Original Research Article

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

Comment [m1]: What the author mean with " Natural "?? I am preferring ordinary

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 N (269.96 kgKg/ha), available P (33.10 kgKg/ha), and available K (336 kgKg/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 thrice. The results showed that viz: 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), stover yield (4.02 t/ha), and biological yield (5.52 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.

Keywords: *Panchagavya, Jeevamrutha, Cow urine, Cowpea, Growth, and Yield*

INTRODUCTION

Cowpea, [*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%, K_2O 1.9%, and P_2O_5 in traces [2][**14**]. *Jeevamrutha* is a low-cost improvised preparation that enriches the soil with indigenous microorganisms required for the mineralization of the soil [3][**5**]. Suemitsu [4][**12**] 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 [6]~~[15]~~ & [5]~~[11]~~**.** The spraying schedule helps in the supply of recommended nutrients to the crop regularly. Blanket application of nutrients may not be intake by plants properly but, foliar application through plant parts intake 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. Walp) under Natural Farming.

MATERIALS AND METHODS

The method that was carried out for the 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,* 2021 (summer season) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) 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 thrice. The treatments which are ~~with T_1 - *Panchagavya* (3%) + spraying at 7 days interval, T_2 - *Panchagavya* (3%) + spraying at 10 days interval T_3 - *Panchagavya* (3%) + spraying at 15 days interval, T_4 - *Jeevamrutha* + spraying at 7 days interval, T_5 - *Jeevamrutha* + spraying at 10 days interval, T_6 - *Jeevamrutha* + spraying at 15 days interval, T_7 - Cow urine + spraying at 7 days interval, T_8 - Cow urine + spraying at 10 days interval, T_9 - Cow urine + spraying at 15 days interval.~~

Treatments	Manure	Spraying at
T1	*Panchagavya* (3%)	7 days interval
T_2	*Panchagavya* (3%)	10 days interval
T_3	*Panchagavya* (3%)	15 days interval
T_4	*Jeevamrutha*	7 days interval
T_5	*Jeevamrutha*	10 days interval
T_6	*Jeevamrutha*	15 days interval
T_7	Cow urine	7 days interval
T_8	Cow urine	10 days interval
T_9	Cow urine	15 days interval

The date of sowing was 06th April 2021 with the seed rate of ~~20kg~~20Kg/ha. The number of spaying at 7, 10, and 15 days are 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, 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]**[**4**].

RESULTS AND DISCUSSION

Effect on the growth. As can be seen in Table.1, growth parameters are summarized statistically.

Plant height (cm). The Significantly taller plant height (91.36 cm) was recorded in T_1 with *Panchagavya* (3%) ~~+~~ which spraying at 7 days intervals. The IAA and GA 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]**.

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~~A n~~**Number of branches.** The significantly higher number of branches (5.47) was recorded at T_1 with *Panchagavya* (3%) ~~+~~ which was ~~spraying~~ sprayed at 7 days intervals. 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 an ~~increased~~ 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[[**~~10~~**].

~~A n~~Number of nodules. A maximum number of nodules (15.00) was recorded T_1 with *Panchagavya* (3%) + spraying at 7 days intervals. 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 Sait and Mehmet [10] [**~~13~~**].

Plant dry weight (g/plant). The highest plant dry matter accumulated in T_1 with *Panchagavya* (3%) + spraying at 7 days intervals. Kumaravelu and Kadamban [11] **~~[7]~~** 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.

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/plant	Number of Nodules/plant	Plant dry weight (g/plant)
T_1	91.36±SE	5.47±SE	15.00±SE	20.31±SE
T_2	90.75±SE	5.00±SE	12.73±SE	19.15±SE
T_3	87.45±SE	4.80±SE	12.33±SE	15.80±SE
T_4	90.40±SE	5.13±SE	9.80±SE	19.43±SE
T_5	87.49±SE	4.87±SE	13.20±SE	15.99±SE
T_6	84.87±SE	4.60±SE	10.07±SE	15.70±SE
T_7	88.45±SE	5.00±SE	10.87±SE	16.97±SE
T_8	79.66±SE	4.47±SE	9.07±SE	15.25±SE
T_9	75.95±SE	3.87±SE	8.53±SE	14.91±SE
F-~~test~~value	xx.xxx ~~S~~	xx.xxx ~~S~~	xx.xxx ~~S~~	xx.xxx
~~SEm (±)~~	~~1.08~~	~~0.11~~	~~0.74~~	~~0.13~~
~~CD (p=0.05)~~	~~3.24~~	~~0.33~~	~~2.22~~	~~3.24~~

T_1- *Panchagavya* (3%) + spraying at 7 days interval, T_2 - *Panchagavya* (3%) + spraying at 10 days interval T_3 - *Panchagavya* (3%) + spraying at 15 days interval, T_4 - *Jeevamrutha* + spraying at 7 days interval, T_5 - *Jeevamrutha* + spraying at 10 days interval, T_6 -*Jeevamrutha* + spraying at 15 days interval, T_7 - Cow urine + spraying at 7 days interval, T_8 - Cow urine + spraying at 10 days interval, T_9 - Cow urine + spraying at 15 days interval.

**=Highly significant *=Significant NS= not significant

In each column, mean followed with the same letter(s) are not significantly different (*P*=0.05)

Effect on the yield. As can be seen in Table.2, yield parameters are summarized statistically.

~~A n~~Number of pods per plant. At harvest, the significantly maximum number of pods/plant (7.27) of cowpea were observed in the treatment ~~combination~~ of *Panchagavya* (3%) ~~+ at~~with an interval of 7 days. The minimum number of pods per plant (4.33) was observed in Cow urine ~~+ at~~with an interval of 15 days. 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 et al. [12] [**~~3~~**].

~~A n~~Number of seeds per pod. At harvest, significantly the maximum number of seeds/plant (12.33) of cowpea were observed in the treatment ~~combination~~ of *Panchagavya* (3%) ~~+~~ with ~~at~~ an interval of 7 days. The minimum number of seeds per plant (5.47) was observed in Cow urine ~~+ at~~with an interval of 15 days.

Comment [m3]: F-values must be added with its significance star(s), i.e., ** or *. Significant letters must be added after each mean within each column to differentiate between treatments

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Seed Index (100 seeds). The significantly maximum test weight (24.00) was recorded in the treatment Jeevamutha~~+ at~~ withy an interval of 7 days. However, *Panchagavya* (3%) ~~+ at~~with an interval of 7 days, *Panchagavya* (3%) ~~+ at~~with an interval of 15 days, Cow Urine~~+ at~~ with an interval of 7 days statistically at par with Jeevamutha~~+ at~~ with an interval of 7days. The minimum test weight (19.33) was recorded in the treatment ~~combination~~ Cow urine ~~+ at~~with an interval of 15 days. Pratik et al. [13] **[9]** 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.[where is the author discussion??

Seed yield (t/ha). The significantly maximum seed yield of cowpea (1.28 t/ha) was observed in the treatment ~~combination~~ of *Panchagavya* (3%) ~~+ at~~with an interval of 7 days. However, Jeevamutha~~+ at~~ with an interval of 7 days, Cow urine ~~+ at~~with an interval of 7 days were statistically at par *Panchagavya* (3%) ~~+ at~~with an interval of 7 days. **[where the discussion??]**

Stover yield (t/ha). The significantly maximum stover yield of cowpea (4.02 t/ha) was observed in the treatment ~~combination~~ of *Panchagavya* (3%) ~~+ at~~with an interval of 7 days. However, *Panchagavya* (3%) ~~+ at~~with an interval of 10 days *Panchagavya* (3%) ~~+ at~~with an interval of 15 days Jeevamutha~~+ at~~ with an interval of 7 days, Jeevamutha~~+ at~~ with an interval of 15 days were statistically at par *Panchagavya* (3%) ~~+ at~~with an interval of 7 days. **[where the discussion??]**

Harvest index (%). There was no significant difference among the treatments. The maximum Harvest index of cowpea was observed in the treatment ~~combination~~ of *Panchagavya* (3%) ~~+ at~~with an interval of 7 days (23.24%). The minimum harvest index of cowpea was observed in the treatment ~~combination~~ of Cow urine ~~+ at~~with an interval of 15 days (21.13%). 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.**[14]**[2]** & **Kumar et al. [15]**[6]. [where is the final and general discussion??]

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 (%)
T_1	7.27±SE	12.33±SE	22.67	1.28±SE	4.02±SE	23.24
T_2	5.67±SE	10.13±SE	22.00	1.18±SE	3.90±SE	22.35
T_3	5.00±SE	7.80±SE	23.00	1.08±SE	3.99±SE	19.63
T_4	6.33±SE	10.67±SE	24.00	1.24±SE	3.92±SE	23.07
T_5	5.20±SE	8.60±SE	21.33	1.10±SE	3.71±SE	21.98
T_6	4.87±SE	7.47±SE	20.67	1.09±SE	4.14±SE	19.98
T_7	5.27±SE	9.20±SE	22.67	1.12±SE	3.69±SE	22.20
T_8	4.60±SE	6.27±SE	19.67	1.04±SE	3.52±SE	20.57
T_9	4.33±SE	5.47±SE	19.33	0.98±SE	3.48±SE	21.13
F-~~test~~value	~~S~~xx.xxx	~~S~~xx.xxx	~~S~~xx.xxx	~~S~~xx.xxx	~~S~~xx.xxx	~~NS~~xx.xxx
~~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~~	-

T_1- *Panchagavya* (3%) + spraying at 7 days interval, T_2 - *Panchagavya* (3%) + spraying at 10 days interval T_3 - *Panchagavya* (3%) + spraying at 15 days interval, T_4 - *Jeevamrutha* + spraying at 7 days interval, T_5 - *Jeevamrutha* + spraying at 10 days interval, T_6 -*Jeevamrutha* + spraying at 15 days interval, T_7 - Cow urine + spraying at 7 days interval, T_8 - Cow urine + spraying at 10 days interval, T_9 - Cow urine + spraying at 15 days interval.

**=Highly significant *=Significant NS= not significant

In each column, mean followed with the same letter(s) are not significantly different (*P*=0.05)

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CONCLUSION

Based on my research trail, the treatment combination of T_1 with *Panchagavya* (3%) + spraying at 7-day intervals was found to be more productive and also economically feasible. Although the findings are based on one season, further research is needed to confirm the findings and their recommendation.

Comment [m8]: In any experimental research, one season results is not recommended, at least 2 successive seasons will be acceptable.

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