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Growth, yield and quality response of green gram (*vigna radiata* L.) to phosphorus levels and vermicompost

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Abstract
The present experiment entitled on "growth, yield and quality response of green gram (*Vignaradiata* L.). To phosphorus levels and vermicompost" was conducted at the experimental farm of department of Agronomy, faculty of Agriculture Science and technology, AKS University, Satna, (M.P.) during the *Kharif* season of 2021-22. The investigation was aimed to assess the productivity of green gram under the application of different phosphorus levels and vermicompost and their subsequent effect on plant growth parameters, yield attributes and yield as well as economics and quality of the produce. The soil of experimental field was sandy clay loam in texture, neutral in reaction with normal EC and analyzing medium in OC, N, P and K content. During crop season, the rainfall was 104.08 mm and other weather conditions were normal for better growth and development of the crop. A set of twelve phosphorus levels and vermicompost treatments were tested in randomized block design with factorial concept 3 replications. Green gram (*var*. Pusa Ratna) was sown at 30 cm row spacing on July 20th 2021. All the fertilizers and nutrients were applied as per the treatments. Other agronomic practices were performed in all the treatments as per recommended package of practices. Based upon this experiment it is concluded that application of phosphorus @ 60kg/ha with combined application of vermicompost @ 5t/ha (P_3V_3) recorded the maximum and significantly highest grain yield (15.58q/ha) and net monetary returns (₹ 80657.00 Rs/ha), while the highest B:C ratio of 3.38: 1. Hence, it can be concluded that application of phosphorus @ 60 kg/ha with vermicompost @ 3t/ha obtained B:C ratio >3.80.0, can be used as an remunerative strategies and can be adopted in semi-arid eastern plain zone of Madhya Pradesh.

Keywords: Phosphorus, vermicompost, yield, green gram

Introduction
Green gram (*vigna radiata* L. Wilezek) is one of the most ancient and extensively leguminous crops of grown in India. Green gram is short duration, drought tolerant pulse crop which also commonly known as "Mung bean". Green gram seed contains 24.7% protein as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to its supply of cheaper protein source, it is designated as "poor man's meat". Green gram is considered as a substitute of animal protein and forms a balanced diet when used with cereals. It is a good source of protein (20-24%), carbohydrates (60-62%), water (10%), fat (1.0%), fiber (4.0%) and ash (3.0%).

Phosphorus is second most critical plant nutrient after nitrogen. But for pulses, it assumes primary importance, owing to its important role in root proliferation, which are the seat of biological nitrogen-fixation and helps plants to draw nutrients from lower layers and consequently thrive under moisture stress conditions. Application of phosphorus also plays an important role in growth, development and maturity of any crop. Hence, phosphorous has referred to as the "master key element" in crop production (Taliman *et al*. 2019) [4].

It has beneficial effects on nodule stimulation, root development, growth and it also hastens maturity as well as improving quality of crop produce. It plays a major role in energy transfer, stimulation of early growth and development, fruiting and seed formation (Osodeke, 2005) [2]. Phosphorus also plays a vital role in the formation and translocation of carbohydrates, root development, crop maturation and resistance to pathogens and also a major component in compounds whose function is related to growth, root development and ripening, which helps in increasing the yield and improves its quality.

Vermicompost, a component of integrated nutrient management and are considered to be cost effective, eco-friendly and renewable source of non-bulky, low-cost plant nutrient supplementing fertilizers in sustainable agriculture system in India (Rao, 2007) [3].

Vermicompost is an organic manure produced by earthworm feeding on biological waste material and plant residue & it contains 2.1-2.6% N, 1.5-1.7% P and 1.4-1.6% K, 10 to 52 ppm Cu, 186.60 ppm Zn, 930.00 ppm Fe and plant growth promoting substances such as NAA, cytokinins, gibberellins, etc. (Giraddi *et al*., 2006) [1].

Vermicompost helps improve soil structure, texture porosity water holding capacity, drainage, and aeration and reduce erosion. It improve plant growth by enabling the growth of new shoots and leaves, thereby increasing productivity.

Material and Methods

The present experiment was conducted during the *Kharif* season of 2021-22 at the Instructional farm, Department of Agronomy, Faculty of Agriculture, science and technology AKS University, Sherganj, Satna (M.P.). Geographically, Satna district lies in the Kymore Plateau and Satpura Hill Zone, MP-4 (Agro-climatic Zone-VIII). It is situated in the north-eastern part of Madhya Pradesh the latitude of $23^0$58' to $25^0$12' N and longitude of $80^0$21' to $81^0$23' east in Rewa division of M.P. State of India at an elevation of 315 m above mean sea level. The experiment consisted of twelve treatments combination & comprising four levels of phosphorus (0, 20, 40, 60kg/ha) and three vermicompost levels (2, 3, 5t/ha). The experiment was laid out in Randomized block design with factorial concept with three replications were tested at agricultural research farm of AKS university Sherganj Satna. In order to determine the textural class and fertility status of the field soil, to study the mechanical composition and chemical properties of the soil, representative soil samples were taken at four randomly selected places in the experimental field from 0-30cm depth were collected prior to fertilizer application before sowing of crop. The composite soil samples were analyzed for the various physico-chemical properties of soil. The composite soil samples were analyzed for the various physic chemical properties of soil. The soil was well drained, clay loam in texture having PH 7.4, EC 0.17 (ds/m), organic carbon (0.46), available nitrogen (178.4kg/ha), available phosphorus (13.2kg/ha) and available potassium (196.0kg/ha).The CRP was sown in spacing (30x10cm) on 20 July 2021 and harvested on 10 October 2021 at maturity.

Results and Discussion

The significantly highest values under phosphorus @ 60kg/ha with the vermicompost @ 5t/ha was verified significantly superior to rest of the treatments for the characters and their respective value such as plant height (11.86, 31.81 and 49.60 cm), Number of branches per plant (3.20, 8.00 and 10.93), number of root nodules per plant (19.40 at the growth stage), number of pods per plant (22.07), number of grains per pod (12.80), highest test weight (38.34g), grain yield per plant (8.29g), grain yield per plot (1.87kg), highest grain yield per hectare (15.58q/ha), Stover yield per hectare (34.01q/ha), The harvest index of green gram under the treatment @ 60kg/ha was found to be non-significant. Highest protein content under the treatment @ 60kg/ha was found to be 22.93%. The highest cost of cultivation of Green gram was recorded under the treatment combination consisting that application of phosphorus @ 60kg/ha with the vermicompost @ 5ton/ha respective value of 24035.00 Rs/ha. The significantly highest gross monetary return of green gram was recorded under the treatment combination consisting that application of phosphorus @ 60kg/ha with the vermicompost @ 5t/ha with the respective value of ₹ 104692.00 Rs/ha which are proved significantly superior to rest of the treatments. The significantly highest net monetary return of Green gram was recorded under the treatment combination consisting that application of phosphorus @ 60kg/ha with the vermicompost @ 5t/ha with the respective value of ₹ 80657.00 Rs/ha which are proved significantly superior to rest of the treatments. The significantly highest B:C ratio of lentil was recorded under the treatment combination consisting that application of phosphorus @ 60kg/ha with the vermicompost @ 3 t/ha with the respective value of 3.38 which are proved significantly superior to rest of the treatments.

Table 1: Plant height (cm) of green gram at 30 DAS as affected by different levels of phosphorus, vermicompost and their interaction

Vermicompost levels	Phosphorus levels				
	P_0 (0kg/ha)	**P_1 (20kg/ha)**	**P_2 (40kg/ha)**	**P_3 (60kg/ha)**	**Mean**
V_1 (2 t/ha)	5.56	6.54	8.16	11.14	7.85
V_2 (3 t/ha)	6.30	7.86	8.28	11.75	8.55
V_3 (5 t/ha)	6.38	8.06	11.69	11.86	9.50
Mean	6.08	7.49	9.37	11.58	

	S.Em±	C.D. (P= 0.05)
Phosphorus (P)	0.87	2.56
Vermicompost (V)	1.01	2.96
Interaction (P x V)	0.50	1.05

Table 2: Plant height (cm) of green gram at 45 Das as affected by different levels of phosphorus, vermicompost and their interaction

Vermicompost levels	Phosphorus levels				
	P_0 (0kg/ha)	**P_1 (20kg/ha)**	**P_2 (40kg/ha)**	**P_3 (60kg/ha)**	**Mean**
V_1 (2 t/ha)	17.55	23.34	24.29	28.71	23.47
V_2 (3 t/ha)	21.03	23.65	24.68	29.83	24.80
V_3 (5 t/ha)	22.13	24.04	29.22	31.81	26.80
Mean	20.24	23.68	26.06	30.11	

	S.Em±	C.D. (P= 0.05)
Phosphorus (P)	1.17	3.44
Vermicompost (V)	1.35	3.97
Interaction (P x V)	0.68	1.40

Table 3: Plant height (cm) of green gram at 60 DAS as affected by different levels of phosphorus, vermicompost and their interaction

Vermicompost levels	Phosphorus levels				
	P_0 (0kg/ha)	**P_1 (20kg/ha)**	**P_2 (40kg/ha)**	**P_3 (60kg/ha)**	**Mean**
V_1 (2 t/ha)	35.70	41.39	42.29	46.69	41.52
V_2 (3 t/ha)	39.15	41.68	42.67	47.71	42.80
V_3 (5 t/ha)	40.19	42.06	47.20	49.60	44.76
Mean	38.35	41.71	44.05	48.00	

	S.Em±	C.D. (P= 0.05)
Phosphorus (P)	1.18	3.47
Vermicompost (V)	1.37	4.01
Interaction (P x V)	0.68	1.42

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