Mysore J. Agric. Sci., 52 (4) : 790-795 (2018)

Influence of Jeevamrutha and Panchagavya on Beneficial Soil Microbial Population and Yield of Organic Fieldbean (*Dolichos lablab* L.)

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Abstract

A study on influence of organic liquid manures, panchagavya and jeevamrutha on soil microbial population and yield of fieldbean (*Dolichos lablab* L.) was conducted at research and demonstration block of Research Institute on Organic Farming, University of Agricultural sciences, GKVK, Bengaluru. Twelve different treatments with three different levels of Jeevamrutha (0, 500, 1000 liters /ha) and Panchagavya (0, 2.5, 5 and 7.5%) were considered with fieldbean (*Dolichos lablab* L.) as a test crop. The soil samples from rhizosphere were analysed at initial and final stages of crop growth for different groups of micro-organisms by serial plate count method. Among different treatments tested, the treatment 12 (J_{1000} $P_{7.50}$) recorded maximum population of general bacteria, fungi and actinomycetes (Initial: $40.33X10^5$ CFU/g, $20.33X10^4$ CFU/g, $15.33X10^3$ CFU/g and Final: $50.33X10^5$ CFU/g, $32.33X10^4$ CFU/g, $20.33 X10^3$ CFU/g), respectively compared to control (J_0P_0). Significant difference in yield of fieldbean was observed with different levels of Jeevamrutha and Panchagavya at 7.5 per cent application. Higher yield of 1472.4 kg per ha was recorded with higher levels of Panchagavya and Jeevamrutha (7.5% and 1000 liter/ ha) application when compared to control treatment. The results indicated that the liquid manures *i.e.,* Jeevamrutha and Panchagavya have supported the multiplication of different beneficial microbial population and yield of fieldbean crop.

Keywords: Panchagavya, Jeevamrutha, Beneficial soil microbes, Organic fieldbean

Organic agriculture is now finding a place in the mainstream of development and shows great promise commercially, socially and environmentally and it combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form (Devakumar *et al*., 2014). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food, long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals (Mahdi *et al.,* 2012). Organically produced fruits, vegetables, spices and condiments, crops, medicinal and aromatic plants etc have good keeping quality than that of conventionally grown products. Sustainable agriculture practices can effectively prevent the entry of pesticides and toxicants in the food chain and prevent soil and water pollution (Boraiah *et al*., 2017).

Liquid organic formulations that are used in organic agriculture like Panchagvya, Beejamrutha and Jeevamrutha are the fermented products which are used as plant growth enhancing substances prepared with material available with farmers. They are the rich sources of beneficial micro flora which support, stimulate the plant growth and help in getting better vegetative growth and also good quality of yield. Formulations prepared using agricultural by-products, *viz.,* bran of grains, oil cakes, farmyard manure *etc*., which are found to support excellent growth carrier and storage media for beneficial microorganisms (Devakumar *et al*., 2011).

Microorganisms play a critical role in soil quality and the beneficial effects of rhizobacteria on plant growth

can be direct or indirect by which PGPR can act beneficially on plant growth by the secretion of growth hormones, biofertilization, stimulation of root growth, rhizoremediation, and plant stress control (Prasad *et al*., 2017). Application of organic manure is an important practice to enhance soil microbial activity (Edesi *et al.,* 2013*)*. Liquid organic manures play a vital role in organic agriculture, known to support beneficial microflora (Devakumar *et al*., 2014) and these liquid organic manures acts as main drivers of nutrient availability in order to improve crop growth. Therefore, an active soil microflora and a considerable pool of accessible nutrients have priority in organic farming. With this in view, a study was undertaken to know the effect of liquid organic manures on soil microbial population in fieldbean crop.

Material and Methods

A field experiment was conducted to study the influence of Panchagavya and Jeevamrutha on microbial population at research and demonstration blocks of Research Institute on Organic Farming (RIOF), University of Agricultural Sciences, Bengaluru, Karnataka, India. The Panchagavya was given as spray at four different levels and Jeevamrutha as soil application at three different levels at vegetative, flowering and pod development stages of crop growth. The treatments comprising of different combinations of Panchagavya and Jeevamrutha are,

T_1- Jeevamrutha 0 litre/ha + Panchagavya 0 %;
T_2- Jeevamrutha 0 litre/ha + Panchagavya 2.5 %;
T_3- Jeevamrutha 0 litre/ha + Panchagavya 5%;
T_4- Jeevamrutha 0 litre/ha + Panchagavya 7.5 %;
T_5- Jeevamrutha 500 litre/ha + Panchagavya 0 %;
T_6- Jeevamrutha 500 litre/ha + Panchagavya 2.5 %;
T_7- Jeevamrutha 500 litre/ha + Panchagavya 5%;
T_8- Jeevamrutha 500 litre/ha + Panchagavya 7.5%;
T_9- Jeevamrutha 1000 litre/ha + Panchagavya 0 %;
T_{10}- Jeevamrutha 1000 litre/ha + Panchagavya 2.5%;
T_{11}- Jeevamrutha 1000 litre/ha + Panchagavya 5%;
T_{12}- Jeevamrutha 1000 litre/ha + Panchagavya 7.5%.

Jeevamrutha was applied as a soil drench and Panchagavya was given as spray at different stages of crop growth. Soil samples were drawn before the imposition of treatment and finally the rhizosphere soil of fieldbean was drawn just before the harvest and was analysed for the microbial population in these two stages. Microbial population was determined by standard plate count technique. The collected soil samples were air dried, sieved and stored for microbial analysis. Ten gram of each soil sample was weighed and added to 100 ml water blank and serially diluted to different dilutions to analyze general bacteria, fungi, actinomycetes, N fixers, Phosphorus solubilising bacteria (PSB). Suitable agar medium was used for all the microorganisms' enumeration (Soil Extract agar for Bacteria, Martins Rose Bengal agar for Fungi, Kusters agar for actinomycetes, Kings B for *Pseudomonas*, Jensens agar medium for N fixers and Sperbers agar medium for Phosphorus solubilising microorganisms). The plates were incubated at 28 ± 2 ºC and the observations were recorded after 48 hours of incubation for bacteria, N-fixers, PSB and *Pseudomonas* and 72 hours of incubation for fungi and actinomycetes. The microbial counts were recorded as colony forming units per gram of soil sample tested.

All the cultural operations of fieldbean crop were done by following organic measures. Cultural and biological measures were followed organically throughout the crop growth. Yield and yield attributes were recorded according to the different treatments. The experimental data was analysed statistically by Fishers method of analysis of variance (ANOVA) outlined by Gomez and Gomez, 1984. The critical difference between treatments was determined at 5 per cent.

Results and Discussion

The yield levels and the soil microbial population were greatly influenced by the application of liquid organic manures in fieldbean. The data pertaining to influence of varied per cent levels of Jeevamrutha and Panchagavya showed significant difference in microbial population both at initial and final stages of crop growth. Microbial population was significantly higher with treatment of P 7.5 per cent and J_{1000} L/ha where a maximum of bacteria $40.33x10^5$ CFU/g, fungi $20.33x10^4$ CFU/ g, actinomycetes $15.33x10^3$ CFU/g,

N fixers 18.67x10^5 CFU/g, *Pseudomonas* 3x10^5 CFU/g, PSB 22x10^5 CFU/g at initial stages of crop growth (Table 1, 2 & 3) were recorded. Similarly, at final stages, the population was higher when compared to initial days and recorded significantly higher population of bacteria (50.33x10^5 CFU/g), fungi (32.33x10^4 CFU/g), actinomycetes (20.33 x10^3 CFU/g), N fixers (21.67x10^5 CFU/g), *Pseudomonas* (3.67 x10^5 CFU/g) and PSB (25X10^5 CFU/g) in the plants treated with higher levels of Jeevamrutha and Panchagavya .

Lower microbial population was observed in control treatment which recorded bacteria 4.33x10^5 CFU/g, fungi 4.67 x 10^4 CFU/g, actinomycetes 3.33 x 10^3 CFU/g, N fixers 6.67 x 10^5 CFU/g, *Pseudomonas* 1 x 10^5CFU/g and PSB 10 x 10^5 CFU/g initially and bacteria 5.33 x 10^5 CFU/g, fungi 8 x 10^4 CFU/g, actinomycetes 4 x 10^3 CFU/g, N fixers 10.33 x 10^5 CFU/g, *Pseudomonas* 1.33 x 10^5CFU/g and PSB 11 x 10^5 CFU/g was recorded at final stages of crop growth.

Increase in microbial population might be due to the application of liquid organic manures at different levels which in turn provides more nutrients for the soil microorganism's multiplication. These findings were on par with observations of Shashidhar *et al.,* 2009 who reported that the application of different organic manures and biofertilizers helps to enhance the soil fertility and microbial population. Devakumar *et al*., 2008; 2011 & 2014 reported that Jeevamrutha and Panchagavya are the rich source of beneficial microorganisms and nutrients which helps the plant growth. These organisms (bacteria and moulds) improve the soil health by solubilising the complex organic substrates in to simple forms and make it available to the plant, resulting in increased productivity (Pathak, et *al.*, 2010). Sreenivasa *et al.* (2011) also reported that liquid manures contains micronutrients in addition to different microflora especially nitrogen fixers and phosphate solubilizers. Organic liquid formulations are source of nutrients in considerable amount. These organic liquid formulations have direct

TABLE 1

Influence of Jeevamrutha and Panchagavya on soil bacteria and fungal population

Panchagavya Levels (%)	Jeevamrutha Levels (Litres ha^{-1})															
	Bacteria 10^5 CFU/ g								Fungi10^4 CFU/ g							
	Initial				Final				Initial				Final			
	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean
P_0	4.33	9.33	20.33	**11.33**	5.33	11.33	22.33	**13.00**	4.67	12.33	14.33	**10.44**	8.00	15.33	17.33	**13.56**
$P_{2.5\%}$	5.67	11.00	24.33	**13.67**	6.33	16.67	32.00	**18.33**	7.00	15.33	14.00	**12.11**	10.00	18.67	23.33	**17.33**
$P_{5\%}$	6.33	13.67	35.33	**18.44**	7.33	23.00	44.00	**24.78**	9.33	17.00	19.33	**15.22**	11.33	22.00	27.33	**20.22**
$P_{7.5\%}$	7.67	20.00	40.33	**22.67**	9.33	27.00	50.33	**28.89**	12.33	15.33	20.33	**16.00**	12.67	25.33	32.33	**23.44**
Mean	**6.00**	**13.50**	**30.08**		**7.08**	**19.50**	**37.17**		**8.83**	**15.00**	**17.00**		**10.00**	**20.33**	**25.08**	
	S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%	
Jeevamrutha	0.40		1.18		0.44		1.28		0.40		1.17		0.48		1.40	
Panchagavya	0.47		1.37		0.50		1.48		0.46		1.35		0.55		1.61	
J x P	0.81		S		0.87		S		0.80		S		0.95		S	

J_0: No Jeevamrutha, J_{500}: Jeevamrutha at 500 L/ha, J_{1000}: Jeevamrutha at 1000 L/ha

P_0: No Panchagavya, $P_{2.5\%}$: 2.5 per cent of Panchagavya, $P_{5\%}$: 5 per cent of Panchagavya, $P_{7.5\%}$: 7.5 per cent of Panchagavya

TABLE 2

Influence of Jeevamrutha and Panchagavya on soil Actinomycetes and N fixer population

Panchagavya Levels (%)	Jeevamrutha Levels (Litres ha^{-1})															
	Actinomycetes (10^3 CFU/ g)								N fixers (10^5 CFU/ g)							
	Initial				Final				Initial				Final			
	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean
P_0	3.33	6.67	7.67	**5.89**	4.00	9.33	10.00	**7.78**	6.67	11.00	13.67	**10.44**	10.33	11.67	17.67	**13.22**
$P_{2.5\%}$	3.67	8.33	9.33	**7.11**	4.33	9.33	12.00	**8.56**	5.33	13.00	14.33	**10.89**	8.67	13.67	17.00	**13.11**
$P_{5\%}$	4.33	9.00	12.33	**8.56**	6.33	10.00	15.33	**10.56**	9.33	11.00	16.67	**12.33**	11.33	16.67	18.00	**15.33**
$P_{7.5\%}$	5.33	10.33	15.33	**10.33**	7.00	12.00	20.33	**13.11**	8.00	11.00	18.67	**12.56**	11.00	17.33	21.67	**16.67**
Mean	**1.99**	**8.58**	**11.17**		**5.42**	**9.50**	**14.42**		**1.99**	**11.50**	**15.83**		**10.33**	**14.83**	**18.58**	
	S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%	
Jeevamrutha	0.27		0.80		0.25		0.72		0.83		2.45		0.36		1.07	
Panchagavya	0.31		0.92		0.28		0.83		0.32		0.93		0.42		1.23	
J X P	0.55		S		0.49		S		0.55		S		0.73		S	

J_0: No Jeevamrutha, J_{500}: Jeevamrutha at 500 L/ha, J_{1000}: Jeevamrutha at 1000 L/ha

P_0: No Panchagavya, $P_{2.5\%}$: 2.5 per cent of Panchagavya, $P_{5\%}$: 5 per cent of Panchagavya, $P_{7.5\%}$: 7.5 per cent of Panchagavya

TABLE 3

Influence of Jeevamrutha and Panchagavya on soil *Pseudomonas* and PSB population

Panchagavya Levels (%)	Jeevamrutha Levels (Litres ha^{-1})															
	Pseudomonas 10^5 CFU/ g								PSB10^5 CFU/ g							
	Initial				Final				Initial				Final			
	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean	J_0	J_{500}	J_{1000}	Mean
P_0	1.00	2.00	1.67	**1.56**	1.33	2.00	2.00	**1.78**	10.00	17.67	18.67	**15.44**	11.00	19.00	19.33	**16.44**
$P_{2.5\%}$	1.33	1.67	1.67	**1.56**	1.67	2.67	2.00	**2.11**	15.00	17.67	21.67	**18.11**	17.33	20.00	24.33	**20.56**
$P_{5\%}$	1.33	1.33	2.33	**1.67**	1.33	2.00	3.00	**2.11**	15.67	19.00	20.00	**18.22**	16.00	20.33	22.33	**19.56**
$P_{7.5\%}$	2.33	2.00	3.00	**2.44**	2.33	2.00	3.67	**2.67**	17.67	17.33	22.00	**19.00**	19.67	19.67	25.00	**21.44**
Mean	**1.99**	**1.75**	**2.17**		**1.67**	**2.17**	**2.67**		**15.83**	**17.92**	**20.58**		**16.00**	**19.75**	**22.75**	
	S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%		S.Em±		CD at 5%	
Jeevamrutha	0.19		0.56		0.12		0.35		0.44		1.28		0.74		2.18	
Panchagavya	0.22		0.65		0.14		0.41		0.51		1.48		0.86		2.52	
J X P	0.38		NS		0.24		S		0.88		S		1.49		NS	

J_0: No Jeevamrutha, J_{500}: Jeevamrutha at 500 L/ha, J_{1000}: Jeevamrutha at 1000 L/ha

P_0: No Panchagavya, $P_{2.5\%}$: 2.5 per cent of Panchagavya, $P_{5\%}$: 5 per cent of Panchagavya, $P_{7.5\%}$: 7.5 per cent of Panchagavya

influence on the microflora of the soil, intern N fixation, P solubilisation which was in conformity with findings of Biradar *et al*. (2017).

Significant difference in yield of fieldbean was observed with different levels of Jeevamrutha and Panchagavya application. Among the different levels, higher yield of 1472.7 kg / ha was recorded with higher levels of Panchagavya (7.5 per cent) and Jeevamrutha (1000 L/ha). Lower yield of 1216.9 kg / ha was recorded with the application of Jeevamrutha alone when compared to the yield obtained by the application of 7.5 per cent Panchagavya and 1000 l/ha of Jeevamrutha together. Yield of fieldbean has varied significantly due to the application of Panchagavya at different levels. Significantly higher mean yield of 1369.7 kg/ha was recorded with the application of 7.5 per cent of Panchagavya application along with different levels of Jeevamrutha (0, 500, 1000 L/ha) whereas, on par yield was recorded with application of Panchagavya at 5, 2.5 and 0 per cent along with different levels of Jeevanrutha (0, 500, 1000 L/ha) as given in Table 4. This might be due to the fact that Jeevamrutha and Panchagavya were rich source of beneficial microorganisms and contains growth promoting substances such as auxins, gibberellins, cytokinens apart from having lower concentration of both macro and micro nutrients. This is in conformity with Devakumar *et al*. (2008) and Devakumar *et al*. (2011). This might be due to better availability and uptake of nutrients which helped in production of more photosynthates and its translocation to the pods during their development (Gopinath *et al*., 2009). Similar increment in growth parameters was also observed with increased level of FYM and liquid manure in field bean by Siddappa (2015). This was also in conformity with Sanjutha *et al*. (2008) who have also reported application of Panchagavya and organic manures significantly influence the plant height, number of branches, nutrient content, total dry matter of production and quality parameters in different crops.

TABLE 4

Influence of different levels of Jeevamrutha and Panchagavya on seed yield of fieldbean (*Dolichos lablab* L.) (kg/ha)

	JxP Table			
	J_0	J_{500}	J_{1000}	Mean
P_0	1007.5	1141.2	1216.9	**1121.9**
$P_{2.5\%}$	1105.5	1269.3	1258.0	**1210.9**
$P_{5\%}$	1191.1	1315.8	1377.8	**1294.9**
$P_{7.5\%}$	1258.0	1378.5	1472.7	**1369.7**
Mean	**1140.5**	**1276.2**	**1331.4**	
	S.Em ±		**CD at 5%**	
Jeevamrutha	32.1		94.1	
Panchagavya	37.0		108.6	
J x P	64.2		188.2	

The present study revealed that the presence of major and micronutrients in the liquid organic manures has direct influence on microflora for N fixation, P solubilisation and other nutrient uptake. Application of liquid organic manures have significant impact on increasing soil microbial population, soil fertility and yield attributes and their by helps in improving soil health and auguments sustainable crop production. These organic formulations could be prepared by the farmers using locally available material for enhancing the yield of crops.

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(*Received :* August, 2018 *Accepted :* September, 2018)