Legume Research, 42(6) 2019: 824-828
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Growth and yield of Cowpea [*Vigna unguiculata* (L.) Walp] as influenced by jeevamrutha and panchagavya application

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Received: 24-08-2017 Accepted: 09-01-2018 DOI: 10.18805/LR-3932

ABSTRACT

A field experiment was carried out during *kharif* 2015 at organic farming block of Research Institute on Organic Farming, University of Agricultural Sciences, Bengaluru to study the influence of different levels of jeevamrutha and panchagavya on growth, yield attributes and yield of cowpea in red sandy loam soil. The results revealed that application of jeevamrutha at 1000L ha^{-1} and panchagavya at 7.5% significantly influenced growth parameters like plant height, number of branches, number of leaves, leaf area and leaf area index. Interaction effect of jeevamrutha and panchagavya was significant in enhancing the grain yield of cowpea besides improvement in yield attributes like number of pods per plant, length of pods, pod weight, number of seeds per pod, seed weight per plant and 100 seed weight. Nodule characteristics – total and effective number of nodules as well fresh and dry weight of nodules was also significantly influenced by jeevamrutha and panchagavya application at different levels and also due to their interaction. Liquid organic formulations – jeevamrutha and panchagavya are effective in producing higher grain yield in cowpea.

Key words: Grain yield, Jeevamrutha, Nodule characteristics, Panchagavya.

INTRODUCTION

Cow pea (*Vigna unguiculata*) is most important among pulse crops. It is popularly called as vegetable meat as it plays an important role in Indian diet on account of high per cent of protein (23.14%) which is double than that of cereals.Conventional agriculture has made an adverse impact on soil and plant health. So as to prevent soil deterioration due to use of conventional agricultural practices and to meet demand of increased food production it has become necessary to make use of organic manures. Utilizing cheap and local inputs with zero utilization of chemicals in any form like fertilizer, herbicide, pesticide has become the simple principle of organic farming. The many benefits associated with organic farming practices have renewed interest in adoption of the same among farming community and this has started gaining momentum in all crops.

Apart from using conventional farm based products, there is an increasing demand for organic liquid formulations like jeevamrutha and panchagavya which help in quick build up of soil fertility through enhanced activity of soil microflora and fauna. Role of foliar application of Panchagavya in production of many plantation crops had been well documented in India (Selvaraj, 2003).Despite many advantages with organic liquid formulations they have not been exploited extensively in crop production and more so in cowpea crop. Keeping these facts in view, field study was planned with an objective to study the growth and yield of cowpea as influenced by jeevamrutha and panchagavya.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2015 at organic farming block of Research Institute on Organic Farming, University of Agricultural Sciences, Bengaluru. Soil of the experimental site was red sandy loam classified as *Alfisols*. Organic carbon, available nitrogen, phosphorus and potassium content of the soil were medium. The experiment was laid out in factorial randomized complete block design (FRCBD) with jeevamrutha and panchagavya as two factors and is tried at three and four levels, respectively. Thus, the 12 treatment combinations were replicated thrice and tried in FRCBD. Jeevamrutha was applied through soil and while panchagavya was applied as foliar spray.

Jeevamrutha and Panchagavya formulations - preparation and application

Jeevamrutha: Jeevamrutha was prepared by mixing 10 kg of cow dung, 10 litre of cow urine, 2 kg of local jaggery, 2 kg of pigeon pea flour and hand full of soil collected from farm. All these were put in 200 litre capacity plastic drum and mixed thoroughly and volume was made up to 200 litre. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon and in the evening continuously for 10 days and it was used for soil application. Jeevamrutha was applied when the soil was wet near the root zone of the crop as per the treatments.

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Panchagavya: Panchagavya was prepared by mixing 7 kg fresh cow dung and 1 kg ghee and incubated in a plastic drum for 2 days and it was mixed daily once. On third day, 10 litres cow urine and 10 litres of water were added and mixed thoroughly and incubated for fermentation for 13 days. Then, 3 litres milk, 2 litres curd, 100 gram yeast, 3 litres tender coconut water, 3 kg jaggery and 12 ripened Cavendish banana were added and contents were incubated for 6 days and the mixture was stirred thoroughly thrice a day. Plastic drum with all the contents was kept in shade and it was covered with wet jute bag. After 21 days of fermentation, mixture was filtered through a cotton cloth and used according to treatments schedule.

Both liquid manures-jeevamrutha and panchagavya were applied to cowpea crop at 20, 40 and 60 days after sowing. Short duration (80-90 days) variety of Cowpea - AV5 was used for the field experiment. Cowpea crop was sown on 17th August 2015 with seed rate of 30 kg ha^{-1} and seeds were sown at spacing of 45cm and seed to seed spacing of 15cm (45cm X 15cm). Irrigation was provided at 10-15 days interval depending on the stage of crop and soil condition. Necessary aftercare operations were followed as per the recommendations. No major pest and disease incidences were noticed during crop growth. Observations on growth parameters were recorded at regular intervals–30,45, 65 days after sowing and at harvest.Experimental data collected was subjected to statistical analysis by adopting Fisher's method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez (1984). Critical Difference (CD) values were calculated whenever the 'F' test was found significant at 5 per cent level.

RESULTS AND DISCUSSION

Application of jeevamrutha at different levels irrespective of different levels of panchagavya has recorded significantly higher growth parameters. Application of jeevamrutha @1000lha^{-1} has recorded higher plant height (65.60cm), number of branches (8.89), number of leaves (26.50), leaf area (1039.56cm^2) and leaf area index (1.54) compared to without application of jeevamrutha (55.82cm, 5.5, 16.65, 588.62cm^2, 0.87, respectively) (Table 1).

Application of panchagavya irrespective of different levels of jeevamrutha has resulted in significantly higher growth. Foliar spray of panchagavya @7.5 percent at 20, 40 and 60 days after sowing recorded significantly higher growth parameters like more number of branches (7.63), number of leaves (24.16), leaf area (929.38cm^2) and leaf area index (1.38) (Table 1).

Application of jeevamrutha and panchagavya at different levels has resulted in significantly higher growth parameters. Soil application of jeevamrutha @ 1000lha^{-1}

Table 1: Growth attributes of cowpea as influenced by as influenced by jeevamrutha and panchagavya.

Treatment	Plant height (cm)	Number of branches	Number of leaves	Leaf area(cm^2)	Leaf Area Index
Jeevamrutha					
J_0 – Control	55.82	5.50	16.65	588.62	0.87
J_1 – 500 litre ha^{-1}	62.03	6.88	22.70	799.75	1.18
J_2 – 1000 litre ha^{-1}	65.60	8.89	26.50	1039.56	1.54
S.Em ±	1.19	0.13	0.39	20.45	0.03
CD (P=0.05)	3.50	0.37	1.13	59.96	0.09
Panchagavya					
P_0 – Control	59.51	6.42	19.91	697.03	1.03
P_1 – Panchagavya 2.5 %	59.66	6.91	21.00	778.84	1.15
P_2 – Panchagavya 5%	64.01	7.40	22.73	831.99	1.23
P_3 – Panchagavya 7.5 %	61.41	7.63	24.16	929.38	1.38
S.Em ±	1.38	0.15	0.45	23.61	0.03
CD (P=0.05)	4.04	0.43	1.31	69.24	0.10
Jeevamrutha × Panchagavya					
J_0P_0	52.47	4.67	14.27	506.76	0.75
J_0P_1	53.93	5.73	16.67	563.19	0.83
J_0P_2	60.30	5.67	16.93	617.29	0.91
J_0P_3	56.57	5.93	18.73	667.23	0.99
J_1P_0	61.90	6.40	19.67	686.65	1.02
J_1P_1	61.97	6.47	21.60	807.73	1.20
J_1P_2	62.10	7.07	24.40	845.78	1.25
J_1P_3	63.80	7.60	25.13	858.84	1.27
J_2P_0	64.17	8.20	25.80	897.67	1.33
J_2P_1	64.73	8.53	24.73	965.60	1.43
J_2P_2	67.93	9.47	26.87	1032.89	1.53
J_2P_3	65.57	9.37	28.60	1262.08	1.87
Mean	61.29	7.09	21.95	809.31	1.20
S.Em ±	2.39	0.25	0.77	40.89	0.06
CD (P=0.05)	NS	0.72	2.26	119.93	0.18

and foliar spray of panchagavya @7.5percent at 20, 40 and 60 days after sowing recorded significantly higher growth parameters like more number of branches(9.37), number of leaves (28.60), leaf area (1262.08cm^2) and leaf area index (1.87) (Table 1).

Increase in growth attributes due to jeevamrutha application might be attributed to solubilisation of nutrients in soil and absorption of nutrients and moisture in the same line as reported by Yogananda *et al. (*2015), Jidhu Vaishnavi and Jayakumar (2016) and Siddappa *et al*. (2016).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.

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 Kibritci (2016) and Velmurgan and Mahendran (2015). Increased allocation of food materials to roots in turn enhance the root volume and there by increased root nodule per plant.

In the present investigation, application of jeevamrutha@1000l ha^{-1} recorded significantly higher grain yield (1412kg ha^{-1}) with an increase of 50.28percent over without jeevamrutha application (702kg ha^{-1}). Similarly, significantly higher haulm yield was also recorded with jeevamrutha@ 1000lha^{-1} (4957kg ha^{-1}) with an increase of 37.10percent over without jeevamrutha application (3118kgha^{-1}) (Table2).

Also, irrespective of jeevamrutha levels, foliar spray of panchagavya @7.5percent given at 20,40 and 60 days after sowing accounted for higher grain yield (1194kgha^{-1}) with an increase of 17.17percent over without panchagavya application (989kgha^{-1}). Similarly, significantly higher haulm yield was also recorded with panchagavya @ 7.5 per cent(4371kgha^{-1}) with an increase of 12.31percent over without panchagavya application (3832kgha^{-1}).

Significantly higher grain yield recorded with application of jeevamrutha @1000lha^{-1} was due to better yield attributing characters like number of pods per plant (20.57), pod length (19.8cm), number of seeds per pod(15.58), seed weight per plant (9.53g) and test weight (11.82g) (Table 2). Increased yield attributes might be due to beneficial effect of jeevamrutha which has reflected in the form of higher plant height (65.60) with more number of

Table 2: Yield attributes, grain yield and haulm yield of cowpea as influenced by as influenced by jeevamrutha and panchagavya.

Treatment	Number of pods plant^{-1}	Number of seeds pod^{-1}	Pod length (cm)	Seed weight (g plant^{-1})	100 seed weight (g)	Grain yield(kg ha^{-1})	Haulm yield(kg ha^{-1})
Jeevamrutha							
J_0 – Control	15.63	12.29	14.8	4.74	11.37	702	3118
J_1 – 500 litre ha^{-1}	17.94	13.95	17.1	7.50	11.65	1111	4122
J_2 – 1000 litre ha^{-1}	20.57	15.58	19.8	9.53	11.82	1412	4957
S.Em ±	0.34	0.26	0.10	0.20	0.02	29	103
CD (P=0.05)	1.00	0.77	0.31	0.58	0.05	86	303
Panchagavya							
P_0 – Control	16.89	13.39	16.1	6.67	11.50	989	3832
P_1 – Panchagavya 2.5 %	17.84	13.73	16.9	6.96	11.58	1031	3957
P_2 – Panchagavya 5%	18.34	14.17	17.7	7.33	11.66	1085	4101
P_3 – Panchagavya 7.5 %	19.12	14.47	18.3	8.06	11.71	1194	4371
S.Em ±	0.39	0.30	0.10	0.23	0.02	34	119
CD (P=0.05)	1.16	0.88	0.40	0.67	0.05	100	350
Jeevamrutha × Panchagavya							
J_0P_0	14.55	11.57	13.64	4.05	11.19	601	2867
J_0P_1	15.36	12.31	14.41	4.20	11.31	623	2997
J_0P_2	15.98	12.60	15.25	4.64	11.45	687	3074
J_0P_3	16.64	12.70	15.78	6.05	11.54	896	3532
J_1P_0	17.06	13.48	16.24	6.83	11.59	1011	3878
J_1P_1	18.03	13.59	16.98	7.30	11.64	1082	3989
J_1P_2	18.13	14.03	17.40	7.71	11.67	1143	4223
J_1P_3	18.55	14.69	17.75	8.16	11.70	1209	4397
J_2P_0	19.06	15.13	18.34	9.14	11.74	1354	4752
J_2P_1	20.14	15.30	19.27	9.37	11.78	1388	4885
J_2P_2	20.91	15.89	20.46	9.63	11.88	1426	5007
J_2P_3	22.16	16.02	21.31	9.98	11.90	1478	5183
Mean	18.05	13.94	17.24	7.25	11.61	1075	4065
S.Em ±	0.68	0.52	0.21	0.40	0.03	59	207
CD (P=0.05)	2.00	1.53	0.61	NS	0.09	171.1	NS

Table 3: Nodule characteristics of cowpea as influenced by jeevamrutha and panchagavya at 45 days after sowing.

Treatment	Total number of nodules (plant^{-1})	Effective number of nodules(plant^{-1})	Fresh weight of nodules(g plant^{-1})	Dry weight of nodules(g plant^{-1})
Jeevamrutha				
J_0 – Control	12.12	9.32	0.70	0.14
J_1 – 500 litre ha^{-1}	20.05	17.05	1.04	0.21
J_2 – 1000 litre ha^{-1}	28.45	25.35	1.75	0.30
S.Em ±	0.32	0.31	0.04	0.003
CD (P=0.05)	0.95	0.91	0.12	0.011
Panchagavya				
P_0 – Control	16.67	14.40	0.91	0.18
P_1 – Panchagavya 2.5 %	18.24	15.91	1.05	0.20
P_2 – Panchagavya 5%	21.18	17.89	1.23	0.22
P_3 – Panchagavya 7.5 %	24.73	20.76	1.47	0.26
S.Em ±	0.37	0.36	0.04	0.004
CD (P=0.05)	1.09	1.05	0.12	0.013
Jeevamrutha X Panchagavya				
J_0P_0	8.53	7.20	0.48	0.11
J_0P_1	9.67	8.80	0.64	0.13
J_0P_2	14.27	9.93	0.78	0.16
J_0P_3	16.00	11.33	0.88	0.17
J_1P_0	17.00	14.00	0.90	0.18
J_1P_1	19.67	16.47	0.97	0.20
J_1P_2	20.93	17.80	1.07	0.21
J_1P_3	22.60	19.93	1.22	0.23
J_2P_0	24.47	22.00	1.34	0.24
J_2P_1	25.40	22.47	1.54	0.27
J_2P_2	28.33	25.93	1.83	0.29
J_2P_3	35.60	31.00	2.30	0.38
Mean	20.21	17.24	1.16	0.21
S.Em ±	0.64	0.62	0.07	0.01
CD (P=0.05)	1.89	1.81	0.21	0.02

branches per plant (8.89) and also due to higher number of nodules (28.45,), effective root nodules (25.35,),and nodule dry weight per plant (0.3g,) (Table 3), respectively at 45 days after sowing observed with jeevamrutha application. In the present study, all the yield attributing parameters were significantly higher with jeevamrutha@1000lha^{-1} which might be due to favorable effects of IAA, GA3, macro and micronutrients. The increase in grain yield and haulm yield of cowpea due to application of jeevamrutha@ 1000lha^{-1} could be due to better availability of nutrients throughout the crop growth which might be the result of improved microbial activity in the soil. These findings are in accordance with Kasbe *et al.* (2009) and Dekhane *et al.* (2011) where in, it is reported that higher nutrient status of Jeevamrutha formulation (2500 lha^{-1}) resulted in profused growth in the form of higher drymatter accumulation and yield parameters. Whenever liquid manures are applied at regular intervals (2 to 3 times), they act as a stimulus in the plant system and in turn increase the production of growth regulators in the cell system and growth hormones which in turn might have enhanced the soil biomass, there by sustaining the availability and uptake of applied as well as native soil nutrients which ultimately have resulted in better growth and yield of crops.

Yield and yield attributes were improved due to application of both jeevamrutha and panchagavya to Cowpea. Significantly higher grain yield (1478kgha^{-1}) was recorded with the soil application of jeevamrutha @1000lha^{-1} and foliar spray of panchagavya@ 7.5percent. Haulm yield did not differ significantly. However, higher haulm yield (5183kgha^{-1}) was recorded with the soil application of jeevamrutha@1000lha^{-1} and foliar spray of Panchagavya @7.5percent.Yield increased significantly due to better yield attributing characters *viz.*,significant increase in number of pods per plant (22.16), seeds per pod (16.02), pod length (21.31cm), seed weight per plant (9.98g),100 seed weight (11.90g).

Crop yield is the complex function of physiological processes and biochemical activities, which modify plant anatomy and morphology of the growing plants. Significantly higher grain and haulm yield may be due to increased number of nodules (24.73), effective root nodules (20.76) and nodules fresh and dryweight per plant, 1.47g and 0.26g, respectively at 45 days after sowing, number of pods per plant(19.12), number of seeds per plant (14.47) and pod length (18.3cm) (Table 2), maximum 100 seed weight (11.71g) and seed weight per plant (8.06g) noticed with foliar spray of panchagavya@7.5 percent applied at 20,40 and 60

days after sowing compared with no foliar spray of panchagavya might be due to presence of IAA and GA present in panchagavya, which could create stimuli in the plant system and increased the production of growth regulators in plant system which in turn stimulated the necessary growth and development of crop. This might be due to favorable 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) which were considered as the important yield attributes having significant positive correlation with seed and haulm yield. These findings are in line with the findings of Devakumar (2014).

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 due to soil application of Jeevamrutha which further also supported the synergistic and complementary effect of Jeevamrutha and Panchagavya after fermentation which favour the higher yield. These findings are in line with those reported by Avudaithai *et al*. (2010) and Kumar *et al*. (2011).

Thus, combined application of jeevamrutha and panchagavya results in better growth and yield attributes resulting into 59 per cent increased grain yield over without application of jeevamrutha and panchagavya in cowpea. Liquid organic formulations can effectively and efficiently be used to get higher grain yield in cowpea. Hence, this study has shown the advantages with organic liquid formulations and thus they can be exploited extensively in crop production

CONCLUSION

Combined application of jeevamrutha and panchagavya resulted in better growth attributes and contributed for improved fertility status of soil. It has resulted in 59 percent increased grain yield (1478 kg ha^{-1} over control 601 kg ha^{-1}). Hence, these liquid formulations are efficient organic substitutes and they can be applied along with organic manures in an integrated approach for obtaining higher crop yield besides improving the nutrient status of the soil.

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