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Response of green gram (*Vigna radiata* L.) varieties to phosphorus on yield and economics

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Abstract

A field experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *kharif*, 2024 on loamy sand soil. The experiment comprises six varieties (MSJ-118, RMG-975, SML 668, MH 421, IPM 02-3 and MH 318) and three levels of phosphorous (Control, 20 and 40 kg ha⁻¹) thereby making 18 treatment combinations was laid out in factorial randomized block design and replicated thrice. The results indicated that among the greengram varieties MH 318 recorded significantly higher seed and stover yield. Maximum net return and B: C ratio obtained with variety MH 318. Further, results showed that application of 40 kg phosphorous ha⁻¹ significantly increased the seed, stover yields, net returns and B: C ratio over preceding level of phosphorus.

Keywords: Mungbean, fertilizer, genotypes, productivity, economics

Introduction

Greengram [*Vigna radiata* (L.) Wilczek], also known as mungbean, stands third after chickpea and pigeonpea among pulses. It occupies 2.93 Mha areas and contributes 2.07 Million tonnes in pulse production in the country (Anonymous, 23-24). The important greengram growing states are Rajasthan, Madhya Pradesh, Uttar Pradesh, Odisha, Maharashtra, Karnataka and Bihar. In Rajasthan, total area under greengram was 22.40 lakh hectares with the production of 9.71 lakh tonnes and productivity of 473 kg ha⁻¹ (Anonymous, 2023-24). It is mainly cultivated in arid and semi-arid districts including Nagaur, Jaipur, Jodhpur, Sikar, Pali, Jhunjhunu and Ajmer. Despite of being such an important crop, the average productivity of greengram in the state is quite low compared to its production potential which is a matter of serious concern. Genotypes play an important role in crop production and the potential yield of a crop within the genetic limit is determined by its environments. The yield of crop varieties varies in different environment. Hence, combination of genotype and environmental factor can bring about increase in production. Differences in yield of genotype are attributed to the complex process occurring in various part of the plant involving many physiological changes. These physiological changes are influenced by environmental factors prevailing at different at different environment 'agronomic manipulation and yield analysis are required. A number of high yielding varieties have been developed at different research station of the state. These varieties also differ in their yielding potential under different climate and edaphic conditions (Verma *et al.*, 2011) [9]. Different varieties of mungbean have varying nutrient demand and climate adaptability. Therefore, selection of appropriate adoptable variety requires immediate and large efforts in the direction of improved varieties for a particular tract and its distribution (Buriro *et al.*, 2015) [2].

Fertilizer is one of the most important inputs required for increasing the yield of any crop. Green gram being legume crop responds well to phosphorus application. Phosphorus is the major essential nutrient required by the crop. In legumes, nitrogen requirement is less as compared to phosphorus because major protein is supplied through nitrogen fixation. Therefore, phosphorus is a key nutrient for increasing productivity of pulses in general and green gram in particular. Legumes as such have a relatively high phosphorus requirement being utilized by plant and bacteria. It assumes primary importance, owing to its important role in root proliferation and thereby atmospheric nitrogen fixation.

Majority of phosphorous gets fixed in the soil due to various factors. The yield and nutritional quality of pulses is greatly influenced by application of phosphorus. It plays a key role in various physiological processes like root growth and dry matter production, nodulation and nitrogen fixation and also in metabolic activities especially in protein synthesis. It also helps in establishing seedling quickly and also hastens maturity as well as improves the quality of crop produce. The most obvious effect of phosphorus is on the root system of plants. It promotes the formation of lateral and fibrous roots, which facilitates more nodule bacteria and ultimately affects the nitrogen fixation in leguminous crops. Phosphatic fertilizers have more importance than nitrogenous fertilizers because it increases the activity of symbiotic bacteria and brings significant improvement in yield attributing characters.

Materials and Methods

The experiment was conducted at Research farm, Vivekananda Global University, Jaipur. Geographically, is situated Geographically this place is situated at 75° 47' East longitude, 26° 51' North latitude and at altitude of 390 m above mean sea level in Jaipur district of Rajasthan. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan. The experiment consisting of six varieties of green gram (MSJ-118, RMG-975, SML-668, MH-421, IPM 02-3 and MH 318) and three treatments of phosphorus application (Control, 20 and 40 kg ha⁻¹), thereby making eighteen treatment combinations.

Seed yield

After threshing, winnowing and cleaning, the produce of each plot was weighed separately in kg per plot and then converted to Seed yield in kg/ha.

Stover yield

Stover yield (kg/ha) was obtained by subtracting Seed yield (kg/ha) from the biological yield (kg/ha).

Biological yield

The weight of the thoroughly sun dried harvested produce of each plot was recorded separately before threshing and expressed as biological yield in (kg/ha).

Economics

The economics of treatments is the prime consideration before making any recommendation to the farmers for its adoption. Hence, to evaluate the effectiveness and profitability of the treatments, comprehensive economics in terms of net returns (₹ ha⁻¹) and B:C ratio was calculated so that the most effective and remunerative treatment could be recommended. The details of calculation with prevailing market rates of the inputs and produce are given in appendices at the end.

Net returns = Gross returns - Total cost of cultivation

$$B:C \text{ ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Results and Discussion

Effect of varieties

Variety MH 318 established its significant superiority over all other varieties were tested in the present experiment in terms of yields. The differential behaviour among the genotypes may be explained primarily on the basis of variation in their genetic makeup and secondly their differential behaviour under different agroclimatic conditions. It is pertinent to note that in terms of straw yield, all the varieties differ significantly from one another yet, in their biological yields considerable variations have been noticed that established variety MH 318 superior to other varieties. This might be due to the fact that excess assimilates stored in the leaves and later their efficient translocation in to seeds at the time of senescence, ultimately led to higher seed yield of MH 318 and IPM 02-3. The findings are in corroborated with the findings of Rathod and Gawande (2014) [7]. The greengram variety MH 318 recorded the maximum gross return and net profit of Rs. 51513 ha⁻¹. The same variety had also maximum B:C ratio (3.24) due to its higher productivity which was followed by variety IPM 02-3 (3.10). MSJ-118 recorded lowest net return (Rs. 27257 ha⁻¹) and B:C ratio (2.18) due to its less return. These findings are similar with the findings of Patel *et al.*, (2013) [5].

Table 1: Effect of varieties and phosphorus on yield and harvest index of greengram

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Net returns	B:C ratio
A. Varieties of greengram						
MSJ 118	837	2054	2892	28.93	27257	2.18
RMG 975	923	2298	3221	28.64	32474	2.41
SML 668	1011	2489	3500	28.88	37666	2.64
MH 421	1069	2682	3751	28.50	41254	2.80
IPM 02-3	1187	2908	4094	28.97	48171	3.10
MH 318	1242	3051	4293	28.93	51513	3.24
SEm+	24	49	69	0.34	1409	0.06
CD (P = 0.05)	70	140	199	NS	4051	0.18
B. Phosphorus application (kg ha⁻¹)						
Control	894	2221	3116	28.68	31276	2.40
20	1083	2666	3749	28.90	42001	2.83
40	1157	2854	4011	28.84	45890	2.96
SEm+	17	34	49	0.24	997	0.04
CD (P = 0.05)	49	99	140	NS	2864	0.12

Effect of phosphorous

The effect of different levels of phosphorus on mean seed

yield kg ha⁻¹ was found to be significant. The application of 40 kg Phosphorous ha⁻¹ was recorded significantly higher

mean seed yield (1226 kg ha^{-1}) followed by the application of $30 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (1157 kg ha^{-1}) and followed by the application of $20 \text{ kg Phosphorous ha}^{-1}$ (1083 kg ha^{-1}). Higher seed yield with higher level of phosphorus may be due to higher reproductive growth. These results reported by Deshbhratar *et al.*, (2010) [3]. Further results revealed that straw yield kg ha^{-1} as influenced by different levels of phosphorus was found to be significant. The application of $40 \text{ kg Phosphorous ha}^{-1}$ recorded maximum straw yield kg ha^{-1} (2854 kg ha^{-1}) which was found significantly superior over lower levels of phosphorus. This might be due to phosphorus application may mobilize the photosynthates from growing organs to Seeds, consequently increasing their number and size (Singh *et al.*, 2017) [8]. Phosphorus resulted in higher rate of dry matter accumulation which might be due to the increase in vegetative development and reproductive attributes under proper availability of phosphorus and better physical condition of soil. Positive responses in terms of yield attributes due to application of phosphorus have also been reported by Patil *et al.*, (2011) [6], Kumar *et al.*, (2012) [4], Patel *et al.*, (2013) [5].

The data on net monetary returns per hectare it was revealed that the application of $40 \text{ kg Phosphorous ha}^{-1}$ gave significantly higher net monetary returns (Rs. 45890 ha^{-1}) over the application of $20 \text{ kg Phosphorous ha}^{-1}$ (Rs. 42001 ha^{-1}) and control (Rs. 31276 ha^{-1}). Similar trends were obtained in benefit: cost ratio it was seen that the application of $40 \text{ kg Phosphorous ha}^{-1}$ and $20 \text{ kg Phosphorous ha}^{-1}$ gave higher on benefit: cost ratio (2.96 and 2.83) followed by the application control treatment because of higher gross monetary returns obtained by the application of $40 \text{ kg Phosphorous ha}^{-1}$.

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