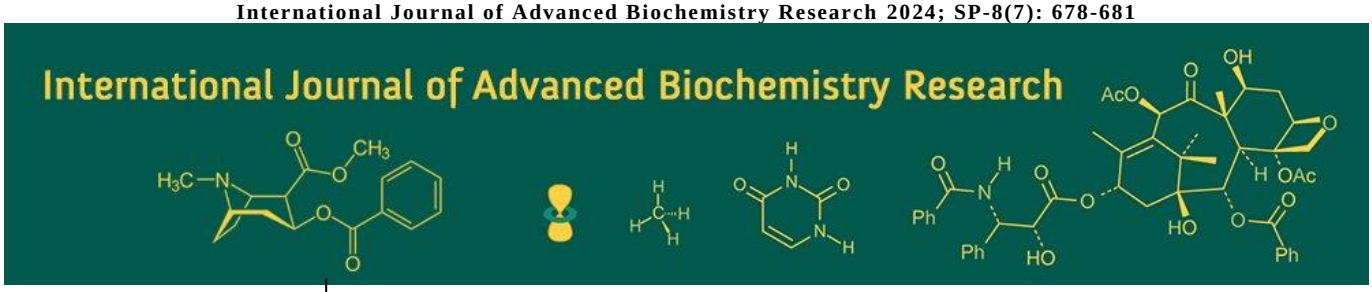

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Effect of solid and liquid organic nutrient source on yield economics of cowpea (*Vigna unguiculalta* L.)

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Abstract
A field experiment was conducted during *kharif* season of 2023 at Crop Research Farm, Department of Agronomy. The experiment was laid out in a Randomized Block Design with ten treatments which have replicated thrice. The treatments details are as fallows T_1: Farm yard manure 5 t/ha + Panchagavya 3%, T_2: Farm yard manure 5 t/ha + Jeevamrut 5%, T_3: Farm yard manure 5 t/ha + Cow urine 2%, T_4: Poultry manure 1 t/ha + Panchagavya 3%, T_5: Poultry manure 1 t/ha + Jeevamrut 5%, T_6: Poultry manure 1 t/ha + Cow urine 2%, T_7: Vermicompost 2 t/ha + Panchagavya 3%, T_8: Vermicompost 2 t/ha + Jeevamrut 5%, T_9: Vermicompost 2 t/ha + Cow urine 2%. Application of Vermicompost 2 t/ha + Panchagavya 3% (Treatment 7) recorded highest plant height (82.26 cm), no. of nodules (6.33 per plant), maximum plant dry weight (20.96 g/plant), crop growth rate (10.30 g/*m*2/day), relative growth rate (0.0269 g/g/day), pods per plant (21.67), pods per plant (5.07), seed per pod (8.11), seed index (21.67), seed yield (1.79 t/ha) and harvest index (34.21) %. The same treatment also recorded maximum gross return (84130 INR/ha), net return (47930 INR/ha), and benefit cost ratio (1.32).

Keywords: Cowpea, FYM, poultry manure, vermicompost, Panchagavya, Jeevamrut, cow urine, growth, yield and economics

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp) is an important grain legume crop that belongs to the Fabaceae family. India is the world's largest producer of pulses, accounting for approximately 25% of the global total. In India, pulse crops are produced on 26.28 million hectares, with an annual production of 18.09 million tonnes and a productivity of 689 kg ha. In Gujarat, it is grown on 2.09 lakh hectares, with an annual production of 1.14 lakh metric tonnes and an average productivity of 546 kg/ha (2023, IIPR). Cowpea (*Vigna unguiculata* L.), a multipurpose legume native to West Africa, is vital to world food security. Its capacity to fix atmospheric nitrogen, survive drought, and have a short growth cycle makes it useful.

Its ability to fix atmospheric nitrogen, withstand drought, and have a short growth cycle make it an important crop, particularly in developing countries. Cowpea is an essential source of protein for millions of people and improves soil fertility through nitrogen fixation by root nodule bacteria (Rhizobium). However, inadequate soil fertility, particularly nitrogen shortage, impedes cowpea production. Sustainable farming practices stress the search for alternatives to petrochemical fertilizers. Organic nutrient supplies, available in both solid and liquid forms, offer a viable option. Solid amendments, such as compost and manure, provide a slow-release supply of nutrients, whereas liquid organic fertilizers give rapidly available nutrients for plant uptake.

This crop's average production is currently 350 kg/ha, which is rather low in comparison to other pulse crops. The cowpea market is valued at $7.21 billion in 2023 and is expected to reach $9.43 billion by 2028, with a CAGR of 5.50%. In recent years, cowpea has been included in various countries' food security programs. Cowpea is becoming increasingly popular due to its high concentration of antioxidants, polyphenols, polyunsaturated fatty acids, and dietary fiber. Cowpea also contributes significantly to soil fertility through biological nitrogen fixing. Farm yard manure (FYM) is made mostly from cow dung, urine, waste straw, and other dairy wastes. It is really useful, and some of its features are rich.

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reach $9.43 billion by 2028, with a CAGR of 5.50%. In recent years, cowpea has been included in various countries' food security programs. Cowpea is becoming increasingly popular due to its high concentration of antioxidants, polyphenols, polyunsaturated fatty acids, and dietary fiber. Cowpea also contributes significantly to soil fertility through biological nitrogen fixing. Farm yard manure (FYM) is made mostly from cow dung, urine, waste straw, and other dairy wastes. It is really useful, and some of its features are rich.

Liquid formulations used in organic agriculture, such as Panchgavya, beejamrut, and jeevamrut, are fermented solutions that are used to enhance plant growth and are created using resources available to farmers. They are rich in beneficial microflora, which encourage plant growth and aid in the production of high-quality yields. Formulations made from agricultural byproducts, such as grain bran, oil cakes, and farmyard manure, are ideal growth carriers and storage media.

Vermicompost (vermi-compost) is the result of a decomposition process that employs several species of worms, typically red wigglers, white worms, and other earthworms, to produce a mixture of decomposing vegetable or food waste, bedding materials, and Vermicompost. This procedure is known as vermicomposting, and the practice of raising worms for this reason is known as vermiculture. Vermicast, also known as worm castings, worm humus, worm manure, or worm farces, is the byproduct of earthworms breaking down organic waste.

Poultry manure fertilizer contains all of the nutrients needed for crop production, and its effectiveness as an organic fertilizer and plant nutrient source has been known for generations. Despite its favorable impact on plant growth, manure accounts for a modest percentage of nutrients applied to fields when compared to commercial fertilizer.

Cow pee, also known as Gomutra, is a liquid byproduct of the cow's metabolism. Cow urine is utilized as medicine in certain parts of India, Myanmar, and Nigeria. While cow urine and cow dung are useful as fertilizers, proponents' claims that they cure diseases and cancer lack scientific backing. Cow urine was used for therapeutic purposes in ancient Ayurvedic medicine. Urine of a pregnant cow is regarded exceptional. it is reported to contain unique hormones and minerals.

Research on Solid and liquid organic sources in cowpea are crucial for optimizing nutritional levels, boosting yield, enhancing quality, reducing environmental effect, and balancing costs. These sources promote plant development, photosynthesis, and protein synthesis. Cowpea can boost biomass and output while improving nutritional quality by striking the right balance. Understanding these aspects can also help farmers build more sustainable and successful farming strategies that benefit both them and the environment.

Aterial and Methods

During the *Kharif* season of 2023, a field experiment was conducted at the Crop Research Farm of the Department of Agronomy, Sam Higginbottom University of Agriculture Technology And Sciences, Prayagraj, Uttar Pradesh. which is located at 25.24’42’’ N latitude,

81.50’ 56” E longitude and 98 m altitude above the mean sea level (SL). The soil of experimental plot was sandy loam, having a nearly neutral soil reaction (pH 7.3), electrical conductivity 0.53 ds/m, medium in available nitrogen (225.83 kg/ha) and potassium (36.10 kg/ha), and low in available phosphorous (38 kg/ha). The experiment was conducted in a Randomized Block Design consisting of 9 treatment combinations and three replications. Organic manures were applied as band placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The treatments comprised of 3 organic manures and 3 spraying frequencies. The plot size of each treatment was 3m x 3m. The cowpea crop was sown on 9 August 2023. Harvesting was done by taking $1m^2$ area from each plot. And from it five plants were randomly selected for recording growth and yield parameters. The observations were recorded for plant height (cm), number of nodules/plant, dry weight (g), Crop growth rate, Relative growth rate, number of pods/plant, number of seeds/pod, seed index (g), seed yield (t/ha), stover yield(t/ha) and Harvest Index (%). The observed data was statistically analysed using analysis of variance (ANOVA) as applicable to randomized block design.

Results and Discussion

Number of pods per plant

At harvest, the significantly higher number of pods/plants were observed in the treatment combination of Vermicompost 2 t/ha along with Panchagavya 3% recording 5.07 pods/plant. which was superior over all other treatments.

Number of seeds per pod

At harvest, significantly maximum number of seeds/pod (8.11) was observed in the treatment combination of Vermicompost 2 t/ha along with Panchagavya 3% which was superior over all other treatments.

Seed Index

The maximum test weight (21.67 g) was recorded in the treatment Jeevamrutha (5%) along with Spacing 45 × 10 cm. The minimum test weight (20.40 g) was recorded in the treatment combination Panchgavya (5%) along with Spacing 40 × 15 cm^2.

Test weight of seed (28.84 g) were recorded in treatment Vermicompost (6t/ha) along with Rhizobium along with Azospirillum. It might be due to Increase in yield attributes in combination of organic manures and biofertilizer (Vermicompost (6t/ha).

The highest 1000 seed weight of 18.35 g was obtained from the L2 treatment, while the lowest 1000 seed weight of 17.30 g was obtained from the FM2 and 17.34 g from the V2 treatments. It was determined that leonardite applications had a more positive effect on the 1000 seed weight compared to other organic and chemical fertilizers. Similar results by Uçar, Soysal and Erman *et al.* (2016) have also been reported.

Seed Yield (t/ha)

At harvest, the data showed that significantly maximum seed yield of cowpea (1.79 t/ha) was foud with the application of Vermicompost 2 t/ha along with Panchagavya 3%. However, treatments 8, 9, 1, 2, 3, 4, and 5 (1.73, 1.69, 1.60, 1.53, 1.42, and 1.29 t/ha respectively) which was found to be statistically at par with all treatments.

The present results are in collaboration with the findings of Rajkhowa *et al*., (2003) [4, 14] in green gram, Khandelwal *et*

al., (2012) [15]. In Grain yield (t/ha), treatment with application of Vermicompost (6t/ha) + Rhizobium + Azospirillum was recorded maximum grain yield (1.31 t/ha) Which was superior over other treatments, Observed that, it was found that the differences between the fertilizer forms were significantly effective in terms of all the examined characteristics. It was determined that the seed yields varied between 3043.3–4126.7 kg/ha, and according to the results of the two-year study, 10,000 kg/ha vermicompost would be sufficient to obtain the highest cowpea yield (4126.7 kg/ha) under Mediterranean climate conditions Yürürdurmaz *et al.* (2022) [10].

Harvest index (%): Significantly higher Harvest index of cowpea was observed in the treatment combination of Vermicompost 2 t/ha along with Panchagavya 3%. (34.21%). though there was significant difference among the treatments.

Economics

The data on the economics of different treatments presented in Table 3 showed that the Maximum gross returns (₹ 84130.00/ha), net returns (₹ 47930.00/ha), and benefit: cost ratio (1.32) were recorded treatment-8 with the application of Vermicompost 2 t/ha + Panchagavya 3% and the minimum gross return (INR.46530.00 /ha), net return (INR.20730.00 /ha) and benefit-cost ratio (0.80) was observed in the treatment -6 with Poultry manure 1 t/ha + Cow urine 2%.

Table 1: Influence of solid and liquid organic nutrient source on yield attributes of cowpea

		Yield attributes				
S. No.	**Treatments**	**Pods/plant (No.)**	**Seeds/pod (No.)**	**Seed Index (g)**	**Seed yield (t/ha)**	**Harvest Index (%)**
1.	Farm yard manure 5 t/ha + Panchagavya 3%	4.90	7.93	20.18	1.60	33.36
2.	Farm yard manure 5 t/ha + Jeevamrut 5%	4.87	7.86	19.62	1.53	32.55
3.	Farm yard manure 5 t/ha + Cow urine 2%	4.85	7.59	19.15	1.42	31.44
4.	Poultry manure 1 t/ha + Panchagavya 3%	4.76	7.24	18.53	1.29	30.84
5.	Poultry manure 1 t/ha + Jeevamrut 5%	4.49	6.87	18.41	1.15	29.37
6.	Poultry manure 1 t/ha + Cow urine 2%	4.47	6.20	17.87	0.99	28.04
7.	Vermicompost 2 t/ha + Panchagavya 3%	5.07	8.11	21.67	1.79	34.21
8.	Vermicompost 2 t/ha + Jeevamrut 5%	5.02	8.06	21.33	1.73	33.76
9.	Vermicompost 2 t/ha + Cow urine 2%	4.96	8.00	21.22	1.69	33.78
	F-Test	S	S	S	S	S
	SEm (±)	0.16	0.30	0.57	0.10	1.82
	CD (P=0.05)	0.49	0.93	1.72	0.32	5.47

Table 2: Influence of solid and liquid organic nutrient source on economics of cowpea

Treatment combinations	Total cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
Farm yard manure 5 t/ha + Panchagavya 3%	34200	75200	41000	1.19
Farm yard manure 5 t/ha + Jeevamrut 5%	33650	71910	38260	1.13
Farm yard manure 5 t/ha + Cow urine 2%	32800	66740	33940	1.03
Poultry manure 1 t/ha + Panchagavya 3%	27200	60630	33430	1.22
Poultry manure 1 t/ha + Jeevamrut 5%	26650	54050	27400	1.02
Poultry manure 1 t/ha + Cow urine 2%	25800	46530	20730	0.80
Vermicompost 2 t/ha + Panchagavya 3%	36200	84130	47930	1.32
Vermicompost 2 t/ha + Jeevamrut 5%	35650	81310	45660	1.28
Vermicompost 2 t/ha + Cow urine 2%	34800	79430	44630	1.28

Conclusion

From the result, it is conducted that the treatment combination of (Treatment no. 7) Vermicompost 2 t/ha along with Panchagavya 3% has recorded highest Grain yield, gross return, net return and benefit cost ratio.

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