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Impact of organic nutrient management on growth and yield of cowpea (*Vigna unguiculata* L.)

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Abstract
In order to determine the "Impact of Organic Nutrient Management on Growth and Yield of Cowpea (*Vigna unguiculata* l.)" a field experiment was carried out at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P.) during the Zaid season of 2024. Jeevamrut at 400 l/ha, 500 l/ha, and 600 l/ha, Farm Yard Manure at 10 t/ha, 15 t/ha, and 20 t/ha, and absolute control were among the treatments. Ten treatments, each replicated three times, were used in the Randomized Block Design (RBD) experiment. The findings showed that Treatment 5 (FYM 15 t/ha + Jeevamrut 500 l/ha) had the highest plant height (57.02 cm), maximum dry weight (26.17 g) was recorded in Treatment 7 (FYM 10t/ha + Jeevamrut 600 l/ha), In comparison to other treatments, the highest number of nodules/plant (17.8), seeds/pod (9.6), and seeds yield (8.8 q/ha) were recorded in Treatment 1 (FYM 10t/ha + Jeevamrut 400 l/ha), the highest number of pods/plant (16.7) was recorded in Treatment 9 (FYM 20t/ha + Jeevamrut 600 l/ha), at post-harvest, the highest test weight (118.7g) was recorded in Treatment 4 (FYM 10t/ha + Jeevamrut 500 l/ha), and the highest straw yield (20.4 q/ha) was recorded in Treatments 1 and 8. Treatment 1 (FYM 10t/ha + Jeevamrut 400 l/ha) had the highest B:C ratio (1.86), whereas Treatment 8 (FYM 15t/ha + Jeevamrut 600 l/ha) had the highest gross return (INR 149943.6/ha).

Keywords: Cowpea, farm yard manure, growth, jeevamrut, yield

Introduction

Cowpea (*Vigna unguiculata*), belongs to the family Leguminosae, sub-family Fabaceae and genus Vigna. It is self-pollinated and response to photoperiod. It is mainly grown for its long pods, seeds and foliage and for fodder. It is commonly known as southern bean, yard- long bean, asparagus bean. It is also known as vegetable meat. (Goud *et al.*, 2020) [2]. India is the largest producer of pulses, accounting for about 25 percent of the global share. Being an inseparable ingredient in the diet of the vast majority of vegetarian population and mainstay of sustainable crop production, pulses continue to be an important component of the rainfed agriculture, since time immemorial. Through symbiotic nitrogen fixation from the air, it can obtain up to 80% of its nitrogen needs. It also leaves behind a significant quantity of organic matter and residual nitrogen for use by future crops (Mohan and Ghandaragiri, 2007) [16]. Both the green shell and the dried stage of cowpeas are eaten as food. In addition, it is cultivated for hay, silage, and pasture for various kinds of animals and as a source of protein, particularly lysine, for the rural people' primary grain meals. One of the most important vegetable legume crops in India is the cowpea (*Vigna unguiculata* L.), which is cultivated extensively in eastern Uttar Pradesh, (Srivastva *et al.* 2022) [12].

Cowpea is an important crop of the world covering an area of about 143.5 lakhs area/ha with a production of 72.6 lakh tones and productivity of 585 kg/ha. West Africa is the key cowpea producing zone, produces 75 per cent of cowpea of world production, mainly in semi-arid agro-ecological zones. In India, cowpea is grown in an area of 13 lakh ha with a production of 31 lakh tones and an average productivity of 238 kg/ha'. The major cowpea growing states are Gujarat. Uttar Pradesh, Rajasthan. Tamil Nadu, Andhra Pradesh and Karnataka. In Karnataka, cowpea is grown in an area of 0.89 lakh ha with a production of 0.36 lakh tons and an average productivity of 426 kg/ha 'respectively (Anon *et al.*, 2015).

Compost, FYM, and liquid organic manures like Jeevamrutha are examples of organic manures that increase soil structure, aeration, and water-holding capacity. Additionally, it increases nutrient solubility, changes soil salinity, sodicity, and pH, and promotes the activity of microorganisms that enable the plant to absorb macro and micronutrients through improved biological processes. (Alabadan *et al.*, 2009) [1].

Utilizing organic materials in agriculture, especially farmyard manure (FYM), has been a fairly common traditional practice because it raises the amount of organic carbon in the soil, which affects the physical characteristics of the soil both directly and indirectly. (Rasool *et al.*, 2008) [13]. Given their affordability and environmental friendliness, FYM may be a viable substitute for fertilizers in increasing crop yields and system sustainability. (Jat *et al.*, 2013) [6].

Jeevamrutha is an inexpensive homemade preparation that adds native microorganisms to the soil, which are necessary for the soil's mineralization (Gore *et al.*, 2011) [10]. These are important for boosting growth and giving the plant system immunity since they combine the qualities of fertilizer and biopesticide. Along with additional ingredients like water, pulse flour, and jaggery, Jeevamrutha is made using readily available farm wastes like calf urine and manure.

Plant growth promoting rhizobacteria (PGPR), which are bacteria that colonize the rhizosphere, can promote plant growth in a variety of direct and indirect ways (Hartman and Tringe, 2019) [9]. Plant performance may be affected by both direct and indirect PGPR pathways. Examples of direct mechanisms include the production of compounds that promote plant growth (phytohormones), the release of fixed forms of nutrients into plant-useful systems (P, K, and Zn), the chelation of nutrients (Fe) through the production of siderophores, the increase in the availability and uptake of nutrients in the soil through biological nitrogen fixation, and other comparable processes (Kour *et al.*, 2023) [5]. The ecological niche known as the rhizosphere, which is made up of the soil around a plant's roots and is influenced by root exudates, is necessary for the growth and function of a diverse yet sizable population of microorganisms (Bakker *et al.*, 2013) [11]. The beneficial bacterial populations that live in the rhizoplane and root endosphere microhabitats and are essential for supporting plant growth are collectively referred to as the root microbiome. (Salwan *et al.*, 2023) [14].

Through solubilization and mineralization, phosphate-solubilizing bacteria (PSB) can make insoluble phosphate available to plants, boosting crop yields while preserving environmental sustainability. (Cheng *et al.*, 2023) [17].

Materials and Methods

A field experiment was carried out during the Zaid season of 2024 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experimental plot's soil had a sandy loam texture, a pH of 6.7, an almost neutral soil reaction, organic carbon (0.280%), electricity conductivity (0.318 dsm-1), available N (171.48 kg/ha), available P (15.2 kg/ha), and available K (142.4 kg/ha). Ten treatments and three replications were used in the Randomized Block Design experiment. A statistical analysis was performed to determine the significance of the observations made on various growth parameters at harvest, including the number of nodules/plants, seeds/pods, seed yield, and stover yield. The results of the experiment were compiled using scientific reasoning and are covered under the heading below.

Results and Discussion

3.1 Growth Attributes

The data on growth-attributing traits are summarized in Table 1. During the research trial, it was observed that plant height increased progressively following germination, reaching its peak around 60 days after sowing (DAS). On the other hand, the quantity of root nodules rose until 45 DAS, at which point it began to decrease by 60 DAS. This reduction in root nodules is likely due to their senescence following the onset of flowering. As the plant transitions to its reproductive phase, the nitrogen fixed by the nodules is mobilized to support the development of generative organs, resulting in the gradual degeneration of the nodules. Treatment 7, which combined FYM (10 t/ha) with a foliar spray of Jeevamrut (600 l/ha), produced the highest number of nodules per plant (19.2); nevertheless, this outcome was determined to be statistically non-significant. The application of FYM (10 t/ha) in conjunction with a foliar spray of Jeevamrut (400 l/ha) in (Treatment 1) resulted in the highest dry weight (20.93 g), which was statistically comparable to T3 and T8. The cheap availability of sprayed phosphorus may be the reason for its beneficial effects on crop development. While Jeevamrut promotes the plant and its growth, which results in a strong yield, FYM helps to create the cumulative effect of increased plant height and other growth qualities. Additionally, Jeevamrut is a rich source of phosphorus, potassium, and nitrogen. All other micronutrients necessary for plant growth and development are also present. These findings are comparable to those of (Sutar *et al.* 2018) and (Parija *et al.* 2013) [4, 15].

3.2 Yield Attributes

Table 1 also provides a summary of the yield-attributing trait data. Treatment 4, which involved applying FYM (10 t/ha) together with a foliar spray of Jeevamrut (500 l/ha), produced the most pods per plant (17.5), however this result was not statistically significant. The application of FYM (10 t/ha) in conjunction with a foliar spray of Jeevamrut (400 l/ha) resulted in a higher number of seeds per pod (9.6) in Treatment 1, but this outcome was determined to be statistically non-significant. Treatment 1, which included FYM (10 t/ha) in addition to a foliar spray of Jeevamrut (400 l/ha), similarly produced the greatest test weight (113.3 g), however this result was likewise determined to be statistically nonsignificant. A foliar spray of Jeevamrut (400 l/ha) and FYM (10 t/ha) together affected important cowpea growth and yield metrics, especially test weight and the number of seeds per pod. Regarding the factors that contribute to yield, Treatment 1 performed the best.

3.3 Grain Yield (q/ha)

Table 1, also summarizes the grain yield data and demonstrates that the foliar spray of Jeevamrut (400 l/ha) in conjunction with FYM (10 t/ha) produced the significantly largest grain production (8.75 q/ha), also known as Treatment 1. Nonetheless, it was discovered that treatments 3 (8.2 q/ha), 4 (8.4 q/ha), 5 (8.0 q/ha), 6 (7.8 q/ha), 7 (7.6 q/ha), 8 (8.7 q/ha), and 9 (7.9 q/ha) were statistically equivalent to treatment 1. This could result from the use of FYM and Jeevamrut, which together increased the number of pods per plant and the quantity of seeds per pod. The application of FYM in conjunction with the foliar spray of Jeevamrut may have boosted microbial activity in the soil, which in turn may have led to a higher seed production by improving nutrient availability throughout crop growth. When FYM was added to soil, it enhanced the plant's access to available nutrients and created a favorable soil environment, which in turn boosted the soil's capacity to hold water and nutrients for a longer length of time. This led to improved growth, yield characteristics, and yield (Yadav *et al.*, 2019) [3]. Every time liquid manures are applied, they stimulate the plant system, which in turn increases the production of growth hormones and growth regulators in the cell system. This may have increased the biomass of the soil, maintaining the availability and uptake of both native and applied soil nutrients, ultimately leading to improved crop growth and yield. Similar results were reported by (Yogananda *et al.*, 2019) 3.4 Stover Yield (q/ha) [18].

The stover yield data, which are summarized in Table 1, revealed that the use of FYM (10 t/ha) and (15 t/ha) in conjunction with foliar sprays of Jeevamrut (400 l/ha) and (600 l/ha), i.e, Treatments 1 and 8, respectively, resulted in a significantly maximum stover yield of 20.4 q/ha. However, it was discovered that treatments 3 (18.4 q/ha), 4 (19.5 q/ha), 5 (18.0 q/ha), 6 (17.3 q/ha), 7 (16.9 q/ha), and 9 (17.4 q/ha) were statistically equivalent to treatments 1 and 8. Increased plant height and higher dry matter accumulation at harvest, which might have resulted from the plants' enhanced assimilate production, could be the cause of the stover yield increase. In addition, FYM enhances the physical, chemical, and biological characteristics of the soil, which may have led to a higher strover yield production. FYM is a good source of organic matter and plant nutrients, which causes successive decomposition that allows the crop to ensure an almost continuous supply of nutrients efficiently throughout the crop's growth period (Parewa and Yadav 2024) [8]. Applying FYM and Jeevamrut increased cowpea crop growth, which in turn increased yield and dry matter buildup, which in turn increased strover yield. The findings were consistent with those of (Yogananda *et al.* 2019) [18].

3.5 Harvest Index (%)

Table 1, also summarizes the harvest index data and reveals that the Absolute control, or Treatment 10, had the greatest harvest index (39.7%), which was statistically determined to be non-significant.

3.6 Economics

Table 2 provides a summary of the economic statistics for various treatments, demonstrated that the application of FYM (10 t/ha) in conjunction with foliar spray of Jeevamrut (400 l/ha) i.e. (Treatment 1) produced the highest net return (90148.2 INR/ha) and benefit-cost ratio (1.86); in contrast, the application of FYM (20 t/ha) in conjunction with foliar spray of Jeevamrut (600 l/ha) i.e. (Treatment 9) produced the lowest net return (43260.0 INR/ha) and the lowest benefit-cost ratio (1.20). These results might be due to higher grain and stover yields in the same treatment because FYM and Jeevamrut foliar spray improved its availability and uptake, improving nodulation and nitrogen fixation, which raised photosynthesis and yield, these results may be the outcome of higher grain and stover yields in the same treatment. A higher B:C ratio is achieved by growing improved cultivars using improved and enhanced organic cultivation techniques, which significantly increases yields and returns. Yogananda *et al.* (2019) [18] and Nagar *et al.* (2024) [7] reported similar findings.

4. Conclusion

Based on a year of testing, the most successful method for optimizing cowpea production's yield and financial gains was to apply FYM at 10 t/ha along with a 400 l/ha foliar spray of Jeevamrut, as in Treatment 1.

Table 1: Effect of Organic Nutrient Management on yield attributes at harvest of cowpea.

	Treatment Combinations	Plant height (cm)	Plant dry weight (g)	Number of nodules/plants	No. of pods /plant	No.of seeds/pod	Test weight (g)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
T_1	FYM 10t/ha + Jeevamrut 400 l/ha	53.5	20.93	13.3	15.7	9.6	113.3	8.8	20.4	30.2
T_2	FYM 15t/ha + Jeevamrut 400 l/ha	53.5	19.63	12.0	14.6	9.2	103.3	7.2	16.2	30.5
T_3	FYM 20t/ha + Jeevamrut 400 l/ha	53.0	20.67	14.2	16.3	9.1	104.3	8.2	18.4	31.0
T_4	FYM 10t/ha + Jeevamrut 500 l/ha	50.0	18.57	12.5	17.5	9.5	118.7	8.4	19.5	30.2
T_5	FYM 15t/ha + Jeevamrut 500 l/ha	57.02	19.77	10.5	14.7	8.2	94	8.0	18.0	30.9
T_6	FYM 20t/ha + Jeevamrut 500 l/ha	51.4	19.30	14.0	14.9	7.3	111.7	7.8	17.3	31.8
T_7	FYM 10t/ha + Jeevamrut 600 l/ha	54.3	18.47	17.8	16.5	9	99.7	7.6	16.9	31.0
T_8	FYM 15t/ha + Jeevamrut 600 l/ha	44.7	20.80	12.0	16.4	8.9	114.3	8.7	20.4	29.9
T_9	FYM 20t/ha + Jeevamrut 600 l/ha	43.1	20.07	11.8	16.7	9.2	92.3	7.9	17.4	31.2
T_{10}	Absolute control	50.9	19.37	11.3	15.6	8.2	102.3	4.3	6.6	39.7
	SEm(±) 1.92		0.25	1.47	0.99	0.88	6.32	0.54	1.23	2.27
	CD (p=0.05) 5.7		0.74					1.61	3.67	

Table 2: Effect of Organic Nutrient Management on economics of cowpea.

S. No.	Treatment Combinations	Cost of Cultivation (INR/ha)	Gross Returns (INR/ha)	Net Returns (INR/ha)	B:C Ratio
1	FYM 10t/ha + Jeevamrut 400 l/ha	48,400	138,548.2	90,148.2	1.86
2	FYM 15t/ha + Jeevamrut 400 l/ha	55,900	129,716.6	73,816.6	1.32
3	FYM 20t/ha + Jeevamrut 400 l/ha	63,400	147,719.8	84,319.8	1.33
4	FYM 10t/ha + Jeevamrut 500 l/ha	50,400	137,315.0	86,915.0	1.72
5	FYM 15t/ha + Jeevamrut 500 l/ha	57,900	140,349.6	82,449.6	1.42
6	FYM 20t/ha + Jeevamrut 500 l/ha	65,400	145,368.0	79,968.0	1.22
7	FYM 10t/ha + Jeevamrut 600 l/ha	52,400	130,504.2	78,104.2	1.49
8	FYM 15t/ha + Jeevamrut 600 l/ha	59,900	149,943.6	90,043.6	1.50
9	FYM 20t/ha + Jeevamrut 600 l/ha	67,400	148,280.4	80,880.4	1.20
10	Absolute control	23,750	67,010.0	43,260.0	1.82

Conclusion

It is concluded that application FYM at 10 t/ha with a foliar spray of Jeevamrut (400 l/ha) as in Treatment 1 recorded the maximum Seed yield, Stover yield, Net returns and Benefit cost ratio in Cowpea.

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