Effect of Different Sources of Organic Manures and Jeevamrutha on Growth and Yield of French Bean (*Phaseolus vulgaris* L.)

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Abstract

A field experiment was conducted at research and demonstration block of Research Institute on Organic Farming, UAS, Bangalore during *kharif* - 2021 and *rabi* 2021-22 to study the combined effect of different sources of organic manures and jeevamrutha on growth and yield of french bean. The experiment was laid out in Factorial RCBD consisting of 16 treatment combinations replicated thrice. Soil of the experimental site was red sandy loam with a pH (6.93), EC (0.27 dS m^{-1}) and medium in available nitrogen (291.5 kg ha^{-1}), phosphorus (28.2 kg ha^{-1}) and potassium (236.4 kg ha^{-1}). The experimental results indicated that application of vermicompost on nitrogen (N) equivalent basis resulted in significantly higher plant height (31.79 cm), number of branches per plant (5.96), number of leaves per plant (41.19), green pod yield (150.48 q ha^{-1}) and haulm yield (38.06 q ha^{-1}) at harvest compared to other organic manure sources, *viz*, poultry manure and FYM. Among levels of jeevamrutha, *viz.,* application of jeevamrutha at 2000 litre ha^{-1} recorded significantly higher green pod yield (139.14 q ha^{-1}) and haulm yield (35.44 q ha^{-1}) compared to other levels of jeevamrutha, *viz.* 1500, 1000 and 0 litre ha^{-1}.

Fʀᴇɴᴄʜ bean (*Phaseolus vulgaris* L.) is an important vegetable crop belonging to family Fabaceae. It is one of the most popular and widely grown vegetable crops in India. It is also known as snap bean, bush bean, kidney bean or string bean. It is consumed by almost every section of society in one or other form *i.e*., as tender green pod or vegetable or dry beans as dal. French bean tender pod contains 1.7g protein, 0.1g fat, 4.5g carbohydrate and 1.8g fiber per 100g which makes it complete food (Tiwari and Chaubey, 2017). Green pods are an important source of vitamin A which is effective in controlling night blindness in human being (Birajdar, 2006).

Due to irrational and non-judicious use of synthetic chemical fertilizers without applying organic manures in the crop production process over the years has led to deterioration of multi-nutrient deficiencies particularly various micronutrients *viz.* Zn, B, Mn, Fe, Mo *etc.,* which have made the soils less responsive to application of nutrients. Considering these adverse impacts on crop production along with rapid escalation of fertilizer costs, there is a paradigm shift from inorganic to organic farming. Addition of organic matter as source of nutrients is crucial to sustain soil health in long term basis and thus, organic farming plays a pivotal role in agricultural system in the country. Organic farming mainly focuses on use of on-farm organic resources to sustain soil health. Keeping all these points in consideration, the investigation was carried out at University of Agricultural Sciences, Bangalore to study the influence of organic manures and jeevamrutha on growth and yield of french bean.

The Mysore Journal of Agricultural Sciences

Mysore J. Agric. Sci., 57 (2) : 403-415 (2023)

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MATERIAL AND METHODS

A field experiment was carried out at research and demonstration block of Research Institute on Organic Farming (RIOF), Gandhi Krishi Vignana Kendra (GKVK), University of Agricultural Sciences, Bangalore which comes under the agroclimatic zone of Eastern dry zone of Karnataka. It is situated at a latitude of 12° 582 North, longitude of 75° 352 East and at an altitude of 930 m above MSL (mean sea level). The experiment was conducted to study the combined effect of different sources of organic manures and jeevamrutha on growth and yield of French bean during *kharif* and *rabi* seasons of 2021-22 under irrigated condition. Experiment was laid out in Randomised Complete Block Design (RCBD) with factorial concept consisting of two factors *viz.,* different organic sources (M_1: No organic manure, M_2: FYM, M_3: Vermicompost and M_4: Poultry Manure - 100% N equivalent basis) and different levels of jeevamrutha (J_1: No jeevamrutha, J_2: 1000 l ha^{-1}, J_3: 1500 l ha^{-1} and J_4: 2000 l ha^{-1}) replicated thrice. Treatment combinations include T_1: Without application of manure and jeevamrutha, T_2: Application of jeevamrutha at 1000 l ha^{-1} without manure, T_3: Application of jeevamrutha at 1500 l ha^{-1} without manure, T_4: Application of jeevamrutha at 2000 l ha^{-1} without manure, T_5: Application of FYM without jeevamrutha, T_6: Application of FYM coupled with jeevamrutha at 1000 l ha^{-1}, T_7: Application of FYM coupled with jeevamrutha at 1500 l ha^{-1}, T_8: Application of FYM coupled with jeevamrutha at 2000 l ha^{-1}, T_9: Application of vermicompost without jeevamrutha, T_{10}: Application of vermicompost coupled with jeevamrutha at 1000 l ha^{-1}, T_{11}: Application of vermicompost coupled with jeevamrutha at 1500 l ha^{-1}, T_{12}: Application of vermicompost coupled with jeevamrutha at 2000 l ha^{-1}, T_{13}: Application of poultry manure without jeevamrutha, T_{14}: Application of poultry manure coupled with jeevamrutha at 1000 l ha^{-1}, T_{15}: Application of poultry manure coupled with jeevamrutha at 1500 l ha^{-1} and T_{16}: Application of poultry manure coupled with jeevamrutha at 2000 l ha^{-1}. Soils of the experimental site was red sandy loam with a pH of 6.93, EC (0.27 dS m^{-1}), medium in available N (291.5 kg ha^{-1}), P_2O_5 (28.2 kg ha^{-1}) and K_2O (236.4 kg ha^{-1}). French bean variety Arka Suvidha was sown with a spacing of 30 cm × 15 cm and recommended agronomic practices were followed to raise the crop. Recommended dose of nutrients for french bean was 63:100:75 NPK kg ha^{-1} and organic nutrients were supplied on the basis of nitrogen equivalent after analysing the nutrient content. Application of Farm Yard Manure (FYM) at the rate of 25 t ha^{-1} as basal application was common for all the treatments. Organic manures were incorporated into the soil, three weeks prior to sowing. Jeevamrutha was applied to the soil by diluting with normal water at 20, 40 and 60 days after sowing (DAS), according to the treatment. Hand weeding as well as earthing up was carried out at 20 DAS to maintain weed free condition and to provide good anchorage to the crop. Other crop protection practices were followed as and when required. Biometric observations on growth and yield parameters were recorded randomly on selected five plants at 20 and 40 days after sowing (DAS) and at harvest in the net plot. Data was subjected to statistical analysis as per the procedure outlined by Gomez and Gomez (1984). To know the effect of individual factors and to compare treatment combinations with control treatments, statistical procedure of factorial randomized complete block was followed.

Preparation of Jeevamrutha

Jeevamrutha was prepared by mixing 10 kg of cow dung, 10 litre of cow urine, 2 kg of jaggery, 2 kg of pigeon pea flour and hand full of soil collected from farm. All these were put in 200 litres plastic drum and mixed thoroughly and volume was made up to 200 litres by adding water. The mixture was stirred well in clock wise direction thrice a day plastic drum was kept shade covered with wet jute bag. Jeevamrutha was fermented for 10 days and applied to the root zone of French bean plants manually (Devakumar *et al.*, 2008 and Palekar, 2006).

RESULTS AND DISCUSSION

Plant Height (cm)

The data of two seasons as well as pooled data pertaining to plant height of French bean as influenced

TABLE 1

Plant height of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *kharif* 2021

Plant height (cm)

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	9.17	9.60	10.47	10.63	9.97	23.01	23.20	23.79	24.10	23.53	25.24	25.72	25.96	26.45	25.84
M_2	10.23	11.07	11.23	11.70	11.06	23.62	25.23	26.05	26.93	25.46	25.68	27.46	28.25	28.95	27.59
M_3	11.23	13.07	13.57	13.73	12.90	26.00	28.12	29.19	30.80	28.53	28.08	30.36	31.32	32.92	30.67
M_4	11.07	11.83	12.53	12.77	12.05	25.51	27.14	27.24	28.43	27.08	27.75	28.79	29.45	30.58	29.14
Mean	10.42	11.39	11.95	12.20		24.53	25.92	26.57	27.56		26.69	28.08	28.75	29.73	
Comparison	S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)	
M	0.24			0.68		0.40			1.14		0.50			1.45	
J	0.24			0.68		0.40			1.14		0.50			1.45	
M × J	0.47			NS		0.79			NS		1.01			NS	

TABLE 2

Plant height of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *rabi* 2021-22

Plant height (cm)

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	9.93	10.37	10.67	10.80	10.44	23.92	24.15	24.85	25.16	24.52	27.49	27.97	28.21	28.70	28.09
M_2	10.93	11.40	11.37	11.63	11.33	25.47	26.56	26.48	27.11	26.41	27.93	29.71	30.50	31.20	29.83
M_3	11.57	12.57	13.17	14.00	12.83	26.95	29.28	30.68	31.84	29.69	30.33	32.61	33.57	35.17	32.92
M_4	10.53	11.73	12.83	13.23	12.08	24.54	27.34	29.90	30.29	28.02	30.00	30.71	31.70	32.83	31.31
Mean	10.74	11.52	12.01	12.42		25.22	26.83	27.98	28.60		28.94	30.25	30.99	31.97	
Comparison	S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)	
M	0.25			0.71		0.41			1.17		0.54			1.57	
J	0.25			0.71		0.41			1.17		0.54			1.57	
M × J	0.49			NS		0.81			NS		1.09			NS	

Note: M_1 : No organic manure, M_2 : Farm yard Manure, M_3 : Vermicompost, M_4 : Poultry manure, J_1 : No jeevamrutha, J_2 : Jeevamrutha 1000 l ha⁻¹, J_3 : Jeevamrutha 1500 l ha⁻¹, J_4 : Jeevamrutha 2000 l ha⁻¹, DAS- Days After Sowing

TABLE 3

Plant height of French bean at different growth stages as influenced by different organic manures and jeevamrutha
(Pooled data of two seasons)

Treatments	Plant height (cm)														
	20 DAS					40 DAS					At harvest				
	J₁	J₂	J₃	J₄	Mean	J₁	J₂	J₃	J₄	Mean	J₁	J₂	J₃	J₄	Mean
M₁	9.55	9.98	10.57	10.72	10.20	23.47	23.68	24.32	24.63	24.02	26.36	26.84	27.08	27.57	26.97
M₂	10.58	11.23	11.30	11.67	11.20	24.55	25.90	26.27	27.02	25.93	26.80	28.58	29.37	30.07	28.71
M₃	11.40	12.82	13.37	13.87	12.86	26.47	28.70	29.94	31.32	29.11	29.20	31.48	32.44	34.04	31.79
M₄	10.80	11.78	12.68	13.00	12.07	25.03	27.24	28.57	29.36	27.55	28.87	29.75	30.57	31.70	30.23
Mean	10.58	11.45	11.98	12.31		24.88	26.38	27.27	28.08		27.81	29.17	29.87	30.85	

Comparison	S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)	
M	0.18			0.53		0.31			0.89		0.52			1.51	
J	0.18			0.53		0.31			0.89		0.52			1.51	
M × J	0.37			NS		0.62			NS		1.04			NS	

Note : M₁ : No organic manure, M₂ : Farm Yard Manure, M₃ : Vermicompost, M₄ : Poultry manure, J₁ : No jeevamrutha, J₂ : Jeevamrutha 1000 l ha⁻¹, J₃ : Jeevamrutha 1500 l ha⁻¹, J₄ : Jeevamrutha 2000 l ha⁻¹, DAS- Days After Sowing

by different organic manure sources and levels of jeevamrutha is presented in tables 1, 2 and 3. In both the seasons, application of vermicompost recorded significantly higher plant height (12.90 and 12.83 cm at 20 DAS, 28.53 and 29.69 cm at 40 DAS and 30.67 and 32.92 cm at harvest, respectively) followed by poultry manure, farm yard manure, as compared to significantly lower plant height in without manure application (9.97 and 10.44 cm at 20 DAS, 23.53 and 24.52 cm at 40 DAS and 25.84 and 28.09 cm at harvest, respectively) was recorded. Among the levels of jeevamrutha, application rate of 2000 litre ha⁻¹ recorded higher plant height in both *kharif* and *rabi* season (12.20 and 12.42 cm at 20 DAS, 27.56 and 28.60 cm at 40 DAS and 29.73 and 31.97 cm at harvest, respectively) which was at par with application of jeevamrutha at 1500 litre ha⁻¹. Without jeevamrutha application treatment recorded lower plant height (10.42 and 10.74 cm at 20 DAS, 24.53 and 25.22 cm at 40 DAS and 26.69 and 28.94 cm at harvest, respectively) (Table 1 and 2). The pooled data indicated that among different sources of organic manures, application of vermicompost recorded significantly higher plant height (12.86, 29.11 and 31.79 cm at 20, 40 DAS and at harvest, respectively) followed by poultry manure, farm yard manure as compared to without manure application (10.20, 24.02 and 26.97 cm at 20 and 40 DAS and at harvest, respectively). Among the levels of jeevamrutha, application rate of 2000 litre ha⁻¹ recorded higher plant height (12.31, 28.08 and 30.85 cm at 20, 40 DAS and at harvest, respectively) which was at par with application of jeevamrutha at 1500 litre ha⁻¹. Lower plant height was observed under no jeevamrutha application (10.58, 24.88 and 27.81 cm at 20, 40 DAS and at harvest, respectively) (Table 3). Plant height at different growth stages did not differ significantly due to the interaction between various organic manures and levels of jeevamrutha application. However, higher plant height was observed with vermicompost in combination with 2000 litre ha⁻¹ jeevamrutha (13.87, 28.57 and 30.57 cm at 20, 40 DAS and at harvest, respectively) and lower plant height was observed with no manure and no jeevamrutha application (9.55, 23.47 and

26.36 cm at 20, 40 DAS and at harvest, respectively). Significantly higher plant height was reported under vermicompost applied treatment and this may be due to the fact that vermicompost contains humified organic matter characterised by high molecular weight and enzymatically active humic fraction which stimulate seed germination and plant growth. Similar result was reported by Adhikari *et al.* (2016) and Sayfalla *et al.* (2015). Jeevamrutha contains plant growth promoting substances like IAA, GA (Devakumar *et al.*, 2008 and Nileema and Sreenivasa, 2011). These might have stimulated the necessary growth and development in plants, leading to better growth of French bean. Similar results were also found by Siddappa (2015) in field bean.

Number of Branches

The data of two seasons as well as pooled data pertaining to number of branches per plant of French bean as influenced by different organic manure sources and levels of jeevamrutha is presented in table 4, 5 and 6. During both the seasons, application of vermicompost recorded significantly higher number of branches per plant (1.37 and 1.63 at 20 DAS, 3.83 and 4.20 at 40 DAS and 5.92 and 6.67 at harvest, respectively) followed by poultry manure, farm yard manure, as compared to without manure application (1.07 and 1.07 at 20 DAS, 3.22 and 3.28 at 40 DAS and 4.95 and 5.10 at harvest, respectively). Among the levels of jeevamrutha, application rate of 2000 litre ha^{-1} recorded significantly higher number of branches in both *kharif* and *rabi* season (3.80 and 3.88 at 40 DAS and 5.98 and 6.15 at harvest, respectively) except at 20 DAS which was statistically at par with application of jeevamrutha at 1500 litre ha^{-1}. Lower number of branches was observed under without jeevamrutha application (1.12 and 1.12 at 20 DAS, 3.30 and 3.37 at 40 DAS and 5.10 and 5.18 at harvest, respectively) (Table 3 and 4). In pooled data of two seasons, among different sources of organic manures, application of vermicompost recorded significantly higher number of branches (1.50, 3.89 and 5.96 at 20, 40 DAS and at harvest, respectively) followed by poultry manure, farm yard manure, as compared to

TABLE 4

Number of branches per plant of french bean at different growth stages as influenced by different organic manures and jeevamrutha during *kharif* 2021

Treatments	20 DAS					40 DAS					At harvest				
	J$_1$	J$_2$	J$_3$	J$_4$	Mean	J$_1$	J$_2$	J$_3$	J$_4$	Mean	J$_1$	J$_2$	J$_3$	J$_4$	Mean
M$_1$	1.07	1.00	1.13	1.07	1.07	3.07	3.07	3.27	3.47	3.22	4.47	4.87	5.13	5.33	4.95
M$_2$	1.07	1.00	1.13	1.20	1.10	3.27	3.47	3.67	3.80	3.55	5.20	5.27	5.67	5.93	5.52
M$_3$	1.20	1.27	1.33	1.67	1.37	3.47	3.73	4.07	4.07	3.83	5.47	5.60	6.00	6.60	5.92
M$_4$	1.13	1.27	1.40	1.53	1.33	3.40	3.53	3.80	3.87	3.65	5.27	5.67	5.87	6.07	5.72
Mean	1.12	1.13	1.25	1.37		3.30	3.45	3.70	3.80		5.10	5.35	5.67	5.98	
Comparison	S.Em±		C.D. (P=0.05)			S.Em±		C.D. (P=0.05)			S.Em±		C.D. (P=0.05)		
M	0.04		0.13			0.03		0.08			0.07		0.19		
J	0.04		0.13			0.03		0.08			0.07		0.19		
M × J	0.09		NS			0.05		NS			0.13		NS		

Note: M$_1$: No organic manure, M$_2$: Farm Yard Manure, M$_3$: Vermicompost, M$_4$: Poultry manure, J$_1$: No jeevamrutha, J$_2$: Jeevamrutha 1000 l ha^{-1}, J$_3$: Jeevamrutha 1500 l ha^{-1}, J$_4$: Jeevamrutha 2000 l ha^{-1}, DAS- Days After Sowing

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TABLE 5

Number of branches per plant of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *rabi* 2021-22

Number of branches per plant

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	1.00	1.00	1.13	1.13	1.07	3.13	3.13	3.33	3.53	3.28	4.60	4.73	5.33	5.73	5.10
M_2	1.00	1.13	1.47	1.40	1.25	3.33	3.53	3.80	3.87	3.63	5.27	5.47	5.87	6.07	5.67
M_3	1.27	1.40	1.80	2.07	1.63	3.53	3.87	4.20	4.20	3.95	5.53	5.67	6.13	6.67	6.00
M_4	1.20	1.20	1.47	1.60	1.37	3.47	3.60	3.93	3.93	3.73	5.33	5.73	5.93	6.13	5.78
Mean	1.12	1.18	1.47	1.55		3.37	3.53	3.82	3.88		5.18	5.40	5.82	6.15	
Comparison	S.Em±	C.D. (P= 0.05)				S.Em±	C.D. (P= 0.05)				S.Em±	C.D. (P= 0.05)			
M	0.05	0.14				0.04	0.13				0.07	0.21			
J	0.05	0.14				0.04	0.13				0.07	0.21			
M × J	0.10	NS				0.09	NS				0.14	NS			

Note: M_1 : No organic manure, M_2 : Farm Yard Manure, M_3 : Vermicompost, M_4 : Poultry manure, J_1 : No jeevamrutha, J_2 : Jeevamrutha 1000 l ha^{-1}, J_3 : Jeevamrutha 1500 l ha^{-1}, J_4 : Jeevamrutha 2000 l ha^{-1}, DAS- Days After Sowing

TABLE 6

Number of branches per plant of French bean at different growth stages as influenced by different organic manures and jeevamrutha (Pooled data of two seasons)

Number of branches per plant

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	1.03	1.00	1.13	1.10	1.07	3.10	3.10	3.30	3.50	3.25	4.53	4.80	5.23	5.53	5.03
M_2	1.03	1.07	1.30	1.30	1.18	3.30	3.50	3.73	3.83	3.59	5.23	5.37	5.77	6.00	5.59
M_3	1.23	1.33	1.57	1.87	1.50	3.50	3.80	4.13	4.13	3.89	5.50	5.63	6.07	6.63	5.96
M_4	1.17	1.23	1.43	1.57	1.35	3.43	3.57	3.87	3.90	3.69	5.30	5.70	5.90	6.10	5.75
Mean	1.12	1.16	1.36	1.46		3.33	3.49	3.76	3.84		5.14	5.38	5.74	6.07	
Comparison	S.Em±	C.D. (P= 0.05)				S.Em±	C.D. (P= 0.05)				S.Em±	C.D. (P= 0.05)			
M	0.03	0.10				0.03	0.09				0.05	0.15			
J	0.03	0.10				0.03	0.09				0.05	0.15			
M × J	0.07	NS				0.06	NS				0.10	NS			

Note: M_1 : No organic manure, M_2 : Farm Yard Manure, M_3 : Vermicompost, M_4 : Poultry manure, J_1 : No jeevamrutha, J_2 : Jeevamrutha 1000 l ha^{-1}, J_3 : Jeevamrutha 1500 l ha^{-1}, J_4 : Jeevamrutha 2000 l ha^{-1}, DAS- Days After Sowing

without manure application. Among the levels of jeevamrutha, application rate of 2000 litre ha^{-1} recorded higher number of branches (1.46, 3.84 and 6.07 at 20, 40 DAS and at harvest, respectively) which was statistically at par with application of jeevamrutha at 1500 litre ha^{-1} except at harvest where it differed significantly. Significantly lower number of branches were observed under without jeevamrutha application (1.12, 3.37 and 5.18 at 20, 40 DAS and at harvest, respectively) except at 20 DAS where it was at par with jeevamrutha at 1000 litre ha^{-1} (Table 6). Number of branches at different growth stages did not differ significantly due to the interaction between various organic manures and levels of jeevamrutha application. Higher numbers of branches were observed with the application of vermicompost which might be due to the fact that vermicompost contains significant quantities of water soluble nutrients which are readily available to the crop during active growth periods (Rajini and Srivastava, 2001; Tomati *et al.*, 1983; Bano *et al.*, 1987 and Bhawalkar, 1991).

Number of Leaves

The data of two seasons as well as pooled data pertaining to number of leaves of French bean as influenced by different organic manure sources and levels of jeevamrutha is presented in Table 7, 8 and 9. During both the seasons, application of vermicompost recorded significantly higher number of leaves (9.83 and 10.12 at 20 DAS, 39.50 and 40.82 at 40 DAS and 43.27 and 42.06 at harvest, respectively) followed by poultry manure, farm yard manure, as compared to without manure application. Among the levels of jeevamrutha, application rate of 2000 litre ha^{-1} recorded higher number of leaves in both *kharif* and *rabi* season (9.58 and 9.92 at 20 DAS, 37.25 and 37.52 at 40 DAS and 38.00 and 39.78 at harvest, respectively) which was statistically at par with application of jeevamrutha at 1500 litre ha^{-1}. Lower number of leaves was observed under without jeevamrutha application (8.47 and 8.73 at 20 DAS, 33.67 and 34.92 at 40 DAS and 33.67 and 35.63 at harvest, respectively) (Table 7 and 8). In pooled data of two seasons, it was observed that among different sources of organic manures, application of

TABLE 7

Number of leaves per plant of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *kharif* 2021

Treatments	Number of leaves per plant														
	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	8.00	8.00	8.40	8.60	8.25	29.00	30.00	31.00	32.00	30.50	30.40	31.13	32.40	32.53	31.62
M_2	8.07	8.60	9.03	9.40	8.77	34.00	35.00	36.00	36.00	35.25	31.93	35.53	37.07	37.60	35.53
M_3	9.20	9.60	10.00	10.53	9.83	36.00	39.00	41.00	42.00	39.50	36.33	40.20	41.47	43.27	40.32
M_4	8.60	9.20	9.60	9.80	9.30	35.67	36.00	37.00	39.00	36.92	36.00	37.27	38.40	38.60	37.57
Mean	8.47	8.85	9.26	9.58		33.67	35.00	36.25	37.25		33.67	36.03	37.33	38.00	
Comparison	S.Em±		C.D. (P= 0.05)			S.Em±		C.D. (P=0.05)			S.Em±		C.D. (P= 0.05)		
M	0.15		0.44			0.44		1.26			0.62		1.80		
J	0.15		0.44			0.44		1.26			0.62		1.80		
M × J	0.30		NS			0.87		NS			1.25		NS		

Note : M$_1$: No organic manure, M$_2$: Farm Yard Manure, M$_3$: Vermicompost, M$_4$: Poultry manure, J$_1$: No jeevamrutha, J$_2$: Jeevamrutha 1000 l ha^{-1}, J$_3$: Jeevamrutha 1500 l ha^{-1}, J$_4$: Jeevamrutha 2000 l ha^{-1}, DAS- Days After Sowing

TABLE 8

Number of leaves per plant of french bean at different growth stages as influenced by different organic manures and jeevamrutha during *rabi* 2021-22

Number of leaves per plant

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	8.13	8.13	8.60	8.80	8.42	32.00	32.13	33.00	33.13	32.57	32.47	32.93	33.60	34.20	33.30
M_2	8.60	8.97	9.07	9.60	9.06	33.27	33.40	34.00	36.13	34.20	33.07	37.53	38.13	39.13	36.97
M_3	9.40	9.80	10.20	11.07	10.12	39.13	40.00	41.67	42.47	40.82	39.27	41.33	42.70	44.93	42.06
M_4	8.80	9.40	9.87	10.20	9.57	35.27	33.33	37.07	38.33	36.00	37.73	38.13	39.20	40.83	38.98
Mean	8.73	9.08	9.43	9.92		34.92	34.72	36.43	37.52		35.63	37.48	38.41	39.78	
Comparison	S.Em±	C.D. (P=0.05)				S.Em±	C.D. (P=0.05)				S.Em±	C.D. (P=0.05)			
M	0.16	0.46				0.48	1.39				0.64	1.84			
J	0.16	0.46				0.48	1.39				0.64	1.84			
M × J	0.32	NS				0.97	NS				1.28	NS			

Note : M_1 : No organic manure, M_2 : Farm Yard Manure, M_3 : Vermicompost, M_4 : Poultry manure, J_1 : No jeevamrutha, J_2 : Jeevamrutha 1000 l ha⁻¹, J_3 : Jeevamrutha 1500 l ha⁻¹, J_4 : Jeevamrutha 2000 l ha⁻¹, DAS- Days After Sowing

TABLE 9

Number of leaves per plant of French bean at different growth stages as influenced by different organic manures and jeevamrutha (Pooled data of two seasons)

Number of leaves per plant

Treatments	20 DAS					40 DAS					At harvest				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	8.07	8.07	8.50	8.70	8.33	30.50	31.07	32.00	32.57	31.53	31.43	32.03	33.00	33.37	32.46
M2	8.33	8.78	9.05	9.50	8.92	33.63	34.20	35.00	36.07	34.73	32.50	36.53	37.60	38.37	36.25
M_3	9.30	9.70	10.10	10.80	9.98	37.57	39.50	41.33	42.23	40.16	37.80	40.77	42.08	44.10	41.19
M_4	8.70	9.30	9.73	10.00	9.43	35.47	34.67	37.03	38.67	36.46	36.87	37.70	38.80	39.72	38.27
Mean	8.60	8.96	9.35	9.75		34.29	34.86	36.34	37.38		34.65	36.76	37.87	38.89	
Comparison	S.Em±	C.D. (P=0.05)				S.Em±	C.D. (P=0.05)				S.Em±	C.D. (P=0.05)			
M	0.14	0.41				0.30	0.87				0.62	1.79			
J	0.14	0.41				0.30	0.87				0.62	1.79			
M × J	0.28	NS				0.60	NS				1.24	NS			

Note: M_1 : No organic manure, M_2 : Farm Yard Manure, M_3 : Vermicompost, M_4 : Poultry manure, J_1 : No jeevamrutha, J_2 : Jeevamrutha 1000 l ha⁻¹, J_3 : Jeevamrutha 1500 l ha⁻¹, J_4 : Jeevamrutha 2000 l ha⁻¹, DAS- Days After Sowing

vermicompost recorded significantly higher number of leaves (9.98, 40.16 and 41.19 at 20, 40 DAS and at harvest, respectively) followed by poultry manure, farm yard manure, as compared to without manure application. Among the levels of jeevamrutha, application rate of 2000 litre ha^{-1} recorded higher number of leaves (9.75, 37.38 and 38.89 at 20, 40 DAS and at harvest, respectively) which were statistically at par with application of jeevamrutha at 1500 litre ha^{-1}. Lower number of leaves were observed under without jeevamrutha application (8.60, 34.29 and 34.65 at 20, 40 DAS and at harvest, respectively) (Table 9). Number of leaves at different growth stages did not differ significantly due to the interaction between various organic manures and levels of jeevamrutha application. However, higher number of leaves were observed with vermicompost in combination with 2000 litre ha^{-1} jeevamrutha (2.07, 4.20 and 6.67 at 20, 40 DAS and at harvest, respectively) and lower number of leaves were observed with no manure and no jeevamrutha application (1.00, 3.13 and 4.60 at 20, 40 DAS and at harvest, respectively). Higher number of leaves were observed with vermicompost application which might be due to the fact that it has hormones like activity and this induces greater root initiation, increased root biomass, enhanced plant growth and development and alters the morphology of plants (Pant *et al*., 2009 and Singh *et al.,* 2008).

Significant difference in above growth parameters *viz*., plant height, number of branches per plant and number of leaves per plant was noticed due to the application of vermicompost and this might be due to the fact that vermicompost contains significant amount of water-soluble nutrients which are readily available to the crop during active growth periods. A large group of beneficial microbial population like bacteria, protozoa, nematodes, fungi, actinomycetes are present in vermicompost. It is stabilized by the mutual interaction between earthworms and microorganisms (Rajini and Srivastava 2001). Biologically active metabolites, particularly gibberellins, cytokinins, auxins and group B vitamins are present in vermicompost which can be applied alone or in combination with organic or inorganic fertilizers, so as to get better yield and quality of diverse crops (Tomati *et al*., 1983, Bano *et al*., 1987 and Bhawalkar, 1991). It was also found that the release of NO_3^- and NH_4^+ form of nitrogen was higher with the application of vermicompost as compared to other organic fertilizer like FYM and poultry manure. Vermicompost is reported to have hormones like activity and this induces greater root initiation, increased root biomass, enhanced plant growth and development and alters the morphology of plants (Pant *et al*., 2009).

Green Pod and Haulm Yield (q ha^{-1})

Green Pod Yield (q ha^{-1})

The data of two seasons as well as pooled data pertaining to green pod yield of French bean as influenced by different organic manure sources and levels of jeevamrutha is presented in table 10. During both the seasons, application of vermicompost recorded significantly higher green pod yield (141.27 and 159.68 q ha^{-1} in *kharif* and *rabi*) followed by poultry manure, farm yard manure as compared to without manure application (93.68 and 103.76 q ha^{-1} in *kharif* and *rabi*). Among the levels of jeevamrutha, application at 2000 litre ha^{-1} recorded significantly higher green pod yield in both *kharif* and *rabi* seasons (133.53 and 144.76 q ha^{-1}) followed by jeevamrutha at 1500 litre ha^{-1} followed by jeevamrutha at 1000 litre ha^{-1} as compared to without jeevamrutha application (99.07 and 118.27 q ha^{-1}). The pooled data of two seasons, it was observed that among different sources of organic manures, application of vermicompost recorded significantly higher green pod yield (150.48 q ha^{-1}) followed by poultry manure (136.82 q ha^{-1}), farm yard manure (114.69 q ha^{-1}), as compared to without manure application (98.72 q ha^{-1}). Among the levels of jeevamrutha, application rate of 2000 litre ha^{-1} recorded significantly higher green pod yield (139.14 q ha^{-1}) followed by jeevamrutha at 1500 litre ha^{-1} (131.18 q ha^{-1}) followed by jeevamrutha at 1000 litre ha^{-1} (121.71 q ha^{-1}) as compared to without jeevamrutha application (108.67 q ha^{-1}). Green pod yield did not differ significantly

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TABLE 10

Green pod yield of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *kharif* 2021, *rabi* 2021-22 and pooled data of two seasons

Green pod yield (q ha⁻¹)

Treatments	Kharif 2021					Rabi 2021-22					Pooled				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	84.65	89.65	97.98	102.43	93.68	94.15	100.22	108.58	112.08	103.76	89.40	94.94	103.28	107.26	98.72
M_2	93.56	103.75	115.56	124.48	109.34	104.31	114.22	126.16	135.48	120.04	98.94	108.99	120.86	129.98	114.69
M_3	115.40	138.68	150.56	160.45	141.27	143.20	159.29	163.31	172.93	159.68	129.30	148.99	156.94	166.69	150.48
M_4	102.65	125.75	137.43	146.75	128.15	131.41	142.11	149.88	158.54	145.49	117.03	133.93	143.66	152.65	136.82
Mean	99.07	114.46	125.38	133.53		118.27	128.96	136.98	144.76		108.67	121.71	131.18	139.14	
Comparison	S.Em±		C.D. (P=0.05)			S.Em±		C.D. (P=0.05)			S.Em±		C.D. (P=0.05)		
M	2.47		7.14			2.65		7.66			2.53		7.31		
J	2.47		7.14			2.65		7.66			2.53		7.31		
M × J	4.95		NS			5.31		NS			5.06		NS		

Note : M₁ : No organic manure, M₂ : Farm Yard Manure, M₃ : Vermicompost, M₄ : Poultry manure, J₁ : No jeevamrutha, J₂ : Jeevamrutha 1000 l ha⁻¹, J₃ : Jeevamrutha 1500 l ha⁻¹, J₄ : Jeevamrutha 2000 l ha⁻¹, DAS- Days After Sowing

due to the interaction between various organic manures and levels of jeevamrutha application. However, higher green pod yield was observed with vermicompost in combination with 2000 litre ha⁻¹ jeevamrutha (166.69 q ha⁻¹) and lower yield was observed with no manure and no jeevamrutha application (89.40 q ha⁻¹).

Haulm Yield (q ha⁻¹)

The data of two seasons as well as pooled data pertaining to haulm yield of french bean as influenced by different organic manure sources and levels of jeevamrutha is presented in table 11. During both the seasons, application of vermicompost recorded significantly higher haulm yield (35.57 and 40.55 q ha⁻¹, respectively) followed by poultry manure, farm yard manure, as compared to without manure application (23.42 and 25.94 q ha⁻¹, respectively).

Among the levels of jeevamrutha, application rate of 2000 litre ha⁻¹ recorded significantly higher haulm yield in both *kharif* and *rabi* season (33.47 and 41.05 q ha⁻¹, respectively) followed by jeevamrutha at 1500 litre ha⁻¹ followed by jeevamrutha at 1000 litre ha⁻¹ as compared to without jeevamrutha application (24.85 and 29.57 q ha⁻¹, respectively). In pooled data of two seasons, it was observed that among different sources of organic manures, application of vermicompost recorded significantly higher haulm yield (38.06 q ha⁻¹) followed by poultry manure, farm yard manure as compared to without manure application (24.68 q ha⁻¹). Among the levels of jeevamrutha, application rate of 2000 litre ha⁻¹ recorded significantly higher green haulm yield (35.44 q ha⁻¹) followed by jeevamrutha at 1500 litre ha⁻¹ followed by jeevamrutha at 1000 litre ha⁻¹ as compared to without jeevamrutha application (27.21 q ha⁻¹). Green pod yield did not differ significantly due to the interaction between various organic manures and levels of jeevamrutha application. However, higher green pod yield was observed with vermicompost in combination with 2000 litre ha⁻¹ jeevamrutha (42.42 q ha⁻¹) and lower yield was observed with no manure and no jeevamrutha application (22.02 q ha⁻¹).

TABLE 11

Haulm yield of French bean at different growth stages as influenced by different organic manures and jeevamrutha during *kharif* 2021, *rabi* 2021-22 and pooled data of two seasons

Treatments	Haulm yield (q ha^{-1})														
	Kharif 2021					*Rabi* 2021-22					Pooled				
	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean	J_1	J_2	J_3	J_4	Mean
M_1	20.50	22.75	24.83	25.61	23.42	23.54	25.06	27.15	28.02	25.94	22.02	23.90	25.99	26.81	24.68
M_2	23.72	26.27	29.22	31.45	27.67	26.08	28.56	31.54	35.87	30.51	24.90	27.41	30.38	33.66	29.09
M_3	29.18	35.00	37.97	40.11	35.57	35.80	39.82	41.83	44.73	40.55	32.49	37.41	39.90	42.42	38.06
M_4	26.00	31.77	34.69	36.69	32.29	32.85	35.53	38.80	41.05	37.06	29.42	33.65	36.75	38.87	34.67
Mean	24.85	28.95	31.68	33.47	24.85	29.57	32.24	34.83	37.42		27.21	30.59	33.25	35.44	
Comparison	S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)		S.Em±			C.D. (P= 0.05)	
M	0.67			1.94		0.85			2.47		0.67			1.93	
J	0.67			1.94		0.85			2.47		0.67			1.93	
M × J	1.34			NS		1.71			NS		1.34			NS	

Note : M$_1$: No organic manure, M$_2$: Farm Yard Manure, M$_3$: Vermicompost, M$_4$: Poultry manure, J$_1$: No jeevamrutha, J$_2$: Jeevamrutha 1000 l ha^{-1}, J$_3$: Jeevamrutha 1500 l ha^{-1}, J$_4$: Jeevamrutha 2000 l ha^{-1}, DAS- Days After Sowing

Significant higher pod and haulm yield of frenchbean (150.48 and 38.06 q ha^{-1}, respectively) was observed with application of vermicompost which might be due to higher and faster release of NO_3^- and NH_4^+ form of nitrogen in vermicompost as compared to other organic manures like FYM and poultry manure and this might be due to the narrow C : N ratio of vermicompost (Velmurugan and Swarnam 2013). This might have facilitated in release of plant nutrients to labile nutrient pool thereby more availability of nutrients to plants (Eswaran and Mariselvi 2016) which resulted in higher plant growth paramenters *viz.* plant height, number of branches and number of leaves ultimatley increasing both pod and haulm yield. Significantly lower pod and haulm yield was observed in case of no manure and no jeevamrutha treatment (98.72 and 24.68 q ha^{-1}) and this might be due to insufficient nutrient availability to the crop for its proper growth and development. Similar result was also reported by Ananda and Sharanappa (2017). Significantly higher number of growth components and yield components in jeevamrutha was due to higher amount of nutrient content like nitrogen, phosphorus and potassium (1.96 %, 0.280 % and 0.173 %, respectively) and also contains Mg (46 ppm) and Cu (51 ppm) and maximum microbial population (maximum CFU of bacteria (855), fungi (29), actinomycetes (8), N-fixers (69) and P-solubilizer (80) was observed in jeevamrutha (Devakumar *et al.* 2008 and 2014). This might have enhanced the decomposition process in the soil which might have resulted in relatively quick release of nutrients from compost compared to the treatments where no jeevamrutha was applied. These results are in consonance with findings of Basavaraj Kumbar (2016) in French bean, Basavaraj Kumbar and Devakumar (2016a). Higher application rate of jeevamrutha hastened the decomposition process and increased the availability of mineralized nutrients to the plant which resulted in increased yield of frenchbean crop. This result is in accordance with the findings of Basavaraj Kumbar and Devakumar (2016b).

From this study it can be concluded that application of vermicompost along with 2000 litre ha^{-1} jeevamrutha is beneficial in improving growth

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and yield of frenchbean by providing better availability of nutrients, improved microbial activity and availability of growth promoting substances.

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