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Effect of vermicompost and panchagavya on growth and yield of greengram (*Vigna radiata* L.)

Manisha Singh, Pathan Muddassir Ibrahim Khan, Joy Dawson and Raksha Verma

Abstract
A field experiment was conducted during *Kharif* 2021 at SMOF (SHIATS Model Organic Farm), Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T1: Vermicompost 4 t/ha + 3% Panchagavya (15,30 DAS), T2: Vermicompost 4 t/ha + 3% Panchagavya (15,45 DAS), T3: Vermicompost 4 t/ha + 3% Panchagavya (30,45 DAS), T4: Vermicompost 5 t/ha + 3% Panchagavya (15,30 DAS), T5: Vermicompost 5 t/ha + 3% Panchagavya (15,45 DAS), T6: Vermicompost 5 t/ha + 3% Panchagavya (30,45 DAS), T7: Vermicompost 6 t/ha + 3% Panchagavya (15,30 DAS), T8: Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS), T9: Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) was recorded significantly higher plant height (31.23 cm), No. of nodules/plant (7.33), No. of Branches/plant (9.20), Plant dry weight (15.84 g/plant), pods/plant (26.67), Seeds/pod (10.33), Test weight (37.56 g), Seed yield (1098.18 kg/ha), gross returns (Rs.76,872.60/ha), net return (Rs.52,563.50/ha) and benefit cost ratio (1.76) as compared to other treatments.

Keywords: Vermicompost, panchagavya, yield

Introduction
Pulses are important not only for their value as human food, but also because of high protein content for livestock. It has been important component of Indian agriculture enabling the land to restore fertility by fixing atmospheric nitrogen, so as to produce reasonable yields of succeeding crops and to meet out the demand of dietary requirement regarding proteins, carbohydrates and other nutrient sources. On an average, pulses contain 22-24 per cent protein as against 8-10 per cent in cereals. A good amount of lysine is present in the pulses. Pulses vary in maturity periods, hence, are useful in different cropping systems. Greengram locally called as moog or mug (*Vigna radiata* L.) belongs to the family Leguminaceae, which fixes atmospheric nitrogen and improves soil fertility by adding 20-25 kg N ha-1 (Karmakar *et al.*, 2013) [4].

Green gram (*Vigna radiata* L.), also known as mungbean, is one of the most important pulse crops and an excellent source of high quality protein. It is also used as sprout salad, vegetable and some Indian dishes like curry, sevpuri, panipuri or Indian chat sprout salad. In India, green gram is cultivated since olden times and is native to the Indian sub-continent and central Asia and is grown in these regions over a long decade. It is also widely cultivated all over Asia, including India, Pakistan, Bangladesh, Sri-Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia, South China and Formosa. Fertilizer only cannot maintain productivity of land in modern farming (Mahalingam *et al.*, 2018) [5].

Greengram is an important pulse crop of India, as it is grown an area of 3.44 million hectares with total production of 1.4 million tonnes and productivity of 406.98 kg/ha. In India, major greengram producing states are Odissa, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar. In Gujarat, it is cultivated in about 2.3 lakh hectares with an annual production of 1.21 lakh tonnes and average productivity of 526.09 kg /ha (Anonymous, 2011).

Organic farming has been considered as a tool for another green revolution. Organic farming is a system that avoids the use of synthetic chemical fertilizers, pesticides and growth regulating hormones and raises the crop with the use of organic manures, crop rotation, legumes, green

manure and biological pest control. In modern farming liquid manure play a crucial role in significant yield increase as well as reduce the fertilizer dose. The Panchagavya, Jivamrut, Sanjivak are ecofriendly liquid organic preparation made from cow products i.e., cow dung, urine, milk, curd, ghee, legume flour and jaggary etc. results in higher growth, yield & quality of crops. They contain macro nutrients, essential micro-nutrients, vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms (Somasunderam *et al.,* 2009) [12].

Vermicompost for enhancing crop productivity and improving soil health is gaining popularity among the farming community. The possibility of utilizing different plant biomass (weed biomass, crop residue etc.) into quality organic manure. Improvement in soil health and crop productivity, following vermicompost application, have been earlier reported by many workers (Rajkhowa *et al.,* 2003; Rajkhowa *et al.,* 2000) [7-8]. Vermicompost enhances soil biodiversity by promoting beneficial microbes, which in turn enhances plant growth directly by production of plant growth regulating substances (hormones and enzymes) and indirectly by controlling plant pathogens, nematodes and other pests.

Materials and Methods

This experimental trial was carried out during *Kharif* 2021 at SMOF (SHIATS Model Organic Farm), Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25^0 30" 42"N latitude, 81^0 60" 56" E longitude and 98 m altitude above the mean sea level (MSL). The experiment laid out in Randomized Block Design which consisting of nine treatments with T1: Vermicompost 4 t/ha + 3% Panchagavya (15,30 DAS), T2: Vermicompost 4 t/ha + 3% Panchagavya (15,45 DAS), T3: Vermicompost 4 t/ha + 3% Panchagavya (30,45 DAS), T4: Vermicompost 5 t/ha + 3% Panchagavya (15,30 DAS), T5: Vermicompost 5 t/ha + 3% Panchagavya (15,45 DAS), T6: Vermicompost 5 t/ha + 3% Panchagavya (30,45 DAS), T7: Vermicompost 6 t/ha + 3% Panchagavya (15,30 DAS), T8: Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS), T9: Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) were replicated thrice. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}. Vermicompost was applied before sowing in respective doses in the plots as per treatment details. The foliar spray of Panchagavya was done on different days interval was done according to the treatment details. In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it several yield parameters after harvest were recorded those parameters are growth parameters like plant height (cm), Plant dry weight (g), nodules/Plant and No. of Branches/plant were recorded. The yield parameters like pods/plant, Seeds/pod, Test weight and Seed yield were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

Results and Discussion

Growth attributes

Plant height

Data in table 1 tabulated that significantly highest plant height (31.23cm) was observed in the treatment with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) over all the other treatments. However, the treatments with application of Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) (30.93 cm) and Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS) (31.10cm) which were found to be statistically at par with treatment Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). Application of vermicompost helped the plants to attain maximum height to the slow release of major nutrients to the plant especially nitrogen and also panchagavya application supplies almost all essential plant nutrients for the growth and development of a plant which eventually resulted in the increase in plant height. The results were found to be similar with Singh *et al*. (2005) and Patil *et al*. (2012) [10, 6].

Plant dry weight (g/plant)

The Treatment with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) recorded significantly maximum dry weight (15.84 g/plant) over all the treatments. However, the treatments with Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) (15.55 g/plant) and Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (15.69 g/plant) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). The probable reason for higher dry matter production might the application of vermicompost stimulated the plant growth due the higher microbial activity and soil reaction and large portion of nitrogen in vermicompost in organic fractions and fermented solution of panchagavya contains various salts rich in N, P, K, S and micronutrients in plant available form. Hence, availability of these nutrients to plants helps in the higher dry matter production in plants. The results were also found to be similar with findings of Shrimal and Khan (2017) and Gopal *et al*. (2017) [9, 2].

Nodules/Plant

Significantly the highest nodules per plant (7.33) was observed in the treatment with application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS), which was significantly higher over rest of the treatments. However, the treatments with Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) (6.87) and Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (7.10) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). The greater photosynthesis production of metabolites and enzymatic activities due to vermicompost application might have influenced into increased nodulation due the availability of Phosphorus through organic source helped in higher root growth which increased nodulation. The results were in confirmatory with Singh *et al.* (2017) [10].

Branches/Plant

Significantly the highest number of Branches per plant (9.20) was observed in the treatment with application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) which was significantly higher over rest of the treatments. However, the treatments with Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (9.10) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). Panchagavya contains NPK, some micronutrients and besides this growth regulatory substances such as IAA, Gibberlic acid, cytokinin and essential plant nutrient have also been reported in panchagavya. All these nutreints and PGR's

have helped in increase number of branches. Similar results were found by Suresh *et al*. (2011) [13]. The higher number of branches due to the application of vermicompost might be due to the availability of desired and required quantity of nutrients for longer period in root zone of growing plants which helped plant cells to divide. The results were found to in correspondence with Aparna *et al*. (2019) [1].

Table 1: Effect of vermicompost and panchagavya on growth parameters of greengram

Treatments	Plant height (cm)	Dry weight (g)	Nodules/plant	Branches/plant
Vermicompost 4 t/ha + 3% Panchagavya (15, 30 DAS)	29.53	14.63	5.70	7.90
Vermicompost 4 t/ha + 3% Panchagavya (15, 45 DAS)	29.70	14.76	5.87	8.07
Vermicompost 4 t/ha + 3% Panchagavya (30, 45 DAS)	30.30	15.15	6.30	8.50
Vermicompost 5 t/ha + 3% Panchagavya (15, 30 DAS)	30.07	14.92	6.10	8.30
Vermicompost 5 t/ha + 3% Panchagavya (15, 45 DAS)	30.70	15.39	6.70	8.70
Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS)	30.93	15.55	6.87	8.87
Vermicompost 6 t/ha + 3% Panchagavya (15,30 DAS)	30.53	15.33	6.50	8.50
Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS)	31.10	15.69	7.10	9.10
Vermicompost 6 t/ha + 3% Panchagavya (30,45 DAS)	31.23	15.84	7.33	9.20
F-test	S	S	S	S
S. EM (±)	0.09	0.05	0.08	0.06
CD (P = 0.05)	0.30	0.16	0.24	0.18

Yield attributes and Yield

Yield attributes and yield of greengram were presented in Table 2.

Pods per plant

Significantly Maximum Pods/plant (26.67) was recorded with the treatment of application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) over all the treatments. However, the treatments Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) (26.00), Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (26.33) and Vermicompost 5 t/ha + 3% Panchagavya (15,45 DAS) (25.67) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS).

Seeds per pod

Significantly highest Seeds/Pod (10.33) was recorded with the treatment of application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) over all the treatments. However, the treatments Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) (9.67) and Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (10.00) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). The foliar spray of panchagavya helped in easy transfer of nutrients and growth stimulants to plants and this might be the reason for enhancement in yield attributes. The smaller quantities of IAA and GA present in panchagavya also helped increase the yield attributes. The findings were in accordance with Gopal *et al*. (2017) [2].

Test weight

Significantly highest Test weight (37.56 g) was recorded with the treatment application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) over all the treatments. However, the treatments with (37.25 g) in Vermicompost 5 t/ha + 3% Panchagavya (30, 45 DAS) and Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (37.50) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS). This positive effect might be due to the fact that nitrogen is well known for its role in development and growth of plant and in various vitally important metabolic processes in the plant, the positive results of vermicompost application helped in increase of plant growth which led to higher yield attributes. The similar findings were found by Singh *et al.* (2017) [10].

Seed yield

Significantly highest Seed yield (1098.18 kg/ha) was recorded with the treatment application of Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) over all the treatments. However, the treatments with (1022.38 kg/ha) in Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) which were found to be statistically at par with Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS).The higher increase in the yield has been reported to be associated with the release of macro and micro nutrients during the course of microbial decomposition. Organic matter also functions as source of energy for soil micro flora which brings about the transformation of other nutrients held in soil or applied through other means, in a form that is readily utilized by growing plants which helped in increase of seed yield. The results were in accordance with Jadhav *et al.* (2011) [3]. The seed yield increased due to the application of panchagavya might be due to it contains smaller amounts of plant growth regulators like IAA, GA and it also contains many nutrients and the foliar application helped plant to utilize all these nutrients efficiently and helped in increase in yield attributes which eventually helped in increase in seed yield. The results were found to be similar with Vimalendran and Wahab (2013) [14].

Table 2: Effect of vermicompost and panchagavya on yield attributes and yield of greengram

Treatments	Pods/Plant	Seeds/pod	Test weight (g)	Seed Yield (kg/ha)
Vermicompost 4 t/ha + 3% Panchagavya (15,30 DAS)	23.33	7.67	35.69	661.30
Vermicompost 4 t/ha + 3% Panchagavya (15,45 DAS)	24.00	8.00	36.10	694.64
Vermicompost 4 t/ha + 3% Panchagavya (30,45 DAS)	24.67	8.67	36.43	781.11
Vermicompost 5 t/ha + 3% Panchagavya (15,30 DAS)	24.33	8.33	36.23	732.37
Vermicompost 5 t/ha + 3% Panchagavya (15,45 DAS)	25.67	9.33	36.99	905.43

Vermicompost 5 t/ha + 3% Panchagavya (30,45 DAS)	26.00	9.67	37.25	981.60
Vermicompost 6 t/ha + 3% Panchagavya (15,30 DAS)	25.00	9.00	36.73	856.93
Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS)	26.33	10.00	37.50	1022.38
Vermicompost 6 t/ha + 3% Panchagavya (30,45 DAS)	26.67	10.33	37.56	1098.18
F-test	S	S	S	S
S. EM (±)	0.52	0.28	0.13	26.15
CD (P = 0.05)	1.57	0.87	0.41	78.39

Economics

Gross returns, Net returns and Benefit cost ratio were significantly influenced due to different treatments.

Gross returns

Higher Gross returns have been recorded with the Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) (Rs.76,872.60/ha) over rest of the treatments followed by Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (Rs.76,678.50/ha) whereas minimum gross return was recorded with Vermicompost 4 t/ha + 3% Panchagavya (15, 30 DAS) (Rs.49,597.50/ha).

Net returns

Higher Net returns have been recorded with the treatment Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) (Rs.52,563.50/ha) over rest of the treatments followed by Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (Rs.46,878.50/ha) whereas minimum Net returns was recorded with Vermicompost 4 t/ha + 3% Panchagavya (15, 30 DAS) (Rs.21,797.50/ha).

Benefit Cost ratio

Higher Benefit cost ratio have been recorded with the treatment Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) (1.76) over rest of the treatments followed by Vermicompost 6 t/ha + 3% Panchagavya (15, 45 DAS) (1.57) whereas lower Benefit cost ratio was recorded with Vermicompost 4 t/ha + 3% Panchagavya (15, 30 DAS) (0.78).

Table 3: Effect of vermicompost and panchagavya on economics of greengram.

Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C Ratio
Vermicompost 4 t/ha + 3% Panchagavya (15,30 DAS)	27,800.00	49,597.50	21,797.50	0.78
Vermicompost 4 t/ha + 3% Panchagavya (15,45 DAS)	27,800.00	52,098.00	24,298.00	0.87
Vermicompost 4 t/ha + 3% Panchagavya (30,45 DAS)	27,800.00	58,583.25	30,783.25	1.10
Vermicompost 5 t/ha + 3% Panchagavya (15,30 DAS)	28,800.00	54,927.75	26,127.75	0.90
Vermicompost 5 t/ha + 3% Panchagavya (15,45 DAS)	28,800.00	67,907.25	39,107.25	1.35
Vermicompost 5 t/ha + 3% Panchagavya (30,45 DAS)	28,800.00	73,620.00	44,820.00	1.55
Vermicompost 6 t/ha + 3% Panchagavya (15,30 DAS)	29,800.00	64,269.75	34,469.75	1.15
Vermicompost 6 t/ha + 3% Panchagavya (15,45 DAS)	29,800.00	76,678.50	46,878.50	1.57
Vermicompost 6 t/ha + 3% Panchagavya (30,45 DAS)	29,800.00	76,872.60	52,563.50	1.76

Conclusion

It is concluded that application of treatment Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) performed exceptionally in obtaining maximum seed yield of greengram. Hence, Vermicompost 6 t/ha + 3% Panchagavya (30, 45 DAS) is beneficial under eastern Uttar Pradesh Conditions.

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