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Optimizing French Bean Growth with Organic Manures in Agroforestry and Open Systems

Surla Govinda Raju [a++*] and Amit Larkin [b#]

[a] Department of Forestry (Silviculture and Agroforestry), College of Forestry, SHUATS, Prayagraj, Uttar Pradesh (211007), India.
[b] Department of Forest Biology, Tree Improvement and Wild Life Sciences, College of Forestry, SHUATS, Prayagraj, Uttar Pradesh (211007), India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried out during the Rabi seasons of 2022–23 and 2023–24 to evaluate the impact of organic manure on the growth performance of French bean cultivated organically within a poplar-based agroforestry system. The study aimed to assess how organic nutrient inputs influence plant development in this integrated land-use approach, emphasizing sustainability and resource efficiency. The trial was carried out in organic experimental block of Forest Nursery and Research Centre (College of Forestry) of Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj. The trial included levels of organic manure nutrient supply treatments. In Both the Shade and Open conditions the treatment T9 (FYM 50 %, Vermicompost 50 %, Poultry

[++] Ph. D. Scholar;
[#] Associate Professor;
**Corresponding author: E-mail: govindraju949@gmail.com;*

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Manure 100) recommended dose of through organics produced the highest plant height, Number of branches and Number of leaves. Plant growth parameters such as plant height during shade (36.84 cm) and open (50.24cm). Number of Branches during shade (25.47) and open (26.20). No of Leaves during shade (24.40) and open (25.05) was recorded maximum. Application of recommended dose of FYM 50 %, Vermicompost 50 %, Poultry Manure 100 % recorded higher values for growth parameters like number of leaves, number of branches, and Plant height as compared to the treatment which received recommended dose of control only.

Keywords: French bean; growth parameters; vermicompost and poultry manure.

1. INTRODUCTION

"In farming systems, organic farming is a method which primarily aims at cultivating the land and raising crops to keep the soil alive and in good health without adding any synthetically produced chemicals. For small and marginal farmers in India, organic farming is most relevant as they are resource poor to provide costly inputs for enhancing yield" (Thakur *et al*., 2021: Alkobaisy *et al*., 2021: Hassan *et al*., 2021; Islam *et al*., 2023). "In the organic farming system approach, a piece of land is used optimally and to its fullest potential to produce a range of nutritious and healthy food as well as other required commodities in a manner which can feed a small family and maintain soil health and productivity by agricultural practices based on principles of nature. In India, certified organic farming has increased from 42,000 hectares in 2003-04 to 1.18 million hectares in 2009" (Willer & Kilcher, 2011).

"A live, healthy soil with proper cropping pattern, crop residue management and effective crop rotation can sustain optimum productivity over the years without any loss in soil fertility" (Sarvade *et al.,* 2019; Khatun *et al*., 2023; Kinigopoulou *et al*., 2023). "These systems take local soil fertility as a key to successful production. In most parts of the country poor soil health due to loss of organic matter and soil microbial load is a major problem. The inclusion of legume crops in the sequence has added advantage of fixing atmospheric nitrogen into the soil and make it available for companion or succeeding crops and will also help to sustain organic matter levels and promote good soil tilth" (Seaman, 2011; Shrivastava *et al.,* 2018; Thakur *et al.,* 2023). "This also helps in protecting soil from soil erosion. Farmers should select the crops which are easy to grow, according to their needs and season for the organic farming. French bean is a good leguminous candidate crop for the organic farming, which helps in sustaining the soil fertility, fist well in cropping sequence for its short growth period and also gives good economic yield to fetch good price in the market and studies conducted by" (Raghav, 2006; Raghav and Sashi Kamal, 2007; Sharma *et al.,* 2014; Raju, *et al.,* 2023) has indicated that yield and quality of organically grown were better than the crop. The present study was carried out with a view to study the effect of different levels of through organic sources on crop performance with respect to crop growth and yield of French bean.

2. MATERIALS AND METHODS

2.1 Experimental Site

Field experiment was carried out during *Rabi* seasons of 2022-23 and 2023-24 at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj.

2.2 Topography

The experimental site is located in the sub-tropical region with 25^0 57' N latitude, 81^0 57' E longitude and 98 meter above the mean sea level. Prayagraj is situated in the south-eastern part of Uttar Pradesh, India, at an elevation of 98 meter above mean sea level.

2.3 Detail of Treatment

The experiment was carried out in a Randomized Block Design with three replications. Organic plots were having similar soil properties and were situated four meter apart from each other and were separated by manual forecasting to organic treatments. The experiment constituted 18 treatments viz.,

Treatment Combinations:- FYM + Vermicompost + Poultry Manure

- Farm yard manure- 26 t/ha.
- Vermi compost – 8 t/ha
- Poultry manure- 6 t/ha

Table 1. Detail of treatment

Treatment No.	Treatment detail
T1	FYM 100 % + Vermicompost 0 % + Poultry Manure 0 %
T2	FYM 100 % + Vermicompost 0 % + Poultry Manure 50 %
T3	FYM 100 % + Vermicompost 0 % + Poultry Manure 100 %
T4	FYM 75 % + Vermicompost 25 % + Poultry Manure 0 %
T5	FYM 75 % + Vermicompost 25 % + Poultry Manure 50 %
T6	FYM 75% + Vermicompost 25 % + Poultry Manure 100 %
T7	FYM 50 % + Vermicompost 50 % + Poultry Manure 0 %
T8	FYM 50 % + Vermicompost 50 % + Poultry Manure 50 %
T9	FYM 50 % + Vermicompost 50 % + Poultry Manure 100 %
T10	FYM 25 % + Vermicompost 75 % + Poultry Manure 0 %
T11	FYM 25 % + Vermicompost 75 % + Poultry Manure 50 %
T12	FYM 25 % + Vermicompost 75 % + Poultry Manure 100 %
T13	FYM 0 % + Vermicompost 100 % + Poultry Manure 0 %
T14	FYM 0 % + Vermicompost 100 % + Poultry Manure 50 %
T15	FYM 0 % + Vermicompost 100 % + Poultry Manure 100 %
T16	FYM 0 % + Vermicompost 0 % + Poultry Manure 0 %
T17	FYM 0 % + Vermicompost 0 % + Poultry Manure 50 %
T18	FYM 0 % + Vermicompost 0 % + Poultry Manure 100 %

The treatment under organic cultivation received well decomposed Farm yard manure (FYM) as source of nutrient prior to sowing. Recommended FYM (25 t/ha), Poultry manure (6 t/ha) and Vermicompost (6 t/ha) was applied to all treatments (T1 to T18) leaving control plot. Quantity of FYM, Poultry manure and Vermicompost required for different treatments was calculated based on dry weight. The recommended dosage of Organic manure for French bean were applied in two equal split doses as basal and side dressed before sowing. The first picking was done after 45 days of sowing and further 3 pickings were made till the crop period of 90 days. Observation on crop growth and yield parameters were recorded at 60 days after sowing and data were analysed using ANOVA (Gomez & Gomez, 1984).

3. RESULTS AND DISCUSSION

Table 2. Effect of treatments on Plant height at 30, 60 and 90 days in shade and open condition

Treatment	Plant height (cm)					
	30 days		60 days		90 days	
	Shade	Open	Shade	Open	Shade	Open
T_1	13.26	18.85	23.29	34.12	31.15	41.53
T_2	13.80	19.85	24.43	35.00	32.30	44.24
T_3	14.13	21.25	25.76	36.32	34.31	45.74
T_4	13.40	19.31	23.62	34.33	31.85	42.67
T_5	13.86	20.49	25.16	35.06	32.57	44.61
T_6	14.87	22.49	26.49	37.74	35.45	46.41
T_7	13.51	19.59	23.75	34.55	31.98	43.70
T_8	14.01	20.41	25.42	35.55	33.66	45.14
T_9	15.31	23.05	26.85	38.76	36.84	50.24
T_{10}	12.86	19.00	23.41	34.26	31.45	41.30
T_{11}	13.84	20.07	24.97	35.05	32.50	44.53
T_{12}	14.46	21.94	25.95	36.97	34.56	46.07
T_{13}	12.95	18.72	23.01	34.09	31.13	43.08
T_{14}	13.67	19.68	24.05	34.77	32.09	43.91
T_{15}	14.11	20.94	25.49	36.31	34.04	45.24
T_{16}	12.53	17.07	22.01	31.06	28.96	39.97
T_{17}	12.97	17.97	22.89	32.70	30.69	40.50
T_{18}	12.82	18.39	21.96	33.54	31.08	40.70
C.D. (P=0.005)	1.49	2.76	1.73	1.67	1.53	41.53
SE(m)	0.52	0.96	0.60	0.58	0.53	44.24

Table 3. Effect of treatments on Number of branches at 30, 60 and 90 days in shade and open condition

Treatment	Number of branches					
	30 days		60 days		90 days	
	Shade	Open	Shade	Open	Shade	Open
T_1	4.70	4.70	14.13	14.10	22.42	23.15
T_2	5.00	4.90	14.57	14.65	23.75	23.47
T_3	5.37	5.30	15.00	15.02	23.87	23.80
T_4	4.77	5.13	14.47	14.30	23.55	23.32
T_5	4.80	5.40	14.63	14.82	23.80	23.67
T_6	5.50	5.80	15.60	15.67	24.47	24.87
T_7	4.87	5.15	14.50	14.38	23.65	23.37
T_8	5.30	5.47	14.73	14.90	22.83	23.72
T_9	5.97	6.57	16.07	16.05	25.47	26.20
T_{10}	4.77	5.07	14.40	14.17	23.53	23.22
T_{11}	5.03	5.33	14.60	14.70	23.78	23.62
T_{12}	5.50	5.68	15.00	15.10	23.99	24.63
T_{13}	4.67	5.03	13.80	14.00	23.35	23.10
T_{14}	4.90	5.57	14.50	14.40	23.66	23.43
T_{15}	5.37	5.57	14.93	14.90	23.33	23.78
T_{16}	4.30	4.33	13.27	12.97	22.97	22.06
T_{17}	4.37	4.77	13.47	13.50	23.23	22.57
T_{18}	4.53	4.73	13.97	13.88	23.33	22.93
C.D. (P=0.005)	0.69	0.90	1.11	1.11	1.34	1.26
SE(m)	0.24	0.96	0.38	0.58	0.47	44.24

The experimental results of French bean on growth as influenced by different level of organic nutrient supply are presented in Table 2. The treatments differ significantly for the plant height in both Shade and Open conditions. During shade condition the maximum plant height was recorded in T9 (36.84) and minimum was recorded in T16 (28.96). In Open condition the maximum plant height was recorded in T9 (50.24) and the maximum was recorded in T16 (39.97).

The experimental results of French bean on growth as influenced by different level of organic nutrient supply are presented in Table 3. The treatments differ significantly for the No of branches in both Shade and Open conditions. During shade condition the maximum branches was recorded in T9 (25.47) and minimum was recorded in T16 (22.97). In Open condition the maximum plant height was recored in T9 (26.20) and the maximum was recorded in T16 (22.06).

Table 4. Effect of treatments on Number of leaves at 30, 60 and 90 days in shade and open condition

Treatment	Number of leaves					
	30 days		60 days		90 days	
	Shade	Open	Shade	Open	Shade	Open
T_1	3.27	4.70	14.70	18.80	21.07	22.03
T_2	3.53	5.20	15.29	18.13	21.47	23.07
T_3	3.80	5.63	15.70	19.37	22.50	24.07
T_4	3.37	4.97	14.93	17.90	21.40	22.40
T_5	3.63	5.37	15.41	18.70	21.87	23.45
T_6	4.07	6.13	16.20	19.97	22.73	24.47
T_7	3.43	5.10	15.03	18.03	21.50	22.97
T_8	3.67	5.47	15.57	19.13	21.93	23.60
T_9	4.07	6.20	16.83	20.27	24.40	25.05
T_{10}	3.37	4.77	14.92	17.93	21.27	22.10
T_{11}	3.60	5.23	15.30	18.50	21.80	23.10
T_{12}	3.97	5.93	16.13	19.37	22.57	24.40

Treatment	Number of leaves					
	30 days		60 days		90 days	
	Shade	Open	Shade	Open	Shade	Open
T_{13}	3.23	4.60	14.72	17.67	20.93	21.93
T_{14}	3.50	5.17	15.07	18.07	21.50	23.02
T_{15}	3.70	5.57	15.63	19.20	21.97	23.90
T_{16}	2.73	4.63	13.68	16.63	20.20	21.32
T_{17}	2.90	4.67	14.00	17.40	20.47	21.37
T_{18}	3.13	4.53	14.65	17.40	20.83	21.30
C.D. (P=0.005)	0.53	0.53	1.32	1.51	1.44	2.05
SE(m)	0.19	0.18	0.46	0.52	0.50	0.71

The experimental results of French bean on growth as influenced by different level of organic nutrient supply are presented in Table 4. The treatments differ significantly for the No of leaves in both Shade and Open conditions. During shade condition the maximum leaves was recorded in T9 (24.40) and minimum was recorded in T16 (20.20). In Open condition the maximum leaves was recorded in T9 (25.05) and the maximum was recorded in T16 (21.32).

4. CONCLUSION

Application of different percentage of organic manures had a significant response on growth of French bean during *Rabi* season of agroforestry system and open conditions. The results obtained revealed that French bean responded well to the application of different organic manures to other treatments in the study. Based on the findings of this study, it may be recommended that FYM 50 % + Vermicompost 50 % + Poultry Manure 100 is adequate for maximum growth of French bean in the study location.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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