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Effect of various levels of phosphorus and integrated nutrient management on growth and yield of green gram [*Vigna radiata* L.]

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Abstract

An experiment was conducted at Lil Farm Dhulkot, Dehradun to study the “Effect of various levels of Phosphorus and Integrated Nutrient Management on growth and yield of green gram [*Vigna radiata* L.] during zaid season of 2023 in factorial randomised block design with three different levels of phosphorus viz. P₁ - 45 kg hectare⁻¹, P₂ - 60 kg hectare⁻¹, P₃ - 75 kg hectare⁻¹ and 4 different levels of INM viz. B₁ - Control, B₂ - 100% RDF, B₃ - PM 5 t/ha + 50% RDF, B₄ - VC 5 t/ha + 50% RDF which was replicated thrice. The variety chosen was PDM - 139 (SAMRAT). The soil was sandy clayey loam with medium Phosphorus and medium Potassium with pH 6.3. Growth and yield attributing characters visualizing plant height, number of leaves, number of branches, plant dry weight (g), crop growth rate (CGR) (g/m²/day), relative growth rate (RGR) (g/g/day), number of pods plant⁻¹, pod length plant⁻¹, number of seeds pod⁻¹, test weight (g), grain yield (q ha⁻¹), stover yield (q ha⁻¹), harvest index (%) were significantly more with the application of 75 kg Phosphorus ha⁻¹ in comparison to 45 kg Phosphorus ha⁻¹ and was at par with 60 kg Phosphorus ha⁻¹. In case of INM the growth, yield attributing characters and yield were significantly more with the application of B₄-Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃-Poultry manure 5 t/ha + 50% RDF, B₂-Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. Based on present investigation it can be said that application of 75 kg Phosphorus ha⁻¹ and 5 t ha⁻¹ vermicompost with 50% RDF yielded maximum growth and yield attributes of green gram.

Keywords: Green gram, *Vigna radiata* L., phosphorus levels, integrated nutrient management, factorial randomized block design, PDM-139 (SAMRAT)

Introduction

Green gram locally called as moong or mung [*Vigna radiata* (L.) Wilczek] belongs to the family leguminaceae. It's one of the important pulse crops of India. India alone accounts for 65% of its world acreage and 54% of the total production. It is grown on about 3.50 mha in the country mainly in Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Orissa and Bihar. Mungbean plays an important role in maintaining and improving the fertility status of the soil, as they have ability to fix atmospheric N (20-25 kg ha⁻¹) symbiotically in soil through root nodules. Being a short duration and having wide adaptability, it generally grown as intercrop, mixed crop and sole crop in kharif as well as in summer season where adequate irrigation facilities are available. It can be grown on a variety of soil and climatic conditions, as it is tolerant to drought. It is mostly grown under dry land farming system where erratic rains often fetch the crop under moisture stress.

Green gram is nutritious, containing 23-26 percent proteins, 57-58 percent carbohydrate, 1.1 percent fat, 9.7 percent water, 3.3 – 3.8 percent fibre and 4 - 4.8 percent ash. As a vegetable protein it is rich in vitamin B, also rich in phosphorus and iron. This warm season legume is a native of India and is still grown on a large acreage there. Often called green gram or golden gram in international publications, it is also cultivated in several countries of Asia, Africa, and South America. Phosphorus is the complex element for availability to plant growth. It's availability is influenced by many factors of which pH is important. Phosphorus (P) is one of the three macronutrients that plants must obtain from the soil. It is a major component of compounds whose functions relate to growth, root development, flowering, and ripening (Raboy, 2003)^[4]. A third major component of soil P is in organic.

Organic forms of P may constitute 30-50% of the total phosphorus in most soils, although it may range from as low as 5% to as high as 95%. Organic P in soil is largely in the form of inositol phosphate.

Materials and Methods

The materials used and methods adopted in the present experiment "Effect of different Integrated Nutrient Management and phosphorus levels on growth and yield of Green gram (*Vigna radiata* L.)" with a brief description of site of experiment, soil properties, climatic condition prevalent in the locality, cropping history, sampling techniques and statistical analysis are adopted within this chapter. The experiment was conducted at Zaid Season of 2023 on plot No.18 of the Crop Research Farm, Learning Integrated Livelihood Farm, Dhoolkot, Dehradun, Uttarakhand (248197), India. The city is located at 25.28° N latitude and 81.54° E longitude. 410 m above mean sea level. The experimental site falls under sub-tropical zone in Uttarakhand region and lies between 26°47' North latitude, 82°12' East longitudes, at an altitude of about 410.0 meter from mean sea level and is subjected to extremes of weather conditions. The region received an average rainfall of about 1200 mm out of which about 80% is concentrated from mid-June to end of September. The soil was sandy loam in texture, low in organic carbon and medium in available nitrogen, phosphorus and low in potassium. The experiment was done with 12 treatments consisting of three levels of phosphorus viz. P₁ – 45 kg ha⁻¹, P₂ – 60 kg ha⁻¹, P₃ – 75 kg ha⁻¹ and four levels of sulphur viz. B₁-Control, B₂-Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₃-Poultry manure 5 t/ha + 50% RDF, B₄-Vermicompost 5 t/ha + 50% RDF. The experiment was done with randomised block design with three replications. The recommended dose of Nitrogen and Potash was applied while Phosphorus and INM were applied as per the treatments. The green gram variety chosen was "PDM 139 (Samrat)".

The observations of various growth and yield attributes were recorded by selecting five random plants from each plot. Pre-harvest observation of plant height, number of leaves, number of branches, crop growth rate, number of pods per plant, pod length, number of seeds per pod was taken and post-harvest data of grain yield and stover yield were taken. Experimental data collected were subjected to statistical analysis by using Fisher's method of analysis of variance (ANOVA) with critical difference at 5% level of significance.

Results and Discussion

Growth attributes

Phosphorus

The effects of different levels of phosphorus on plant height was significant, the maximum plant height recorded (71.41 cm) with the application of P₃-75 kg phosphorus ha⁻¹. The increase in plant height of green gram with increasing rate of phosphorus application also reported by Owla *et al.* (2007) [7] and Ali *et al.* (2010) [4]. The interaction effects of different levels of phosphorus on number of branches were significant at 45 DAS and 60 DAS. The maximum number of branches recorded at 45, 60 DAS was 3.86, 4.00 respectively in T₃- 75 kg phosphorus ha⁻¹. The interaction effects of different levels of phosphorus on number of nodules was non-significant at 15, 30, 45, 60 DAS. The maximum number of nodules recorded at 15, 30, 45, 60

DAS was 6.67, 30.60, 65.27, 24.67 respectively in T₃- 75 kg phosphorus ha⁻¹. The increase in number of nodules of green gram with increasing rate of phosphorus application also reported by Owla *et al.* (2007) [7] and Ali *et al.* (2010) [4] and Ram and Dixit (2001) [9]. The number of nodules affected by different levels of phosphorus. The third level of phosphorus is best level comparison to 45 kg and 60 kg ha⁻¹ (Fraz *et al.*, 2006) [8]. The increase in number of nodules of green gram with increasing rate of phosphorus application also reported by Ali *et al.* (2010) and Owla *et al.* (2007) [7] and Ram and Dixit (2001) [9].

The highest dry weight was recorded (27.44 gm) in P₃- 75 kg phosphorus ha⁻¹ which was significantly more than P₁ and P₂. The highest CGR was recorded (10.06 g/m²/day) and highest RGR (0.04 g/g/day) with the application of 75 kg ha⁻¹ Phosphorus which was non-significantly more to the other treatment levels.

Integrated Nutrient Management

The effects of different levels of INM on plant height was significant, the maximum plant height recorded (54.08 cm) with the application of B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly more than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The maximum number of branches (17.8) was recorded with the application of B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂-Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The number of nodules (15.65) was most in B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂-Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control.

The highest dry weight was recorded (20.34 g) in B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂-Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The highest CGR was recorded (10.45g/m²/day) B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The Highest RGR(0.03 g/g/day) was recorded with the application of B₄ -Vermicompost 5 t/ha + 50% RDF, which was non-significantly more to the other treatment levels.

Effect on yield attributes

Phosphorus Levels

The highest number of pod per plant (26.40) and number of seed per pod (11.80) was recorded in P³, followed by P¹ and P² and P¹ respectively. The highest test weight (41.81g) was recorded in P³ which was significantly higher than P² and P¹. The grain yield (1.40t/ha) and stover yield (2.68t/ha) was highest with the application of 75kg/ha⁻¹ Phosphorus, which was significantly higher than P² and P¹. The harvest index (35.48%) was found non-significantly more than P² and P¹.

The increase in number of seed per pod⁻¹, seed yield, stover yield of green gram with increasing rate of phosphorus application also reported by Owla *et al.* (2007) [7] and Ali *et al.* (2010) [4], Bairwa *et al.* (2014) and Ram and Dixit (2001) [9]. The number of grains affected of different levels of phosphorus. The third level of phosphorus is best level

comparison to 25 kg and 50 kg ha⁻¹ (Fraz *et al.*, 2006 Malik *et al.*, 2006) [8].

Integrated Nutrient Management

The effects of different levels of INM on plant height was significant, the maximum of pod per plant (18.85) with the application of B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly more than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The most number of seed per pod (8.83) was recorded with the application of B₄ - Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The highest test weight (31.37g) was most in B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly

higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control.

The highest grain yield was recorded (1.06t/ha) in B₄ - Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The highest stover yield was recorded (2.0t/ha) B₄ -Vermicompost 5 t/ha + 50% RDF, which was significantly higher than B₃ -Poultry manure 5 t/ha + 50% RDF, B₂- Recommended dose of Fertilizers (25:50:25 kg NPK/ha), B₁-Control. The harvest index (26.35) was recorded with the application of B₃ -Poultry manure 5 t/ha + 50% RDF, which was non-significantly more to the other treatment levels.

Table 1: Effect of various levels of Phosphorus and Sulphur on growth attributes of Mung bean (*Vigna radiata* L.)

Treatments	Plant Height (cm)	Number of Nodules	Number of Branches	Plant Dry Weight (g/plant)	Crop Growth Rate (CGR) (g/m ² /day)	Relative Growth Rate (RGR) (g/g/day)
Integrated Nutrient Management levels (B)						
B ₁ - Control	51.52	14.58	16.3	18.08	4.26	0.02
B ₂ - 100% RDF	52.42	15.67	16.7	19.16	7.74	0.02
B ₃ - PM 5 t/ha + 50% RDF	51.57	14.68	16.7	19.19	5.72	0.03
B ₄ - VC 5 t/ha + 50% RDF	54.08	15.65	17.8	20.34	10.45	0.03
F - test	S	S	S	S	S	NS
SE (m) ±	0.69	0.78	0.07	0.49	1.29	0.003
CD (P = 0.05)	1.42	1.59	0.14	0.99	2.64	-
Phosphorus levels (P)						
P ₁ - 45 kg P ha ⁻¹	69.57	19.77	2.30	24.51	9.01	0.03
P ₂ - 60 kg P ha ⁻¹	69.02	19.37	2.13	24.76	9.12	0.03
P ₃ - 75 kg P ha ⁻¹	71.41	21.03	2.32	27.44	10.06	0.04
F - test	S	S	S	S	NS	NS
SE (m) ±	0.60	0.67	0.06	0.42	1.11	0.002
CD (P = 0.05)	1.23	1.38	0.12	0.86	-	-

Table 2: Effect of various levels of Phosphorus and Sulphur on yield attributes of Mung bean (*Vigna radiata* L.)

Treatments	Number of Pods plant ⁻¹	No. of Seeds pod ⁻¹	Test Weight (g)	Grain Yield (t ha ⁻¹)	Stover Yield (t ha ⁻¹)	Harvest Index (%)
Integrated Nutrient Management levels (B)						
B ₁ - Control	17.03	8.33	30.15	0.95	1.83	25.67
B ₂ - 100% RDF	18.72	8.57	30.55	1.03	1.99	25.68
B ₃ - PM 5 t/ha + 50% RDF	18.41	8.40	30.37	1.04	1.90	26.35
B ₄ - VC 5 t/ha + 50% RDF	18.85	8.83	31.37	1.06	2.00	26.31
F - test	S	S	S	S	S	NS
SE (m) ±	0.79	0.17	0.47	0.03	0.07	0.88
CD (P = 0.05)	1.62	0.34	0.95	0.07	0.15	-
Phosphorus levels (P)						
P ₁ - 45 kg P ha ⁻¹	23.45	11.15	40.52	1.21	2.52	34.44
P ₂ - 60 kg P ha ⁻¹	23.18	11.18	40.14	1.31	2.52	34.08
P ₃ - 75 kg P ha ⁻¹	26.40	11.80	41.81	1.40	2.68	35.48
F - test	S	S	S	S	S	NS
SE (m) ±	0.68	0.14	0.40	0.03	0.06	0.76
CD (P = 0.05)	1.40	0.29	0.82	0.06	0.13	-

Conclusion

Application of Phosphorus 75 kg ha⁻¹ along with Vermicompost 5 t/ha + 50% RDF were significantly increased in all the growth and yield attributes of green gram plant. The highest pods plant⁻¹, grains pod⁻¹ and test weight, Seed yield and stover yield were observed in treatment T₁₂ (Vermicompost 5 t/ha + 50% RDF + Phosphorus 75 kg ha⁻¹). Maximum gross return was also obtained in T₁₂ (Vermicompost 5 t/ha + 50% RDF + Phosphorus 75 kg ha⁻¹while). It is concluded that mungbean

crop should preferably be grown with 75 kg of phosphorus along with Vermicompost 5 t/ha + 50% RDF under agro-ecological conditions of Dehradun.

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