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Impact of Integrated Nutrient Management on Growth and Economics of Green Gram (*Vigna radiata* L.) under Prayagraj Zone

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ABSTRACT

An experiment was conducted at Agricultural Research Farm, Faculty of Agriculture & Allied Sciences, Prayagraj (U.P.), India during *Kharif* season of 2022 to study the impact of integrated nutrient management on growth, yield and economics of green gram (*Vigna radiata* L.). 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* L.). 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 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.

Key words: *Green gram, INM, Growth and Economic*

Introduction

For India, pulses are a crucial crop. They produce high returns for farmers, are a significant source of protein, and support the sustainability of both agriculture and the environment. The "International Year of Pulses" was recognized by the UN Food and Agriculture Organization for 2016. Pulses are a significant source of protein for humans, but their poor productivity is mostly due to the fact that they can only be grown in marginal or submarginal environments with little or no management. In order to grow pulses at the optimum rate of productivity, efficient and balanced fertilization is necessary. Pulses have a significant role in cattle feed and fodder, including hay, green fodder, and concentrates, aside from the human diet. They may be produced as a primary crop, intercrop, catch crop, and green manure crop due to their short lifespan. Due to the fixation of atmospheric nitrogen and the addition of

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residues, pulses also increase soil fertility. 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. According to Government of India 3^{rd} advance estimates, green gram production in 2021 is 2.64 million tonnes.

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 (Venkatesh *et al.*, 2015).

Bio-fertilizers too are one of the important ingredients in INM. Bio-fertilizers themselves are not really a source of nutrients but their application increases the availability of nutrients to the crops due to enhanced mineralization (Barkha *et al.* 2020). Integrated nutrient management facilitates better utilization of resources. In this approach, all possible organic sources of nutrients are applied based one conomic consideration and the balance required for the crop is supplemented with chemical fertilizers. Use of bio-compostis an important practice under I NM asitisa 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. (Barkha *et al.,* 2020).

Materials and Methods

The experiment was conducted during *Kharif* season of 2022 at Agricultural Research Farm, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj (U.P.), India 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 % level of significance as suggested by Cochran and Cox (1957). Critical differences at 5 % level of probability were worked out for comparing treatment.

Results and Discussion

Effect on growth parameters

It was observed that at the 60 DAS, plant fresh weight (653.16) 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}) (628.06) and T_{10}(60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (621.73) was found to be statistically at par with T_4.

Observed that the 60 DAS, plant nodule (111.33) 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}) (99.56) and T_{10}(60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}) (96.83) was found to be statistically at par with T_4.

Nitrogen is essential because it is a component of chlorophyll, the molecule that plants employ to convert solar energy into sugars from water and carbon dioxide (*i.e.*, photosynthesis). It's also a key component of amino acids, which are the building blocks of proteins (Thakor *et al.,* 2020). Phosphorus is an essential component of ATP, or the "energy unit" of plants. ATP is formed during photosynthesis, has

Table 1. Effect of integrated nutrient management on plant growth of green gram

Tr. No.	Treatment combination	At harvest	
		Fresh weight (g)	No. of nodule $plant^{-1}$
T_1	100% RDF	608.13	86.76
T_2	100% RDF + Seed treatment (*Rhizobium* and PSB)	613.76	86.80
T_3	100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	618.16	87.50
T_4	100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	653.16	111.33
T_5	80% RDF + Seed treatment (*Rhizobium* and PSB)	549.16	78.46
T_6	80% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	621.20	94.46
T_7	80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	628.06	99.56
T_8	60% RDF + Seed treatment (*Rhizobium* and PSB)	484.36	78.33
T_9	60% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	595.40	79.10
T_{10}	60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	621.73	96.83
T_{11}	Control	406.63	72.03
	SEm±	38.72	4.35
	CD (p=0.05)	115.05	12.94

CD (p=0.05)

Table 2. Economics of green gram under integrated nutrient management

	Treatment combination	Economics			
		Total cost of cultivation (ha^{-1})	Gross returns (ha^{-1})	Net returns (ha^{1})	B: C ratio
T_1	100% RDF	25353	73,754.50	48,401.50	1.90
T_2	100% RDF + seed treatment (*Rhizobium* and PSB)	25603	76,465.50	50,862.50	1.98
T_3	100% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	26853	86,764.00	59,911.00	2.23
T_4	100% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	28103	104,120.00	76,017.00	2.70
T_5	80% RDF + Seed treatment (*Rhizobium* and PSB)	25526	75,852.00	50,326.00	1.97
T_6	80% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	26776	82,839.50	56,063.50	2.09
T_7	80% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	28026	102,145.00	74,119.00	2.64
T_8	60% RDF + Seed treatment (*Rhizobium* and PSB)	25449	74,567.50	49,118.50	1.93
T_9	60% RDF + Seed treatment (*Rhizobium* and PSB) + 2.5 t FYM ha^{-1}	26699	81,009.00	54,310.00	2.03
T_{10}	60% RDF + Seed treatment (*Rhizobium* and PSB) + 5.0 t FYM ha^{-1}	27949	101,421.50	73,472.50	2.62
T_{11}	Control	25170	51,948.00	26,778.00	1.06

Plate 1. Pod picking during field experiment

Plate 2. Green gram harvest during field experiment

phosphorus in its structure, and processes from seedling development through grain production and maturity. As a result, phosphorus is critical for the overall health and vigour of all plants (Patel *et al.* 2019). The use of *Rhizobium* inoculum in green gram plants can enhance the number of root nodules, which are responsible for nitrogen fixation in the plants (Singh *et al.*, 2018). Phosphate solubilizing bacteria (PSB) are the primary providers of plant nutrition in agriculture and have the potential to play a critical role in making soluble phosphorus accessible to plants (Bhavya *et al.*, 2018). Farmyard manure (FYM) application is recognized to keep soil productivity longer than inorganic fertilizers. FYM includes all of the macro- and micronutrients needed for plant development, although nitrogen, phosphorus, and potassium have the most impact (Kamdi *et al.*, 2014). 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.

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Conflict of Interest: None.

Conclusion

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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