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Combinative Effect of Liquid Organic Manures and Spraying Schedule on Growth and Yield of Cowpea 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

During *Zaid,* 2022, a field experiment was conducted at Crop Research Farm, Department of Agronomy, Sam Higginbottom university of Agriculture, Technology and Sciences, Prayagraj (U.P). The soil in experimental plot was found to be sandy loam in texture, nearly neutral in soil reaction (pH 7.1). The soil had 0.76% natural carbon, 269.97 kg/ha available N and 33.09 kg/ha available P. The treatments applied were Panchagavya (30 ml/lit), Jeevamrutha (250 ml/lit), cow urine (100 ml/lit), with the spraying schedule of every 7, 10 & 15 alternative intervals. The experiment plot was designed in a randomized block of nine treatments, three times each. Based on the objectives taken, maximum plant height (88.07 cm), total number of branches (5.02/m^2), number of nodules

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(40.87), plant dry matter accumulation (20.66 g/plant), maximum number of pods per plant (25.67), number of seeds per pods (11.60), seed yield (1.62 t/ha), stover yield (3.89 t/ha), biological yield (5.54 t/ha) were observed significantly higher in treatment combination of Panchagavya (30 ml /lit) spraying interval at 10 days interval. However, the maximum gross returns (₹ 97,200.00/ha), net returns (₹ 61,385.00/ha), and benefit: cost ratio (1.71) was found to be higher in Panchagavya (30 ml /lit) spraying interval at 10 days interval treatment combination.

Keywords: Panchagavya; jeevamrutha; cow urine; cowpea; growth and yield.

1. INTRODUCTION

"Cowpea (*Vigna unguiculata* L.) is also known as Black eyed pea. It is considered to be one of the most important pulse crops. Cowpea is a multipurpose arid grain legume and is broadly cultivated in arid and semiarid regions of Asia and Africa. It is native to central Africa, and belongs to Fabaceae family. It is commercially grown all over India for its green pods which are used as vegetable. It is one of the most ancient human food. It can be used as a pulse or green pod vegetable and haulm as an excellent animal feed. The amino acid details reveals that lysine, leusine and phenylanine contents are higher in cowpea. Cowpea plays an vital role in the Indian diet on having highest of protein content (23.14 %), which is double than the cereals. It also contains fibre (3.9%), ash (3.20 %), fat (1.3 %) and carbohydrates (56.8 %). Cowpea is grown as mulch crop, intercrop, mixed crop and green crop, catch crop. It also helps to improve the soil fertility by the atmospheric nitrogen fixation in the soil (56 kg N/ha to the successive crop) in association with symbiotic bacteria under favorable conditions" [1]. The result of this symbiosis is the formation of nodules in the roots of the plant, and in the nodules the bacteria can convert atmospheric nitrogen to ammonia and be used by the plant in "fertilizer and pesticide free agriculture". India is the world's largest producer of pulses (25% of global production),consumer (27% of global consumption) and exporter of pulses (14%) [16]. "The current global scenario firmly highlights the need to adopt environment friendly agricultural practices for sustainable agriculture. Chemical agriculture has made an adverse effect on the healthcare on both soil and beneficial soil microbial communities and the plants cultivated in those soils. This ultimately has led to a high demand for organic produce by the present day health conscious society and unbalanced attempts are being made by farmers all over the world to purify the land by switching to organic farming providing with chemical fertilizers and pesticides. Organic manure serves as an alternate practice to mineral fertilizers for improving the soil structure" [2] and microbial biomass [3]. "Inorganic fertilizers are costly and also causes pollution. There is a massive gap between the requirement and availability of fertilizers" [4]. Cow urine contains nutrients like N 1%, K2O 1.9%, and P2O5 in trace amounts.

Jeevamrutha is a low-cost, easy-to-prepare which enriches the soil with natural organisms essential for mineralization [5]. "Organic liquid formulations like jeevamrutha and panchagavya benefit in speedy buildup of soil fertility through boosted activity of soil fauna and microflora" [15].

"Panchagavya, is an organic product is a potential source for providing immunity and play a growth promoting in the plant system" [6]. "The presence of Naturally occurring, beneficial, beneficial bacteria (EMO) are found in panchagavya, especially lactic acid bacteria, yeasts, actinomycetes, photosynthetic bacteria, growth promoting factors like IAA, GA and certain fungi comprises beneficial effect in improving soil quality, growth, and yield of crops" [7,8]. "The spraying interval helps in the supply of recommended nutrients to the crop. Panchagavya is an organic product made from five different cow products, usually applied to crop plants in organic farming. It is used as foliar spray, soil application and seed treatment" [9].

"Cow urine contains N, P, K, Na, S, Ca, Mg, Cu, I, NH_3, silver, urea, uric and oxalic acid, lead, hippuric acid, ethylene oxide, glycosides, glucose, citric acid, alkaline, creatinine, eltine, enzymes, steroids phosphates, lead, propylene oxide, acetate, andesine, carbolic acid and growth substances" [10]. [19] examined "cow urine for its phenolic content and acidic nature. They found benzoic acid (68.4%), phenylacetic acid (17.4%), α-hydroxybenzoic acid (1.75%) α-phenyl propionic acid (0.7%), β-3-indole propionic acid (0.55%), 3,4-dimethoxy benzoic

acid (0.99%). 3- indole acetic acid (0.1%), They also found phenolic compounds in cow urine".

By keeping these points in mind, the present investigation entitled, "Combinative Effect of Liquid Organic Manures and Spraying Schedule on Growth and Yield of Cowpea 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.

1. To evaluate the effect of cow-based liquid manures and spraying schedule on growth and yield of cowpea under natural farming.
2. To work out the economics of different treatment combinations

2. MATERIALS AND METHODS

The methodology, materials, and the techniques adopted in this present experiment entitled, "Combinative Effect of Liquid Organic Manures and Spraying Schedule on Growth and Yield of Cowpea Under Natural Farming", was carried out during *Zaid* season of 2022 at Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The soil in the experimental field constitutes a part of central Gangetic alluvium and deep and is neutral. The soil was sandy loam in texture, low in natural carbon (0.76%) and medium in available nitrogen (269.97 kg/ha), phosphorus (33.09 kg/ha), and low in potassium (336 kg/ha), pH (7.1) and zinc. The experimental field was designed in a Randomized Block Design (RBD). The treatments comprised of panchagavya, Jeevamrutha and Cow urine with different spraying intervals. There were 9 treatments each repeated thrice, randomly arranged in each replication and divided into 27 plots. The treatment combinations are T_1: Panchagavya (30 ml/lit) + at an interval of 7 days, T_2: Panchagavya (30 ml/lit) + at an interval of 10 days, T_3: Panchagavya (30 ml/lit) + at an interval of 15 days, T_4: Jeevamrutha (250 ml/lit) + at an interval of 7 days, T5: Jeevamrutha (250 ml/lit) + at an interval of 10 days, T_6 : Jeevamrutha (250 ml/lit) + at an interval of 15 days, T_7: Cow urine (100 ml/lit) + at an interval of 7 days, T_8: Cow urine (100 ml/lit) + at an interval of 10 days, and T_9: Cow urine (100 ml/lit) + at an interval of 15 day.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

At 80 DAS, significantly maximum plant height (88.07 cm) was observed with application of Panchagavya (30 ml/lit) + at an interval of 10 days. However, Panchagavya (30 ml/lit) + at an interval of 7 days (84.71), Panchagavya (30 ml/lit) + at an interval of 15 days (80.86 cm), Jeevamrutha (250 ml/lit) + at an interval of 10 days (83.38 cm) and Cow urine (100 ml/lit) + at an interval of 7 days (86.27 cm) were statistically at par with Panchagavya + at an interval of 10 days.

Patel et al. [17] reported that the presence of GA and IAA in panchagavya could have caused the stimuli in plant systems and increased the production of growth regulators in the cell system and action of growth regulators that eventually stimulated the growth and development when applied as foliar spray.

Number of branches/ plant - The data recorded that significantly maximum number of branches (5.02) were observed with application of Panchagavya (30 ml/lit) + at an interval of 10 days. However, Panchagavya (30 ml/lit) + at an interval of 7 days (4.65), Jeevamrutha (250 ml/lit) + at an interval of 10 days (4.78) and Panchagavya (30ml/lit) + at an interval of 15 days (4.59), were statistically at par with Panchagavya (30ml/lit) + at an interval of 10 days.

"The presence of auxin content in Panchagavya after its application results in the activation of cell division and cell elongation in the auxiliary buds which promotes the increased growth of the number of branches, leaves and leaf area. The application of panchagavya would have encouraged the endogenous synthesis of native auxins resulted in early active growth" [11].

Number of nodules/ plant - The data recorded the significantly maximum nodules (40.87 nodules/plant) observed with application of Panchagavya (30ml/lit) + at an interval of 10 days. Jeevamrutha (250 ml/lit) + at an interval of 7 days (38.32), Jeevamrutha (250 ml/lit) + at an interval of 10 days (40.07), Jeevamrutha (250 ml/lit) + at an interval of 15 days (39.44) and Cow urine (100 ml/lit) + at an interval of 10 days (38.65) were statistically at par with Panchagavya (30ml/lit) + at an interval of 10 days.

Table 1. Effect of liquid organic manures and spraying schedule on growth parameters of cowpea

S. No.	Treatment Combinations	Plant height (cm)	No. of branches/ plant	No. of nodules/ plant	Plant dry weight (g/plant)
1	Panchagavya (30 ml/lit) + at an interval of 7 days	84.71	4.65	34.40	18.84
2	Panchagavya (30 ml/lit) + at an interval of 10 days	88.07	5.02	40.87	20.66
3	Panchagavya (30 ml/lit) + at an interval of 15 days	80.86	4.59	36.79	16.67
4	Jeevamrutha (250 ml/lit) + at an interval of 7 days	79.46	4.42	38.32	19.52
5	Jeevamrutha (250 ml/lit) + at an interval of 10 days	83.38	4.78	40.07	16.78
6	Jeevamrutha (250 ml/lit) + at an interval of 15days	78.80	4.37	39.44	17.08
7	Cow urine (100 ml/lit) + at an interval of 7 days	86.27	4.49	37.67	18.56
8	Cow urine (100 ml/lit) + at an interval of 10 days	77.85	4.42	38.65	17.43
9	Cow urine (100 ml/lit) + at an interval of 15 days	78.66	3.56	37.43	15.87
	F test	S	S	S	S
	SEm±	2.41	0.15	1.83	1.04
	CD (P = 0.05)	7.30	0.47	5.49	3.20

Table 2. Effect of liquid organic manures and spraying schedule on yield attributes of cowpea

S. no.	Treatment combinations	Pods/ plant	Seeds/ pod	Seed Index(g)	Seed yield (t/ha)	Stover yield(t/ha)	Harvest index (%)
1	Panchagavya (30 ml/lit) + at an interval of 7 days	22.27	10.33	22.67	1.54	3.43	28.09
2	Panchagavya (30 ml/lit) + at an interval of 10 days	25.67	11.60	21.00	1.62	3.89	29.78
3	Panchagavya (30 ml/lit) + at an interval of 15 days	23.00	9.80	22.00	1.19	2.45	28.78
4	Jeevamrutha (250 ml/lit) + at an interval of 7 days	19.33	8.67	21.00	1.38	3.20	26.94
5	Jeevamrutha (250 ml/lit) + at an interval of 10 days	24.20	11.06	23.33	1.32	2.99	30.63
6	Jeevamrutha (250 ml/lit) + at an interval of 15days	22.67	9.47	22.67	1.02	2.67	25.21
7	Cow urine (100 ml/lit) + at an interval of 7 days	21.27	10.23	21.67	1.03	3.37	26.74
8	Cow urine (100 ml/lit) + at an interval of 10 days	19.60	9.27	20.67	0.88	2.88	23.40
9	Cow urine (100 ml/lit) + at an interval of 15 days	17.33	8.47	21.33	0.96	3.02	24.12
	F test	S	S	NS	S	S	S
	SEm±	0.95	0.42	0.42	0.13	0.20	0.83
	CD (P = 0.05)	2.87	1.40	-	0.45	0.69	2.63

Table 3. Economics of cowpea on effect of liquid organic manure and spraying schedule

S. no	Treatment combinations	Total cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
1.	Panchagavya (30 ml/lit) + at an interval of 7 days	41,515.00	92,400.00	50,885.00	1.23
2.	Panchagavya (30 ml/lit) + at an interval of 10 days	35,815.00	97,200.00	61,385.00	1.71
3.	Panchagavya (30 ml/lit) + at an interval of 15 days	30,115.00	71,400.00	41,285.00	1.37
4.	Jeevamrutha (250 ml/lit) + at an interval of 7 days	39,315.00	82,800.00	43,485.00	1.11
5.	Jeevamrutha (250 ml/lit) + at an interval of 10 days	34,215.00	79,200.00	44,985.00	1.31
6.	Jeevamrutha (250 ml/lit) + at an interval of 15days	29,115.00	61,200.00	32,085.00	1.10
7.	Cow urine (100 ml/lit) + at an interval of 7 days	24,465.00	61,800.00	37,335.00	1.53
8.	Cow urine (100 ml/lit) + at an interval of 10 days	23,415.00	52,800.00	29,385.00	1.25
9.	Cow urine (100 ml/lit) + at an interval of 15 days	22,365.00	57,600.00	35,235.00	1.58

**Economics not subjected to data analysis*

"Improved growth parameters due to interaction of jeevamrutha and panchagavya might be due to collaborative effect of Rhizobacteria with Panchagavya spray and soil application of jeevamrutha has helped translocation of carbohydrates to developing root nodules as reported" by [12] and [13].

Plant dry weight - The data observed the maximum dry matter accumulation (20.66 g/plant) was recorded with application of Panchagavya (30 ml/lit) + at an interval of 10 days. Panchagavya (30 ml/lit) + at an interval of 7 days (18.84 g/plant), Jeevamrutha + at an interval of 7 days (19.52 g/plant) and Cow urine (100 ml/lit) + at an interval of 7 days (18.56 g/plant) was statistically at par with Panchagavya (30 ml/lit) + at an interval of 10 days.

3.2 Yield and Yield Parameters

Number of pods/ plant - The data recorded the significantly higher number of pods/plants were observed in the treatment combination of Panchagavya (30 ml/lit) + at an interval of 10 days recording 25.67 pods/plant. Treatment Panchagavya (30 ml/lit) + at an interval of 15 days (23.00 pods/plant) and Jeevamutha + at an interval of 10days (24.20 pods/plant) were statistically at par with Panchagavya (250 ml/lit) + at an interval of 10 days.

Number of seeds/ pod - The data recorded significantly maximum number of seeds/pod (11.60) was observed in the treatment combination of Panchagavya (30 ml/lit) + at an interval of 10 days. However, Panchagavya (30ml/lit) + at an interval of 7 days (10.33 seeds/pod), Jeevamutha (250 ml/lit) + at an interval of 10 days (11.06 pods/plant) and Cow Urine (100 ml/lit) + at an interval of 7 days (10.23 seeds/pod) were statistically at par with Panchagavya (30ml/lit) + at an interval of 10 days. The minimum number of seeds per plant (8.47) was recorded in Cow urine (100 ml/lit) + at an interval of 15 days.

Seed index - The significantly maximum seed index (23.33) was recorded in the treatment Jeevamutha (250 ml/lit) + at an interval of 10 days. The minimum test weight (20.67) was recorded in the treatment combination Cow urine (100 ml/lit) + at an interval of 10 days.

Seed yield - The significantly maximum seed yield of cowpea (1.62 t/ha) was observed in the treatment combination of Panchagavya (30 ml/lit) + at an interval of 10 days. However, Panchagavya (30 ml/lit) + at an interval of 7 days (1.54 t/ha), Jeevamutha (250 ml/lit) + at an interval of 7 days (1.19 t/ha), Jeevamutha (250 ml/lit) + at an interval of 10 days (1.38 t/ha) and Jeevamutha (250 ml/lit) + at an interval of 15 days (1.32 t/ha) were statistically at par Panchagavya (30 ml/lit) + at an interval of 10 days. [18] reported that "the 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 influenced by different treatments of panchagavya application".

Stover yield - The significantly higher stover yield of cowpea (3.89 t/ha) was observed in the treatment combination of Panchagavya (30 ml/lit) + at an interval of 10 days. Panchagavya (30 ml/lit) + at an interval of 7 days (3.43 t/ha), Jeevamutha (250 ml/lit) + at an interval of 7 days (3.20 t/ha), Cow urine (100 ml/lit) + at an interval of 7 days (3.37 t/ha) were statistically at par Panchagavya (30 ml/lit) + at an interval of 10 days.

Harvest index - Significantly higher Harvest index was observed in cowpea when treated with of Jeevamutha (250 ml/lit) + at an interval of 10 days (30.63%).

Avudaithai et al. [14] and Kumar et al. [15] reported that "Improvement in yield and yield attributes might be due to stimulus 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".

3.3 Economics

From the results (Table 3) the highest gross return (97,200.00 INR/ha), net returns (61,385.00 INR/ha), and benefit cost ratio (1.71) were observed in the treatment of Panchagavya (30 ml/lit) + at an interval of 10 days

4. CONCLUSION

As per the present research trial, the treatment combination of Panchagavya (30 ml/lit) with spraying interval at 10 days interval was found to be more productive.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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