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Research Article

Evaluation of productivity and profitability of summer season forage cowpea at varying jeevamrit formulations and their application interval

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Abstract

The concept of 'Zero Budget Natural Farming' is gaining popularity among the farmers due to their increasing awareness about soil, plant, animal and human health as well as increasing cultivation cost. The present study was carried out to optimize the jeevamarit formulation and their spraying interval in summer forage cowpea. The experiment was conducted with treatments consisting of three jeevamrit formulations *viz.* jeevamrit-1 (5 kg cow dung + 2.5-liter cow urine), jeevamrit-2 (10 kg cow dung + 5-liter cow urine) and jeevamrit-3 (15 kg cow dung + 7.5-liter cow urine); and three spraying intervals (at every one, two and three week's intervals). The results revealed that both formulations and their spraying interval had a significant effect on fodder yield, nutritional quality, net energy for lactation, nutrient uptake, net returns and benefit cost ratio. The maximum green fodder yield was recorded with spraying of jeevamrit formulations-3 at every 2-week interval (32.4 t ha^{-1}). The maximum net returns (Rs 22853 ha^{-1}) and B:C ratio (1.81) was recorded with spraying of jeevamrit formulations-2 at every 2-week intervals. Thus, spraying of jeevamrit formulations-2 at every 2-week interval was found to be most effective for maximum productivity, profitability and quality of summer season forage cowpea.

Keywords: Forage cowpea, Forage quality, Jeevamrit, Natural farming, Net energy for lactation

Introduction

Green revolution technologies overcame the food shortage of our country and transformed it from ship-to-mouth to self-sufficient, and now it is the exporter of major agricultural commodities. But indiscriminate and disproportionate use of chemical fertilizers and pesticides and intensive agriculture practices led to soil toxicity, diminishing water resources, soil salinity, loss of soil fertility, global warming, and increased incidence of human and livestock diseases (Rahman, 2015). Looking at the negative effects of these chemical fertilizers and pesticides on soil health and their increasing cost, some farmers are now thinking of practicing the methods that improve beneficial microorganisms in soil and reduce cultivation costs. Natural Farming or Zero Budget Natural Farming discourages buying inputs like chemical fertilizers and pesticides and advocates enhancing the beneficial microorganisms in soil. In this farming, jeevamrit is claimed as a panacea and it is reported that a consortium of beneficial microorganisms in jeevamrit converts the nutrients which are in non-available form to available form (Kaur *et al*., 2021). Jeevamrit enhances microbial activity in the soil and helps in the improvement of soil fertility (Joshi, 2012). The application of liquid formulations of beejamrit and jeevamrit would supplement the application of bio-fertilizers and they can be easily prepared by farmers using locally available materials (Devakumar *et al*., 2014). However, the information related to the preparation and application of jeevamrit and beejamrit in field crops, particularly in forage crops, is very meager. Hence, there is a need to generate information on the preparation of different jeevamrit formulation and their frequency of application in forage crops. Therefore, the present study was conducted to identify the suitable jeevamrit formulation with appropriate spraying intervals and to evaluate their effect on productivity, quality and profitability of summer season forage cowpea.

Materials and Methods

***Study area and soil site*:** A field experiment was carried out to identify the suitable jeevamrit formulation and their spraying interval in forage cowpeas during the summer season of 2022 at an agriculture farm, ICAR-Central Institute for Research on Goats, Makhdoom, Mathura (Uttar Pradesh). The soil of the experimental field was neutral in reaction (pH 7.1) with EC of 0.22 dS m^{-1}. The soil was low in organic carbon (0.28%), medium in available nitrogen (256 kg ha^{-1}) and potassium (159 kg ha^{-1}); and high in available phosphorus (38 kg ha^{-1}).

Experimental design and treatments: The treatments consist of three jeevamrit formulations (jeevamrit-1, jeevamrit-2 and jeevamrit-3) and three spraying intervals (at 1-week intervals, at every 2-week intervals and at every 3-weeks interval). The experiment was laid out in a factorial randomized block design with three replications. The field was allocated into 27 plots and each plot was 6 m x 8 m in size. All treatments were allocated randomly to each plot. The details of the preparation of different jeevamrit formulations are in Table 1.

Cultural operations and treatment application: A Cowpea variety Russian giant was sown on 24th March, 2022 with row-to-row spacing of 30 cm by using the seed rate of 25 kg ha^{-1}. The seeds were treated with beejamrit before the sowing. The beejamrit was prepared by using 5 kg cow dung + 5 liter cow urine + 50 g lime + one handful of soil in 20 liters of water. The spraying of jeevamrit was done as per the treatments. The crop was harvested 72 days after sowing for fodder.

Observations recorded: The growth parameters (were measured at harvest of green fodder. Green fodder harvest was done from the net plot and then converted into t ha^{-1} to obtain green fodder yield. The randomly collected green fodder samples were first dried in the sun and then transferred in a hot air oven for drying at a temperature of 65°C till constant weight. On the basis of these samples, the green fodder yields were converted into dry fodder yield and were expressed in t ha^{-1}. Green and dry fodder production efficiency was calculated by using the following formula-

Table 1. Quantity of ingredients used for the preparation of different jeevamrit formulation

Jeevamrit formulation	Ingredients
Jeevamrit-1	5 kg cow dung + 2.5 liter cow urine + 2 kg pulse flour + 2 kg jaggery + one hand full of soil + 200 liter water
Jeevamrit-2	10 kg cow dung + 5 liter cow urine + 2 kg pulse flour + 2 kg jaggery + one hand full of soil+ 200 liter water
Jeevamrit-3	15 kg cow dung + 7.5 liter cow urine + 2 kg pulse flour + 2 kg jaggery + one hand full of soil + 200 liter water

*Different jeevamrit formulations were used at the 5th day of their preparation for spraying

$$\text{Green or Dry fodder production efficiency (kg ha}^{-1}\text{ day}^{-1}) = \frac{\text{Green or dry fodder yield (kg ha}^{-1})}{\text{Days for cutting}}$$

Fodder quality and nutrient analysis: The oven-dried samples of cowpea were grounded and used for proximate analysis. The crude protein (%) of the sample was calculated by multiplying the N content with the factor 6.25. Ether extract (EE) was analyzed by Soxhlet's extraction apparatus (AOAC, 2005). Ash was determined by placing the sample in a muffle furnace for ignition at 550°C for 2 to 3 hours (AOAC, 2005). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed as described by Van soest *et al.*, (1991) and AOAC (2005), respectively. Total digestible nutrients (TDN), digestible dry matter (DDM), dry matter intake (DMI), relative feed value (RFV), and net energy for lactation (NE_l) were estimated according to the following equations adapted from Horrocks and Vallentine (1999) whereas, relative feed quality (RFQ) adapted from Undersander *et al*. (2010).

$$\text{TDN} = -1.291 \times \text{ADF} + 101.35$$

$$\text{DMI} = 120/\%\text{NDF on dry matter basis}$$

$$\text{DMD} = 88.9 - (0.779 \times \text{ADF})$$

$$\text{RFV} = \text{DMD} \times \text{DMI} \times 0.775$$

$$\text{RFQ} = \frac{(\text{DMI, \% of BW}) \times (\text{TDN, \% of DM})}{1.23}$$

$$NE_l \text{ (Mcal/kg)} = [1.044 - (0.0119 \times \text{ADF})] \times 2.205$$

Estimation of nutrients in forage cowpeas was done as per the following methods (Table 2).

Economic analysis: To find out the most profitable treatments, the economics of different treatments were worked out.

Net return = Gross return (Rs ha^{-1}) – Cost of cultivation (Rs ha^{-1}) and B: C ratio = Gross return (Rs ha^{-1})/cost of cultivation (Rs ha^{-1}).

Statistical analysis: All the data were subjected to statistical analysis by adopting the appropriate method described by Gomez and Gomez (1984). All the data were subjected to ANOVA using MS Excel (2010). The critical difference (CD) was found by using p = 0.05 and the significance was decided as α <0.05.

Results and Discussion

Growth and forage yield: Different jeevamrit formulations and their spraying interval had a significant effect on the growth, forage yield, and forage production efficiencies of summer cowpeas (Table 3). Significantly highest plant height (182 cm), number of leaves per plant (50.7), green fodder yield (29.2 t ha^{-1}), dry fodder yield (5.2 t ha^{-1}), and green (406 kg ha^{-1} day^{-1}) and dry (73 kg ha^{-1} day^{-1}) fodder production efficiencies were recorded with the application of jeevamrit formulations-3 (15 kg cow dung + 7.5-liter cow urine). However, jeevamrit formulations-2

Table 2. Methods for estimation of nitrogen, phosphorus and potassium

Nutrient	Method
N	Micro Kjeldahl method
P	Vanadomolybdate phosphoric method (Richards, 1968)
K	Flame Photometeric method (Richards,1968)

(10 kg cow dung + 5-liter cow urine) recorded comparable growth and forage yield parameters with jeevamrit formulations-3. The higher growth and forage yield of summer cowpea with jeevamrit formulations-3 (15 kg cow dung + 7.5-liter cow urine) might be due to their higher nutrient concentration and microbial population as compared to jeevamrit-1 (5 kg cow dung + 2.5-liter cow urine) as Devakumar *et al.* (2008) had reported the presence of many beneficial microorganisms *viz*., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in jeevamrit. Further, among the treatments of different spraying intervals, spraying of jeevamrit at every 1-week interval recorded significantly highest plant height (186 cm), no. of branches per plant (3.38), number of leaves per plant (51.4), green fodder yield (29.7 t ha^{-1}), dry fodder yield (5.3 t ha^{-1}), and green (413 kg ha^{-1} day^{-1}) and dry (74 kg ha^{-1} day^{-1}) fodder production efficiencies. However, spraying of jeevamrit at every 1-week interval and every 2-week interval was recorded at par value of growth and forage yield of summer cowpea. The higher growth and forage yield of cowpea at spraying of jeevamrit at every 1-week interval might be due to the fact that frequent application of jeevamrit added more nutrients to the canopy of the plants which led to higher growth and yield of the plants. Kaur *et al.* (2021) recorded that the application of jeevamrit (20%) at 2-week intervals recorded the highest dry matter accumulation per square meter in wheat. Sutar *et al*. (2018) reported that the application of jeevamrit at 1000 liter ha^{-1} recorded significantly taller plants and a higher number of branches per plant than the application of jeevamrit at 500 liter ha^{-1} in cowpea.

Proximate chemical constituents and their yield: Crude protein, ether extract, ash, and NDF and ADF content of summer cowpea were significantly influenced by different jeevamrit formulations and their spraying interval (Table 4). Significantly highest crude protein (16.15%), ether extract (2.59%) and ash content (13.90%), whereas significantly lowest NDF (42.33%) and ADF (27.60%) content were recorded with the application of jeevamrit formulations-3. However, jeevamrit formulations-2 were recorded at par value of crude protein, ether extract, ash, NDF and ADF content with jeevamrit formulations-3. The higher value of proximate chemical constitutes with jeevamrit formulations-3 might be due to their higher nutrient concentration compared to jeevamrit-1 (5 kg cow dung + 2.5 liter cow urine) as it is an excellent source of nitrogen, phosphorus, potassium,

Table 3. Effect of different jeevamrit formulations and their spraying interval on growth and forage yield of summer cowpea

Treatment	Plant height (cm)	No. of branches $plant^{-1}$	No. of leaves $plant^{-1}$	GFY (t ha^{-1})	DFY (t ha^{-1})	GFPE (kg ha^{-1} day^{-1})	DFPE (kg ha^{-1} day^{-1})
Jeevamrit (J)							
Jeevamrit-1	166	3.22	48.1	25.0	4.3	347	60
Jeevamrit-2	178	3.30	50.0	27.8	5.0	386	69
Jeevamrit-3	182	3.35	50.7	29.2	5.2	406	73
SEM±	4	0.04	0.7	0.8	0.2	11	2
CD (P=0.05)	11	NS	2.1	2.4	0.5	33	7
Spray interval in weeks (I)							
One week	186	3.38	51.4	29.7	5.3	413	74
Two week	180	3.30	49.5	28.5	5.1	395	70
Three Week	159	3.20	47.9	23.8	4.2	331	58
SEM±	4	0.04	0.7	0.8	0.2	11	2
CD (P=0.05)	11	0.13	2.1	2.4	0.5	33	7
Interaction (J x I)							
F-test	S	NS	NS	S	NS	S	NS
SEM±	6	0.08	1.2	1.4	0.3	19	4
CD (P=0.05)	19	0.23	3.6	4.1	0.9	57	12

GFY: Green fodder yield; DFY: Dry fodder yield; GFPE: Green fodder production efficiency; DFPE: Dry fodder production efficiency

Table 4. Effect of different jeevamrit formulations and their spraying interval on proximate chemical constitutes of summer cowpea

Treatment	CP (%)	EE (%)	Ash (%)	NDF (%)	ADF (%)
Jeevamrit (J)					
Jeevamrit-1	15.44	2.46	13.27	44.30	29.18
Jeevamrit-2	16.00	2.55	13.62	42.96	28.05
Jeevamrit-3	16.15	2.59	13.90	42.33	27.60
SEM±	0.18	0.03	0.16	0.52	0.41
CD (P=0.05)	0.53	0.08	0.49	1.56	1.24
Spray interval in weeks (I)					
One week	16.40	2.63	14.06	42.02	27.31
Two week	16.04	2.56	13.62	43.05	28.27
Three Week	15.14	2.41	13.11	44.52	29.25
SEM±	0.18	0.03	0.16	0.52	0.41
CD (P=0.05)	0.53	0.08	0.49	1.56	1.24
Interaction (J x I)					
F-test	NS	NS	NS	NS	NS
SEM±	0.31	0.05	0.28	0.90	0.71
CD (P=0.05)	0.92	0.14	0.85	2.70	2.14

CP: Crude protein; EE: Ether extract; NDF: Neutral detergent fiber; ADF: Acid detergent fiber

natural carbon and lot of other micronutrients which are required for plant (Maity *et al*., 2020). Among the treatments of spraying interval, spraying of jeevamrit at every 1-week interval recorded significantly highest crude protein (16.40%), ether extract (2.63%) and ash content (14.06%); and significantly lowest NDF (42.02%) and ADF (27.31%) content of summer cowpea. However, spraying of jeevamrit at every 1-week interval and every 2-week interval was recorded at par value of proximate chemical constituents of summer cowpea. According to Aulakh *et al.* (2013), jeevamrit prepared from the dung and urine of Indian cows contains 0.04, 0.04, 0.28 and 0.43 g/l of nitrogen, phosphorus, potassium and sulfur. Hence the higher values of crude protein, ether extract and ash content at spraying of jeevamrit at every 1-week interval might be due to the fact that frequent application of jeevamrit added more nutrients to the canopy of the plants, which led to a higher value of crude protein, ether extract and ash content in summer cowpea.

Similarly, a yield of crude protein, ether extract, ash content was also significantly influenced by different jeevamrit formulations and their spraying interval (Table 5). The highest value of crude protein yield (847 kg ha^{-1}), ether extract yield (136 kg ha^{-1}) and ash yield (729 kg ha^{-1}) was recorded with the application of jeevamrit formulations-3. However, jeevamrit formulations-2 were recorded at par values of yield of these parameters with jeevamrit formulations-3. Further, spraying of jeevamrit at every 1-week interval also recorded significantly the highest value of crude protein (872 kg ha^{-1}), ether extract

Table 5. Effect of different jeevamrit formulations and their spraying interval on yield of proximate chemical constitutes of summer cowpea

Treatment	CP yield (kg ha^{-1})	EE yield (kg ha^{-1})	Ash yield (kg ha^{-1})
Jeevamrit (J)			
Jeevamrit-1	671	107	577
Jeevamrit-2	798	127	679
Jeevamrit-3	847	136	729
SEM±	31	5	27
CD (P=0.05)	93	14	81
Spray interval in weeks (I)			
One week	872	140	748
Two week	814	130	690
Three Week	631	100	546
SEM±	31	5	27
CD (P=0.05)	93	14	81
Interaction (J x I)			
F-test	NS	NS	NS
SEM±	54	8	47
CD (P=0.05)	162	24	141

CP: Crude protein; EE: Ether extract

(140 kg ha^{-1}) and ash (748 kg ha^{-1}) yield. However, spraying of jeevamrit at every 1-week interval and every 2-week interval recorded at par values of yield of these proximate chemical constitutes summer cowpea. The higher yield of proximate chemical constituents with the application of jeevamrit formulations-3 (15 kg cow dung + 7.5 liter cow urine) and with the spraying of jeevamrit at every 1-week interval might be due to higher values of crude protein, ether extract and ash content; and dry fodder yield with these treatments as yield of these parameters are calculated by multiplying the with respective dry fodder yield.

Fodder qualities and net energy for lactation: Comparative analysis of different jeevamrit formulations and their spraying interval revealed that highest value of TDN content (65.72 and 66.09%), digestible dry matter (67.40 and 67.62%), relative feed value (148.37 and 150.00%), relative feed quality (151.77 and 153.81%) and net energy for lactation (1.58 and 1.59 Mcal kg^{-1}) in summer cowpea were recorded with the application of jeevamrit formulations-3 (15 kg cow dung + 7.5 liter cow urine) among the different jeevamrit formulations and spraying of jeevamrit at every 1-week interval among the different spraying interval treatments, respectively. Further, the values of dry matter intake were found to be non-significant with different jeevamrit formulations, whereas it was highest when jeevamrit was sprayed at every 1-week interval. However, among the different jeevamrit formulations, jeevamrit formulations-2 and jeevamrit formulations-3, and among the different spraying intervals, spraying of jeevamrit at every 1-week interval and every 2-week intervals recorded at par values of fodder qualities and net energy for lactation of summer cowpea (Table 6). TDN is a measure of apparent digestible energy. The maximum value of TDN content may be attributed to the minimum value of ADF contents in the respective treatments. According to Carmi *et al.* (2006), TDN content in forage is inversely related to ADF concentration in feed; therefore, as a concentration of ADF increases, there is a decline in TDN content, which limits an animal's ability to utilize the nutrients that are present in the forage. Dry matter intake is negatively correlated with NDF, whereas digestible dry matter is negatively correlated with ADF. Horrocks and Vallentine (1999) also reported that where NDF is high, forage quality and dry matter intake are low. Relative feed value (RFV) is an index that is used to predict the intake and energy value of forage which is derived from DMD and DMI (Lithourgidis *et al.*, 2006). Differences in the digestibility of the fiber fraction can result in a difference in animal performance when forages with a similar RFV are fed. Therefore, the relative feed quality (RFQ) index has been developed to overcome this difference. According to Jeranyama and Garcia (2004) this index takes into consideration the differences in digestibility of the fiber

Table 6. Effect of different jeevamrit formulations and their spraying interval on fodder qualities and net energy for lactation of summer cowpea

Treatment	TDN (%)	DMI (%)	DDM (%)	RFV (%)	RFQ (%)	NE_l (Mcal/kg)
Jeevamrit (J)						
Jeevamrit-1	63.68	2.71	66.17	139.29	140.71	1.54
Jeevamrit-2	65.13	2.80	67.05	145.30	148.08	1.57
Jeevamrit-3	65.72	2.84	67.40	148.37	151.77	1.58
SEM±	0.53	0.03	0.32	1.89	2.15	0.01
CD (P=0.05)	1.60	NS	0.96	5.66	6.44	0.03
Spray interval in weeks (I)						
One week	66.09	2.86	67.62	150.00	153.81	1.59
Two week	64.85	2.79	66.88	144.68	147.21	1.56
Three Week	63.59	2.70	66.12	138.27	139.54	1.53
SEM±	0.53	0.03	0.32	1.89	2.15	0.01
CD (P=0.05)	1.60	0.10	0.96	5.66	6.44	0.03
Interaction (J x I)						
F-test	NS	NS	NS	NS	NS	NS
SEM±	0.92	0.06	0.56	3.27	3.72	0.02
CD (P=0.05)	2.77	0.18	1.67	9.80	11.15	0.06

TDN: Total digestible nutrients; DMI: Dry matter intake; DDM: Digestible dry matter; RFV: Relative feed value; RFQ: Relative feed quality; NE_l: Net energy for lactation fraction and can be used to more accurately predict animal performance and match animal needs. NE_l includes energy used for maintenance and milk production because energy is used with the same efficiency, whether for milk production or for maintenance. Using databases containing the ADF content of feeds and the NE_l content of those feeds, regression equations have been developed to predict NE_l from the ADF content of a feed. According to Ondarza (2000) as ADF increases, NE_l decreases.

Nutrient content and uptake: Nitrogen, phosphorus, potassium and calcium content of summer season fodder cowpea were significantly influenced by different jeevamrit formulations and their spraying intervals (Table 7). The highest value of nitrogen (2.58%), phosphorus (0.341%), potassium (2.29%) and calcium (0.204%) content were recorded with the application of jeevamrit formulations-3. However, jeevamrit formulations-2 recorded at par value of N, P, K and Ca content with jeevamrit formulations-3 in summer cowpea. The higher value of nutrient content with jeevamrit formulations-3 might be due to their higher nutrient concentration compared to jeevamrit-1 as jeevamrit prepared from 10 kg of cow dung and 10 liter of cow urine contains 0.004, 0.004 and 0.028% (Aulakh *et al*., 2018), 0.077, 0.017 and 0.013% (Gore and Sreenivasa, 2011), 1.96, 0.173 and 0.280% (Devakumar *et al*., 2014) of N, P and K, respectively. Among the treatments of spraying interval, spraying of jeevamrit at every 1-week interval recorded significantly highest nitrogen (2.62%), phosphorus (0.345%), potassium (2.32%) and calcium (0.206%) content of summer cowpea. However, spraying of jeevamrit at every 1-week interval and every 2-week interval was recorded at par value of N, P, K and Ca content in summer cowpeas. Higher values of nitrogen, phosphorus, potassium and calcium content at the spraying of jeevamrit at every 1-week interval might be due to the fact that frequent application of jeevamrit added more nutrients to the canopy of the plants, which led to higher values of N, P, K and Ca content in summer cowpea. Jeevamrit promotes immense biological activity in the soil and enhances nutrient availability to crops (Gore and Sreenivasa, 2011). According to Choudhary *et al.* (2022), higher phosphorus uptake is because of increased microbial activity, which might have helped in solubilization of native and applied phosphorus and provided a greater quantity of available phosphorus for plant uptake.

Similarly, uptakes of nitrogen, phosphorus, potassium and calcium were also significantly influenced by different jeevamrit formulations and their spraying interval (Table 8). The highest value of nitrogen (135.6 kg ha^{-1}), phosphorus (17.9 kg ha^{-1}), potassium (120.3 kg ha^{-1}) and calcium (10.7 kg ha^{-1}) uptake were recorded with the application of jeevamrit formulations-3. However, jeevamrit formulations-2 were recorded at par values of uptake of these nutrients with jeevamrit formulations-3. Further, spraying of jeevamrit at every 1-week interval

Table 7. Effect of different jeevamrit formulations and their spraying interval on nutrient content of summer cowpea

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)
Jeevamrit (J)				
Jeevamrit-1	2.47	0.309	2.12	0.184
Jeevamrit-2	2.56	0.335	2.22	0.199
Jeevamrit-3	2.58	0.341	2.29	0.204
SEM±	0.03	0.003	0.04	0.003
CD (P=0.05)	0.08	0.010	0.11	0.009
Spray interval in weeks (I)				
One week	2.62	0.345	2.32	0.206
Two week	2.57	0.336	2.23	0.203
Three Week	2.42	0.304	2.08	0.179
SEM±	0.03	0.003	0.04	0.003
CD (P=0.05)	0.08	0.010	0.11	0.009
Interaction (J x I)				
F-test	NS	NS	NS	NS
SEM±	0.05	0.006	0.06	0.005
CD (P=0.05)	0.15	0.018	0.18	0.015

Table 8. Effect of different jeevamrit formulations and their spraying interval on nutrient uptake of summer cowpea

Treatment	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Ca uptake (kg ha^{-1})
Jeevamrit (J)				
Jeevamrit-1	107.4	13.4	92.4	8.0
Jeevamrit-2	127.7	16.7	111.1	10.0
Jeevamrit-3	135.6	17.9	120.3	10.7
SEM±	5.0	0.6	4.7	0.4
CD (P=0.05)	14.9	1.7	14.0	1.0
Spray interval in weeks (I)				
One week	139.5	18.4	123.7	11.0
Two week	130.2	17.1	113.5	10.3
Three Week	100.9	12.7	86.7	7.4
SEM±	5.0	0.6	4.7	0.4
CD (P=0.05)	14.9	1.7	14.0	1.0
Interaction (J x I)				
F-test	NS	NS	NS	NS
SEM±	8.6	1.0	8.1	0.6
CD (P=0.05)	25.9	2.9	24.2	1.8

N: Nitrogen; P: phosphorus; K: Potassium; Ca: Calcium also recorded significantly highest values of nitrogen (139.5 kg ha^{-1}), phosphorus (18.4 kg ha^{-1}), potassium (123.7 kg ha^{-1}) and calcium (11.0 kg ha^{-1}) uptake. However, spraying of jeevamrit at every 1-week interval and every 2-week interval recorded par values of uptake of these nutrients in summer cowpeas. The higher uptake of nutrients with the application of jeevamrit formulations-3 and with the spraying of jeevamrit at every 1-week interval might be due to higher values of N, P, K and Ca content and dry fodder yield with these treatments as uptake of these nutrients is calculated by multiplying the nutrient content with respective dry fodder yield. A positive correlation between dry fodder yield and uptake of nitrogen, phosphorus and potassium might be a factor for higher uptake of N, P and K in fodder (Kadam *et al.*, 2020). According to Choudhary *et al.* (2022), jeevamrit has an important role in increasing nutrient concentration in plants and dry matter yield through the increased availability and solubility of nutrients in the soil and, thus, enhancing their accumulation and transportation in plants.

Economics: The gross returns, net returns and benefit-cost ratio of summer season forage cowpeas are significantly influenced by different jeevamrit formulations and their spraying interval (Table 9). The maximum gross returns (Rs 46773 ha^{-1}), net returns (Rs 17136 ha^{-1}) and benefit-cost ratio (1.58) of forage cowpea were recorded with the application of jeevamrit formulations-3. However, jeevamrit formulations-2 recorded at par values of net returns and benefit-cost ratio with jeevamrit formulations-3. The higher net returns and benefit-cost ratio with jeevamrit formulations-3 might be due to the higher green fodder yield of summer cowpeas with this treatment. Safiullah *et al.* (2018) reported the highest net income and cost-benefit ratio with the application of organic liquid manure, *i.e.,* jeevamrit. Further, among the different spraying intervals, spraying of jeevamrit every 2-week recorded the highest net returns (₹17197 ha-1) and benefit-cost ratio (1.60) of summer cowpeas significantly. However, spraying of jeevamrit at every 1-week interval and every 2-week interval was recorded at par value of net returns and benefit-cost ratio. The higher net returns and benefit-cost ratio of summer cowpeas at every 2-week spraying interval might be due to lower preparation and spraying cost of jeevamrit as compared to spraying at every 1-week interval and higher green fodder yield as compared to spraying at every 3-week interval. Kaur *et al.* (2021) reported higher net returns and benefit-cost ratio with the application of jeevamrit @ 10% at 2-week intervals.

Table 9. Effect of different jeevamrit formulations and their spraying interval on economics of summer cowpea

Treatment	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B:C ratio
Jeevamrit (J)			
Jeevamrit-1	39982	11511	1.40
Jeevamrit-2	44516	15465	1.54
Jeevamrit-3	46773	17136	1.58
SEM±	1271	1271	0.04
CD (P=0.05)	3811	3811	0.13
Spray interval in weeks (I)			
One week	47591	15020	1.46
Two week	45547	17197	1.60
Three Week	38133	11895	1.45
SEM±	1271	1271	0.04
CD (P=0.05)	3811	3811	0.13
Interaction (J x I)			
F-test	S	S	S
SEM±	2202	2202	0.08
CD (P=0.05)	6600	6600	0.23

Interaction effect of different jeevamrit formulations and spraying interval: The interaction effect of different jeevamrit formulations and spraying interval on green fodder yield of summer season forage cowpea was found significant (Fig 1). The maximum green fodder yield (32.4 t ha^{-1}) was recorded with spraying of jeevamrit formulations-3 at every 2-week interval. However, spraying of jeevamrit formulations-2 at every 2-week interval (32.0 t ha^{-1}); spraying of jeevamrit formulations-3 at every 2-week interval (29.6 t ha^{-1}); spraying of jeevamrit formulations-2 at every one week's interval (28.4 t ha^{-1}); and spraying of jeevamrit formulations-1 (5 kg cow dung + 2.5 liter cow urine) at every one week's interval (28.4 t ha^{-1}) recorded statistically at par value of green fodder yield with the spraying of jeevamrit formulations-3 at every two week's interval. The higher green fodder yield of summer cowpea with the spraying of jeevamrit formulations-3 at every one week's interval might be due to the higher nutrient concentration in jeevamrit-3 and frequent spraying of this formulation added more nutrient concentration and microbial population as compared to other formulations, which led to higher

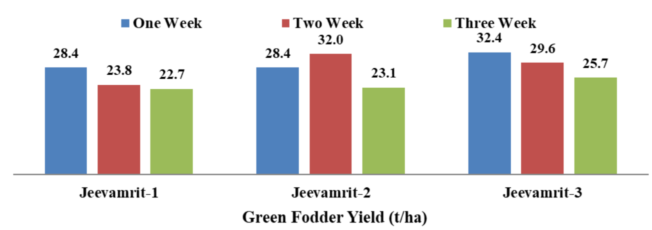

Fig 1. Interaction effect of different jeevamrit formulations and their spraying interval on green fodder yield of summer cowpea

Table 10. Interaction effect of different jeevamrit formulations and their spraying interval on net returns and B:C ratio of summer cowpea

Attributes	Net Returns (Rs ha^{-1})			B:C ratio		
	Spraying interval			Spraying interval		
Jeevamrit formulations	One week	Two week	Three week	One week	Two week	Three week
Jeevamrit-1	13796	12873	18393	1.44	1.40	1.55
Jeevamrit-2	10255	22853	18485	1.37	1.81	1.64
Jeevamrit-3	10484	10669	14531	1.40	1.41	1.55
SEM±	2202			0.08		
CD (P=0.05)	6600			0.23		

green fodder yield. Application of jeevamrit (20%) at two week's intervals recorded the highest dry matter accumulation per square meter in wheat (Kaur *et al.*, 2021). Further, an interaction effect of different jeevamrit formulations and their spraying interval was also found to be significant on net returns and the B: C ratio of summer cowpeas (Table 10). The maximum net returns (Rs 22853 ha^{-1}) and B: C ratio (1.81) were recorded with a spraying of jeevamrit formulations-2 (10 kg cow dung + 5 liter cow urine) at every 2-week interval. However, spraying of jeevamrit formulations-2 at every 3-week interval (Rs 18485 ha^{-1} and 1.64) recorded statistically at par values of net returns and B: C ratio with the spraying of jeevamrit formulations-2 at every 2-week interval. The higher net returns and benefit-cost ratio of summer cowpea with the spraying of jeevamrit formulations-2 at every 2-week interval might be due to higher green fodder yield and lower preparation and spraying cost of jeevamrit as compared to spraying of jeevamrit-3 at every one week's interval. Kaur *et al.* (2021) reported higher net returns and benefit-cost ratio with the application of jeevamrit @ 10% at 2-week intervals.

Conclusion

The research finding revealed that different jeevamrit formulations and their spraying interval had a significant effect on green and dry fodder yield; crude protein, ether extract and ash content; TDN, RFV, RFQ, net energy for lactation; content and uptakes of N, P, K and Ca; and net returns and benefit-cost ratio of summer season forage cowpea. The interaction effect of different jeevamrit formulations and spraying interval on green fodder yield, net returns and B: C ratio was also found significant. The maximum green fodder yield was recorded with spraying of jeevamrit formulations-3 (15 kg cow dung + 7.5 liter cow urine) at every 2-week interval, which was at par with spraying of jeevamrit formulations-2 (10 kg cow dung + 5 liter cow urine) at every two week's interval. The maximum net returns and B: C ratio were recorded with a spraying of jeevamrit formulations-2 (10 kg cow dung + 5-liter cow urine) at every 2-week interval. Hence, this investigation recommended spraying of jeevamrit formulations-2 (10 kg cow dung + 5-liter cow urine) at every 2-week interval for obtaining maximum productivity, profitability and quality of summer season forage cowpea.

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References

AOAC. 2005. *Official Methods of Analysis*. Eighteenth revised. Association of Official Analytical Chemists, Arlington, Virginia, USA.

Aulakh, C.S., H. Singh, S.S. Walia, R.P. Phutela and G. Singh. 2013. Evaluation of microbial culture (Jeevamrit) preparation and its effect on productivity of field crops. *Indian Journal of Agronomy* 58: 182-186.

Aulakh, C.S., H. Singh, S.S. Walia, R.P. Phutela and G. Singh. 2018. Effect of farmyard manure and jeevamrit in maize–wheat organic production system in Punjab. *Agricultural Research Journal* 55: 485-489.

Carmi, A., Y. Aharoni, M. Edelstein, N. Umiel, A. Hagiladi, E. Yosef, M. Nikbachat, A. Zenou and J. Miron. 2006. Effects of irrigation and plant density on yield, composition and in vitro digestibility of a new forage sorghum variety, Tal, at two maturity stages. *Animal Feed Science and Technology* 131: 120-132.

Choudhary, R., R. Kumar, G.D. Sharma, R.P. Sharma, N. Rana and P. Dev. 2022. Effect of natural farming on yield performances, soil health and nutrient uptake in wheat + gram intercropping system in sub-temperate regions of Himachal Pradesh. *Journal of Crop and Weed* 18: 01-08.

Devakumar, N., S. Shubha, S.B. Gouder and G.G.E. Rao. 2014. Microbial analytical studies of traditional organic preparations- beejamrutha and jeevamrutha. In: *Proceedings of 4th ISOFAR Scientific Conference on Building Organic Bridges* (October 13-15, 2014), Organic World Congress 2014, Istanbul, Turkey.

Devakumar, N., G.G.E. Rao, S. Shubha, I. Khan, Nagaraj and S.B. Gowda. 2008. Activates of Organic Farming

Research Centre. Navile, Shimoga, University of Agriculture Sciences Bangalore. pp. 12.

Gomez, K. A. and A. A. Gomez. 1984. *Statistical Procedures for Agricultural Research*. John Wiley and Sons, New York.

Gore, N.S and M.N. Sreenivasa. 2011. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. *Karnataka Journal of Agricultural Sciences* 24: 153-157.

Horrocks, R. D. and J. F. Vallentine. 1999. *Harvested Forages*. Academic Press, London, UK.

Jeranyama, P. and A. D. Garcia. 2004. Understanding relative feed value (RFV) and relative forage quality (RFQ). Extension Extra, Cooperative Extension Service. SDSU. http://agbiopubs.sdstate.edu/articles/ExEx8149.pdf

Joshi, M. 2012. *New Vistas of Organic Farming*. Scientific Publishers, New Delhi. pp. 140.

Kadam, S.S., N.S. Solanki, Mohd. Arif, L.N. Dashora and B. Upadhyay. 2020. Growth, yield and economics of dual purpose oats (*Avena sativa* L.) as affected by sowing time, cutting schedules and nitrogen levels. *Range Management and Agroforestry* 41: 87-93.

Kaur, P., J.P. Saini, Meenakshi and Avnee. 2021. Optimization of jeevamrit doses and application time for enhancing productivity of wheat under natural farming system. *Journal of Pharmacognosy and Phytochemistry* 10: 405-408.

Lithourgidis, A. S., I. B. Vasilakoglou, K. V. Dhima, C. A. Dordas, and M. D. Yiakoulaki. 2006. Forage yield and quality of common vetch mixtures with oat and triticale in two seeding ratios. *Field Crops Research* 99: 106-113.

Maity, P., R. Rijal and A. Kumar. 2020. Application of liquid manures on growth of various crops: A Review. *International Journal of Current Microbiology and Applied Science*, Special Issue 11: 1601-1611.

Ondarza, M. B. D. 2000. *Energy. Paradox Nutrition*. Nutrition consulting for the dairy industry. http://www.milkproduction.com/Library/Scientific articles/Nutrition /Energy/

Rahman, S. 2015. Green Revolution in India: Environmental Degradation and Impact on Livestock. *Asian Journal of Water, Environment and Pollution* 12:75-80.

Richards, L.A. 1968. Diagnosis and improvement of saline and alkaline soils. USDA Handbook No. 60, Oxford and IBH Pub. Co., New Delhi.

Safiullah, K., A. Durani, H. Durrani, and M. Akbar. 2018. Effect of solid and liquid organic manures on growth, yield and economics of sweet corn (*Zea mays* L. Var. Saccharata Sturt) under South Gujarat condition. *International Journal of Pure and Applied Bioscience* 6: 567-574.

Sutar, R., G.M. Sujith and N. Devakumar. 2018. N. Growth and yield of cowpea [*Vigna unguiculata* (L.) Walp] as influenced by jeevamrutha and panchagavya application. *Legume Research* 3932: 1-5.

Undersander, D., J.E. Moore and N. Schneider. 2010. Relative forage quality. *Focus on Forage* 12: 1-3.

Van Soest, P.J., J.B. Robertson and B.A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Sciences* 74: 3583-3597.