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Influence of integrated nutrient management on growth and yield of french bean (*Phaseolus vulgaris* L.) Cv. pant Anupama under valley conditions of Dehradun

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Abstract
The present study was carried out on research field of Department of Agriculture, D.I.B.N.S, Manduwala (Dehradun) during 2019 to study the effect of integrated nutrient management (INM) on growth and yield of French bean under valley conditions of Dehradun. Treatments included eight combinations viz., T_2 (100% RDF), T_3 (100% RDF + FYM), T_4 (75% RDF + FYM), T_5 (50% RDF + FYM), T_6 (100% RDF + FYM), T_7 (75% RDF + Vermicompost + FYM), T_8 (50% RDF + Vermicompost + FYM), besides an absolute control i.e., T_1 (no organic and inorganic fertilizers applied) and was laid out in Randomized Block Design with three replications.

The results revealed that application of 100% RDF + Vermicompost + FYM significantly decrease the days of germination (7.00), while increase growth, yield significantly over control and highest plant height (31.12 cm) at flowering stage & 33.08 cm at maturity stage). Number of primary branches plant^{-1} (6.33), days to 50% germination (38.66), number of plants bed^{-1} (66.00), pod length (15.06 cm), pod width (0.90 cm), number of pods plant^{-1} (38.66), average pod weight (5.79 g), fresh pod yield plant^{-1} (227.99 g), fresh pod yield bed^{-1} (15.04 kg), fresh pod yield hectare^{-1} (37.60 t), dry matter content (9.67%) and protein content (6.76%) were also recorded with application of 100% RDF + Vermicompost + FYM and lowest in control. Thus, growth and yield may be improved by integrated use of organic and inorganic sources of nutrient and the nutrient management.

Keywords: French bean, RDF, vermicompost, yield

1. Introduction
French bean (*Phaseolus vulgaris* L.) 2n=22 of family Leguminosae (Fabaceae) is a nutritious vegetable grown for its tender green pods with high protein, calcium and iron content. It is one of the most important legume vegetable grown forits tender pods in a commercial scale in all types of soils ranging from sandy loam to clay soils but it cannot withstand water logging. Being a short duration crop French bean can be grown under different cropping patterns of hills and plains of Uttrakhand. In India it is mainly grown in Himanchal Pradesh, Punjab, Haryana, Uttar Pradesh, Uttrakhand, Bihar, Gujrat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu and Odisha. French bean has evolved from wild growing vine distributed in the high lands of Middle-America and Andes. South Mexico and Central America are considered as the primary centre of origin, which lies in Peru-Bollivia-Ecuador region.

French bean is a warm requiring tender vegetable crop that cannot tolerate frost, high temperature and high rainfall. Its seeds do not germinate below 15 ^{o}C, and a most favorable soil temperature for its seed germination is ranged from 18 ^{0}C to 24 ^{0}C. The crop thrive best at a temperature range at 15 ^{0}C to 25 ^{0}C thus in plains of India it is grown in cool season.

French bean is a nutritious vegetable. It contains higher amount of protein, vitamin A and vitamin C, Potassium, Magnesium, Calcium, and Phosphorus. However, it is low in fat content. Each 100 g of tender pods of French bean contains 90% moisture, 1.10% fiber, 1.80% protein, 0.10% fat, 7.10% carbohydrate, 31.0(Kcal) energy, 37.0 mg calcium, 38.0 mg phosphorous, 1.0 mg iron, 668 vitamin A (IU), 0.08 mg thiamine, 0.11 mg riboflavin, 0.75 mg niacin and 16.3 mg vitamin C (Gebhardtet *et al*., 1982). In addition to the consumption of green pods as cooked vegetable and dry bean seed use as pulses.

The fertility status of soil is not that high to meet the entire nutrient requirement of the crop. Hence, external supply of nutrient through fertilizers has become the urgent need of the hour. Therefore, the optimum fertilizer dosage with FYM and vermicompost for the crop has to be

standardized which enables as to meet the entire nutrient requirement of the crop throughout the crop growing period and to get a good yield. Standardization of genotypes for their performance in different location with varied cultural practices to overall increase in the yield in one hand and generating a good economic return to the farmer in other hand is most important in standardization of cultural practices for a particular variety in a particular location.

In Uttarakhand valley conditions of Dehradun region, the crop is mainly grown in kharif and rainy season. Due to low temperature in the high hills of Uttarakhand and other part the French bean perform well and fetches very good price in the market. The French bean is fleshy and good yielding and prized for its taste for which it has got very good market demand. French bean cultivation in plains of Uttarakhand in winter season under irrigated condition is not available for the farmers. So, realizing the popularity of bean cultivation in rainy season in high hills of Uttarakhand and has been taken to study the performance of the French bean in Dehradun valley conditions with normal cultural crop cultivation practices and keeping in view its poor nodulation.

2. Materials and Methods

This present experiment was conducted at research farm of Department of Agriculture, Dolphin (PG) Institute of Biomedical and Natural Sciences, Manduwala, Dehradun, Uttarakhand (India), during 2019. The soil of experiment site is sandy loam in nature with pH 6.3, high in inorganic C 0.84% (Walkley and Black, 1934), medium in available N 96.6 kg/ha (Subbiah and Asija, 1954), available P 3.05 kg/ha (Olsen *et al*., 1954) and available K 136 kg/ha (Jackson, 1967). The experiment was laid out in a Randomized Block Design having 8 treatments (Table-1), comprising different combinations of inorganic fertilizers with organic manure viz., T_2 (100% RDF), T_3 (100% RDF + FYM), T_4 (75% RDF + FYM), T_5 (50% RDF + FYM), T_6 (100% RDF + FYM), T_7 (75% RDF + Vermicompost + FYM), T_8 (50% RDF + Vermicompost + FYM), besides an absolute control i.e., T_1 (no organic and inorganic fertilizer applied) and was replicated thrice. The climate of the experimental site is temperate characterized by moderately hot summers and very cold winters. Rainfall received during the growing season (April to July) was 157.4 mm. The mean monthly maximum and minimum temperatures during the growing seasons varied from 26.4 to 39.5 ^{0}C and 12.4 to 23.4 ^{0}C respectively, whereas mean minimum relative humidity 41.71 to 62.57% and mean maximum relative humidity was 46 to 66 per cent. Recommended doses of NPK fertilizers applied to French bean were N: P_2O_5: K_2O @ 30:60:40 kg/ha. The NPK was applied as basal at the time of sowing. Organic manures (farm yard manure and vermicompost) were incorporated according to the treatments at the time of field preparation and mixed thoroughly. French bean (Pant Anupama) was sown @ 70 kg/ha at spacing row to row 40cm and plant to plant 10 cm on 13th March and harvested on 5th July. All other agronomic practices were followed as per standard recommendations. The grain and straw yield of French bean were recorded and observation on growth, yield and quality attributers were recorded from five randomly selected tagged plants from each plot. Protein estimation was done in laboratory by Lowry's method.

The data were analyzed as per the standard procedure for Analysis of Variance (ANOVA) as described by Gomez and Gomez, (1984). The significance of treatments was tested by 'F' test (Variance ratio). Standard error of mean (SEm±) was computed in all cases. The difference in the treatment mean was tested by using critical difference (CD) at 5% level of significance.

Table 1: Various organic and inorganic treatment combinations

S No.	Treatment Combinations	
1	Control	T_1
2	100% RDF	T_2
3	100% RDF+FYM	T_3
4	75% RDF+FYM	T_4
5	50% RDF+FYM	T_5
6	100% RDF+Vermicompost+FYM	T_6
7	75% RDF+Vermicompost+FYM	T_7
8	50% RDF+Vermicompost+FYM	T_8

3. Result and Discussion

3.1 Growth characters

Results in table-2 showed that French bean growth characters were significantly influence with the application of various organic and inorganic fertilizers. The minimum days taken to 50% germination were recorded (7.00 cm) in treatment T_6 (100% RDF + Vermicompost + FYM) and the maximum days of germination was observed (10.66 cm) in treatment T_1 (Control). Highest plant height at maturity stage was recorded (33.08 cm) in treatment T_6 (100% RDF + Vermicompost + FYM) and the lowest plant height was observed (25.78 cm) in treatment T_1 (Control). Present finding results are in line with results obtained by Singh *et al.,* (2009) [9], Zahida *et al.,* (2016) [10] and Sharma *et al.,* (2017) [8]. Highest number of primary branches per plant was recorded in treatment T_6 (6.33) i.e. (100% RDF + Vermicompost + FYM) and T_7 (6.33) i.e. (75% RDF + Vermicompost + FYM) and the lowest number of primary branches per plant was recorded (3.33) in treatment T_1 (Control). El-Bassiony *et al.,* (2010) [2], Sarma *et al.,* (2014) [7] and Zahida *et al.,* (2016) [10] showed similar result by application of FYM with vermicompost. Minimum days to 50% flowering was taken in treatment T_6 (38.66) DAS i.e. (100% RDF + Vermicompost + FYM) and maximum days taken to 50% flowering (47.66) DAS in treatment T_1 (Control). Similar findings were also reported by Das *et al.,* (2014) [1]. Maximum number of plants per bed was observed in treatment T_6 (66.00) i.e. (100% RDF + Vermicompost + FYM) and minimum number of plants per bed was observed (32.66) in treatment T_1 (Control). This increase in growth attributes might have been due to more and quick supply of NPK with heavy application of inorganic fertilization which increased photosynthetic activity, cell division, elongation and differentiation etc. resulting in higher growth attributes.

Table 2: Influence of Organic and Inorganic Fertilizers on Growth Parameters of French Bean (*Phaseolus Vulgaris* L.)

Treatment	Days to 50% germination	Plant height (maturity stage)	Number of primary branches	Days to 50% flowering	Number of plants per bed
T_1	10.66	25.78	3.33	47.66	32.66
T_2	10.33	29.22	4.33	43.66	41.00
T_3	7.33	31.99	5.66	40.00	51.00
T_4	8.66	30.95	4.66	42.00	44.66
T_5	9.33	28.27	4.00	43.33	35.33
T_6	7.00	33.08	6.33	38.66	66.00
T_7	7.33	32.66	6.33	39.00	58.33
T_8	7.66	30.77	5.33	42.66	48.66
Range	7.00 - 10.66	33.08 - 25.78	3.33 - 6.33	38.66 - 47.66	66.00 - 32.66
SE(m)±	0.312	0.452	0.295	1.276	0.518
CD at 5%	0.955	1.383	0.905	3.909	1.585

3.2 Yield characters

The presented data in table-3 concerning with the yield parameters of French bean are affected by different dose of organic with inorganic fertilizers. The yield parameters gave a significant influence at 5% level. Highest pod length (cm) was recorded in treatment T_6 (15.06 cm) i.e. (100% RDF + Vermicompost + FYM) and minimum pod length was recorded (9.07 cm) in treatment T_1 (Control). Highest pod width was recorded in treatment T_6 (0.90 cm) i.e. (100% RDF + Vermicompost + FYM) and minimum pod width was recorded (0.74 cm) in treatment T_1 (Control). Prabhakar *et al.*, (2011) [5] found that the yield and yield components were significantly increased by the application of 100% recommended dose of N (RND) through organics sources. Maximum number of pods per plant was obtained in treatment T_6 (38.66) i.e. (100% RDF + Vermicompost + FYM) and minimum number of pods per plant was obtained (19.66) in treatment T_1 (Control). Maximum average pods weight was recorded in treatment T_6 (5.79 g) i.e. (100% RDF + Vermicompost + FYM) and minimum average pod weight was recorded (3.05 g) in treatment T_1 (Control). Highest fresh pod yield per plant was recorded in treatment T_6 (227.99 g) i.e. (100% RDF + Vermicompost + FYM) and minimum number of fresh pod yield per plant was recorded (59.99 g) in treatment T_1 (Control). Highest fresh pod yield per bed was recorded in treatment T_6 (15.04 kg) i.e. (100% RDF + Vermicompost + FYM) and minimum number of fresh pod yield per bed was recorded (1.95 kg) in treatment and T_1 (Control). Highest fresh pod yield per hectare was recorded in treatment T_6 (37.60 t) i.e. (100% RDF + Vermicompost + FYM) and minimum number of fresh pod yield per hectare was recorded (4.88 t) in treatment T_1 (Control). The increase in yield attributes might have been due to increased availability of NPK, higher total dry matter production and more vegetative growth resulting in better development of yield attributes and higher seed yield with application of heavy inorganic fertilization. Prabhakar *et al.*, (2011) [5], Sarma *et al.*, (2014) [7] and Meena *et al.*, (2018) [4] and Sharma *et al.*, (2017) [8] found in their research that the yield and yield components were significantly increased by the application of chemicals and bio-regulators.

Table 3: Influence of Organic and Inorganic Fertilizers on Yield Attributes of French bean (*Phaseolus Vulgaris* L.)

Treatment	Pod length (cm)	Pod width (cm)	Number of pods per plant	Average pod weight (g)	Fresh pod yield per plant (g)	Fresh pod yield per bed (kg)	Fresh pod yield per hectare (t)	Dry matter content (%)
T_1	9.07	0.69	19.66	3.05	59.99	1.95	4.48	5.56
T_2	10.75	0.74	24.33	3.46	90.99	3.73	9.32	6.23
T_3	13.66	0.84	32.33	4.64	150.14	7.65	19.14	8.35
T_4	11.68	0.75	28.66	3.61	103.59	4.62	11.55	6.71
T_5	10.04	0.70	22.33	3.17	77.34	2.72	6.81	5.90
T_6	15.06	0.90	38.66	5.79	227.99	15.04	37.60	9.67
T_7	14.18	0.88	34.66	5.03	174.34	10.17	25.42	9.43
T_8	12.95	0.78	30.66	4.39	134.63	6.21	16.36	7.89
Range	9.07 - 15.06	0.69 - 0.90	19.66-38.66	3.05-5.79	5.99-227.99	1.95-15.04	4.48-37.60	5.56 - 9.67
SE(m)±	0.187	0.028	0.825	0.02	2.066	0.136	0.322	0.019
CD at 5%	0.572	0.086	2.526	0.06	6.326	`0.417	0.985	0.057

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