitrogen through biological nitrogen fixation and their tap root system, which opens the soil up to deeper strata, make them well known for improving the physical characteristics of the soil. Pulses being resistant to drought perform well in moisture-stress conditions, therefore, pulses are an ideal choice for the rainfed area where the annual precipitation is very low. In India, green gram covers 41.43 lakh ha area with a production of 22.30 lakh tonnes and average productivity of 538 kg ha⁻¹. In Madhya Pradesh, it is grown in the area of. 13.14. lakh ha with the production and productivity of 4.48 lakh tonnes and 341 kg ha⁻¹, respectively (Anonymous, 2022-23) ^[2].

One of the most well-known pulse crops in India is green gram, sometimes referred to as moong bean. The Leguminosae family includes the self-pollinating, short-day plant known as green gram. It possesses five to ten times more phosphoric acid than other pulses and is regarded as a great source of digestible protein (24%), carbohydrates (60%), fat (1.3%), minerals, and vitamins (Gangai *et al.*, 2008). Daal is the primary form in which it is consumed. It's utilized to make delectable dishes like papad, halwa, dosa, bara, and idli, among others. Because it is highly digestible and nutritional, it can be used as cat food. It has deep root system and grows expeditiously, thus, can be used as cover crop. It is also used as a green manure crop and restores the soil fertility. Besides, it is effective in reducing high cholesterol levels.

Higher yield of green gram can be achieved by proper agronomic operations (like fertilizer management, weed management, water management etc.) and with the use of improved quality seeds of short duration variety which can thrive well under unfavourable conditions. Poor fertilizer management is one of the principal causes of lower productivity of green gram. Application of balanced nutrition results in copious yield. Application of chemical fertilizer gives the required quantity of nutrient to crop but its persistent use can affect soil health and heavy depletion of nutrient from the soil, Thus, it can damage soil fertility and cause greater threat to sustainable agriculture. Organic fertilizer has the ability to provide and restore the

essential nutrient in the soil, Thereupon, the application of chemical fertilizers should be decreased and application of organic manure should be increased for restoration and repletion of soil nutrient. However, application of only organic manure does not result in significant crop yield. Therefore, combined use of organic and inorganic manure is beneficial. For improving the production potential of green gram balanced use of organic, inorganic manure and biofertilizer has immense scope (Verma *et al.*, 2017)^[15].

The prime objective of inorganic and organic fertilizers management is to provide all the essential mineral nutrients for successful crop production while causing the least amount of damage to the health of the soil. In Intensive crop production, fertilizers are widely used which leads to soil nutrient imbalance. Inorganic and organic fertilizers includes integrated use of organic manure, green manure, biofertilizer and chemical fertilizer. Due to increasing cost of fertilizer, resource poor farmers are facing difficulties in application of recommended dose of fertilizer. Inorganic and organic fertilizers not only maintains the productivity and fertility status of the soil but also ensures crop sustainability and reduces the cost of synthetic fertilizers.

With the correct blend of synthetic fertilizers, organic manures, and biofertilizers, agriculture may be kept economical and sustainable while still producing large amounts of food without sacrificing soil health or crop quality or quantity. An important element of integrated nutrient management (INM) is organic manure, which not only improves soil health but also supplies vital micronutrients that inorganic fertilizers do not. Farm Yard Manure (FYM) is the most popular and easily accessible organic plant fertilizer source for Indian farmers.

Materials and Methods

The experiment was carried out at the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.) during *Rabi* season of year 2023-24. The experiment was conducted in a randomized complete block design with three replications. The experiment consisted of 12 treatments i.e., 11 different inorganic and organic fertilizers treatments and 1 control treatment, thus making 12 treatments. An appropriate sample provides an estimate or a sample value which is as close as possible to the value that would have been obtained, had all plant in the plot been measured the plot value. The difference between the sample value and plot constitutes sampling error. Thus, a good sampling technique gives a small sampling error. Error of sample estimates generally decreases with the size of sampling and number of sampling unit per plot and the sampling design. However, an increase in either the size or the number of sampling unit almost always increases cost. Therefore, the choices of an appropriate sampling technique are primarily concerned with maintaining the proper balance between the sizes of the sampling unit and design to achieve the maximum precision at minimum cost. Single plot as a sampling unit and five plants are appropriate number of plants according to requirement for experimental plot as a sample size and random sampling techniques (Gomez and Gomez, 1984)^[6] were adopted for recording growth and yield attributes of test crops.

Treatment Details

T1: Control
T2: NPK @ 10:20:10 kg/ha.
T3: NPK @ 15:30:15 kg/ha.
T4: NPK @ 20:40:20 kg/ha

T5: FYM @ 3.5 MT/ha.
T6: FYM @ 7.0 MT/ha.
T7: Vermicompost @ 2.5 MT/ha.
T8: Vermicompost @ 5.0 MT/ha.
T9: Poultry manure @ 2.5 MT/ha
T10: Poultry manure @ 5.0 MT/ha
T11: Compost @ 3.5 MT/ha
T12: Compost @ 7.0 MT/ha

Results and Discussion

Data regarding plant height and number of branches per plant are reported in Table 1. Statistical analysis of the data revealed that effect of applied different inorganic and organic fertilizers treatments have been found non- significant at 20 DAS for plant height variable but at 40 DAS and harvest stage significant increase in plant height was realized. At different growth stages (20, 40 DAS and harvest) application of 100% RDF + *Rhizobium* inoculation has produced the tallest plant over rest all the treatment and the height wise smallest plants were produced under control plot (T1). Maximum increase in plant height was observed with the application of 100% RDF (20:40:20 NPK) with *Rhizobium* inoculation may be due to abundance supply of available nitrogen and phosphorus during crop growth stages. Availability of higher amount of nitrogen accelerated the growth because nitrogen plays a principal role in photosynthesis (as it is paramount element of chlorophyll), it is a fundamental and significant element of protein synthesis, its application causes engorged in plants. Thereupon, sufficient amount of applied nitrogen escalated the plant growth. Application of *Rhizobium* provides plenitude amount of available phosphorus which escalated root growth and conclusively accelerated absorption of another essential nutrient from deeper layers on soil eventually, contributed in increased plant growth. Whereas, potassium played prime role in physiological activities. Growth performance of crop is closely related to availability of chief nutrients thus, sufficient nutrient accessibility promotes plant growth. Indistinguishable findings were also noted by Nagarajan and Balachandar. (2001)^[9], Hakeem *et al.* (2007)^[7], Shihare, *et al.* (2013)^[10], and Tyagi and Singh (2022)^[13]

The data delineated in Table 4.2 to 4.4 and Fig. 4.4 to 4.9 suggested that effect of applied different inorganic and organic fertilizers treatments have been found significant. At 20 DAS, 40 DAS and at harvest stage significant increase in number of leaves plant⁻¹, number of branches plant⁻¹ and number root nodule plant⁻¹ were realized. At different growth stages all the quality and quantity traits were higher with application of 100% RDF + *Rhizobium* inoculation over rest all the treatment and all the parameters were found lowest under control plot (T1). Maximum increase in number of leaves plant⁻¹, number of branches plant⁻¹ root nodule plant⁻¹, yield contributing characters and yields were observed with the application of 100% RDF (20:40:20 NPK) with *Rhizobium* inoculation may be due to abundance supply of available nitrogen and phosphorus during crop growth stages. Availability of higher amount of nitrogen accelerated the growth because nitrogen plays a principle role in photosynthesis (as it is paramount element of chlorophyll), it is a fundamental and significant element of protein synthesis, its application causes engorged in plants. Thereupon, sufficient amount of applied nitrogen escalated the plant growth. Application of *Rhizobium* provides plenitude amount of available nitrogen and sufficient phosphorus escalated root growth and conclusively accelerated absorption of other essential nutrient from deeper layers on soil eventually, contributed in increased plant growth. Whereas, potassium

played prime role in physiological activities. Growth performance of crop is closely related to availability of chief nutrients thus, sufficient nutrient accessibility promoted growth and given high yield. Indistinguishable findings were also noted by Nagarajan and Balachandar (2001)^[9], Thiyareshwari and perumal (2002)^[12], Hakeem *et al.* (2007)^[7] and Divyavani *et al.* (2022)^[5].

All the yield indices (pods plant⁻¹, seeds pod⁻¹, test weight), delineated in previous chapter have shown significant result with the application of different inorganic and organic fertilizers treatment. Higher pods plant⁻¹ (24.27), seeds pod⁻¹ (6.07), test weight (37.14 g) were obtained under T4 (NPK @ 20:40:20 kg/ha). The immense and enough availability of prime nutrients ensured exceptional vegetative growth together with superior yield contributing traits with the application of T4 (NPK @ 20:40:20 kg/ha). Highest photosynthate production occurred due to plenitude amount of available nutrients which brought notable increment in yield contributing characters. Indistinguishable findings were also noted by Thiyareshwari and perumal (2002)^[12], Abraham and Lal (2004)^[1], Shihare, *et al.* (2013)^[10], Choudhary, *et al.* (2017)^[4] and Divyavani *et al.* (2022)^[5], Yield (seed yield, stover yield, harvest index and protein content) was realized higher with T4 (NPK @ 20:40:20 kg/ha). Plenitude amount of availability of nutrients escalated physiological processes, translocation and accumulation of photosynthetic assimilates which caused positive impact on growth and yield related parameter, thus both the yields (seed and stover) were realized greater in terms of production. Highest seed yield of 14.33 q ha⁻¹ and stover yield of 31.52 q ha⁻¹ were produced with T4 (NPK @ 20:40:20 kg/ha). The rise in yield was caused predominantly due to abundance of prime nutrients (N,P,K) and accessibility of nutrients elevated with the application of 100% RDF + *Rhizobium* inoculation. *Rhizobium* prompted nitrogen fixation and added nitrogen in the soil and better accessibility of nitrogen promoted growth of crop viz. number of dark and thick leaves, branches, dry matter content and eventually higher seed and stover yields were gained. Alike findings were also noted by Thiyareshwari and perumal (2002)^[12], Hakeem *et al.* (2007)^[7], Shihare, *et al.* (2013)^[10], and Divyavani *et al.* (2022)^[5], The paramount harvest index (31.26%) was found with T4 (NPK @ 20:40:20 kg/ha). This

greater gain in harvest index was ascribe to the plenitude amount of obtainable nutrients in soil and escalated translocation and accumulation of advantageous photosynthetic assimilates in economical parts of crop plant. Indistinguishable findings were also addressed by Chaudhary, *et al.* (2017).

The quality character (protein content) of green gram was found to be superior with the application of 100% RDF and *Rhizobium*. With adequate amount of accessible N,P,K protein content increased. Protein content (24.39%) observed higher with T4. Indistinguishable findings were also noted by Vasanthi and Subramanian (2004)^[14] and Singh *et al.* (2007)^[11].

Nitrogen is a pivotal element of protein and amino acid, thus plenitude amount of nitrogen caused escalation of protein in seeds of green gram. The critical analysis of data delineated has suggested in green gram the protein content was greater with T4 (NPK @ 20:40:20 kg/ha) above rest all treatments.

Significant influence was observed in net income, gross income and B:C ratio with the implementation of various inorganic and organic fertilizers treatments. Whereas, non-significant influence of various treatments was found on cost of cultivation.

During the investigation notable With the application of Vermicompost @ 5.0 MT/ha. (T8) maximal cost of cultivation (₹ 24938 ha⁻¹) was closely followed by Vermicompost @ 2.5 MT/ha. (₹ 24585 ha⁻¹). On the contrary minimum cost of cultivation (₹ 18990 ha⁻¹) was found under control treatment (T1). Maximal cultivation cost was occurred under T6 owing to combined investment cost of FYM @ 7.0 MT/ha., while in control treatment cost was lowest ascribe to no use of fertilizer at all. Thereafter, greater economic values viz., gross income of ₹ 93615.33 ha⁻¹, net income of ₹ 71984.33 ha⁻¹ with application of T4 (NPK @ 20:40:20 kg/ha). 100% RDF + *Rhizobium* inoculation (T4) has been obtained on account of maximal seed and stover yield under this treatment (T4) as compared to rest all treatments. Thereupon, maximal B:C ratio of 3.33 was also achieved under 100% RDF + *Rhizobium* inoculation (T4). Maximal B:C ratio ascribe to reduction in additional cost of fertilizer source as compare to FYM @ 7.0 MT/ha. (T6). Indistinguishable findings were also noted by Singh *et al.* (2007)^[11], in lentil crop alike result was concluded by Singh *et al.* (2013)^[11], Meena, *et al.* (2016)^[8] and Choudhary *et al.* (2018)^[3].

Table 1: Response of inorganic and organic fertilizers on yield potential of green gram (*Vigna radiata* L.)

Treatments	Plant height (cm)	Numbers of branches/plants	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	Test weight (g)	Seed yield (q ha ⁻¹)	Stover yield (q ha ⁻¹)	Harvest index (%)	Protein content (%)	B:C Ratio
Control	49.63	4.37	16.33	4.13	30.08	5.80	16.94	25.47	19.49	1.03
NPK @ 10:20:10 kg/ha.	55.18	5.80	21.07	5.73	35.43	10.94	26.58	29.12	20.50	2.33
NPK @ 15:30:15 kg/ha.	54.26	5.02	21.67	5.81	35.70	11.09	29.39	28.26	22.39	2.20
NPK @ 20:40:20 kg/ha	57.74	6.40	24.27	6.07	37.14	14.33	31.52	31.26	24.39	3.33
FYM @ 3.5 MT/ha.	54.30	5.57	18.73	5.07	32.80	10.10	24.86	28.84	22.11	1.71
FYM @ 7.0 MT/ha.	53.41	4.77	18.20	4.73	31.96	8.66	21.94	28.31	20.94	1.39
Vermicompost @ 2.5 MT/ha.	55.11	5.60	19.40	5.27	33.57	10.67	26.14	28.93	22.51	1.85
Vermicompost @ 5.0 MT/ha.	52.71	4.53	17.47	4.67	31.31	8.44	21.28	28.37	20.88	1.32
Poultry manure @ 2.5 MT/ha.	55.26	5.03	22.67	4.80	35.74	12.09	30.39	27.42	23.10	2.03
Poultry manure @ 5.0 MT/ha.	56.26	6.03	23.67	5.80	36.74	13.09	31.39	29.42	24.10	2.97
Compost @ 3.5 MT/ha.	54.04	5.50	18.67	4.93	32.45	9.69	23.95	28.78	21.83	2.03
Compost @ 7.0 MT/ha.	53.50	5.37	18.27	4.80	32.05	9.44	23.84	28.37	21.52	2.05
S.Em. +	0.82	0.22	0.92	0.22	0.22	0.59	0.96	0.68	0.21	0.17
C.D. 5%	2.44	0.64	2.72	0.65	0.66	1.75	2.84	2.01	0.62	0.50

Conclusion

Based upon the experimental result it is concluded that the one-year based experiment, it is concluded that amongst all twelve treatments the greater seed yield (14.33 q ha^{-1}), net income ($71984.33 \text{ ₹ ha}^{-1}$) and B:C ratio (3.33) was realized under T4 (NPK @ 20:40:20 kg/ha). Thereupon, the utilization of NPK @ 20:40:20 kg/ha in green gram crop is beneficial.

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