

## Original Research Article

### **Influence of Vermicompost, Neem ~~Ce~~ake and Biofertilizers on Growth, Yield and Economics of Green ~~G~~ram (*Vigna radiata* L.)**

**Comment [U1]:** Suggestions:

- 1) The manuscript should be prepared based on the Author Guidelines.
- 2) . The manuscript should be proofread by a Native Speaker.
- 3) The Introduction section should be added previous studies on Nano N and the rates on Cotton or similar crops.

#### **ABSTRACT**

The findings of the present experiment entitled, influence of vermicompost, neem cake and biofertilizers on growth, yield and economics of green gram (*Vignaradiata* L.),carried out during the *khari*f season of 2023 at the Baba Farid Institute of Technology's Crop Research Farm in Dehradun. It is situated between latitude ~~30.3436~~ and longitude 77.9367. ~~The Shivalik hills and the lower Himalayas in the Indian states of Uttarakhand, Himachal Pradesh, and Haryana are home to the extraordinarily wide and lengthy valley known as the doon valley. The experiment was conducted in Randomized Block Design consisting of 10 treatment combinations with 3 replications and was laid out with the different treatments allocated randomly in each replication. Application of ~~Vermicompost-vermicompost~~(1.25t/ha) + ~~Neem-neem~~ cake (0.625 t/ha) + ~~r~~Rhizobium (10 ~~gm~~/kg seed) + PSB (10~~gm~~/kg seed), recorded maximum plant height (45.44 cm), ~~N~~number of branches per plant (6.08), ~~n~~Number of nodules/plant (11.05), ~~—Dry-dry~~ weight (g/plant) (6.57), ~~n~~No. of pods/plant(28.38), ~~Seeds-seeds~~ per pod (10.13), ~~t~~Fest weight(g) (38.14), ~~Grain-grain~~ yield (1094.06 kg/ha), ~~s~~Stover yield (1523.95 kg/ha) and ~~Biological-biological~~ yield (2618.01 kg/ha. Where the maximum gross return (101249.80 INR/ha), net return (76043.75 INR/ha) and B:C ratio (3.02) were also recorded with application of ~~Vermicompost-vermicompost~~(1.25t/ha) + ~~Neem-neem~~ cake (0.625 t/ha) + ~~Rhizobium-rhizobium~~ (10 ~~gm~~/kg seed) + PSB (10~~gm~~/kg seed).~~

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**Keywords:**-Green ~~gram~~Gram, Biofertilizers, Vermicompost, Neem Cake, Growth, Yield and Economics

#### **INTRODUCTION**

Agriculture has always occupied a pride place in Indian economy. Green gram (*Vigna radiata*L.) commonly known as “mung” or “mung bean”. It is one of the most important and extensively cultivated pulse crops of the Indian sub-continent. Pulses are important food crops occupying a unique position in every known system of farming as main, catch, cover, green manure, intercrop and mix crop. Its inclusion in rotation keeps the soil alive and productive. The great significance of agriculture in the country’s economy is well understood by the fact that it is mainstay of the people. India is predominantly an agricultural country, as more than 58.00 per cent of its population is living in villages and majority of them are engaged in agricultural enterprise (Anonymous, 2018).

Pulses are the main source of protein particularly for vegetables. The per capita availability of pulses declining fast from 56g per day in 1968 to 32g per day as on 2014 against the minimum requirement of 70g per day as prescribed by ICMR (Anonymous, 2014). In India, green gram represents 18% (34.4 lakh hectares) of total pulse area and 11.48 % (514 lakh tonnes) of pulse production (CMIE, 2014-15). Pulses account for about one-fifth of acreage under food grains and about one-twelfth of their production. Their share in the total cropped area as well as in the value of output of principal crops is also about one-twelfth. They constitute a group of leguminous family and as such they play an important role in maintaining soil fertility.

Biofertilizers are the green manure and organics. Biofertilizers are carrier-based inoculants containing cells of efficient strains of specific microorganisms (namely bacteria) used by farmers for enhancing the productivity of the soil by fixing atmospheric nitrogen or by solubilizing soil phosphate or by stimulating plant growth for synthesis of growth promoting substances. Biofertilizers play a main key role for selective adsorption of immobile (P, Zn, Cu) and mobile (C, S, Ca, K, Mn, Cl, Br, and N) elements to plants (Tinker, 1984). The rhizosphere bacteria secrete growth substances and secondary metabolic, which contribute to seed germination and plant growth (Subba Rao, 1982, 2002; Dwivedi, 1989). In recent years, free living bacteria (Azotobacter), associate (Azospirillum) and symbiotic (Rhizobium) bacteria and phosphate solubilizing one (Bacillus megaterium, B. polymyxa and Ps. Striata) are gaining much popularity. Such

practices are being encouraged to save the chemical fertilizers natural economy and the environment.

Neem cake (residue of neem seed after oil extraction), when added to the soil, not only improves the soil with organic matter, but also lowers nitrogen losses by inhibiting nitrification and prolongs the availability of nitrogen to both short-duration and long duration crops. It increases the yield of crops on the long term, an excellent soil conditioner and has no negative effect on the environment (Lokanadhan et al., 2012). The seed cake also contains nitrogen (2-5%), phosphorus (0.5-1.0%), potassium (1-2%), calcium (0.5-3%) and magnesium (0.3-1%) (Radwanski and Wickens, 1981).

Vermicompost contains growth enhancing substances with many numbers of beneficial microorganisms like nitrogen fixing, P solubilising and cellulose decomposing organisms. Enriching vermicompost with rock phosphate may enhance multiplication of beneficial microbes and the P solubilising organisms present and are expected to react with rock with phosphate and convert the insoluble phosphate to plant available forms. The phosphate solubilizing microorganisms (Pseudomonas) play an important role in conversion of unavailable inorganic P (Ca-P, Fe-P and Al-P) into available inorganic P forms through secretion of organic acids and enzymes (Singh, 1999).

## MATERIALS AND METHODS

This experiment was laid out during the *Kharif* season of 2023 at the Baba Farid Institute of Technology's Crop Research Farm in Dehradun. It is situated between latitude 30.3436 and longitude 77.9367. The Shivalik hills and the lower Himalayas in the Indian states of Uttarakhand, Himachal Pradesh, and Haryana are home to the extraordinarily wide and lengthy valley known as the doon valley. The experiment was laid out in Randomized Block Design (RBD) which consisting of ten treatments; T<sub>1</sub> - Vermicompost vermicompost (2.5t/ha) + Rhizobium (20gm/kg seed), T<sub>2</sub> - Vermicompost vermicompost (2.5t/ha) + PSB (20gm/kg seed), T<sub>3</sub> - Vermicompost vermicompost (2.5t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed), T<sub>4</sub> - Neem

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neem cake (1.25t/ha) + [Rhizobium-rhizobium](#) (20gm/kg seed), T<sub>5</sub> - [Neem-neem](#) cake (1.25t/ha) + PSB (20gm/kg seed), T<sub>6</sub> - [Neem-neem](#) cake (1.25t/ha) + [Rhizobium rhizobium](#) (10gm/kg seed) + PSB (10gm/kg seed), T<sub>7</sub> - [Vermicompost vermicompost](#)(1.25t/ha) + [Neem-neem](#) cake (0.625t/ha) + [Rhizobium-rhizobium](#) (20gm/kg seed), T<sub>8</sub> - [Vermicompost-vermicompost](#)(1.25t/ha) + [Neem-neem](#) cake (0.625t/ha) + PSB (20gm/kg seed), T<sub>9</sub> - [Vermicompost-vermicompost](#)(1.25t/ha) + [Neem neem](#) cake (0.625t/ha) + [Rhizobium-rhizobium](#) (10gm/kg seed + PSB (10gm/kg seed), T<sub>10</sub> - [Controlcontrol](#). The soil in the experimental area was sandy loam with pH (7.6), [Organic-organic cCarbon](#) (0.36%), [Available-available N](#) (0.028%), [Available-available P](#) (13.05kg/ha), and [Available-available K](#) (156.44 kg/ha). Seeds are sown at a spacing of 30 cm × 10 cm to a seed rate of 12-16 kg/ha. Data recorded on different aspects of crop, viz., growth, yield attributes were subjected to statistical analysis by analysis of variance (ANOVA) method- (Gomez and Gomez, 1976) and economic data analysis by mathematical method.

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## RESULTS AND DISCUSSION

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### Growth [parameters-parameters](#)

#### Plant [Height-height](#) (cm)

The data revealed that significantly and maximum plant height (45.44 cm) was observed the applications of [Vermicompost-vermicompost](#)(1.25t/ha) + [Neem-neem](#) cake (0.625t/ha) + [Rhizobium-rhizobium](#) (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value (35.19 cm) was observed in treatment [Controlcontrol](#).

#### Number of [branches-branches](#) plant<sup>-1</sup>

The data revealed that significantly and maximum number of branches plant<sup>-1</sup> (6.08) was observed the applications of [Vermicompost-vermicompost](#)(1.25t/ha) + [Neem-neem](#) cake (0.625 t/ha) + [Rhizobium-rhizobium](#) (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value (4.25) was observed in treatment [Controlcontrol](#).

#### Number of nodules plant<sup>-1</sup>

The data revealed that significantly and maximum number of nodules plant<sup>-1</sup> (11.05) was observed the applications of [Vermicompost-vermicompost](#)(1.25t/ha) + [Neem](#)

neem cake (0.625 t/ha) + Rhizobium-rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value (5.71) was observed in treatment Controlcontrol.

#### **Dry weight (g) plant<sup>-1</sup>**

The data revealed that significantly and maximum dry weight (g) per plant (6.57) was observed the applications of Vermicompost-vermicompost(1.25t/ha) + Neem-neem cake (0.625 t/ha) + Rhizobium-rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value (4.14) was observed in treatment Controlcontrol.

#### **Yield and Yield Attributeattribute**

##### **Number of pods per per-plant**

The results revealed that there was significant difference between the treatments and maximum no. of pods per plant (28.38) was observed by the application of Vermicompost-vermicompost(1.25t/ha) + Neem-neem cake (0.625 t/ha) + Rhizobium rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value no. of pods per plant (22.07) was observed in control.

##### **Number of sSeeds per pod**

The results revealed that there was significant difference between the treatments and maximum no. of seeds/pod (10.13) was observed by the application of Vermicompost (1.25t/ha) + Neem cake (0.625 t/ha) + Rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value no. of seeds/pod (6.78) was observed in control.

##### **Grain yield (kg/ha)**

The results revealed that there was significant difference between the treatments and maximum grain yield (kg/ha) (1094.06) was observed by the application of Vermicompost-vermicompost(1.25t/ha) + Neem-neem cake (0.625 t/ha) + Rhizobium rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value grain yield (kg/ha) (482.33) was observed in control.

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### **Stover yield (kg/ha)**

The results revealed that there was significant difference between the treatments and maximum stover yield (kg/ha) (1523.95) was observed by the application of Vermicompost-vermicompost(1.25t/ha) + Neem-neem cake (0.625 t/ha) + Rhizobium rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value stover yield (kg/ha) (549.13) was observed in control.

### **Biological yield (kg/ha)**

The results revealed that there was significant difference between the treatments and maximum biological yield (kg/ha) (2618.01) was observed by the application of Vermicompost-vermicompost(1.25t/ha) + Neem-neem cake (0.625 t/ha) + Rhizobium rhizobium (10 gm/kg seed) + PSB (10gm/kg seed), whereas the lowest value biological yield (kg/ha) (1031.36) was observed in control.

### **Economics**

#### **Cost of Production-production (INR/ha)**

Cost of production (26714.00 INR) was found to be highest in treatment 5 [NNeem cake (1.25t/ha) + PSB (20gm/kg seed)] as compared to other treatment.

#### **Gross return (INR/ha)**

Gross return (101249.8) was found to be highest in treatment 9 [VVermicompost (1.25t/ha) + NNeem-neem cake (0.625t/ha) + RRhizobium-rhizobium (10 gm/kg seed) + PSB (10 gm/kg seed)] as compared to other treatment.

#### **Net return (INR/ha)**

Net return (76043.75) was found to be highest in treatment 9 [VVermicompost (1.25t/ha) + NNeem-neem cake (0.625t/ha) + RRhizobium-rhizobium (10 gm/kg seed) + PSB (10 gm/kg seed)] as compared to other treatment.

#### **B: C Ratio-ratio**

Benefit Cost Ratio (3.02) was found to be highest in treatment 9 [~~V~~vermicompost (1.25t/ha) + ~~Neem-neem~~ cake (0.625t/ha) + Rhizobium (10 gm/kg seed) + PSB (10 ~~gm~~/kg seed)] as compared to other treatment.

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#### **CONCLUSIONS:**

It is concluded that for obtaining higher yield in green gram, the treatment combination of ~~Vermicompost-vermicompost~~(1.25t/ha) + ~~Neem-neem~~ cake (0.625t/ha) + ~~Rhizobium-rhizobium~~ (10 gm/kg seed) + PSB (10gm/kg seed) recorded significantly ~~Higher-higher Grain-grain~~ yield (1094.06 kg ha<sup>-1</sup>), ~~Gross-gross~~ returns (101249.80 INR/ha), ~~Net-net~~ returns (76043.75 INR/ha) and ~~Benefit-benefit Cost-cost r~~Ratio (3.02).

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UNDER PEER REVIEW

**Table1.Effect of vermicompost, neem cake and biofertilizers on Growth of Greengram**

S.No.	Treatment Combination	At 60 DAS			
		Plant Height <u>height</u> (cm)	Number of branches plant <sup>-1</sup>	Number of nodules plant <sup>-1</sup>	Dry weight (g) plant <sup>-1</sup>
1	Vermicompost (2.5t/ha) + Rhizobium (20gm/kg seed)	42.12	4.88	8.52	4.98
2	Vermicompost (2.5t/ha) + PSB (20gm/kg seed)	41.39	4.71	7.50	5.15
3	Vermicompost (2.5t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)	43.48	4.40	9.29	5.34
4	Neem cake (1.25t/ha) + Rhizobium (20gm/kg seed)	43.12	5.31	9.48	4.51
5	Neem cake (1.25t/ha) + PSB (20gm/kg seed)	43.19	4.79	8.54	5.09
6	Neem cake (1.25t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)	42.50	4.29	9.76	4.72
7	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (20 gm/kg seed)	43.87	5.01	10.08	5.40
8	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + PSB (20 gm/kg seed)	44.71	5.89	10.90	5.54
9	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (10 gm/kg seed) + PSB (10gm/kg seed)	45.44	6.08	11.05	6.57
10	Control	35.19	4.25	5.71	4.14
	<b>F-Test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. at 0.5</b>	3.61	0.96	2.34	0.55
	<b>S.Ed(+)</b>	1.22	0.32	0.79	0.18

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**Table 2. Effect of vermicompost, neem cake and biofertilizers on yield and yield attribute of Greengram**

S.No.	Treatment Combination	Yield and yield attribute				
		No. of pods plant <sup>-1</sup>	Seeds pod <sup>-1</sup>	Grain yield (kg ha <sup>-1</sup> )	Stover yield (kg ha <sup>-1</sup> )	Biological yield (kg ha <sup>-1</sup> )
<u>14</u>	<u>Vermicompost (2.5t/ha) + Rhizobium (20g/kg seed)</u> <u>Vermicompost (2.5t/ha) + Rhizobium (20gm/kg seed)</u>	22.81	7.79	579.05	794.35	1373.40
<u>22</u>	<u>Vermicompost (2.5t/ha) + PSB (20g/kg seed)</u> <u>Vermicompost (2.5t/ha) + PSB (20gm/kg seed)</u>	23.37	7.65	617.31	836.53	1453.83
<u>33</u>	<u>Vermicompost (2.5t/ha) + Rhizobium (10g/kg seed) + PSB (10g/kg seed)</u> <u>Vermicompost (2.5t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)</u>	25.57	6.81	633.05	855.00	1488.05
<u>44</u>	<u>Neem cake (1.25t/ha) + Rhizobium (20g/kg seed)</u> <u>Neem cake (1.25t/ha) + Rhizobium (20gm/kg seed)</u>	24.24	7.38	633.63	849.10	1482.73
<u>55</u>	<u>Neem cake (1.25t/ha) + PSB (20g/kg seed)</u> <u>Neem cake (1.25t/ha) + PSB (20gm/kg seed)</u>	23.31	8.37	655.47	819.18	1474.65
<u>66</u>	<u>Neem cake (1.25t/ha) + Rhizobium (10g/kg seed) + PSB (10g/kg seed)</u> <u>Neem cake (1.25t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)</u>	25.42	7.97	713.21	711.19	1424.41
<u>77</u>	<u>Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (20 g/kg seed)</u> <u>Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (20gm/kg seed)</u>	26.74	8.98	883.23	1000.64	1883.87
<u>88</u>	<u>Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + PSB (20 g/kg seed)</u> <u>Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + PSB (20gm/kg seed)</u>	27.81	9.87	1041.38	1227.49	2268.87
<u>99</u>	<u>Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (10 g/kg seed) + PSB (10g/kg seed)</u> <u>Vermicompost (1.25t/ha) + Neem cake</u>	28.38	10.13	1094.06	1523.95	2618.01

<u>1040</u>	(0.625t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed) Control	22.07	6.78	482.23	549.13	1031.36
	<b>F-Test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. at 0.5</b>	2.23	1.44	170.74	193.85	246.02
	<b>S.Ed(+)</b>	0.75	0.48	57.47	65.25	82.81

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**Table 3. Economics of green gram on levels of vermicompost, neem cake and biofertilizers**

S.No.	Treatment Combination	Economics			
		Total Cost of Cultivation	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
<u>11</u>	Vermicompost (2.5t/ha) + Rhizobium (20g/kg seed) Vermicompost (2.5t/ha) + Rhizobium (20gm/kg seed)	23698	53526.94	29828.94	1.26
<u>22</u>	Vermicompost (2.5t/ha) + PSB (20g/kg seed) Vermicompost (2.5t/ha) + PSB (20gm/kg seed)	23714	57011.62	33297.62	1.40
<u>33</u>	Vermicompost (2.5t/ha) + Rhizobium (10g/kg seed) + PSB (10g/kg seed) Vermicompost (2.5t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)	23706	58451.56	34745.56	1.47
<u>44</u>	Neem cake (1.25t/ha) + Rhizobium (20g/kg seed) Neem cake (1.25t/ha) +	26698	58471.62	31773.62	1.19

	Rhizobium (20gm/kg seed)			
<u>55</u>	Neem cake (1.25t/ha) + PSB (20g/kg seed) (20gm/kg seed)	26714	60190.83	33476.83
<u>66</u>	Neem cake (1.25t/ha) + Rhizobium (10g/kg seed) + PSB (10g/kg seed) eake (1.25t/ha) + Rhizobium (10gm/kg seed) + PSB (10gm/kg seed)	26706	64592.74	37886.74
<u>77</u>	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (20 g/kg seed) Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (20 gm/kg seed)	25198	80590.4	55392.4
<u>88</u>	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + PSB (20 g/kg seed) Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + PSB (20 gm/kg seed)	25214	95259.11	70045.11
<u>99</u>	Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (10 g/kg seed) + PSB (10g/kg seed) Vermicompost (1.25t/ha) + Neem cake (0.625t/ha) + Rhizobium (10 gm/kg seed) + PSB (10 gm/kg seed)	25206	101249.8	76043.75
<u>1010</u>	ControlControl	21650	44014.94	22364.94

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