Original Research Article

Influence of INM on Growth and Yield of Green Gram (*Vigna radiata* L.) NEPZ

ABSTRACT

A study was conducted in green gram to investigate the impact of integrated nutrient management on growth, yield and economics of green gram (*Vigna radiata* L.) at Agricultural Research Farm of United University, Rawatpur, Jhalwa, Prayagraj (U.P.), India during *Kharif* season of 2022. The experiment was carried out in randomized bock design with three replications in various permissible combinations with inorganic fertilizers, *rhizobium* and PSB along with FYM on green gram (*Vigna radiata*). This study revealed that 100% RDF + 5.0 tonnes FYM ha^{-1} + *Rhizobium* and PSB seed inoculation significantly increased plant height (91.99 cm), dry weight (105.45 g) and number of root nodules (111.33). The same treatment combination also proved most effective in improving the yield and yield attributing parameters *viz.,* number of pods $plant^{-1}$ (31.43), number of seeds pod^{-1} (12.46), test weight (37.26 g) and harvest index (34.90 %). Thus, application of farm yard manure @5 tonnes ha^{-1} along with *Rhizobium* and PSB helped in increase in yield over control. However, application of 100% RDF along with bio-fertilizer and FYM @5.0 tonnes ha^{-1} significantly increase gross return (₹ 104,120.00) net returns (₹ 76,017.00) and benefit: cost ratio (2.70). These results indicate that inorganic fertilizers along with bio-fertilizers and addition of organic matter proved to be useful in achieving the yield with integrated use of different sources of nutrients.

***Keywords*:** Green gram, INM, Growth, Yield attributes and Yield

Introduction

Green gram (*Vigna radiata* L.) is one of the most important and extensively cultivated pulse crops. India shares about 35- 37 % and 27 % of the total area and production of pulses, respectively in the world. Green gram commonly knows as “mung” or “mung bean” is the most important crop of the South-East Asia and particularly the India sub-continent. This popular and ancient crop is especially recognized as an excellent source of protein. It also plays an important role in maintaining and improving the fertility of soil through its ability to fix atmospheric nitrogen in the soil by root nodules. Green gram contains about 24.3 % protein and a good source of riboflavin **(Ranpariya *et al*. 2017).** India is the major producer of green gram in the world and grown in almost all the States. It is grown in about 4.5 million hectares with the total production of 2.5 million tonnes with a productivity of 548 kg ha^{-1} and contributing 10 % to the total pulse production **(Anonymous, 2021).** Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Bihar and Karnataka are the major pulses producing states in India.

In green gram, roots have symbiotic rhizobia bacteria which help in fixing atmospheric nitrogen into the soil **(Anjum *et al.* 2006).** For increasing the growth and yield of green gram starter dose of nitrogen is essential. Nitrogen plays a major role in synthesis of protein, chlorophyll and plant enzymes of legume. The chemical fertilizers are used in huge quantity alone hazards the soil and environment. Synthetic fertilizers include mostly macronutrients in excessive quantities, which have clogged the soil and had a harmful impact on crops, livestock, and humans **(Moller, 2009).** The utilization of organic sources of nutrients for crop growth should be prioritised for sustainable agriculture **(Tejada *et al.* 2009).** Organic manures contains both macro and micronutrients and enhance soil fertility, soil porosity, infiltration rate, total carbon, water holding capacity, cation exchange capacity, reducing bulk density, check soil erosion and lead to the increasing availability of plant nutrients through mineralization process. Use of chemical fertilizers in combination with organic sources of nutrients will help to improve physico-chemical properties of the soils, efficient utilization of applied fertilizers for improving seed quality and quantity. Organic sources provide a good substrate for the growth of microorganisms and maintain a favorable nutritional balance and soil physical properties. It is recognized that combined source of organic manures, bio-fertilizers and chemical fertilizers play a key role in increasing the productivity of the soil. Farmyard manure is known to play an important role in improving the productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition **(Kumar *et al.* 2011).** The increasing cost of inorganic fertilizer, growing environmental concern and energy crisis have created considerable interest for the alternative cheap sources of plant nutrients. Considering the above facts, the present study on integrated approach of organic manures, bio-fertilizers and inorganic fertilizers was carried out to assess the productivity and profitability of green gram cultivation.

Material and Methods

A field experiment was conducted during *Kharif* season 2022 at Agricultural Research Farm of United University, Rawatpur, Jhalwa, Prayagraj (U.P.), India which is situated at 25.39^0 N latitude, 81.75^0 E longitude with an altitude of 113 meters above mean sea level. To study the impact of integrated nutrient management on growth, yield and economics of green gram (*Vigna radiata* L.) under integrated approaches of nutrients. The experiment was laid out in randomized block design with three replication. The experiment was comprised of eleven treatment *viz*., T_1 100% RDF, T_2 100% RDF + Seed treatment (*Rhizobium* and PSB), T_3 100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}, T_4 100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}, T_5 80% RDF + Seed treatment (*Rhizobium* and PSB), T_6 80% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}, T_7 80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}, T_8 60% RDF + Seed treatment (*Rhizobium* and PSB), T_9 60% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}, T_{10} 60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1} and T_{11} Control. Green gram variety 'PDM-139 (Samrat)' was sown after pre-sowing irrigation using 15 kg ha^{-1} seed rate. A basal dose of 20 kg N, 50 kg P_2O_5 was applied per hectare as recommended dose of fertilizer. FYM was applied in the field as per the treatment details before sowing and mixed in soil. Accordingly, seeds were inoculated with *rhizobium* and PSB. For statistical analysis "Analysis of variance" technique was applied to the data recorded for each character. Overall differences were tested by "F" test of significance at 5 percent level of significance as suggested by **Cochran and Cox (1957).** Critical differences at 5 percent level of probability were worked out for comparing treatment.

Results and Discussion

Effect on growth parameters

Data pertain to the 60 DAS, plant height (91.99 cm) was maximum T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). While T_7 (80% RDF + Seed treatment

(*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (90.74 cm), T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (86.44 cm) and T_3 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}) (82.12 cm) was found to be statistically at par with T_4.

Observed that the 60 DAS, number of branch (7.46) was maximum T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). While T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (7.13) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (7.00) was found to be statistically at par with T_4.

Observed that the 60 DAS, plant dry matter accumulation (105.45) was maximum T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). While T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (101.91) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (101.20) was found to be statistically at par with T_4.

Nitrogen is so vital because it is a major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide (*i.e.*, photosynthesis). It is also a major component of amino acids, the building blocks of proteins **(Thakor *et al*. 2020).** Phosphorus is a vital component of ATP, the "energy unit" of plants. ATP forms during photosynthesis, has phosphorus in its structure, and processes from the beginning of seedling growth. Thus, phosphorus is essential for the general health and vigor of all plants **(Patel *et al*. 2019).** The application of *rhizobium* inoculum in green gram plants can increase the root nodules, which function to fix nitrogen for plants **(Singh *et al*. 2018).** Phosphate solubilizing bacteria (PSB) are the main contributors of plant nutrition in agriculture and could play a pivotal role in making soluble phosphorus available to plants **(Bhavya *et al*. 2018).** Application of Farmyard Manure (FYM) is known to keep soil productivity longer than inorganic fertilizers. FYM contains all the macro- and micronutrients required for plant growth, but its main effect is due to nitrogen, phosphorus, and potassium **(Kamdi *et al*. 2014).**

Table 1: Effect of integrated nutrient management on growth of green gram

Tr. No.	Treatment combination	At harvest		
		Plant height (cm) at harvest	**Number branches $plant^{-1}$ at harvest**	**Dry matter accumulation (gm^{-2})**
T_1	100% RDF	76.46	6.20	88.53
T_2	100% RDF + Seed treatment (*Rhizobium* and PSB)	78.17	6.30	88.93
T_3	100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	82.12	6.73	98.86
T_4	100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	91.99	7.46	105.45
T_5	80% RDF + Seed treatment (*Rhizobium* and PSB)	70.99	6.06	78.71
T_6	80% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	82.20	6.93	99.80
T_7	80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	90.74	7.13	101.91
T_8	60% RDF + Seed treatment (*Rhizobium* and PSB)	68.78	5.80	78.56
T_9	60% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	71.41	6.13	80.16
T_{10}	60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	86.44	7.00	101.20
T_{11}	Control	54.86	5.40	75.00
	SEm±	5.68	0.40	38.72
	CD (p=0.05)	16.89	1.19	115.05

Effect on yield attributes and yield

Maximum (31.43) number of pods plant^{-1} was obtained with application of T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). Whereas, T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (30.20) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (29.76) were statistically at par.

Maximum (12.46) number of seeds pod^{-1} was obtained with application of T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). Whereas, T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (12.26) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (11.93) were statistically at par.

Maximum (37.267 g) test weight (g) was obtained with application of T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) which was superior over rest of the treatments. Whereas, T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (36.36 g) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (36.30 g) were statistically at par.

Highest seed yield (1.33 t ha^{-1}) was obtained with application of T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). Whereas, T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (1.31) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (1.30) were statistically at par.

Stover yield (t ha^{-1}) was maximum (2.49 t ha^{-1}) in the application T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}). Whereas, T_7 (80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (2.44 t ha^{-1}) and T_{10} (60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1} (2.39 t ha^{-1}) were statistically at par.

Maximum harvest index was obtained with application of T_1 100% RDF (37.24 %). While, minimum harvest index (33.68%) was obtained with application of T_4 (100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}).

Future scope

As that conclusion are based on research conducted over a single season in Allahabad's agro-ecological environments, more experiment may be necessary before it could be considered a recommendation.

Table 2: Effect of integrated nutrient management on yield attributes of green gram

Tr. No.	Treatment	Number of pods plant $^{-1}$	Number of seeds pod $^{-1}$	Test weigh (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Harvest index (%)
T_1	100% RDF	26.70	11.26	32.86	0.97	1.60	37.24
T_2	100% RDF + Seed treatment (*Rhizobium* and PSB)	27.46	11.73	33.56	1.00	1.84	34.82
T_3	100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	28.33	11.76	34.70	1.11	1.32	33.68
T_4	100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	31.43	12.46	37.26	1.33	2.49	34.90
T_5	80% RDF + Seed treatment (*Rhizobium* and PSB)	25.23	10.13	30.06	0.98	1.80	35.13
T_6	80% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	29.73	11.86	35.86	1.01	1.90	35.86
T_7	80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	30.20	12.26	36.36	1.31	2.44	35.00
T_8	60% RDF + Seed treatment (*Rhizobium* and PSB)	24.70	9.76	29.96	0.97	1.64	36.93
T_9	60% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	25.86	10.36	31.40	1.00	1.89	35.56
T_{10}	60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	29.76	11.93	36.30	1.30	2.39	35.26
T_{11}	Control	23.80	9.70	28.70	0.66	2.19	33.33
	SEm±	1.15	0.34	1.67	40.76	70.28	0.76
	CD (p=0.05)	3.43	1.01	4.97	121.10	208.81	-

Conclusions

Thus, from the experiment it can be concluded that integrated application of 100% recommended dose of fertilizer with *Rhizobium* and phosphate solubilizing bacteria (PSB) and farm yard manure @ 5 t ha^{-1} was found to be the best treatment for enhancing the productivity and obtaining more net returns and benefit: cost ratio in green gram cultivation.

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