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**Koyyalamudi Nikhila Priyansha**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

**Victor Debbarma**

Assistant Professor, Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

**Kunjam Sudharshan**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

**Corresponding Author:**

**Koyyalamudi Nikhila Priyansha**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

## Effect of bio-fertilizers and organic manures on growth and yield of Groundnut (*Arachis hypogaea* L.)

**Koyyalamudi Nikhila Priyansha, Victor Debbarma and Kunjam Sudharshan**

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### Abstract

The field experiment titled “Effect of bio-fertilizers and organic manures on growth and yield of Groundnut.” was conducted during Zaid season of 2023 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experiment was done under Randomized Block Design with nine treatments and replicated thrice. The treatments combinations are T1: Rhizobium + Vermicompost – 1.3 t/ha, T2: VAM + Vermicompost – 1.3 t/ha, T3: PSB + Vermicompost – 1.3 t/ha, T4: Rhizobium + FYM – 8.0 t/ha, T5 VAM + FYM – 8.0 t/ha, T6: PSB + FYM – 8.0 t/ha, T7: Rhizobium + Poultry manure – 1.3 t/ha, T8: VAM + Poultry manure – 1.3 t/ha, T9: PSB + Poultry manure – 1.3 t/ha, are used. The result showed that treatment nine (T9) [PSB + Poultry manure – (1.3t/ha)] recorded significantly higher plant height (41.43 cm), maximum number of root nodules/plant (64.07), higher plant dry weight (53.90 g/plant), maximum number of pods/plant (30.00), maximum number of kernels/pod (2.00), higher seed yield (2.56 t/ha), higher haulm yield (4.62 t/ha) compared to other treatment combinations. The maximum gross return (134006.00 INR/ha), maximum net returns (87156.00 INR/ha), highest benefit cost ratio (1.86) was also recorded in treatment 9 [PSB + Poultry manure – (1.3 t/ha)].

**Keywords:** bio-fertilizers, groundnut, growth parameters, organic manures, yield attributes

### 1. Introduction

Groundnut is a unique and important legume and oilseed crop in India. It has multiple names such as goober, peanut, monkey nut, earthnut, and manila nut. It is the biggest source of edible oil in the world and the fourth most significant oilseed crop globally. Cysteine is one of the amino acids found in groundnuts, and it is necessary for animal growth. After the oil is extracted, a groundnut cake has a high protein content that is valued as organic manure and animal feed and contains 7 to 8% N, 1.5% P, and 1% K. Groundnut ranks first in area and second in terms of production after soyabean and is grown in almost all parts of the country over wide range of agro-climatic condition.

Groundnut ranks first in area and second in terms of production after soyabean and is grown in almost all parts of the country over wide range of agro-climatic condition. Globally, groundnut covers area of 28.89 million hectares with the production of 54.41 million tons with the productivity of 1.88 tons/ha (USDA). In India, groundnut is grown over an area about 5.75 million hectares with a production of 10.11 million tons and productivity of 1.7 t/ha (GOI, 2022) [7]. During 2022 total area coverage under groundnut in Uttar Pradesh 1.21 million hectares with a production of 1.24 million tons and the productivity 1.02 t/ha (GOI, 2022) [7].

Research into the potential of combining biofertilizers with organic manures like FYM, castor cake, *vermicompost* etc., is currently popular. According to (Zalate and Padman, 2009) [19], biofertilizers and organic manure have been shown to interact favourably in legume crops. Recent years have seen a rise in the importance of organic farming due to the recognition of the intrinsic advantages it provides in maintaining agricultural production, environmental safety, and a dynamic soil nutrition status (Sen *et al.*, 2021) [14].

Biofertilizers can play a major role in meeting a crop's nutritional needs by helping to solubilize insoluble phosphorus sources (PSB) and promoting biological nitrogen fixation (BNF).

*Pseudomonas* and *Bacillus* species of bacteria have the ability to solubilize difficult-to-solve sources of inorganic phosphorus. A crop's ability to grow, absorb nutrients, and increase in production is enhanced by inoculating seeds with phosphate solubilizing bacteria (PSB). (Bharathi *et al.*, 2021)<sup>[2]</sup>. The soil contains phosphate, which can be changed from being inaccessible to being soluble by the phosphobacterium, a type of bacterial phosphate soluble. It indirectly affects nodulation, which helps to raise yield (Satpute *et al.*, 2020)<sup>[13]</sup>.

The direct process behind plant growth and development is nitrogen fixation. The development of a symbiotic connection depends on *Rhizobium* conforming to the root surface. This complicated procedure includes the release of flavonoids and isoflavonoids by plant roots as well as the creation of nod factors by bacteria. Legumes have been inoculated with *Rhizobium* all over the world. (Gaur *et al.*, 2023)<sup>[5]</sup>. The growth of plants, the improvement of nutritional quality, the defense of plants against pathogens, and the protection of plants from salinity and drought are all made possible by VAM fungi. Ecto- and endomycorrhizas are the two names for the two different kinds of mycorrhizae. The extracellular fungal growth found inside the root cortex is referred to as the ecto-mycorrhizas (Koshariya *et al.*, 2023)<sup>[9]</sup>.

Poultry manure contains significant levels of plant nutrients; once it has decomposed, it must be used as manure. By enriching poultry wastes with phosphatic and biofertilizers, one can improve the amount of nutrients present and their availability. One way to manage resources is through recycling industrial wastes; another is through disposal (Khan *et al.*, 2022)<sup>[8]</sup>.

*Vermicompost* has a high concentration of micronutrients, microorganisms from various groups such as fungi, bacteria, and actinomycetes, phytohormones, soil enzymes, and humic acids, and is free of pests and diseases. It improves soil quality and increases plant growth productivity. (Perli *et al.*, 2022)<sup>[12]</sup>.

Keeping all the points in view the above fact, the experiment was conducted to find out the "Effect of bio-fertilizers and organic manures on growth and yield of Groundnut."

## Material and Methods

The experiment was conducted during *Zaid* season 2023. The experiment was conducted in Randomized Block Design (RBD) consisting of nine treatments which are replicated thrice and was laid out with the different treatments allocated randomly in each replication. The treatment combinations are *Rhizobium* + *Vermicompost* – 1.3 t/ha, VAM + *Vermicompost* – 1.3 t/ha, PSB + *Vermicompost* – 1.3 t/ha *Rhizobium* + FYM – 8.0 t/ha, VAM + FYM – 8.0 t/ha, PSB + FYM – 8.0 t/ha, *Rhizobium* + Poultry manure – 1.3 t/ha, VAM + Poultry manure – 1.3 t/ha, PSB + Poultry manure – 1.3 t/ha. The Groundnut seeds were sown at a spacing of 30 cm row to row and 10 cm plant to plant with a seed rate of 110 kg/ha. The growth contributing characteristic such plant height(cm), number of root nodules/plant, and plant dry weight(g/plant) and yield contributing characters such as the number of pods/plant, number of kernels/pod, seed yield (t/ha), haulm yield (t/ha) were recorded at the time of harvest. The analysis of variance method was used to examine data on many aspects of the crop, such as growth, yield attributes, and yield by Gomez and Gomez (1976)<sup>[6]</sup>.

## Results and Discussion

### Growth Parameters

### Plant Height

Significant and higher plant height (41.4 cm) was recorded in the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + *Vermicompost* (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] was found to be statistically at par with treatment 9 [PSB + Poultry manure (1.3 t/ha)]. Significant and higher plant height was observed with application of PSB may be due to the PSB inoculation produced a lot of nodulations because the extra nitrogen and phosphorus supplied helped create new cells and promoted development. Similar results were also reported by Zalate and Padmani (2009)<sup>[19]</sup>. Further, significant and higher plant height was recorded with application of Poultry manure may be due to sufficient source of nitrogen accumulation, which may have helped in the plant growth and led to rise in plant height. Similar findings were reported by Wilson and Debbarma (2022)<sup>[18]</sup>.

### Number of nodules/plant

The significant and maximum number of nodules/plant (64.07) was recorded in the treatment- 9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + *Vermicompost* (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] were statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. The significant and maximum number of nodules/plant was observed with the application of PSB might be due to P-solubilizer and nitrifying bacteria which may have fixed more nitrogen and increased absorption, they also contributed to improved root growth and dry pod production. These results were in conformity with those of Vadthe and Umsha (2022)<sup>[17]</sup>. Further, significant and maximum number of nodules/plant was observed with the application of poultry manure may be due to poultry manure has high in potassium, phosphate, nitrogen, and other important nutrients, which might helped in enhancing soil structure, aeration, moisture-holding ability, nutrient retention, and water infiltration, in contrast to mineral fertilizers. The present findings are within the close proximity of Vadthe and Umsha (2022)<sup>[17]</sup>.

### Plant Dry weight

Significant and higher plant dry weight (53.90g) was observed in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + *Vermicompost* (1.3 t/ha)], treatment 6 [PSB + FYM (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] were found to be statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. The significant and higher plant dry weight was with the application of PSB might be due to P-solubilizing microorganisms and nitrifying bacteria boost plant growth by improving nutrient uptake, leading to increased vigour and larger plants by enhancing photosynthesis, carbohydrate accumulation and dry matter production. These results are in agreement with the findings of Satpute *et al.* (2020)<sup>[13]</sup>. Further, higher plant dry weight was with the application of poultry manure may be due to availability and sufficient supply of organic materials supplied by poultry manure. These findings were similar to Uhwa *et al.* (2022).

### Yield Parameters

#### Number of pods/plant

Significant and maximum number of pods/plant (30.00) were recorded in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + *Vermicompost* (1.3 t/ha)], treatment 6 [PSB + FYM (1.3 t/ha)] and treatment 8 [VAM +

Poultry manure (1.3 t/ha)] were found to be statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. Significant and higher number of pods/plant was recorded with the application of PSB might be due to phosphorus enhances dry matter accumulation, translocation from sources to sink, and yield attributes by promoting vegetative and reproductive development, improving soil conditions, and increasing photosynthetic activity, photosynthate translocation, and nutrient uptake. These results are in conformity with those of Singh *et al.* (2018) in greengram. Further, significant and maximum number of pods/plants was with the application of poultry manure might be due to enhanced yield by providing abundant easily accessible plant nutrients throughout the growth cycle, particularly during critical growth stages, leading to improved uptake, plant vigour, and superior yield attributes. These findings are in accordance with the those of Khan *et al.* (2022)<sup>[8]</sup> in blackgram.

#### Number of kernels/pod

Significant and maximum number of kernels/pod (2.00) was recorded in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + Vermicompost (1.3 t/ha)], treatment 2 [VAM + Vermicompost (1.3 t/ha)], treatment 6 [PSB + FYM (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] were statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. Significant and maximum number of kernels/pod was with the application of PSB might be due to its large root system, enhanced nodulation, faster overall development, and increased metabolite production and translocation, may have contributed to a rise in the number of kernels/pod, particularly to productive structures (pods and seeds). The similar results were also reported by Abhishali *et al.* (2023)<sup>[1]</sup> in greengram. Further, significant and maximum number of kernels/pod with the application of Poultry manure might be due to the increased availability of P and N, their increased uptake by plants may have accelerated a number of physiological processes within the plant, resulting in improved yield and growth characteristics. The results of present investigation are in line with those of Sen *et al.* (2021)<sup>[14]</sup>.

#### Seed Yield (t/ha)

Significant and higher seed yield (2.56 t/ha) was recorded in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + Vermicompost (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] were found to be statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. Significant and higher seed yield was obtained with the application of PSB might be due to P-solubilizer and nitrifying bacteria caused an increase in root nodules, which in turn improved root development and seed production by fixing more

nitrogen and subsequently boosting its absorption, resulted in higher seed yield. These findings closely followed the results of Vadthe and Umesha (2022)<sup>[17]</sup>. Further, significant and higher seed yield was with the application of poultry manure might be due to the fact that organic manures being a source of nutrients it increased the soil environment and promote a proliferous root system, which improved the soil ability to absorb water and nutrients from lower layers and increased seed yield. The results are close conformity with those of Patri and Sinha (2012)<sup>[11]</sup>.

#### Haulm yield (t/ha)

Significant and higher haulm yield (4.62 t/ha), was observed in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. However, treatment 3 [PSB + Vermicompost (1.3 t/ha)] and treatment 8 [VAM + Poultry manure (1.3 t/ha)] were found to be statistically at par with the treatment 9 [PSB + Poultry manure (1.3 t/ha)]. Significant and higher haulm yield was with the application of PSB might be due to the release of organic acids such as citric, oxalic, and malic from chemically bound calcium phosphate allows PSB to release native phosphorus, by improving photosynthetic production and the division of photosynthates between the vegetative and reproductive structures, which may have contributed to haulm yield. Similar results were also reported by Kulkarni *et al.* (2018)<sup>[10]</sup>. Further, significant and higher haulm yield was obtained with the application of poultry manure may be due to enhance in yield by increasing N-fixing bacteria activity, humic acid levels, and micronutrient availability, promoting better plant growth and higher yields. The results are in close conformity with those of Choudhary *et al.* (2017)<sup>[4]</sup>.

#### Economics

The maximum gross return (134006.00 INR/ha), maximum net returns (87156.00 INR/ha), highest Benefit cost ratio (1.86) was also recorded in treatment-9 [PSB + Poultry manure (1.3 t/ha)]. Highest benefit cost ratio was recorded with application of PSB might be due to higher levels of N and P available to plants, along with their increased uptake, may have accelerated a number of physiological processes within the plant, resulting in higher seed and haulm yields, which in turn produces the maximum benefit-cost ratio. Similar results were obtained by Appana *et al.* (2021)<sup>[2]</sup>. Further, increase in benefit cost ratio was recorded with the application of poultry manure might be due to it has a relatively high nitrogen content, but as a result nitrogen releases slowly, it may be more available to crops in their latter stages. Higher photosynthates produced in the late stages of the crop were incapable to be transferred to the reproductive organs, which ultimately led to higher haulm yields. These findings are similar with those of Chatra *et al.* (2013)<sup>[3]</sup>.

**Table 1:** Influence of bio-fertilizers and organic manures on growth of Groundnut.

AT 80 DAS				60-80 DAS		
S.No.	Treatments	Plant height (cm)	Number of root nodules/plant	Plant dry weight(g)	Crop Growth Rate (g/m <sup>2</sup> /day)	Relative growth rate (g/g/day)
1	Rhizobium + Vermicompost – 1.3 t/ha	26.41	46.00	42.51	34.86	0.0337
2	VAM + Vermicompost – 1.3 t/ha	29.22	50.73	44.22	34.59	0.0316
3	PSB + Vermicompost – 1.3 t/ha	39.00	62.67	51.08	32.81	0.0242
4	Rhizobium + FYM – 8.0 t/ha	24.83	42.00	44.31	31.34	0.0278
5	VAM + FYM – 8.0 t/ha	28.11	46.80	47.38	30.81	0.0250
6	PSB + FYM – 8.0 t/ha	31.50	52.00	49.96	41.27	0.0342
7	Rhizobium + Poultry manure – 1.3 t/ha	25.22	42.00	44.23	36.11	0.0336
8	VAM + Poultry manure – 1.3 t/ha	40.63	63.53	52.39	37.31	0.0279
9	PSB + Poultry manure – 1.3 t/ha	41.43	64.07	53.90	35.00	0.0253
	F-test	S	S	S	NS	NS

SEm ( $\pm$ )	3.73	1.92	1.73	4.16	0.0035
CD (P=0.05)	11.09	5.75	5.14	--	--

**Table 2:** Influence of bio-fertilizers and organic manures on yield and yield attributes of Groundnut.

S No	Treatments	Number of pods/plant	Number of kernels/pod	Seed index (g)	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest index (%)
1.	Rhizobium + Vermicompost – 1.3 t/ha	24.47	1.73	36.80	1.88	3.60	36.15
2.	VAM + Vermicompost – 1.3 t/ha	25.88	1.87	38.12	1.96	3.66	39.21
3.	PSB + Vermicompost – 1.3 t/ha	27.49	1.93	39.46	2.31	4.30	36.89
4.	Rhizobium + FYM – 8.0 t/ha	22.03	1.73	35.73	1.82	3.54	36.52
5.	VAM + FYM – 8.0 t/ha	25.13	1.70	37.56	1.91	3.63	36.32
6.	PSB + FYM – 8.0 t/ha	26.75	1.80	38.21	2.12	4.12	34.95
7.	Rhizobium + Poultry manure – 1.3 t/ha	23.73	1.73	36.10	1.85	3.59	35.70
8.	VAM + Poultry manure – 1.3 t/ha	28.10	1.97	39.88	2.42	4.57	37.47
9.	PSB + Poultry manure – 1.3 t/ha	30.00	2.00	40.33	2.56	4.62	37.34
	F-test	S	S	NS	S	S	NS
	SEm ( $\pm$ )	1.23	0.07	1.39	0.12	0.11	1.46
	CD (P=0.05)	3.68	0.21	--	0.36	0.34	--

**Table 3:** Influence of bio-fertilizers and organic manures on Economics of Groundnut.

S No	Treatments	Total cost of cultivation (INR)	Gross Returns (INR)	Net Returns (INR)	B:C ratio
1	Rhizobium + Vermicompost – 1.3 t/ha	44050.00	98680.00	54630.00	1.24
2	VAM + Vermicompost – 1.3 t/ha	44350.00	102758.00	58408.00	1.32
3	PSB + Vermicompost – 1.3 t/ha	44250.00	121090.00	76840.00	1.74
4	Rhizobium + FYM – 8.0 t/ha	56150.00	95602.00	39452.00	0.70
5	VAM + FYM – 8.0 t/ha	56450.00	100219.00	43769.00	0.78
6	PSB + FYM – 8.0 t/ha	56350.00	111356.00	55006.00	0.98
7	Rhizobium + Poultry manure – 1.3 t/ha	46650.00	97167.00	50517.00	1.08
8	VAM + Poultry manure – 1.3 t/ha	46950.00	126941.00	79991.00	1.70
9	PSB + Poultry manure – 1.3 t/ha	46850.00	134006.00	87156.00	1.86

### Conclusion

It is concluded that in groundnut with the application of Poultry manure 1.3 t/ha along with PSB (treatment 9) was observed highest growth and yield.

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