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Effect of integrated nutrient management on growth, yield and yield attributing parameters of French bean (*Phaseolus vulgaris* L.)

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Abstract
An experiment entitled "Effect of Integrated Nutrient Management on Growth, Yield and Yield attributing parameters of French bean (*Phaseolus vulgaris* L.)" was carried out during *Rabi* season of 2018-19 at the research plot of All India Coordinated Research Project (AICRP) on Vegetable Crops of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India. The experiment was laid out in Randomized Block Design (RBD) with eight treatments replicated thrice. All the recommended package of practices except nutrient management was given uniformly to all the treatments to raise a good crop. In this investigation, the results revealed that application of 75% NPK through inorganic source along with 25% N through vermicompost (T_3) recorded significantly higher growth parameters viz., plant height (47 cm), number of primary branches (5.53), leaf area (169.55 cm^2) ; yield and yield attributing parameters viz., pod length (13.58 cm), pod girth (1.17 cm), average pod weight (6.45 g), number of pods per plant (23.95) and pod yield (97.89 q ha^{-1}). The next best treatment was T_2 where 75% NPK through inorganic source along with 25% N through FYM was applied.

Keywords: Integrated nutrient management, FYM, vermicompost, growth, yield

Introduction
French bean (*Phaseolus vulgaris* L.) as an important leguminous vegetable crop in India, is extensively grown for its green pods and dry seeds (known as 'Rajmah'). French bean (*Phaseolus vulgaris* L.) which is also called as common bean, snap bean, bush bean, field bean, garden bean, kidney bean, haricot bean, wax bean, string bean, navy bean, marrow bean etc. is one of the most popular and widely grown vegetables in India. The word *phaseolus* is derived from the Greek word, Phaselua, a canoe – like boat reminiscent of a bean pod. Over 14,000 cultivars of french bean are known to exist, and the International Center for Tropical Agriculture in Colombia is the main repository for the germplasm (Adsule *et al*., 1998) [1].
French bean is characteristically shy of nitrogen fixation and hence require larger amount of nitrogen. Being a fertilizer responsive crop, french bean responds well to nutrition, while excess nitrogen results in poor pod yield. Like other legumes it also fixes atmospheric nitrogen and improves soil fertility (Adsule *et al.*, 1998) [1]. Therefore, it requires large quantity of nitrogenous fertilizer. Increasing cost of inorganic fertilizers and reduction in soil health with chemical fertilizers, it is essential to replace inorganic fertilizers through organic for sustainable agriculture. Organic sources of the plant nutrients have been reported to improve growth, yield attributes, yield and soil fertility status. In commercial agriculture, the use of chemical fertilizers cannot be ruled out completely. However, there is a need for integrated use of alternate sources of nutrients for sustaining the crop productivity (Dar *et al*., 2014) [6]. The integration of organic and inorganic sources of plant nutrients has proved superior to individual components with respect to growth, yield and quality of pulses (Ghosh *et al*., 2014; Datt *et al*., 2013) [8, 5]. Keeping this in view, an experiment was carried out to improve yield and soil fertility of French bean with integrated nitrogen management under temperate conditions.

Materials and Methods
The experiment was carried out at research plot of All India Coordinated Research Project (AICRP) on Vegetable Crops of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India during *Rabi* season of 2018-19. The experiment was laid out in Randomized Block Design (RBD) with eight treatments replicated thrice.

The eight treatment schedules were T_1 (100% NPK through inorganic source), T_2 (75% NPK through inorganic source + 25% N through FYM), T_3 (75% NPK through inorganic source + 25% N through vermicompost), T_4 (50% NPK through inorganic source + 50% N through FYM), T_5 (50% NPK through inorganic source + 50% N through vermicompost), T_6 (25% NPK through inorganic source + 75% N through FYM), T_7 (25% NPK through inorganic source + 75% N through vermicompost) and T_8 (control, no fertilizer). All the recommended package of practices except nutrient management was given uniformly to all the treatments to raise a good crop. The required amount of fertilizers as per treatment schedule were calculated on the basis of plot size and applied through different sources like urea, single super phosphate (SSP), muriate of potash (MOP), FYM and vermicompost. Full dose of P and K were applied as basal dose through SSP and MOP respectively. Half dose of N was given as basal dose through urea at the time of sowing and the remaining half of N was top dressed in two equal split doses at 21 and 35 days after sowing. Organic manures such as FYM and vermicompost were applied 7 days before sowing as per treatment requirement. Sowing of healthy seeds of Falguni variety of french bean was done at a spacing of 50 cm X 25 cm. Five plants were selected randomly from the net plot area of each treatment and were tagged for recording various morphological observations in respect of growth and yield of the crop. The data recorded during the experiment were statistically analysed using Analysis of Variance technique given by Panse and Sukhatme (1985) [11].

Results and Discussion

Growth parameters: In the present investigation significantly better results on growth parameters viz., maximum plant height (47 cm), number of primary branches per plant (5.53) and leaf area (169.55 cm^2) were recorded with the application of 75% NPK through inorganic source + 25% N through vermicompost (T_3) but it was *statistically at par* with the treatment T_2 (75% NPK through inorganic source along with 25% N through FYM), T_1 (100% NPK through inorganic source) and T_5 (50% NPK through inorganic source + 50% N through inorganic vermicompost). The lowest value of growth parameters were recorded in control treatment (T_8) where no fertilizers applied. This might be due to more availability and uptake of different nutrients for initial requirement of crop growth in these treatment combinations than other treatments. Nitrogen is important nutrient responsible for better cell division, cell enlargement as well as cell elongation. During the trial organic nitrogen will be mineralized slowly but steadily and supplied required quantity of useable nitrogen during progressive growth period but initial requirement of nitrogen would be met from inorganic source as it would be available instantly to the plant. This results are in conformity with the findings of Jagdale *et al*. (2005) [7], Kalange (2006) [8], Band *et al*. (2007) [2], Kamble *et al*. (2016) [9] and Mohanty *et al*. (2017) [10] in french bean.

Table 1: Effect of integrated nutrient management on growth parameters of French bean

Treatment	Plant height (cm)	Number of primary branches per plant	Leaf area (cm^2)
T_1 (100% NPK through inorganic source)	45.67	4.97	165.62
T_2 (75% NPK through inorganic source along with 25% N through FYM)	46.20	5.00	164.67
T_3 (75% NPK through inorganic source + 25% N through vermicompost)	47.00	5.53	169.55
T_4 (50% NPK through inorganic source + 50% N through FYM)	42.80	4.33	146.69
T_5 (50% NPK through inorganic source + 50% N through inorganic vermicompost)	44.80	4.75	152.46
T_6 (25% NPK through inorganic source + 75% N through FYM)	40.47	3.83	115.01
T_7 (25% NPK through inorganic source + 75% N through vermicompost)	41.53	3.88	123.97
T_8 (control, no fertilizer)	29.40	3.22	101.74
Mean	42.23	4.40	142.47
SE (m) ±	1.67	0.34	4.24
CD (5%)	5.06	1.04	12.85

Yield and yield attributing parameters: In the present investigation significantly higher yield and yield attributing parameters include pod length (13.58 cm), pod girth (1.17 cm), average pod weight (6.45 g), number of pods per plant (23.95) and pod yield (97.89 q ha^{-1}) were recorded with the application of 75% NPK through inorganic source + 25% N through vermicompost (T_3) followed by application of 75% NPK through inorganic source + 25% N through FYM (T_2) and 50% NPK through inorganic source + 50% N through vermicompost (T_5) which were *statistically at par*. The higher pod length, pod girth, average pod weight, number of pods per plant and pod yield per ha in this treatment might be due to integrated use of inorganic fertilizers along with organic manures (FYM or vermicompost) improved the physical properties (water and nutrient holding capacity) of soil thus making more availability of nutrients to the plants and would have also provided both macro and micro nutrients specification in optimum which in turn creates favourable environment for growth and development of the crop. Similar findings were also reported by Jagdale *et al*. (2005) [7], Band *et al*. (2007) [2] in french bean, Das *et al*. (2011) [5] in cow pea, Shwetha *et al*. (2012) [13] in french bean, Reddy *et al*. (2014) [12] in cluster bean, Srinivasan *et al*. (2015) and Kamble *et al*. (2016) [9] in french bean, Singh and Kumar (2016) [14] in cluster bean and Mohanty *et al*. (2017) [10] in french bean.

Table 2: Effect of integrated nutrient management on growth parameters of french bean

Treatment	Pod length (cm)	Pod girth (cm)	Average pod weight(g)	Number of pods per plant	Pod yield (q ha^{-1})
T_1 (100% NPK through inorganic source)	11.52	0.91	5.53	19.50	80.98
T_2 (75% NPK through inorganic source along with 25% N through FYM)	13.07	1.05	6.20	22.62	93.45
T_3 (75% NPK through inorganic source + 25% N through vermicompost)	13.58	1.17	6.45	23.95	97.89
T_4 (50% NPK through inorganic source + 50% N through FYM)	12.21	0.98	5.80	21.54	87.28
T_5 (50% NPK through inorganic source + 50% N through inorganic vermicompost)	12.75	1.06	5.92	22.40	91.35
T_6 (25% NPK through inorganic source + 75% N through FYM)	11.08	0.79	5.21	18.81	75.30
T_7 (25% NPK through inorganic source + 75% N through vermicompost)	11.38	0.80	5.45	19.77	80.24
T_8 (control, no fertilizer)	9.78	0.77	4.00	12.28	56.41
Mean	11.92	0.94	5.57	20.11	82.86
SE (m) ±	0.74	0.07	0.24	1.27	4.99
CD (5%)	2.24	0.21	0.72	3.85	15.14

Conclusion

Based on the present field experimentation it can be concluded that integrated application of 75% NPK through inorganic source along with 25% N through vermicompost (T_3) was the best treatment in terms of growth, yield and yield attributing parameters. The next best treatment was T_2 where 75% NPK through inorganic source along with 25% N through FYM was applied. Therefore there is scope to reduce the inorganic fertilizer dose by 25% and replace it by application of either vermicompost or FYM which helps in increasing growth and pod yield of French bean.

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