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Effect of organic manures and microbial culture on growth and yield of cowpea (*Vigna unguiculata* L.)

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Abstract

The present experiment was carried out during September, 2024 to March, 2025 in Research Field, Department of Horticulture, SHUATS, Prayagraj. A field experiment was undertaken to determine the optimal combination of organic manures and microbial culture treatments suited to the agroclimatic conditions of Prayagraj. The study was laid out in a Randomized Block Design (RBD) comprising ten treatment combinations, each replicated three times. From the present experimental findings, it was observed that treatment T₈ (Poultry manure (15t/ha) + Rhizobium (20 g/kg) + PSB (20 g/kg)) found best in all the parameters like plant height (64.93 cm), number of branches (17.20), number of leaves (81.83), days taken to first flowering (34.20 days), days taken to 50% (55.96), number of days to harvest (59.83), number of pods per plant (12.13), number of seeds per pod (12.95), pod length (32.96 cm), pod girth (2.59 cm) and pods yield q per hectare (108.80). In terms of maximum gross returns (Rs. 326400.00 per ha), net returns (Rs. 253262.00 per ha) and benefit-cost ratio (3.46) is found in treatment T₈ followed by T₃ (Poultry manure (15t/ha)), whereas minimum is recorded in treatment T₁ (RDF (20:40:20 kg/ha)).

Keywords: Cowpea, organic manures, rhizobium, phosphorus solubilizing bacteria, open field

1. Introduction

Cowpea (*Vigna unguiculata* L.) is a diploid legume crop with a chromosome number of $2n = 22$. It is an annual herbaceous plant valued for its high protein content, typically ranging between 18% and 25%, comparable to that of certain other protein-rich crops. Cowpea is well-adapted to hot and dry climates, making it a reliable component in diverse cropping systems globally. Among the five recognized cultivated cultivar groups, *unguiculata* is the most prominent and is further classified into 11 subspecies complexes. However, cowpea production is often constrained by various biotic and abiotic challenges. Extensive research has been conducted on the inheritance patterns of both qualitative and quantitative traits to facilitate its genetic improvement. Through breeding efforts, genotypes have been developed with tolerance to drought, heat, and aluminum toxicity, as well as with improved seed protein content and resistance to pests like aphids, flower thrips, pod borers, and bruchids. Additionally, resistance to diseases such as cercospora leaf spot, bacterial blight, bean common mosaic virus, and parasitic weeds has also been achieved. The combination of conventional breeding methods with marker-assisted selection holds great promise for incorporating multiple beneficial traits into a single variety, aiding the development of cowpea cultivars that are more resilient to climate stressors.

Organic compost serves as a sustainable approach to supplying essential nutrients to plants without causing harm to the environment. Various studies have explored how organic fertilizers and composted waste materials—such as pig manure, farmyard manure (FYM), crop residues, and ashes—can influence soil health and crop performance. These organic inputs have been shown to improve soil fertility and contribute positively to overall crop quality Rahman (2009) [8].

Natural sources of nutrients like farmyard manure (FYM), vermicompost, poultry droppings, and oilcakes play an important role in improving soil physical properties. They enhance porosity, support better air circulation, and boost the soil's ability to hold moisture. Additionally, these inputs promote microbial activity in the soil, which facilitates the availability of macro-

and micronutrients to plants through enhanced biological mechanisms. They also play a role in improving nutrient solubility and can influence key soil properties, including salinity, sodicity, and pH levels.

Vermicompost is potential source due to the presence of readily available plant nutrients, growth enhancing substances, and a number of beneficial microorganisms like nitrogen fixing, P solubilizing and cellulose decomposing organism. Vermicompost application in cowpea crop improved nutrient levels both in the root zone and plant system.

The cost of nitrogenous and phosphatic fertilizers is increasing day by day, hence, it forces to use some other cheaper sources like *Rhizobium* and phosphorus solubilizing bacteria. The cowpea, being a leguminous crop fixes the atmospheric nitrogen from the air with the help of *Rhizobium* bacteria. The phosphorus solubilizing bacteria (PSB) like *Pseudomonas* and *Bacillus* also increase the availability of phosphorus to the plant by converting insoluble phosphorus form to soluble form. Use of bio-fertilizer can have a greater importance in increasing fertilizer use efficiency. Thus, judicious use of fertilizers in combination with organic manures and bio-fertilizers to cowpea crop improve the seed yield and quality of seed.

Organic Manure are live carrier based microbial preparations used in agriculture as low input resources to enhance the availability of plant nutrients and promote the plant growth by way of synthesizing growth factors. They possess unique ability to fix atmospheric N either by living symbiotically with the roots of leguminous plants or non-symbiotically or transforming the native soil nutrients such as P, Zn, Cu and S etc. from fixed to usable form through biological processes. Neem Cake is supplemented through seed treatment which enhance nodulation increasing N fixation in the soil for plant uptake. Thus, enthusiasm for biological and organic fertilizers stems from their advantage in increasing yield and being environmentally safe. Legumes are very important, not only as food crops, but possesses high propensity to grow in depleted soils thereby serving as a medium of fertilizing succeeding crops through their unique symbiotic capability with nitrogen fixing *Rhizobium* bacteria, which are inhibited in root nodules of the legumes and the nitrogen balance in the soil is there by preserved Bhagariya *et al.*, (2020) [2].

2. Materials and Methods

2.1 Geographical location of the experimental site

The experimental site is located at a latitude of 25.41° North and longitude of 81.84 ° East, with an altitude of 98 meters above the mean sea level (MSL).

2.2 Climatic conditions of the experimental area

Prayagraj falls within the humid subtropical climatic zone, characterized by a warm, humid monsoon season, a hot and dry summer, and a cold, dry winter. The region records an average annual temperature of approximately 26.1°C, with monthly averages typically ranging between 18°C and 29°C. Daily maximum temperatures generally reach around 22°C, while minimum temperatures average near 9°C. The area receives an average annual rainfall of about 1042.2 mm. Extreme temperatures in this region can rise as high as 46°C to 48°C during peak summer and drop to around 4°C to 5°C in winter. Relative humidity levels vary significantly, ranging from 20% to 94% throughout the year.

Experimental details

S. No.	Treatment combination
T ₁	RDF (20:40:20 kg/ha)
T ₂	FYM (30t/ha)
T ₃	Poultry manure (15t/ha)
T ₄	Goat manure (15t/ha)
T ₅	Vermicompost (10t/ha)
T ₆	RDF (20:40:20 kg/ha) + <i>Rhizobium</i> (20 g/kg) + PSB (30t/ha)
T ₇	FYM (30t/ha) + <i>Rhizobium</i> (20 g/kg) + PSB (20 g/kg)
T ₈	Poultry manure (15t/ha) + <i>Rhizobium</i> (20 g/kg) + PSB (20 g/kg)
T ₉	Goat manure (15t/ha) + <i>Rhizobium</i> (20 g/kg) + PSB (20 g/kg)
T ₁₀	Vermicompost (10t/ha) + <i>Rhizobium</i> (20 g/kg) + PSB (20 g/kg)

3. Results and Discussion

Plant height (cm) recorded at harvest and at harvest were significant due to different treatments (Table 4.1). Significantly higher plant height of 64.93 cm was recorded under treatment T₈ (Poultry manure (15t/ha) + *Rhizobium* (20 g/kg) + PSB (20 g/kg)) at 60 DAS and at harvest, respectively. The minimum plant height of 52.99 cm at harvest was recorded respectively under treatment T₁ (RDF 20:40:20 kg/ha). The present findings are in close accordance with those reported by Mandge (2007), Gupta (2014), Meena *et al.* (2015) [6], Joshi *et al.* (2016a) [4], Joshi *et al.* (2018) [5] and Pargi *et al.* (2018) [7].

The number of branches plant due to different treatments was found significant. Among different treatments, significantly highest number of branches plant (14.80) was recorded under treatment T₈ (Poultry manure + *Rhizobium* + PSB) Among all the treatments the lowest (8.76) number of branches plant was observed in treatment T₁ (RDF (20:40:20 kg/ha)). These results are in accordance with the findings of Malav *et al.* (2018), and Bhutadiya *et al.* (2020) [2] reported that application of castor cake recorded significantly higher number of branches per plant.

The number of leaves plant⁻¹ due to different treatments was found significant. Among different treatments, significantly highest number of leaves plant⁻¹ (81.83) was recorded under treatment T₈ (Poultry manure + *Rhizobium* + PSB (15t/ha)). Among all the treatments the lowest (53.80) number of leaves plant⁻¹ was observed in treatment T₁ (RDF (20:40:20 kg/ha)). The presence of phosphorus solubilizing bacteria (PSB) might have enhanced the availability of phosphorus. These results are already in agreement with the findings reported by Gupta (2014), Meena *et al.* (2015) [6] and Pargi *et al.* (2018) [7].

The number of days to first flowering due to different treatments was found significant. Among different treatments, significantly highest number of days to first flowering (34.20) was recorded under treatment T₈ (Poultry manure + *Rhizobium* + PSB (15t/ha)). Among all the treatments the lowest (31.20) number of days to first flowering was observed in treatment T₁ (RDF (20:40:20 kg/ha)).

The number of flowers per cluster due to different treatments were found significant. Among different treatments, significantly highest number of flower per cluster (6.50) was recorded under treatment T₈ (Poultry manure + *Rhizobium* + PSB (15t/ha)) followed by the treatment higher number of flowers per cluster in T₃ (6.33). Among all the treatments the lowest (4.60) number of flowers per cluster was observed in treatment T₁ (RDF (20:40:20 kg/ha)).

The number of days to harvesting due to different treatments were found significant. Among different treatments, significantly highest number of days to harvesting (59.83) was

recorded under treatment T₈ (Poultry manure + Rhizobium + PSB (15t/ha)) followed by the treatment higher number of days to harvesting in T₃ (58.06). Among all the treatments the lowest (93.81) number of days to harvesting was observed in treatment T₁ (RDF (20:40:20 kg/ha)).

The number of pods plant⁻¹ was influenced significantly by different treatments. Significantly the higher number of pods plant (12.13) was recorded under the application of Poultry manure + Rhizobium + PSB (15t/ha) i.e. treatment T₈. Followed by the treatment T₂ (Poultry manure-15t/ha) remained at par with treatment T₃ (11.07). Significantly the lower number of pods plant⁻¹ (8.47) was recorded under the treatment T₁ (RDF (20:40:20 kg/ha)). These results are in conformity with the results of Verma *et al.* (2014) [12], Meena *et al.* (2015) [6], Joshi *et al.* (2016a) [4], Joshi *et al.* (2018) [5], Pargi *et al.* (2018) [7] and Singh *et al.* (2018) [9].

The number of seeds per pod was influenced significantly by different treatments. Significantly the higher number of seeds per pods (12.95) was recorded under the application of Poultry manure + Rhizobium + PSB (15t/ha) i.e. treatment T₈. Followed by the treatment (Poultry manure-15t/ha) remained at par with treatment T₃ (1.207). Significantly the lower number of seeds per pods (10.88) was recorded under the treatment T₁ (RDF (20:40:20 kg/ha)). Similar results due to RDF were obtained by Gupta (2014), Verma *et al.* (2014) [12], Meena *et al.* (2015) [6], Joshi *et al.* (2016) [4], Joshi *et al.* (2018) [5], Pargi *et al.* (2018) [7] and Singh *et al.* (2018) [10] in cowpea.

The pods yield q per ha was influenced significantly by different treatments. Significantly the higher pods yield q per ha (108.80) was recorded under the application of Poultry manure +

Rhizobium + PSB (15t/ha) i.e. treatment T₈, followed by the treatment (Poultry manure-15t/ha) remained at par with treatment T₃ (103.31). Significantly the lower pods yield q per ha (84.96) was recorded under the treatment T₁ (RDF (20:40:20 kg/ha)). The results are in close agreement with those of Verma *et al.* (2014) [12], Meena *et al.* (2015) [6], Joshi *et al.* (2016a) [4], Joshi *et al.* (2018) [5], Pargi *et al.* (2018) [7] and Singh *et al.* (2018) [9].

The results from revealed that different treatments including organic manure and microbial fertilizers to put their significant effect on pod length of cowpea. However numerically higher length of pod (32.93 cm) was obtained through the application of T₈ and the lower value of pod length (16.08 cm) was recorded under control treatment T₁. The probable reason for this non-significant effect of the treatment on pod length may be due to the fact that the pod length is attributed to genetic characteristic of the seed which remained constant under all the treatments. This result is in conformity with the findings of Joshi *et al.* (2016a) [4].

The results revealed that different treatments including organic manure and microbial fertilizers to put their significant effect on pod girth of cowpea. However numerically higher girth of pod (2.59 cm) was obtained through the application of T₈ and the lower value of pod girth (2.19 cm) was recorded under control treatment T₁. The probable reason for this non-significant effect of the treatment on pod girth may be due to the fact that the pod girth is attributed to genetic characteristic of the seed which remained constant under all the treatments. This result is in conformity with the findings of Joshi *et al.* (2016a) [4].

Table 1: Effect of organic manures and microbial culture on growth of different terms of cowpea

Treatment	Plant Height(cm)	Number of branches per plant	Number of leaves per plant	Days to first flowering	Number of Days to 50% flowering	Number of Flowers per cluster
T ₀	10.95	8.76	53.8	31.20	44.93	4.60
T ₁	15.61	13.42	67.06	31.97	49.19	4.80
T ₂	18.89	16.7	81.06	34.03	54.19	6.33
T ₃	17.59	15.4	71.13	33.33	52.26	5.67
T ₄	16.99	14.8	67.93	32.27	51.06	4.80
T ₅	12.69	10.5	64.13	31.60	48.26	4.60
T ₆	16.99	14.8	67.86	32.00	50.99	5.00
T ₇	19.39	17.2	81.83	34.20	55.96	6.50
T ₈	17.79	15.6	76.46	33.93	53.59	5.67
T ₉	17.19	15	71	33.13	52.13	5.47
F- test	S	S	S	S	S	S
S. Ed. (±)	1.46	0.84	2.63	0.35	1.01	0.22
C. D. (P = 0.05)	0.73	0.42	1.31	0.17	0.50	0.11

Table 2: Effect of organic manures and microbial culture on growth of different terms of cowpea

Treatment	Number of days to harvesting	Pod length (cm)	Pod Girth (cm)	Number of pods per plant	Number of seed per pod	Pod yield (q/ha)
T ₀	53.81	16.08	2.19	8.47	10.88	84.96
T ₁	54.06	20.72	2.29	9.47	10.81	88.87
T ₂	58.06	31.36	2.51	11.07	12.7	103.31
T ₃	57.13	24.06	2.41	10.00	12.43	98.24
T ₄	55.93	22.81	2.37	9.76	11.86	92.9
T ₅	64.13	19.72	2.25	9.18	10.07	87.43
T ₆	54.86	21.88	2.3	9.47	10.95	89.89
T ₇	59.83	32.93	2.59	12.13	12.95	108.8
T ₈	57.46	24.6	2.47	10.93	12.53	99.12
T ₉	56.82	23.53	2.39	9.87	12.19	94.23
F- test	S	S	S	S	S	S
S. Ed. (±)	0.97	1.31	0.04	0.34	0.31	2.39
C. D. (P = 0.05)	0.48	0.65	0.02	0.17	0.16	1.19

4. Conclusion

It may be concluded from the findings of the present study that showed positive response on physical quality attributes of cowpea plant. The best treatment was found T₈ Poultry manure (15t/ha) + Rhizobium (20 g/kg) + PSB (20 g/kg) in all aspects such as growth parameter, fruit yield parameter and followed by the variety Poultry manure (15t/ha)-T₃ found best in all term. This variety was also good in economics return.

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