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Effect of Integrated Nutrient Management on Yield of French Bean (*Phaseolus vulgaris* L.)

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A B S T R A C T

An experiment on integrated nutrient management in French bean was conducted during 2018-2019 with treatments being T_1 (50%RDF + 25%FYM + 25% Vermicompost), T_2 [75% RDF + 25%FYM, T_3 (75%RDF + 25% Vermicompost), T_4 (75%RDF + 25%FYM + Bio-fertilizer (Rhizobium+PSB)], T_5 [75% RDF + 25%Vermicompost+Bio-fertilizer (Rhizobium+PSB)], T_6 [75%RDF + 12.5%FYM + 12.5% Vermicompost + Bio-fertilizer (Rhizobium+PSB)] and T_7 (100%RDF). On the course of investigation, it was observed that the number of pods per plant was highest in T_5 (20.00) followed by T_6 (17.60), length of pod was highest with T_5 (11.01 cm) followed by T_6 (10.67 cm), pod circumference was highest in T_5 (3.17 cm) followed by (3.11 cm) in T_6, number of seeds per pod was highest in T_5 (7.73) followed by T_6 (7.50) and seed length was highest in T_5 (1.84 cm) followed by T_6 (1.76 cm). However, yield of fresh pod per hectare was highest in T_5 (97.93 q/ha) followed by 89.54 q/ha in T_6 and 88.56 q/ha in T_3 and the lowest seed yield of 71.99 q/ha was obtained in T_7. It can be concluded that application of 75% RDF along with 25% vermicompost and biofertilizer application produced a good environment supporting very good growth of French bean to produce significantly higher marketable yield during rabi season under agro climatic condition of Ranchi.

Introduction

French bean (*Phaseolus vulgaris* L.) 2n=22 of family Leguminoseae (Fabaceae) is a short duration and one of the most precious and highly relished vegetables in North India. Pulses constitute the major part of Indian vegetarian diet that fulfills major share of protein requirement of predominantly vegetarian population of India. In India, many pulse crops are grown like mung, urd, gram and among these French bean is most important. French bean is an excellent source of protein. It is widely grown bean because of its short duration and nutritious values. It is a valuable source of protein, vitamins and minerals Hundred grams of green pods contain 22% protein, 78% of carbohydrates, 221 I.U. vitamin A, 11 mg vitamin C, 381 mg Calcium. It is rich in amino acids like tryptophan,

methionine and some phenolic compounds like tannin and polyphenol oxidase [14]. Moreover, the protein of rajma has proved to be a quality protein for human consumption in the manner the soybean oil proved its worth.

French bean is assured crop which responds well to fertilization. It is especially characterized by lack of nodules though it is legume, due to absence of NOD gene regulator. It is inefficient in nitrogen fixation [3].

Therefore, it responds well to high nitrogen fertilization. There is a worldwide consensus that sole dependence on chemical input based agriculture is not suitable in long run and only integrated plant nutrient systems (IPNS) involving a combination of fertilizer, organic manure and bio-fertilizers are essential to sustain crop production, preserve soil health and biodiversity. In addition to this, organic manures help in improving the use efficiency of inorganic fertilizers.

Use of biofertilizers not only reduce the risk of environmental pollution but also bring the cost of cultivation. Vermicompost, FYM and biofertilizers are highly efficient organic manures, which can increase production and improve the quality of vegetables. These organic manures increase the fertility of land by increasing the NPK content, water holding capacity and productivity of soil. Organic manures have been the traditional means of maintaining soil fertility as it provides a balanced source of nutrient for crops and accelerate the biological activity.

The advantage of combining organic and inorganic sources of nutrients in integrated nutrient management has been proved superior. Therefore, keeping these facts in view, present study was undertaken to evaluate the influence of integrated nutrient management on yield of french bean.

Materials and Methods

A field experiment was conducted at Experimental farm of Department of Horticulture, Ranchi Agriculture College, Birsa Agricultural University, Kanke, Ranchi during *rabi* 2018-19. The mean annual precipitation of this region is 1400mm of which 80-85 percent is received during June to September. Temperature of this region varies as low as 6.00°C in winter to as high 37.70°C in summer and April and May are the hottest months with an average maximum temperature of 37.70°C and 36.80°C, respectively while December and January are the coldest months of the year having temperature 6.00°C. The relative humidity (R.H.) rises upto 87.00 per cent during November and February and falls down to 40.50 per cent during May

The soil of experimental field was sandy loam in texture (sand: 60.4%, silt: 20.0% and clay: 19.6%) with 6.1 pH, high in organic carbon (0.57%) and low to medium in nitrogen (229.79 Kg/ha), phosphorus (35.40 Kg/ha) and potassium (237 Kg/ha). The experiment was carried out from Nov 2018 to March 2019 in Randomized Block Design (RBD) with 7 treatment replicated three times. The whole field was divided into three blocks, each representing a replication. The plot size was 9m x 9m and the spacing was 40cm x 10 cm. Treatments were allocated to each plot randomly using Fisher and Yates Random Number (1963).

Swarna Priya variety was taken for this experiment. Biofertilizer viz. *Rhizobium* and PSB (Phosphorus Solubilising Bacteria) were applied as seed treatment. Well decomposed vermicompost was incorporated in soil and mixed thoroughly as basal dose. Under each treatment, full dose of phosphorus, potash and ½ dose of nitrogen (if to be given through fertilizer)

were applied as basal dose and ½ dose of nitrogen was applied as split one month after sowing. The source of nitrogen, phosphorus and potash were urea, SSP and MOP respectively. All cultural operations were performed as per recommendations. Sowing of healthy seed was done with spacing of 40 cm × 10cm. Five plants form each plot were selected randomly and marked from each treatment to calculate number of pods per plant, length of pod, pod circumference, number of seeds per pod, seed length and yield of fresh pod per hectare.

Results and Discussion

The result of the present study indicated that among the 7 different treatments, the treatment combination of T_5[75%RDF + 25% (N) Vermicompost (1.25t/ha) + Bio-fertilizer (Rhizobium+PSB)] and T_6[75%RDF + 12.5% (N) FYM (1t/ha) + 12.5% (N) Vermicompost (0.625t/ha) + Bio-fertilizer (Rhizobium+PSB)] recorded significant improvement in various yield and yield attributing characters viz., number of pods per plant, pod length, pod circumference, number of seeds per pod, seed length and yield of pod per hectare (Table 1 and 2).

Number of pods per plant

The highest number of pods per plant (20) was found in T5 followed by 17.6 in T6 and 16.54 in T3(75%RDF + 25% Vermicompost). T6(17.6) and T3(16.54) were at par to T5. The lowest pod number of 13.8 was observed in T7 i.e. 100 percent RDF. This might be because integrated use of chemical fertilizers, bio fertilizers and vermicompost increased the physical properties of soil (water and nutrient holding capacity). Availability of nutrient helps the plant to bear more number of flowers and reduce the chance of flower and fruit drop, as a result, more number of pods per plant are obtained. This result is in consonance with [2], [7] and [9] in French bean (Fig. 1).

Pod length and pod circumference

The maximum pod length (11.01cm) was recorded in the treatment T5 [75%RDF + 25% Vermicompost + Biofertiizer (Rhizobium and PSB)], followed by T6(75% RDF +12.5% FYM + 12.5% Vermicompost + Biofertilizer), T3(75% RDF + 25%Vermicompost), T1(50% RDF + 25%FYM + 25% Vermicompost), T2(75% RDF + 25% FYM), T7[100% RDF (Chemical treatment)] and T4[75%RDF + 25% FYM + Biofertiizer (Rhizobium + PSB)], having values 10.67, 10.43, 10.09, 9.90, 9.21 and 9.12. Statistically it was observed that T6 was at par to T5 but, was significantly higher than other treatments and the minimum value (F9.1) of pod length was obtained in the treatment T2. It is evident from the data that pod circumference was highest (3.16cm) in T5[75%RDF + 25% Vermicompost + Biofertiizer (Rhizobium + PSB)], followed by T3(75% RDF + 25%Vermicompost) with 3.10cm and T1(50% RDF + 25%FYM + 25% Vermicompost) with 2.92cm. From statistical analysis, it was evident that T3 and T1 were at par to T5. The minimum value (2.68cm) was recorded in T7 (100%RDF).

The higher length and girth of the pods might be due to the synergistic effect of organics and biofertilizer in making available more of plant nutrients by improving the soil physical health and solubilizing the nutrients in soil. The increased vegetative growth, balance C: N ratio and increased accumulation of carbohydrates, in turn might have increased pod size. The results are in confirmation with [9], [10] and [4].

Number of seeds per pod

The highest number of seeds (7.73) was recorded with T2(75% RDF + 25% FYM)

followed by 7.50 in T6(75% RDF +12.5% FYM + 12.5% Vermicompost + Biofertilizer) and 6.56 in T5[75%RDF + 25% Vermicompost + Biofertiizer (Rhizobium + PSB)]. The lowest number of seeds per pod of 5.97 was found with T7(100% RDF). This indicates that 100% RDF through chemical fertilizer produced some impact on growth but yield attributing characters were much influenced by supplemental organic source which changed the soil condition making it favorable for influencing the economic traits controlling yield. Increase in number of pods per plant, length of pod and number of seeds per pod were also reported by [5], [1] and [11].

Seed length

Maximum seed length of 1.84cm was recorded in the treatment T5[75%RDF + 25% Vermicompost + Biofertiizer (Rhizobium and PSB)], followed by T6(75% RDF +12.5% FYM + 12.5% Vermicompost + Biofertilizer) i.e. 1.76cm and T3(75%RDF + 25% Vermicompost) i.e. 1.72. Statistically, it was observed that T6 and T3 was at par to T5 and the minimum value (1.27cm) of seed length was obtained in the treatment T9 (absolute control). It might be due to production of more amounts of food materials and accumulation of potash in the seed. The above findings are in harmony with [8] and [6].

Hundred seed weight

From the close observation of data (Table 3), it is evident that among different treatments the maximum value of hundred seed weight of French bean was recorded in T6[75%RDF + 12.5%FYM + 12.5% Vermicompost + Bio-fertilizer (Rhizobium+PSB)] i.e. 49.71g, which was significantly superior than rest other treatments. The minimum value (46.09g) of 100 seed weight was recorded in T7. It might be due to production of more amounts of food materials and accumulation of potash in the seed. Increase in photosynthetic area and translocation of photosynthates in plants, subsequently accelerated the formation of large-sized seed. The above findings are in harmony with [2], [6] and [8].

Table.1 Treatment details

Treatment	Treatment details
T_1	50%RDF + 25% (N) FYM (2t/ha) + 25% (N) Vermicompost (1.25t/ha)
T_2	75%RDF + 25% (N) FYM (2t/ha)
T_3	75%RDF + 25% (N) Vermicompost(1.25t/ha)
T_4	75%RDF + 25% (N) FYM (2000kg/ha) + Bio-fertilizer (Rhizobium+PSB)
T_5	75%RDF + 25% (N) Vermicompost(1.25t/ha) + Bio-fertilizer (Rhizobium+PSB)
T_6	75%RDF + 12.5% (N) FYM (1t/ha) + 12.5% (N) Vermicompost(0.625t/ha) + Bio-fertilizer (Rhizobium+PSB)
T_7	100%RDF (Chemical fertilizer)

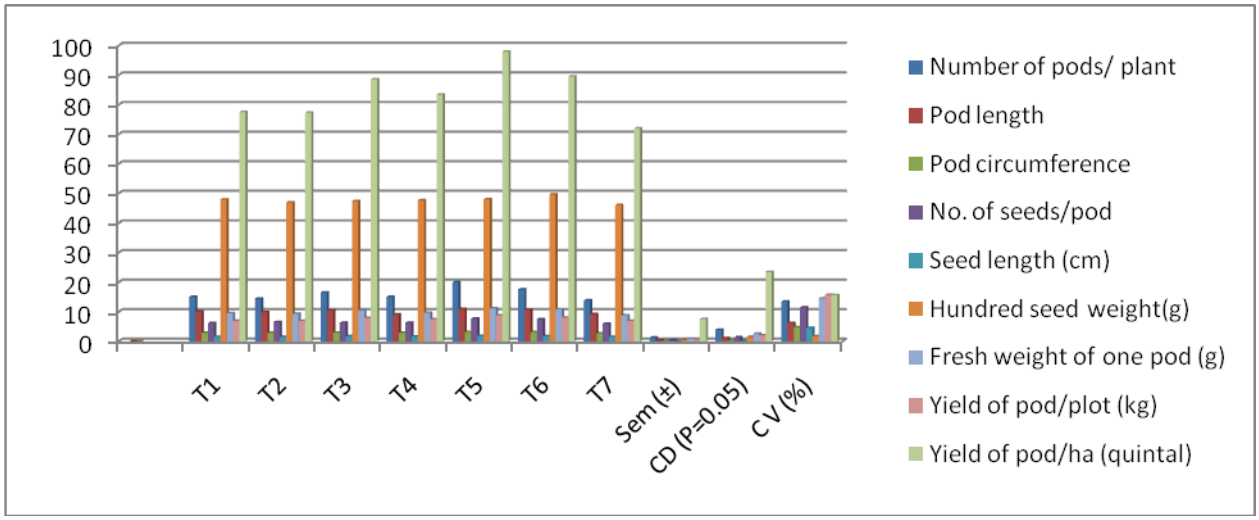
Table.2 Cropping history of the experimental field

YEARS	KHARIF	RABI
2015-16	Tomato	Fallow
2016-17	Tomato	French bean

Table.3 Effect of INM on yield and yield attributing characters

Treatment	Number of pods/ plant	Pod length (cm)	Pod circumference (cm)	No. of seeds/pod	Seed length (cm)	Hundred seed weight(g)	Fresh weight of one pod (g)	Yield of pod/plot (kg)	Yield of pod/ha (quintal)
T1	15.07	10.09	2.91	6.20	1.58	47.99	9.57	6.97	77.51
T2	14.47	9.90	2.91	6.56	1.49	46.96	9.34	6.95	77.28
T3	16.54	10.43	2.92	6.27	1.72	47.44	10.45	7.96	88.56
T4	15.13	9.12	2.90	6.33	1.67	47.67	9.67	7.50	83.43
T5	20.00	11.01	3.17	7.73	1.84	48.05	11.16	8.81	97.93
T6	17.60	10.67	3.11	7.50	1.76	49.71	10.85	8.05	89.54
T7	13.87	9.21	2.68	5.97	1.53	46.09	8.75	6.94	71.99
Sem (±)	1.26	0.36	0.08	0.44	0.04	0.48	0.84	0.69	7.6
CD (P=0.05)	3.89	1.11	0.25	1.37	0.14	1.48	2.59	2.11	23.44
C V (%)	13.45	6.22	4.81	11.53	4.59	1.74	14.56	15.70	15.68

Fig.1



Yield per hectare

The maximum yield per ha was recorded in T5[75%RDF + 25% Vermicompost + Biofertiizer (Rhizobium and PSB)] i.e. 97.93 quintal per hectare which was superior to all other treatments tried in experiment followed by 89.54 quintal in T6(75% RDF +12.5% FYM + 12.5% Vermicompost + Biofertilizer), 88.56 quintal in T3 (75% RDF + 25% Vermicompost), 83.42 quintal in T4[75%RDF + 25% FYM + Biofertiizer (Rhizobium + PSB)], 77.28 quintal in T7[100% RDF (Chemical treatment)] and the lowest was recorded in T9 (43.17 q/ha) i.e. control. This might be due to gradual and steady release of nutrient from both vermicompost and bio fertilizers that help in plant metabolic activity, resulting in luxury vegetative growth followed by early reproductive phase. The increased

synthesis of carbohydrates, accumulation of potash, in turn increased the pod yield.

Application of vermicompost and biofertilizers helped in improving soil health as well as facilitates slow and continuous supply of nutrient to the plant. The increase in yield might be due to the better performance of yield attributes as these attributes influence directly influenced the yield. The above obtained results were in harmony with [7] and [9].

It was observed that combination of organic and inorganic sources of fertilizer influenced yield attributing characters and also the yield. The application of vermicompost and biofertilizer in some treatments performed better with suitable nutrient combination. It can be concluded that application of 75%RDF +25% vermicompost along with biofertilizer produced better yield (97.93q/ha) as compared to other treatments.

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