



Effect of Cow-based Liquid Manure and Spraying Schedule on Growth and Yield of Cowpea (*Vigna unguiculata* L.) under Natural Farming

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid* (summer), 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P), India. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), organic carbon (0.75%), available nitrogen (269.96 Kg/ha), available phosphorus (33.10 Kg/ha), and available potassium (336 Kg/ha). The treatments comprised of Panchagavya (3%), Jeevamrutha (500 lit/ha), cow urine (2500 lit./ha), and spraying schedule on (7, 10 &15) different days. The experiment was laid out in Randomized Block Design with nine treatments each replicated three times. The results showed that; Plant height (91.36 cm), number of branches per plant (5.47), number of nodules per plant (15), plant dry weight (20.31 g/plant) were recorded significantly higher with Panchagavya (3%) + at an interval of 7 days. Whereas, the number of pods per plant (7.27), number of seeds per pod (12.33), seed yield (1.28 t/ha), and stover yield (4.02 t/ha) was recorded significantly higher with the application of Panchagavya (3%) + at an interval of 7 days. Thus, foliar application of cow-based liquid manure with a different spraying schedule could be a promising option for yield enhancement in cowpea.

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1. INTRODUCTION

Cowpea is scientifically named as *Vigna unguiculata* (L.), is one of the most important pulse crops. Cowpea belongs to the order Rosales, family Fabaceae, and genus *Vigna* which consists of 169 species. It is grown primarily for its chief source of dietary protein lysine. It is used as a pulse or green pod vegetable and haulm as an excellent animal feed. Inorganic fertilizers are costly and cause pollution. There is a huge gap between the requirement and availability of fertilizers. Organic farming practices provide balanced nutrition thereby taking care of soil health by improving physical, chemical, and biological properties of the soil through the easy release of nutrients and nutrient cycling now a day's people have recognized the importance of organic fertilizers. Demand for organically produced food is high, it has a symbiotic association with *Rhizobium* bacteria which plays an important role in fixing atmospheric nitrogen symbiotically.

India is the largest producer (25 % of global production), the consumer (27 % of world consumption), and the importer (14 %) of pulses in the world [1]. Pulses account for around 20 percent of the area under food grains and contribute around 7 to 10 percent of the total food grain production in the country. Cowpea is an important pulse crop of India that occupies an area of 3.9 M ha with a production of 2.2 M T and productivity of 564 Kg per hectare.

Apart from using conventional farm-based products, there is an increasing demand for improvised materials like cow-urine, *Jeevamrutha*, *Panchagavya*, fish amino acids, fermented plant juices, etc. which mainly enrich the soil with indigenous microorganisms. Cow urine is having nutrients like N 1%, K₂O 1.9%, and P₂O₅ in traces [2]. *Jeevamrutha* is a low-cost improvised preparation that enriches the soil with

indigenous microorganisms required for the mineralization of the soil [3]. [4] examined cow urine for its acidic and phenolic content. They obtained benzoic acid (68.4%), phenylacetic acid (17.4%), α -hydroxybenzoic acid (1.75%) α -phenyl propionic acid (0.7%), 3- indole acetic acid (0.1%), β -3-indole propionic acid (0.55%), 3, 4-dimethoxy benzoic acid (0.99%). They also obtained phenolic compounds in cow urine. The presence of naturally occurring, beneficial, effective micro-organisms (EMO's) in *Panchagavya* predominantly, lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria, and certain fungi have the beneficial effect especially in improving soil quality, growth, and yield of crops [5] & [6]. The spraying schedule helps in the supply of recommended nutrients to the crop regularly. Blanket application of nutrients may not be taken by plants properly but, foliar application through plant parts consume directly by crop. Therefore, present study was taken to investigate the Effect of Cow-based Liquid Manures and Spraying Schedule on Growth and Yield of Cowpea (*Vigna unguiculata* L.) under Natural Farming.

2. MATERIALS AND METHODS

The method taken for germination test was "Top of Paper (TP) Media" at Agronomy laboratory, SHUATS, Prayagraj on 16th March 2021. Germination of cowpea var. *Gomathi* had recorded as 86.6%. A field trial was conducted during *Zaid* (summer season), 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P), India which is located at 25°39'42" N latitude, 81°67'56" E longitude, and 98m altitude above the mean sea level (MSL). The soil was sandy loam in texture, low in organic carbon and medium in available nitrogen, phosphorus, and low in potassium. The experiment was laid out in Randomized Block Design with nine treatments each replicated three times. The treatments combination are;

Treatments	Organic Liquid-Manure	Spraying schedule at
1	<i>Panchagavya</i> (3%)	7 days interval
2	<i>Panchagavya</i> (3%)	10 days interval
3	<i>Panchagavya</i> (3%)	15 days interval
4	<i>Jeevamrutha</i> (500 lit/ha)	7 days interval
5	<i>Jeevamrutha</i> (500 lit/ha)	10 days interval
6	<i>Jeevamrutha</i> (500 lit/ha)	15 days interval
7	Cow urine (2500 lit/ha)	7 days interval
8	Cow urine (2500 lit/ha)	10 days interval
9	Cow urine (2500 lit/ha)	15 days interval

The date of sowing was 6th April 2021 with the seed rate of 20 Kg/ha. The number of spraying at 7, 10, and 15 days were 11, 8, and 5, respectively. The growth parameters of the plants were recorded at frequent intervals from germination up until harvest and finally, the yield parameters were recorded after harvest. The growth parameters such as plant height, number of branches, number of nodules, and plant dry weight. The yield parameters such as numbers of pods per plant, number of seeds per pod, seed index, seed yield, stover yield, and harvest index. These parameters were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design [7].

3. RESULTS AND DISCUSSION

Effect on the growth of cowpea. As can be seen in Table.1, growth parameters are summarized statistically. significantly taller plant height (121.71 cm) was recorded with application of Panchagavya (3%) which sprayed at an interval of 7 days. However, Panchagavya (3%) which sprayed at an interval of 10 days (90.75 cm), Jeevamrutha which sprayed at an interval of 7 days (90.40 cm), Cow urine which sprayed at an interval of 10 days (88.45 cm) were statistically at par with Panchagavya (3%) which sprayed at an interval of 7 days. Significantly maximum number of branches (5.47) was recorded with application of Panchagavya (3%) which sprayed at an interval of 7 days. The minimum number of branches was recorded in the treatment combination Cow urine which sprayed at an interval of 15 days (3.87). Significantly maximum nodules (15.00) recorded with application of Panchagavya (3%) which sprayed at an interval of 7 days. However, Jeevamrutha which sprayed at an interval of 10 days (13.20) was statistically at par with Panchagavya (3%) which sprayed at an interval of 7 days. The minimum nodules were recorded in the treatment combination Cow urine which sprayed at an interval of 15 days (8.53). Maximum dry matter accumulation (17.31) was recorded with application of Panchagavya (3%) which sprayed at an interval of 7 days. However, Panchagavya (3%) which sprayed at an interval of 10 days (19.15), Jeevamrutha which sprayed at an interval of 7 days (19.43) were statistically at par with Panchagavya (3%) which sprayed at an interval of 7 days. The minimum dry matter accumulation was recorded in the treatment combination Cow urine which sprayed at an interval of 15 days (12.25). The results

demonstrate that the *Indole-acidic-acid* and *Gibberellic acid* present in *Panchagavya*, when applied as a foliar spray, could have created stimuli in the plant system and increased the production of growth regulators in the cell system and the action of growth regulators in the plant system ultimately stimulated the necessary growth and development. Similar findings were also reported by [8]. 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 an increasing the 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 [9]. Enhanced growth parameters due to interaction of *jeevamrutha* and *Panchagavya* might be due to the synergistic effect of *Rhizobacteria* with *Panchagavya* spray and soil application of *jeevamrutha* has helped translocation of carbohydrates to develop root nodules as reported by [10]. [11] reported that in Petri plate culture the green gram seedlings showed significant growth increase at 4 percent *Panchagavya* treatment, but *Panchagavya* at 6 percent generally inhibited the plant height, fresh and dry mass of the seedlings. In a pot study, 3 percent *Panchagavya* spray at 10 days after sowing significantly increased the growth of green gram plants. Lateral roots, the number of nodules, fresh and dry mass of the plants increased significantly at 3 and 4 percent treatment.

Effect on the yield of cowpea. As can be seen in Table 2, yield parameters are summarized statistically. In the time of harvest, the significantly maximum number of pods/plant (7.27) of cowpea were observed in the treatment combination of *Panchagavya* (3%) which sprayed at an interval of 7 days. The minimum number of pods per plant (4.33) was observed in Cow urine which sprayed at an interval of 15 days. Significantly the maximum number of seeds/plant (12.33) of cowpea were observed in the treatment combination of *Panchagavya* (3%) which sprayed at an interval of 7 days. The minimum number of seeds per plant (5.47) was observed in Cow urine which sprayed at an interval of 15 days. The significantly maximum test weight (24 g) was recorded in the treatment *Jeevamrutha* which sprayed at an interval of 7 days. However, *Panchagavya* (3%) which sprayed at an interval of 7 days, *Panchagavya* (3%) which sprayed at an interval of 15 days, Cow Urine which sprayed at an interval of 7 days

statistically at par with *Jeevamutha* which sprayed at an interval of 7 days. The minimum test weight (19.33 g) was recorded in the treatment combination Cow urine which sprayed at an interval of 15 days. The significantly maximum seed yield of cowpea (1.28 t/ha) was observed in the treatment combination of *Panchagavya* (3%) which sprayed at an interval of 7 days. However, *Jeevamutha* sprayed at an interval of 7 days, Cow urine which sprayed at an interval of 7 days were statistically at par with *Panchagavya* (3%) which sprayed at an interval of 7 days. Significantly maximum stover yield of cowpea (4.02 t/ha) was observed in the treatment combination of *Panchagavya* (3%) which sprayed at an interval of 7 days. However, *Panchagavya* (3%) which sprayed at an interval of 10 days, *Panchagavya* (3%) which sprayed at an interval of 15 days, *Jeevamutha* which sprayed at an interval of 7 days, *Jeevamrutha* which sprayed at an interval of 15 days were statistically at par with *Panchagavya* (3%) which sprayed at an interval of 7 days. There was no significant difference among the treatments in harvest index. The maximum Harvest index of cowpea was observed in the treatment combination of *Panchagavya* (3%) which sprayed at an interval of 7 days (23.24%). The minimum harvest index of cowpea was observed in the treatment combination of Cow urine which

sprayed at an interval of 15 days (21.13%). The results demonstrate that 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 [12]. [13] 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. 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 [14] & [15]. [16] reported that in groundnut foliar application of *panchagavya* and leaf extract of neem recorded a significantly higher number of nodules, number of pods per plant, pod weight per plant, pod yield, haulm yield, harvest index, 100 kernels weight, shelling percent, nitrogen, and phosphorus uptake and oil content over other sources.

Table 1. Effect of Cow-based Liquid Manures and Spraying Schedule on Growth of Cowpea under Natural Farming

Treatment	At harvest			
	Plant height (cm)	Number of Branches per plant	Number of Nodules per plant	Plant dry weight (g/plant)
1	91.36 **	5.47 **	15.00 **	20.31 **
2	90.75 *	5.00	12.73	19.15 *
3	87.45	4.80	12.33	15.80
4	90.40 *	5.13	9.80	19.43 *
5	87.49	4.87	13.20 *	15.99
6	84.87	4.60	10.07	15.70
7	88.45 *	5.00	10.87	16.97
8	79.66	4.47	9.07	15.25
9	75.95	3.87	8.53	14.91
F-value	23.92	17.00	8.42	3.55
SEm (±)	1.08	0.11	0.74	0.13
CD (p=0.05)	3.24	0.33	2.22	3.24

1- *Panchagavya* (3%) + spraying at 7 days interval, 2 - *Panchagavya* (3%) + spraying at 10 days interval 3- *Panchagavya* (3%) + spraying at 15 days interval, 4- *Jeevamrutha* + spraying at 7 days interval, 5 - *Jeevamrutha* + spraying at 10 days interval, 6 -*Jeevamrutha* + spraying at 15 days interval, 7 - Cow urine + spraying at 7 days interval, 8 - Cow urine + spraying at 10 days interval, 9 - Cow urine + spraying at 15 days interval.

**=Highly significant *=Significant CD= Critical Difference
In each column, mean followed with the same letter(s) are not significantly different (P=0.05)

Table 2. Effect of Cow-based Liquid Manures and Spraying Schedule on Yield of Cowpea under Natural Farming

Treatment	At harvest					
	Pods/plant	Seeds/pod	Seed Index	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1	7.27 **	12.33 **	22.67 *	1.28 **	4.02 **	23.24
2	5.67	10.13	22.00	1.18	3.90 *	22.35
3	5.00	7.80	23.00 *	1.08	3.99 *	19.63
4	6.33	10.67	24.00 **	1.24 *	3.92 *	23.07
5	5.20	8.60	21.33	1.10	3.71	21.98
6	4.87	7.47	20.67	1.09	4.14 *	19.98
7	5.27	9.20	22.67 *	1.12 *	3.69	22.20
8	4.60	6.27	19.67	1.04	3.52	20.57
9	4.33	5.47	19.33	0.98	3.48	21.13
F-value	48.85	24.96	8.85	26.07	13.02	NS
SEm (±)	0.13	0.44	0.53	0.02	0.06	0.87
CD (p=0.05)	0.39	1.31	1.59	0.06	0.19	-

1- *Panchagavya* (3%) + spraying at 7 days interval, 2 - *Panchagavya* (3%) + spraying at 10 days interval 3- *Panchagavya* (3%) + spraying at 15 days interval, 4- *Jeevamrutha* + spraying at 7 days interval, 5- *Jeevamrutha* + spraying at 10 days interval, 6 -*Jeevamrutha* + spraying at 15 days interval, 7 - Cow urine + spraying at 7 days interval, 8 - Cow urine + spraying at 10 days interval, 9 - Cow urine + spraying at 15 days interval.

**=Highly significant * =Significant NS= not significant CD= Critical Difference
In each column, mean followed with the same letter(s) are not significantly different (P=0.05)

4. CONCLUSION

Based on my research trail, the combination of treatment 1 with *Panchagavya* (3%) which sprayed at 7-day intervals was found to be more productive and economically feasible. Hence, these liquid formulations are efficient organic substitutes in different spraying schedule obtaining higher crop yield besides improving the nutrient status of the soil.

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COMPETING OF INTEREST

Authors have declared that no competing interests exist.

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