Original Research Article

Efficacy of Liquid Organics on Growth and Yield of Cowpea under Natural Farming

ABSTRACT

A field experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) during *Zaid, 2022*. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), organic carbon (0.75%), available N (269.96 kg/ha), available P (33.10 kg/ha), and available K (336 kg/ha). The treatments applied were of Panchagavya (2, 4 and 6 %) and Jeevamrutha 500 and 1000 l/ha. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. Based on the objectives taken maximum plant height (84.34 cm), number of total branches (5.34), number of nodules (40.87), plant dry matter accumulation (17.96 g/plant), number of pods per plant (25.47), number of seeds per pods (11.78), seed yield (1.78 t/ha), stover yield (3.99 t/ha) and biological yield (5.77 t/ha) were recorded significantly higher in treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. Further, the maximum gross returns (₹ 71200.00/ha) and net returns (₹ 31300.00/ha) were recorded higher in treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. However, B:C ratio was highest in 1.78 Panchagavya (2 %) + control.

***Keywords*:** *Panchagavya, Jeevamrutha, , Growth, and Yield, Cowpea.*

INTRODUCTION

Cowpea (*Vigna unguiculata* L.), is one of the most important pulse crops. Cowpea is a multipurpose arid grain legume referred to as southern pea, black-eyed pea, etc., and is extensively cultivated in arid and semiarid regions of Africa and Asia. It is native to central Africa. It belongs to family Fabaceae. It is commercially grown throughout India for its green pods which are used as vegetable. It is one of the most ancient human food sources and has probably been used as a crop plant since Neolithic time (**Chevalier, 1964**). It is used as a pulse or green pod vegetable and haulm as an excellent animal feed. The amino acid profile reveals that lysine, leusine and phenylanine content are relatively higher in cowpea (**Bressani and Elias, 1980**). Cowpea plays an important role in the Indian diet on account of a high percentage of protein (23.14 %), which is double that of cereals. It also contains carbohydrates (56.8 %), fibre (3.9 %), ash (3.20 %) and fat (1.3 %). Cowpea is grown as catch crop, mulch crop, intercrop, mixed crop and green crop. Cowpea contributes to the improvement of soil fertility by the atmospheric nitrogen fixation in the soil (56 kg N/ha to the subsequent crop) in association with symbiotic bacteria under favorable conditions (**Kalegore *et al*. 2018**). The result of this symbiosis is to form nodules on the plant root, within which the bacteria can convert atmospheric nitrogen into ammonia that can be used by the plant.

India is the largest producer (25 % of global production), the consumer (27 % of world consumption),and the importer (14 %) of pulses in the world **(Annonymous, 2015)**. In India vegetable cowpea is grown over an area of 23,012 ha with production of 1,33,587 tons of green pod and productivity of 5800 kg/ha. The leading states are UP, Bihar, Jharkhand, West Bengal, Odisha etc. The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture. Chemical agriculture has made an adverse impact on the healthcare of not only soil but also the beneficial soil microbial communities and the plants cultivated in these soils. This eventually has lead to a high demand for organic produce by the present day health conscious society and sporadic attempts are being made byfarmers all over the world to detoxify the land by switching over to organic farming dispensing with chemical fertilizers and pesticides (**Sarkar *et al*., 2014**). Organic manure serves as an alternate practice to mineral fertilizers for improving soil structure (**Dauda *et al*., 2008**) and microbial biomass (**Suresh *et al*., 2004**). Inorganic fertilizers are costly and cause pollution. There is a huge gapbetween the requirement and availability of fertilizers. Cow urine is having nutrients like N 1%, K_2O 1.9%, and P_2O_5 in traces **(Tamhane *et al.*, 1965**).

Jeevamrutha is a low-cost improvised preparation that enriches the soil with indigenous microorganisms required for the mineralization of the soil **(Gore *et al.*, 2011)**. Organic liquid formulations like jeevamrutha and panchagavya help in the quick buildup of soil fertility through enhanced activity of soil microflora and fauna **(Kumar *et al.*, 2008).**

Panchagavya, an organic product is a potential source to play a growth promoting and providing immunity in the plant system **(Natarajan, 2002).** The presence of naturally occurring, beneficial, effective micro-organisms (EMO's) in panchagavya predominantly, lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria, and certainfungi have the beneficial effect especially in improving soil quality, growth, and yield of crops **(Xu and Xu, 2000; Selvaraj *et al.*, 2007)**. The spraying schedule helps in the supply of recommended nutrients to the crop regularly. **Vallimayil and Sekar (2012)** reported to Panchagavya is an organic product blended from five different cow products, commonly applied to crop plants in organic farming. It is used as foliar spray, soil application and seed treatment.

By keeping these points in mind, the present investigation entitled, **"Efficacy of Liquid Organics on Growth and Yield of Cowpea (*Vigna Unguiculata* L.) under Natural Farming"**, was conducted at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during *Zaid* season of 2022, with the following objectives.

MATERIALS AND METHODS

The methodology, materials, and the techniques adopted in this present experiment entitled, **"Efficacy of Liquid Organics on Growth and Yield of Cowpea (*Vigna Unguiculata* L.) under Natural Farming"**, was carried out at Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *Zaid* season of 2022. The soil of the experimental field constitutes a part of central Gangetic alluvium and is neutral and deep. The soil was sandy loam in texture, low in organic carbon (0.75%) and medium in available nitrogen (269.96 kg/ha), phosphorus (33.10 kg/ha), and low in potassium (336 kg/ha), pH (7.1) and zinc. The experimental field was laid out in Randomized Block Design (RBD). The treatments comprised of 3 levels of panchagavya and 3 levels of Jeevamrutha. There were 9 treatments each replicated thrice, randomly arranged in each replication and divided into 27 plots. The treatment combinations are T_1 Panchagavya 2 % + control, T_2 Panchagavya 2 %+ Jeevamrutha 500 l/ha,

T_3 Panchagavya 2% + Jeevamrutha 1000 l/ha, T_4 Panchagavya 4 % + control, T_5 Panchagavya4 %+ Jeevamrutha 500 l/ha, T_6 Panchagavya 4 %+ Jeevamrutha 1000 l/ha, T_7 Panchagavya 6 %+ control, T_8 Panchagavya 6 %+ Jeevamrutha 500 l/ha, T_9 Panchagavya 6 %+ Jeevamrutha 1000 l/ha. The data recorded on different aspects of crop *viz.*, growthparameters, yield attributes and economics were subjected to statistical analysis by variance method **(Gomez and Gomez, (1984)**.

RESULT AND DISCUSSION

GROWTH PARAMETERS

At 80 DAS the data recorded that significant and higher plant height (84.34 cm) was observed in Panchagavya(6%)+ Jeevamrutha 1000l/ha(T_9). However, Panchagavya (6%) + Jeevamrutha 500 l/ha (83.52 cm), Panchagavya (6 %) + control (82.65 cm) and Panchagavya (4 %) + Jeevamrutha 500 l/ha (81.41 cm) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha. The IAA and GA present in panchagavya when applied as foliar spray could have created stimuli in the plant system and increased the production of growth regulators in cell system and the action of growth regulators in plant system ultimately stimulated the necessary growth and development. Similar findings were also reported by **Patel (2012).**

Number of branches/ plant - The data recorded that significant and maximum number of branches (5.34) was recorded with application of Panchagavya (6 %) + Jeevamrutha 1000 l/ha(T_9). However, Panchagavya (6 %) + Jeevamrutha 500 l/ha (4.87), Panchagavya (6 %) + control (4.74), Panchagavya (4 %) + Jeevamrutha 1000 l/ha (4.78) and Panchagavya (4 %) + control (4.65) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.The auxin content in Panchagavya upon its application leads to the activation of cell division and cell elongation in the auxiliary buds which had a promoting effect in increased number of branches, leaves and leaf area. The application of panchagavya would have induced the endogenous synthesis of native auxins resulting in an early active growth **(Reshma *et al.*, 2018)**.

Number of nodules/ plant - The data recorded that significant and maximum nodule (13.32 nodules/plant) recorded with application of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. However, Panchagavya (6 %) + Jeevamrutha 500 l/ha (11.65), Panchagavya (4 %) + Jeevamrutha 500 l/ha (10.89) and Panchagavya (2 %) + Jeevamrutha 1000 l/ha (11.07) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

Enhanced growth parameters due to interaction of jeevamrutha and panchagavya might be due to synergistic effect of *Rhizobacteria* with Panchagavya spray and soil application of jeevamrutha has helped translocation of carbohydrates to developing root nodules as reported by **Sait and Mehmet Kibritei (2016) and Velmurgan and Mahendran (2015).**

Plant dry weight - The data recorded that significant and maximum dry matter accumulation (17.96 g/plant) was recorded with application of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. However, Panchagavya (6 %) + Jeevamrut 500 l/ha (17.84 g/plant) and Panchagavya (4 %) + Jeevamrutha 500 l/ha (16.78 g/plant) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

Yield and yield parameters

Number of pods/ plant - The data recorded that significant and higher number of pods/plants were observed in the treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha(T_9) recording 25.47 pods/plant. Treatment Panchagavya (6 %) + Jeevamrutha 500 l/ha (23.65 pods/plant) and Panchagavya (4 %) + Jeevamrutha 1000 l/ha (24.80 pods/plant) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

Number of seeds/ pod - The data recorded that significant and maximum number of seeds/pod (11.78) was observed in the treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha(T_9). However, Panchagavya (6 %) + Jeevamrutha 500 l/ha (11.43 seeds/pod), Panchagavya(6%) + control (10.65 pods/plant) and Panchagavya (4 %) + Jeevamrutha 500 l/ha (10.04 seeds/pod) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

The effect of panchagavya on vegetative growth (plant height, number of leaves and branches per plant) and reproductive growth (pods per plant, pod length, seeds per pod, test weight and seed yield per plant) were considered as the important yield attributes having a significant positive correlation with seed and haulm yield. These findings are in line with the findings of **Devakumar (2014)**.

Seed index - The maximum test weight (23.33 g) was recorded in the treatment Panchagavya (2 %) + Jeevamrutha 500 l/ha. The minimum test weight (20.67 g) was recorded in the treatmentcombination Panchagavya (4 %) + control.

Seed yield - The significantly maximum seed yield of cowpea (1.78 t/ha) was observed in the treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. However, Panchagavya (6 %) + Jeevamrutha 500 l/ha (1.69 t/ha), Panchagavya (4 %) + Jeevamrutha 1000 l/ha (1.48 t/ha) and Panchagavya (4 %) + Jeevamrutha 500 l/ha (1.55) were statistically at par Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

Crop yield is the complex function of physiological processes and biochemical activities, which modify plant anatomy and morphology of the growing plants. Seed and stover yield of chickpea were significantly influenced by different treatments of panchagavya application **Pratik *et al.* (2020).**

Stover yield - The significantly maximum stover yield of cowpea (3.99 t/ha) was observed in the treatment combination of Panchagavya (6 %) + Jeevamrutha 1000 l/ha. However, Panchagavya (6 %) + Jeevamrutha 500 l/ha (3.58 t/ha), Panchagavya (6 %) + control (3.48 t/ha) and Panchagavya (4 %) + Jeevamrutha 500 l/ha (3.68 t/ha) were statistically at par with Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

Harvest index - Significantly higher Harvest index of cowpea was observed in the treatment combination of Panchagavya (4 %) + Jeevamrutha 500 l/ha (37.71 %).

Improvement in yield and yield attributes might be due to stimulation in root growth by inorganic nutrients as well better absorption of water and nutrients complementary effect of Jeevamrutha and Panchagavya after fermentation which favors the higher yield. These findings are in line with those reported by **Avudaithai *et al.* (2010) and Kumar *et al.* (2011).**

Economics

The result revealed (Table 3)that maximum gross return (71,200.00 INR/ha), higher net returns (31,300.00 INR/ha), and highest benefit cost ratio (1.71) was recorded in the treatment Panchagavya (6 %) + Jeevamrutha 1000 l/ha.

CONCLUSION

As per my research trial, the treatment combination of Panchagavya (6%) + Jeevamrutha 1000 l/ha(T_9) was found to be more productive. Although the findings are based on one season, further research is needed to confirm the findings and their recommendation.

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Table 1. Efficacy of liquid organics on growth parameters of Cowpea.

S. No.	Trearment Combinations	Plant height (cm)	No. of branches/ plant	No. of nodules/ plant	Plant dry weight (g/plant)
1	Panchagavya (2 %) + control	73.93	3.56	9.77	14.43
2	Panchagavya (2 %) + Jeevamrutha 500 l/ha	74.47	4.12	8.34	12.87
3	Panchagavya (2 %) + Jeevamrutha 1000 l/ha	78.88	3.98	11.07	14.67
4	Panchagavya (4 %) + control	75.76	4.65	7.36	16.52
5	Panchagavya (4 %) + Jeevamrutha 500 l/ha	81.41	4.43	10.89	16.78
6	Panchagavya (4 %) + Jeevamrutha 1000 l/ha	74.79	4.78	10.43	15.08
7	Panchagavya (6 %) + control	82.65	4.74	9.44	16.56
8	Panchagavya (6 %) + Jeevamrutha 500 l/ha	83.52	4.87	11.65	17.84
9	Panchagavya (6 %) + Jeevamrutha 1000 l/ha	84.34	5.34	13.32	17.96
	F test	S	S	S	S
	SEm±	1.34	0.23	0.94	0.40
	CD (P = 0.05)	4.02	0.72	2.82	1.26

Table 2. Efficacy of Liquid Organics on Yield attributes of Cowpea

S. no.	Treatment combinations	Pods/plant	Seeds/ pods	Seed Index(g)	Seedyield (t/ha)	Stoveryield (t/ha)	Harvest index (%)
1	Panchagavya (2 %) + control	16.45	8.67	21.00	0.88	2.32	27.50
2	Panchagavya (2 %) + Jeevamrutha 500 l/ha	19.23	9.90	23.33	0.99	2.54	28.05
3	Panchagavya (2 %) + Jeevamrutha 1000 l/ha	17.98	9.67	21.54	1.23	2.43	33.61
4	Panchagavya (4 %) + control	22.67	10.04	20.67	1.03	3.68	21.87
5	Panchagavya (4 %) + Jeevamrutha 500 l/ha	22.54	9.87	21.00	1.55	2.56	37.71
6	Panchagavya (4 %) + Jeevamrutha 1000 l/ha	24.80	10.54	22.00	1.48	3.12	32.17
7	Panchagavya (6 %) + control	21.56	10.65	22.23	1.36	3.48	28.10
8	Panchagavya (6 %) + Jeevamrutha 500 l/ha	23.65	11.43	22.49	1.69	3.58	32.07
9	Panchagavya (6 %) + Jeevamrutha 1000 l/ha	25.47	11.78	21.33	1.78	3.99	30.85
	F test	S	S	NS	S	S	S
	SEm±	0.95	0.42	0.42	0.10	0.15	0.83
	CD (P = 0.05)	2.87	1.40	-	0.33	0.49	2.63

Table 3. Effect of liquid organic manures and spraying schedule on economics of Cowpea

S. No.	Treatment combination	Gross returns (`/ha)	Net returns (`/ha)	B:C ratio
1	Panchagavya (2 %) + control	26400	16900	1.78
2	Panchagavya (2 %) + Jeevamrutha 500 l/ha	39600	24400	1.61
3	Panchagavya (2 %) + Jeevamrutha 1000 l/ha	49200	28300	1.35
4	Panchagavya (4 %) + control	41200	22200	1.17
5	Panchagavya (4 %) + Jeevamrutha 500 l/ha	62000	37300	1.51
6	Panchagavya (4 %) + Jeevamrutha 1000 l/ha	59200	28800	0.95
7	Panchagavya (6 %) + control	54400	25900	0.91
8	Panchagavya (6 %) + Jeevamrutha 500 l/ha	67600	33400	0.98
9	Panchagavya (6 %) + Jeevamrutha 1000 l/ha	71200	31300	0.78