

Growth and yield of French bean (*Phaseolus vulgaris* L.) under organic farming

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Abstract

A field experiment was conducted during 2007-2010 to study the effect of levels of organic manure and conventional practices on growth and yield of French bean grown organically. The trial was carried out in organic experimental block of IHR farm, Hesaraghatta, Bangalore. The trial included four levels of organic manure nutrient and two inorganic nutrient supply treatments. The treatment which received 100 per cent recommended dose of N (RDN) through organics produced the highest pod yield (17.77 t/ha) followed by treatments which received 75 per cent RDN through organics and conventional practices (17.45 and 15.93 t/ha). Plant growth parameters such as plant height (45.5 cm), number of leaves per plant (42.9), leaf area per plant (2706 cm²), nodules per plant (43.9), pod weight per plant (160.1g) and pod length (14.7 cm) were also comparatively higher in this treatment resulting in better pod yield. Application of recommended dose of chemical fertilizer in conjunction with farm yard manure recorded higher values for growth and yield parameters like number of leaves, leaf area, dry matter production, number of pods, pod weight per plant and pod length which also resulted in significantly higher pod yield as compared to the treatment which received recommended dose of chemical fertilizer only.

Key words: Organic farming, French bean, nutrients, growth and yield parameters, yield

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. 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 and 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. 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). 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, fits 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 and Sashi Kamal (2007) has indicated that yield and quality of organically grown

cowpea were better than the crop using chemical fertilizer only. Hence, the present study was carried out with a view to study the effect of different levels of nutrients through organic sources on crop performance with respect to crop growth and yield of French bean.

Materials and methods

Field experiment was carried out during *kharif* seasons of 2007-2010 at Indian Institute of Horticultural Research, Bangalore. The soil of experiment site was well drained sandy loam with pH 6.81 and EC 0.22 ds/m. The initial organic carbon content of soil was 0.51 per cent and available N, P₂O₅ and K₂O were 186, 20.9 and 168 kg/ha, respectively. The experiment was carried out in a Randomized Block Design with four replications. Organic and inorganic plots were having similar soil properties and were situated five meter apart from each other and were separated by a *Glyricidia* live hedge to protect from any possible spray drift to organic treatments. The experiment constituted six treatments viz., T₁: 25 %, T₂: 50 %, T₃: 75 %, T₄:100 % of recommended dose of nitrogen equivalent to FYM application, T₅: Conventional practice (Recommended FYM @25t/ha + Recommended N P K fertilizers) and T₆: Only recommended N P K fertilizers. The treatment under organic cultivation received well decomposed Farm yard manure (FYM) as source of nutrient prior to sowing. Recommended FYM (25t/ha) was applied to treatments T₁ to T₄ besides treatment FYM. Quantity of FYM required for different treatments was calculated based on dry weight and total nitrogen content of manure used. The recommended dosage of N:P:K is 60:80:60 kg per hectare for French bean. N and K were applied in two equal split doses as basal and side dressed after thirty days of sowing and entire amount of P was applied as basal dose in T₅ and T₆. Farm yard manures applied in organic treatments was enriched

with bio-fertilizers and bioagents like *Azospirillum*, phosphate solubilizing bacteria (PSB), *Pseudomonas fluorescense* and *Trichoderma harzianum* before field application. Supplemental P was given through PSB treated rock phosphate @ 50 kg/ha/year and neem cake was also added @ 625 kg/ha. Sowing of French bean variety Arka Anoop (Rust and bacterial blight resistant, bush type) was done at the spacing of 60 x 20 cm. The crop was irrigated with inline drip system having the discharge rate of 4 liters per hour as and when required to supply irrigation @ 0.7 Epan losses. Organic plant protection was taken up using *T. harzianum*, *Beauveria basiana*, *Verticillium lecani*, neem seed powder extract (4%), neem and pongamia soap (0.7 %). For T₅ & T₆, recommended plant protection chemicals were used. The first picking was done after 45 days of sowing and further 3 pickings were made till the crop period of 70 days. Observation on crop growth and yield parameters were recorded at 50 days after sowing and data were analyzed using ANOVA (Gomez and Gomez, 1983).

Results and discussion

The experimental results of French bean on growth as influenced by different level of organic nutrient supply are presented in Table 1. The treatments did not differ significantly for the plant height but T₆ (46.4 cm) and T₁ (39.4 cm) recorded maximum and minimum values, respectively. Plant growth parameters such as number of leaves per plant, leaf area per plant, number of nodules per plant and dry matter in different parts of the plants were significantly influenced by different levels of nutrients. Higher amount of FYM application equivalent to 75 and 100 per cent of recommended N (T₃ & T₄) as well as chemical treatments remained at par for number of leaves and leaf area per plant. All these four treatments recorded significantly higher values than T₁ and T₂. The treatments T₄ and T₅ recorded the highest number of leaves (42.9) and leaf area (2741 cm²) per plant, respectively. The gradual increase in FYM application according to N equivalents resulted in increased number of nodules per plant and further it decreased significantly with the application of chemical fertilizer with or without organic manure. It shows that use of organic manures in required quantity also has beneficial effect on number of nodules in leguminous crop. Otieno *et al.* (2007) also observed higher number of nodules in the plants treated with organic manures compared to control in different legume species. Rana *et al.* (2006) recorded significantly higher number of nodules per plant with higher quantity of farm yard application in French bean. This slow mineralization and additional phosphorus present in the manure perhaps resulted in the positive effect on nodulation. With respect to dry matter partitioning in different parts of the plant, the application of

organic manure equivalent to recommended quantity of nitrogen recorded significantly higher dry matter accumulation in leaf and pods. The same treatment also recorded higher dry matter accumulation in stem but it remained on par with all treatments except T₁. This indicates that dry matter in stem does not change much, with respect to the quantity of nutrients applied. This might be due to comparatively slow growth rate of stem as compared to leaf production and very rapid pod formation and growth between 40 and 60 days after sowing of crop. However, nutrients play an important role in leaf as well as pod dry matter accumulation in French bean plant. Similarly, the total dry matter accumulation in the plant was also higher, when the higher quantities of organic manure were applied as compared to chemical treatments. Similar results were also reported by Ashwini (2005) in French bean crop. The over all better crop growth parameters including higher dry matter production was due to better soil conditions prevalent in treatments, which received higher quantity of organic manure.

The yield and yield attributing characters like number of pods per plant, pod weight per plant, dry matter in pods differed significantly with the treatments (Table 2). Application of recommended inorganic fertilizer along with farm yard manure treatment (T₅) resulted in significantly higher number of pods per plant (44.20) than other treatments except T₄, while the only recommended NPK fertilizer treatment (T₆) recorded the lowest (29.30). Girija and Britto (2006) have also reported that the yield component in cluster bean were better under organic farming than inorganic farming. The increase in quantity of organic manure application with regards to recommended N equivalent increased pod weight and pod yield in French bean. Similar performance in garden pea was reported by Pandey *et al.* (2006). The application of farm yard manure equivalent to recommended N recorded significantly higher pod weight (160.1 g/plant) and pod yield (17.77 t/ha) than all other treatments except T₃. Higher yield components such as number of pods per plant, pod weight per plant and pod length in these two treatments (T₃ and T₄) resulted in higher yields to the tune of 18.5 per cent than the treatment which

Table 2. Yield parameters of French bean as influenced by different organic nutrient levels and sources (pooled data of 4 years, Year x treatment effect was not significant)

Treatments	Pods/ plant	Pod weight /plant (g)	Pod length (cm)	Dry matter content in pods (%)	Pod yield (t/ha)
T ₁	35.40	133.8	13.6	8.99	14.86
T ₂	38.00	140.7	13.6	8.53	15.61
T ₃	38.60	157.2	13.8	8.41	17.45
T ₄	43.90	160.1	14.7	8.20	17.77
T ₅	44.20	143.5	13.6	8.22	15.93
T ₆	29.30	112.6	13.3	7.86	12.50
CD (P=0.05)	2.81	6.84	NS	0.85	0.76

Table 1. Effect of different organic nutrients levels and sources on growth parameters of French bean (pooled data of 4 years, Year x Treatment effect was not significant)

Treatments	Plant height (cm)	Leaves/plant	Leaf area/ plant (cm ²)	Nodules/ plant	Dry matter (g/plant)			
					Leaf	Stem	Pod	Total
T ₁	39.4	37.0	2259	35.4	5.25	8.71	12.0	25.96
T ₂	39.8	37.3	2332	38.6	5.62	9.83	12.0	27.45
T ₃	44.2	40.7	2577	38.0	6.06	9.98	13.2	29.24
T ₄	45.5	42.9	2706	43.9	7.09	10.21	13.1	30.40
T ₅	43.2	42.1	2741	36.2	7.01	10.20	11.8	29.01
T ₆	46.4	40.7	2614	39.2	5.15	9.30	8.9	23.35
CD (P=0.05)	NS	2.34	335.1	2.34	0.59	0.92	0.61	

received lowest quantity of farm yard manure (T₁). Jasrotia and Sharma (1998) also reported substantial increase in productivity of French bean with higher rate of farm yard manure application. The application of recommended dose through inorganic sources (T₆) resulted in the lowest values for pod weight (112.6 g/per plant) and yield (12.50 t/ha). All the organic treatments (T₁ to T₄) and conventional practice (T₅) recorded higher percentage of dry matter content in the pods than recommended NPK fertilizers alone (T₆).

From the study, it is evident that French bean can be cultivated organically by supplying organic manures equivalent to 75 to 100 per cent of recommended nitrogen. The yield was higher under organic farming treatments when compared to conventional integrated nutrient management system in French bean. However, chemical fertilizer application alone resulted in substantial decrease in productivity.

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