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Effect of Organic nutrition on growth and yield of Cowpea (*Vigna unguiculata* L.)

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Abstract
The field experiment was entitled "Effect of Organic nutrition on growth and yield of Cowpea (*Vigna unguiculata* L.) in the Crop Research Farm, Naini Agriculture Institute, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during *Kharif* season 2024 on cowpea crop. The treatments applied were of organic manure consisting of Farm Yard Manure 5 t/ha, and Vermicompost 2.5 t/ha and Foliar application at 25 and 40 DAS by Panchagavya 3%, 5%, and 7%. The soil of experimental plot was sandy loam in texture, neutral in soil reaction (pH 6.8), organic carbon (0.562%), available N (220.00 kg/ha), available P (28.2 kg/ha) and available K (240.7 kg/ha). The experiment was laid out in Randomized Block Design which consisted of ten treatments and replicated thrice. The result showed that significantly higher growth parameters *viz.*, Plant height (90.53 cm), number of nodules (10.38/plant), dry weight (16.09 g/plant), pods/plant (11.07), seed/pod (10.40), test weight (37.12) and yield attributes and yield grain yield (1484.15 kg/ha) and stover yield (2675.00 kg/ha) were recorded in treatment 9 (FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%) compared to other treatments. and Maximum gross return (INR 143685.15/ha), net return (INR 97904.90/ha) and B:C ratio (2.13) were also recorded in treatment 9 (FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%). It is concluded that application of FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7% in Treatment 9 in Cowpea has recorded highest grain yield, stover yield, gross return, net return and benefit cost ratio respectively.

Keywords: Cowpea, farm yard manure, Panchagavya, vermicompost, yield

Introduction
Pulses hold a unique place in the global farming system. Pulses are high in protein, vitamins, fiber, minerals (iron, zinc, magnesium) and essential amino acids, all of which are important for human health (Yadav *et al*. 2017) [17]. Pulses are the second most important food crop in terms of food security, after cereals. Pulses are an excellent source of protein in the diet. Pulses provide a significant amount of protein in the Indian diet. Pulses benefit both human and soil health by increasing nitrogen content through symbiotic nitrogen fixation from the atmosphere and mushrooming the number of soil microorganisms. India is the world's largest producer and consumer of pulses, accounting for around 35% of global area, 25% of global output and 27% of global consumption (Anonymous, 2023). India's total pulse output is at 23.15 million tonnes with a land area of 28.34 million hectare (Anonymous, 2020). Pulse production, on the other hand, does not keep up with demand in the country.
Cowpea (*Vigna unguiculata* (L.) Walp) is an important grain legume crop and belong to family *Fabaceae*. India is the largest producer of pulses and accounts for about 25 per cent of the global share. root of cowpea has a strong taproot and many spreading lateral roots in surface of soil and leaves. The leaves are usually dark green in colour. A versatile legume native to West Africa, plays a critical role in global food security. Its ability to fix atmospheric nitrogen, tolerate drought, and have a short growth cycle makes it a valuable crop, particularly in developing nations. Cowpea provides a vital source of protein for millions and enriches soil fertility through nitrogen fixation by root nodule bacteria (*Rhizobium*). However, low soil fertility, especially nitrogen deficiency, hinders cowpea production. Sustainable agricultural practices emphasize exploring alternatives to synthetic fertilizers. Organic nutrient sources, offered in solid and liquid forms, provide a promising solution. Solid amendments like compost and manure offer a slow-release source of

nutrients, while liquid organic fertilizers provide readily available nutrients for plant uptake. Cowpea output makes up around 10% of India's total pulse production. Globally, pulses covers an area of 959.68 lakh hectares with the production of 973.92 lakh tons with the productivity of 1015kg/ha (FAO,2023). In India, Cowpea is grown over an area about 48.38 lakh hectares with a production of 27.28 lakh tons and productivity of 564 kg/ha. During 2022 total area coverage under Cowpea in Uttar Pradesh
5.72 lakh hectares with a production of 2.99 lakh tons and the productivity 522 kg/ha ICARIIPR Annual report (2023).
The soil application of organic manures and liquid organic foliar sprays at flower
initiation and 15 days after flowering (DAF) significantly enhances the seed yield and seed quality parameters of Cowpea. Use of organic manures alone or in combination with liquid organic manures will help to improve soil physico-chemical properties and effective utilization of applied organic manures for improved seed yield and seed quality. Sharma *et al*. (2012) [13] reported that FYM will decompose in moist soil to improve the soil structure and release the nutrients contained in it, in the soluble form for growth of the crop. It improves physical, chemical and biological properties of the soil and thereby increases number of nodules in Cowpea. Vermicompost is the product of the decomposition process using various species of worms, usually red wigglers, white worms, and earthworms, to create a mixture of decomposing vegetable or food waste and bedding materials. Vermicompost is rich in macronutrients like N (0.5-1.5%), P_2O_5 (0.1-0.3%) and K_2O (0.15-0.56%). Vermicompost increases availability of phosphorus in soil, which in turn improves various vegetative and reproductive growth parameters of Cowpea (Singh *et al*. 2022) [14].
Foliar application targets the above ground parts where the nutrient is needed and rapid
absorption is facilitated. To compensate the decline in root activity and nutrient up taken specially during reproductive stages, foliar application can be a better strategy. It is a shortterm approach which improves the quality of produce by reaching the site of food synthesis directly and preserves the crop yield with low environmental impact. Panchagavya is an organic product having the potential to play the role of promoting growth and providing immunity to plant system. It content (0.06% N), (0.03% P) and (0.045%). Panchagavya consists of major five products viz. cow dung, cow urine, milk, curd, ghee and in addition to this it also contains some raw materials like jaggery, banana, tender coconut, and water. Foliar spray of Panchagavya significantly increases higher number of pods per plant of green gram and plays direct role in increasing yield of the crop (Singh *et al*. 2022) [14].

Material and methods

The field experiment was conducted on Cowpea during *Kharif* season of 2024 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). To study the Effect of Organic nutrition on growth and yield of Cowpea (*Vigna unguiculata* L.). The soil of experimental plot was sandy loam in texture, neutral in soil reaction (pH 6.8), organic carbon (0.562%), available N (220.00 kg/ha), available P (28.2 kg/ha) and available K
(240.7 kg/ha). The treatments applied were of organic manure consisting of Farm Yard Manure 5 t/ha, and Vermicompost 2.5 t/ha and Foliar application at 25 and 40 DAS by Panchagavya 3%, 5%, and 7%. The experiment was laid out in Randomized Block Design which consisted of ten treatments and replicated thrice. The treatment combinations are., T_1: Farm yard manure 5 t/ha + Panchagavya 3%, T_2: Farm yard manure 5 t/ha + Panchagavya 5%, T_3: Farm yard manure 5 t/ha + Panchagavya 7%, T_4: Vermicompost 2 t/ha + Panchagavya 3%, T_5: Vermicompost 2 t/ha + Panchagavya 5%, T_6: Vermicompost 2 t/ha + Panchagavya 7%, T_7: Farm yard manure 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 3%, T_8: Farm yard manure 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 5%, T_9: Farm yard manure 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%, T_{10}: Blanket application of FYM 5 t/ha. Cowpea (Ankur Gomti) were planted on 4th August 2024, with a 30 cm × 10 cm spacing. Using a hand hoe, furrows 4-5 cm deep were dug along the seed rows in order to apply organic manure as a spreading method. Once germination occurred, the gaps were closed by transplanting ten days following sowing. Seedlings were removed where needed to keep the space between plants at 30 cm by 10 cm. Intercultural operations were conducted at intervals of 25 to 45 days in order to decrease crop density and weed competition. The crop was harvested on October 15th, 2024. Plant growth characteristics, including Plant height (cm), Number of branches/plant, Number of nodules/plant, Plant dry weight (g), Crop growth rate (g/m^2/day), Relative growth rate (g/g/day), yield attributes and yield Number of pods/plant, Number of seeds/pod, Test weight (g), Seed yield (t/ha), Stover yield (t/ha), Harvest index (%)] were subjected to statistical analyzed by analysis of variance method as reported by Gomez and Gomez (1976) [6] and Mohan *et al.*, (2024) [10] Economics were also calculated Cost of cultivation (INR/ha), Gross returns (INR/ha), Net returns (INR/ha) and benefit-cost ratio. Prayagraj has subtropical and semiarid climatic conditions, with both extremes of temperature, *i.e.*, *Kharif* and Winter. It would be hot which commences in the month of February and with draws by the end of October. The meteorological data including the weekly average of the maximum and minimum temperature, relative humidity, and rainfall recorded at the Agro-meteorological Observatory at Naini Agricultural Institute, SHUATS.

Growth attributes of Cowpea

Plant height (cm)

Based on the data at 80 DAS, higher plant height (90.53 cm) was recorded in treatment 9 (FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7%). Significant and highest plant height was observed with the application of FYM (5 ton/ha) might be due to the adequate availability of plant nutrient through appropriate nutrient supply and sunlight to each plant. An appropriate FYM supply indirectly helps in providing nitrogen supply and its availability helped the plants to attain more vigour in term of plant height and improve the soil conditions. (Yadev *et al*., 2017) [17]. Further, the application of foliar spraying of Panchagavya can enhance soil fertility by increasing organic matter, beneficial microorganisms, and nutrient availability and contain growth regulators like betaines and oligosaccharides that induces growth responses in plant. the growth of the plant by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars and lowers the water potential of cell resulting in the entry of water into

cell causing elongation. These results were in conformity with those of Anuja *et al*. (2013) [3].

Number of Nodules/plants

Based on data collected at 80 DAS, treatment 9 (FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7%) showed the highest number of nodules/plant (11.30) which were found to be statistically at par with the highest. The maximum number of nodules/plant was with application of FYM might be due to the increasing leg hemoglobin pigment formation in nodules. The application of FYM might be due to better proliferation of roots and increased nodulation due to higher phosphorus availability which leads to higher plant growth (Singh *et al*. 2017) [15]. Further Foliar applied nutrients play a vital role in acceleration the root growth, contributing to better absorption of nutrients from the soil. Panchagavya can enhance soil fertility by increasing organic matter, beneficial microorganisms, and nutrient availability. It also helps in maintaining soil and improving soil structure. The present findings are within the proximity of Patel *et al*., (2019) [11].

Plant dry weight (g)

The data showed that significant and highest plant dry weight (16.09 g) was recorded in Treatment 9 FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7% showed the highest dry weight among all treatment. Significant and higher plant dry weight (g) was observed with the application of the significant and higher plant dry weight was with the application of Panchagavya might be due to the continuous and slow release of nutrients Arunraj *et al*. (2017). Further, maximum plant dry weight. The significant and highest plant height was observed with the application of FYM (5 ton/ha) might be due to the adequate availability of plant nutrient through appropriate nutrient supply and sunlight to each plant. An appropriate FYM supply indirectly helps in providing nitrogen supply and its availability helped the plants to attain more vigour in term of plant height and improve the soil conditions. (Yadev *et al*., 2017) [17]. Further, the application of foliar spraying of Panchagavya can enhance soil fertility by increasing organic matter, beneficial microorganisms, and nutrient availability. It also helps in maintaining soil pH and improving soil structure contains vitamins, growth hormones like auxins, cytokinin's and gibberellins that enhanced the growth of the plant by efficient nutrient uptake from soil was reported by Sharma *et al*., (2023) [16]. it also aided in synthesis of proteins and enzyme facilitating overall plant growth and vigour. Similar results were reported by Balakrishnan *et al*. (2007) [4].

Yield and yield attributes

Number of Pods/plant

The data showed that treatment 9 (FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7%), was recorded significantly maximum number of pods per plant (11.07) which was superior over all other treatments. The significant maximum number of seeds/pods with application of FYM 5 t/ha might be due to sufficient availability of nutrients and their absorption by the plants, with better photosynthetic activity, resulted highest number of seeds per pods. Similar finding was reported by Jadhav *et al.,* (2016) [8]. Further, the increase in seeds/pods with the application of Panchagavya might be due to proper translocation of photosynthates, pollen viability, pollen tube growth etc. Highest seed yield was also obtained due to availability of micronutrients such as Boron, Calcium, Iron which improves photosynthesis and assimilates transportation to sinks and finally increases seeds in pods Priya *et al.* 2024) [12].

Number of Seeds/pod

The result revealed that significant and maximum number of Seeds/pod at time of harvest, treatment 9 (FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7%), was recorded significantly maximum number of seeds per plant (10.40) which was superior over all other treatments. The significant and higher seed yield was with the application of FYM might be due to increases in stimulation of cell division, photosynthetic process as well as formation of chlorophyll ultimately helped in realization of higher grain yield Anuja *et al*. (2013) [3]. Further, the increase in seeds/pod with foliar application Panchagavya might be due to its ability to divert more flow of assimilates towards the developing seeds Priya *et al., (*2024) [12].

Test weight (g)

At harvest, highest test weight (37.12 g) was recorded in (Treatment - 9) FYM 2.5 t/ha + Vermicompost 1 t/ha along with Panchagavya 7%, was recorded significantly maximum Stover yield (1566.88 kg/ha) which was superior over all other treatments. Further, maximum test weight was observed with the foliar application Panchagavya might had significantly influenced the growth and yield of Cowpea such as increased test weight. It may be due to higher uptake of macro and micronutrients by plant for development of plant and presence of growth promoting hormones and translocation of metabolites to the reproductive yield. This result was corporated by Singh *et al*., (2022**)** [14]**.**

Seed Yield (t/ha)

The data showed that significant and higher at harvest, (Treatment - 9) FYM 2.5 t/ha + Vermicompost 1 t/ha along with Panchagavya 7%, was recorded significantly maximum Stover yield (1484.15 kg/ha) which was superior over all other treatments. The significant and higher haulm yield was observed with the application of FYM might be due to more soil fertility enhances the plant metabolism and photosynthetic activity. Similar results have been. Results were similar to Jadhav *et al*. (2016) [8]. Further increase in seed yield with application of might be due to it enhances the growth parameters and there by increased the photosynthetic rate and translocation of metabolites to the reproductive pods. Similar results were reported by Mahesh *et al*. (2022) [14] and Priya *et al.* (2024) [12].

Stover yield (t/ha)

The data showed that significant and higher stover was recorded in Treatment 9 (FYM 2.5 t/ha along with Vermicompost 1 t/ha along with Panchagavya 7%), was recorded significantly maximum Stover yield (1484.15 kg/ha) which was superior over all other treatments. The significant and maximum Stover yield was obtained with the application of Panchagavya might be due to the part of amino acid, which helps in chlorophyll formation, photosynthetic process, activation of enzymes and grain formation Anuja *et al*. (2013) [3].

Harvest index (%)
At harvest, highest harvest index (35.32%) was recorded in (Treatment - 9) FYM 2.5 t/ha + Vermicompost 1 t/ha along with Panchagavya 7%, though there was no significant difference among the treatments.

Economic analysis
Maximum gross return (INR 143685.15/ha), net return (INR 97904.90/ha) and B:C ratio (2.13) were also recorded in treatment 9 (FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%). Higher benefit cost ratio was recorded with the application of FYM and Vermicompost might be due to higher grain and strove yield which resulted in increases the gross return, ultimately increases the benefit ratio. Similar result was recorded by Anuja *et al*. (2013) [3].

Conclusion
It can be concluded that the application of (FYM 2.5 t/ha and Vermicompost 1 t/ha along with Panchagavya 7%) recorded higher yield and benefit cost ratio in cowpea in treatment 9.

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Competing Interests
Authors have declared that no competing interests exist.

Table 1: Influence of Organic nutrition on growth attributes of Cowpea

S. No.	Treatment Combinations	Plant Height (cm)	Dry Weight (g)	No. of Nodules/plant	CGR (g/m²/day)	RGR (g/g/day)
		80 DAS	80 DAS	80 DAS	60-80 DAS	60-80 DAS
1	Farm yard manure - 5 t/ha + Panchagavya 3%	77.86	12.27	9.71	12.51	0.13
2	Farm yard manure - 5 t/ha + Panchagavya 5%	78.80	13.08	9.98	13.76	0.12
3	Farm yard manure - 5 t/ha + Panchagavya 7%	80.86	14.17	10.35	13.87	0.11
4	Vermicompost - 2 t/ha + Panchagavya 3%	81.21	13.48	10.56	15.85	0.11
5	Vermicompost - 2 t/ha + Panchagavya 5%	83.45	14.85	10.97	17.03	0.10
6	Vermicompost - 2 t/ha + Panchagavya 7%	86.56	14.33	10.37	17.25	0.11
7	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 3%	87.12	15.38	10.39	17.21	0.10
8	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 5%	89.89	15.57	10.28	17.32	0.10
9	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%	90.53	16.09	11.30	20.20	0.10
10	Blanket application of FYM 5 t/ha	74.45	11.56	8.57	11.10	0.12
F-test		S	S	S	S	NS
SE(m) ±		0.43	0.81	0.43	1.25	0.07
CD (p=0.05)		1.30	2.41	1.30	3.72	—

Table 2: Influence of Organic nutrition on yield and yield attributes of Cowpea.

S. No.	Treatment Combinations	Pods/Plant	Seeds/Pod	100-Seed Weight (g)	Seed Yield (kg/ha)	Haulm Yield (kg/ha)	Harvest Index (%)
1	Farm yard manure - 5 t/ha + Panchagavya 3%	8.60	8.40	31.53	880.77	1663.33	33.05
2	Farm yard manure - 5 t/ha + Panchagavya 5%	8.93	8.13	32.23	923.43	1706.67	33.14
3	Farm yard manure - 5 t/ha + Panchagavya 7%	9.07	7.27	32.63	948.31	1884.67	33.72
4	Vermicompost - 2 t/ha + Panchagavya 3%	9.93	8.27	33.13	1007.87	2031.67	32.89
5	Vermicompost - 2 t/ha + Panchagavya 5%	9.95	9.00	33.34	1059.00	2200.33	33.27
6	Vermicompost - 2 t/ha + Panchagavya 7%	10.40	9.34	34.25	1162.06	2342.00	33.38
7	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 3%	10.73	9.80	35.64	1291.88	2430.00	33.20
8	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 5%	10.87	9.53	36.21	1358.92	2650.00	32.35
9	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%	11.07	10.40	37.12	1484.15	2675.00	35.32
10	Blanket application of FYM 5 t/ha	9.93	7.30	30.54	837.45	1393.00	33.05
	F-test	S	S	S	S	S	NS
	SEm (±)	0.45	0.59	1.17	63.50	104.0	1.43
	CD (p=0.05)	1.35	1.78	3.48	188.66	309.15	—

Table 3: Influence of Organic nutrition on economics of Cowpea.

S. No.	Treatment Combinations	Cost of Cultivation (INR/ha)	Gross Return (INR/ha)	Net Return (INR/ha)	B:C Ratio
1	Farm yard manure 5 t/ha + Panchagavya 3%	38,331.25	77,986.47	39,155.22	1.08
2	Farm yard manure 5 t/ha + Panchagavya 5%	38,832.25	82,000.35	43,168.10	1.11
3	Farm yard manure 5 t/ha + Panchagavya 7%	38,833.25	87,268.25	48,435.00	1.24
4	Vermicompost 2 t/ha + Panchagavya 3%	42,354.75	91,155.35	48,800.60	1.15
5	Vermicompost 2 t/ha + Panchagavya 5%	42,355.75	97,404.40	55,048.25	1.29
6	Vermicompost 2 t/ha + Panchagavya 7%	42,356.75	101,899.90	59,543.15	1.40
7	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 3%	45,778.25	127,780.65	82,002.40	1.79
8	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 5%	45,779.25	132,431.05	86,651.80	1.89
9	FYM 2.5 t/ha + Vermicompost 1 t/ha + Panchagavya 7%	45,780.25	143,685.15	97,904.90	2.13
10	Blanket application of FYM 5 t/ha	33,544.00	69,197.50	35,653.50	1.06

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