

Original Research Article

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Effect of Different Concentrations of Biofertilizers on the Growth and Yield of French Bean (*Phaseolus vulgaris*) Arka Anoop

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ABSTRACT

The investigation was conducted at department of plant biotechnology, University of Agricultural Sciences, GKVK, Bangalore, from Jan to May during Rabi season, 2015, on sandy loam soil, pH having 5.3 to 5.5 to study the effect of different concentrations of biofertilizers as sources of nutrients along with inorganic fertilizers in French bean under green house conditions with an objective to study growth and yield without degrading soil quality by using various nutrient compositions with varying concentrations. Experimental treatments comprised of (a) three levels of biofertilizer with different combinations and concentrations (9gm each) in five treatments. The experiment was laid out in different five pots randomized with three replications (Kumar *et al.*, 2009) (5). The results indicate that the highest plant height (48.34 cm) was obtained in treatment T3 with each 9gm *Rhizobium leguminosarum* + 9 gm of phosphate solubilizing bacteria, the highest dry weight plant (22.20g), Pods per plant (10.00), Pods per cluster (3.00) and pod yield (71.06 g) Number of leaves per plant (28.83), number of cluster per plant (3.73), seeds per pod (7). Application of combination of 9 gm of *Rhizobium leguminosarum* + 9gm of phosphate solubilizing bacteria biofertilizers was proved to be the best possible combination.

Keywords

Biofertilizers,
Pseudomonas,
Nitrogen, French
bean, Yield

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Introduction

The crop productivity is dependent on the availability of sufficient nutrients and this nutritional demand is met by means of mineral fertilizers which are applied to soil at different stages of plant growth (NIIR,

2004)3. The recommendation level of fertilizers is crop and region specific based on the crop variety and inherent nutrient supplying capacity of the soil in which crop is being produced (Pramanik *et al.*, 2014)6. French bean (*Phaseolus vulgaris* L.) is one of the most important leguminous vegetables in

India. It is a nutritious vegetable and can be grown extensively because of its short duration and for nutritive values (Broughton *et al.*, 2003)4.

It is a good source of protein, calcium, phosphorus, iron, carotene, thiamine, riboflavin and vitamin C (Afzal *et al.*, 2008) 1. In India, it is grown for tender vegetables, shelled green beans and dry beans (Rajmah).

These plants originated from the Americas but is now cultivated all over the world due to its nutritional and culinary values. French bean is grown as a cash crop by large and small holder farmers (CIAT, 2006)6.

The highest yield is obtained in soils with a PH between 5.3 and 6.0 (Sankhyan *et al.*, (2001)) 9. The use of chemical fertilizers has drained the soil and resulted in the loss of crop productivity (Satti *et al.*, 2010)10.

So to obtain maximum return farmers need to apply eco-friendly bio-fertilizers that play a vital role in the formation of nodules to fix atmospheric nitrogen by symbiotic process in the root system of legume crops making the nutrient available to the plants and due to this culture the rate of use of bio-fertilizers are increasing day by day (Basu *et al.*, 1990)

2. Biofertilizers are carrier-based inoculants containing cells of efficient strains of specific microorganisms (namely bacteria) used by farmers for enhancing the productivity of the soil by fixing atmospheric nitrogen or by solubilizing soil phosphate or by stimulating plant growth for synthesis of growth promoting substances and play a main key role for selective adsorption of immobile (P, Zn, Cu) bacteria secrete growth substances and secondary metabolic, which contribute to seed germination and plant growth (Rao *et al.*, 1982) 8. In large sense, the term may be used to include all organic resources (manure) for plant growth which are rendered in an

available form for plant absorption through microorganisms or plant associations or interactions (Singh *et al.*, 2009) 11. Keeping the views of the above aspects the present research work was, therefore, undertaken to find out the response of French bean to biofertilizers, N:P:K, and their different combination and concentrations treatments under controlled condition in the green house at department of plant biotechnology, University of Agricultural Sciences, GKVK, Bangalore, from Jan to May 2015.

Materials and Methods

The experiment was carried out at the department of plant biotechnology, University of Agricultural Sciences, GKVK, Bangalore, from Jan to May during Rabi season, 2015, on sandy loam soil, pH having 5.3 to 5.5. Experimental treatments comprised of three levels of biofertilizer (*Rhizobia*, *Pseudomonas* and PSB) with different combinations and concentrations (9gm each) in five treatments (T1, T2, T3, T4, T5) with three set of replications (R1, R2, R3) (Table 1). Inorganic fertilizers 9gm (N:P:K) which are widely used in agriculture were used as materials (Kumar *et al.*, 2009)

5. Method of cultural operation was adopted as per recommended practices. And observations were recorded mainly on growth (germination count, plant height, number of leaves, no. of pods per plant, branches per plant, dry weight of plant, cluster per plant) and yield (no. of seed per pod, pods per plant, pods per cluster, pod length, pod yield).

Data analysis

Statistical analysis was done using ANOVA (Analysis of Variance). The statistically analysis of data pertaining to plant height (cm), number of branches per plant, Number of leaves per plant, number of cluster per plant, seeds per pod, pod length, dry weight

(g), Pods per plant, Pods per cluster and pod yield (g) was done to check significant differences observed among the treatments.

The Standard Error of the Mean (SEM) quantifies the precision of the mean. It is a measure of how far your sample mean is likely to be from the true population mean. It is expressed in the same units as the data. The coefficient of variation (CV), also known as “relative variability”, equals the standard deviation divided by the mean. It can be expressed either as a fraction or a percent.

Results and Discussion

In all the observation aspects of growth and yield, the maximum value was recorded under bio-fertilizer treatment (T3) 9 gm of *Rhizobium leguminosarum* +9 gm of phosphate solubilizing bacteria). But minimum value was found variably in different treatments and different observation aspects.

The average growth and yield per plot was found highest in T3 with germination count of 10 days, plant height (48.34 cm), no. of leaves per plant (28.83), no. of pods per plant (10), branches per plant (9.33), dry weight per plant (22.20 gm), no. of seeds per pod (7), pods per plant (10), pods per cluster (3), pod length (15.23 cm), pod yield (71.06 gm) and lowest in T2 (9 gm *Rhizobium leguminosarum*) having plant height (34.16 cm), no. of leaves per plant (21.25), no. of pods per plant (2.30), branches per plant (8.33), dry weight per plant (16.28 gm), no. of seeds per pod (4.33), pods per cluster (1.33), pod length (10.45 cm), pod yield (56.41 gm) respectively.

The morphological characters of different treatments are as: the number of days taken for germination was 8 days from the date of sowing (6/02/2015). Germination percentage

was 85% in T3, which was the maximum percentage among all treatments.

Number of days taken for Flower initiation was 28 days in T2. Flower color was noted as creamish white in all treatments (Table 2).

The height of the plant was found to be highest in treatment three (T3) followed by treatment four (T4). The plant height was more in all the treatments as compared to (T2). The total number of branches was found to be highest in treatment three (T3) followed by treatment four (T4). The number of branches was more in all the treatments as compared to (T2) (Table 3).

The total number of leaves per plant was found to be highest in treatment three (T3) followed by treatment four (T4). The Dry weight of the plant was found to be highest in treatment three (T3) followed by treatment four (T4).

The number of Cluster per plant was found to be highest in treatment three (T3) followed by treatment four (T4). The number of Cluster per plant was more in all the treatments as compared to (T2).

The number of Pods per plant was found to be highest in Treatment three (T3) followed by Treatment four (T4). The number of Pods per plant was more in all the treatments as compared to (T2). The number of Pods per cluster was found to be highest in Treatment three (T3).

The Pod length was found to be highest in Treatment three (T3) followed by Treatment four (T4). The Pod yield was found to be highest in Treatment three (T3) followed by Treatment four (T4). The Pod yield was more in all the treatments as compared to (T2) (Table 4) (Fig. 1).

Table.1 The experiment comprised of the following treatments

Treatments	Material(s) used	N:P:K (gm)	Quantity (gm)
T1 (control)	N:P:K	9	-
T2	<i>Rhizobium leguminosarum</i> , N:P:K	9	9
T3	<i>Rhizobium leguminosarum</i> + phosphate solubilizing bacteria (PSB)+ N:P:K	9	9+9
T4	<i>Rhizobium leguminosarum</i> + <i>Pseudomonas</i> +N:P:K	9	9+9
T5	<i>Rhizobium leguminosarum</i> + phosphate solubilizing bacteria (PSB)+ <i>Pseudomonas</i> +N:P:K	9	9+9+9

Table.2 Effect of different concentrations of biofertilizers on number of days for germination, percent germination and flower colour of *Phaseolus vulgaris*.

Treatments	No. of days for germination	% germination	Flower colour	No. Of days for flower initiation
T ₁	13 days	45	Creamy yellow	41
T ₂	7 days	66.6	Creamy yellow	28
T ₃	10 days	85	Creamy yellow	31
T ₄	9 days	72	Creamy yellow	37
T ₅	11 days	63	Creamy yellow	39

Table.3 Effect of different concentrations of biofertilizers on plant height, branches per plant, number of leaves per plant, dry weight of plant (g), and cluster per plant in *Phaseolus vulgaris*

S. No	Treatments	Plant height (cm)	Branches per plant	Number of leaves per plant	Dry weight of the plant (g)	Cluster per plant
1	T1 (Control)	37.50	8.66	23.08	17.95	2.33
2	T2	34.16	8.33	21.25	16.28	1.67
3	T3	48.34	9.33	28.83	22.20	3.73
4	T4	43.76	8.66	26.01	20.04	2.67
5	T5	40.13	8.33	24.23	19.29	2.67
	SEM±	0.676	0.182	0.760	0.430	0.183
	CD	2.878	3.648	5.455	3.891	12.483
	CV	2.205	0.595	2.479	1.403	0.595

Table.4 Effect of different concentrations of biofertilizers on pods per plant, pods per cluster, seeds per pod, pod length and pod yield in *Phaseolus vulgaris*.

S. No	Treatments	Pods per plant	Pods per cluster	Seeds per pod	Pod Length	Pod Yield (g)
1	T1 (Control)	5.66	2.33	5.33	11.06	55.32
2	T2	2.30	1.33	4.33	10.45	56.41
3	T3	10.00	3.00	7	15.23	71.06
4	T4	6.33	2.33	6.33	14.46	69.33
5	T5	5.33	2.00	6.00	13.62	67.73
	SEM±	0.019	0.224	0.342	0.485	2.640
	CD	29.754	17.604	10.200	6.481	7.148
	CV	3.724	0.729	1.114	1.582	8.610

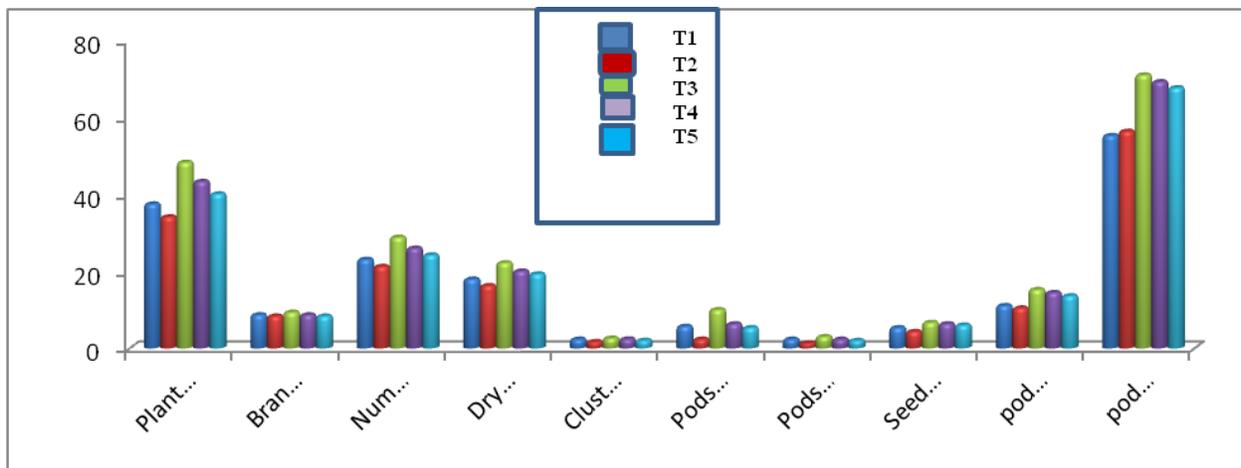


Fig.1 Effect of different concentrations of Biofertilizers on the plant

The results of the present study indicate that among the treatments soil application T3 (Treatment three) with nine grams of *Rhizobium leguminosarum* and nine grams of phosphate solubilizing bacteria (PSB) recorded increased plant height (cm), number of branches per plant, Number of leaves per plant, number of cluster per plant, seeds per pod, pod length, dry weight (g), Pods per plant, Pods per cluster and pod yield (g).

The maximum plant height was 48.34cm, number of branches per plant was 9.33, Number of leaves per plant was 28.83, dry weight was 22.20g, number of cluster per plant was 3.73, Pods per plant was 10.00,

Pods per cluster was 3.00, seeds per pod was 7.00, pod length was 15.23cm and pod yield 71.06 g in treatment three (T3). The minimum plant height was 34.16cm, number of branches per plant was 9.33, Number of leaves per plant was 21.25, dry weight was 16.28g, number of cluster per plant was 1.67, Pods per plant was 2.30, Pods per cluster was 1.33, seeds per pod was 4.33, pod length was 10.45cm and pod yield 56.41g in treatment one (T1).

Hence the concentration of biofertilizers used in treatment three can be suggested to the farmers to increase the growth and yield of French bean.

A field experiment was conducted at Department Of Plant Biotechnology, UAS, GKVK Campus, Bangalore to study the effect of various Concentrations of bio-fertilizers on growth, yield of French bean. The results revealed that the application of T2 significantly increased the plant height (cm), number of branches per plant, leaf area (cm²) and dry weight (g) of plant in Arka anoop. The number of clusters per plant, number of pods per plant, number of pods per cluster, number of seeds per pod, pod length and pod yield per plant (g) was also significantly increased by the application of T2 as compared to control(T1) and other treatments (T3, T4, T5).

The results obtained from the investigation on the “Effect of different concentrations of biofertilizers on the growth and yield of French beans (*Phaseolus vulgaris*) arka anoop” by using different concentrations and types of biofertilizers on various treatments, treated with different compositions of biofertilizers on French beans. In the present study, efforts were made to screen, characterize selected french bean (arka anoop) accessions for their effect in the growth and yield of French bean. Thus the biofertilizer used and the its respective concentration can be used by the present farmers as a good source of French bean yield.

Aknowledgement

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Competing Interests

The authors declare that they have no competing interests

Ethical Procedure

As an expert scientist and along with co-authors of concerned field, the paper has been submitted with full responsibility, following due ethical procedure, and there is no duplicate publication, fraud, plagiarism, or concerns about animal or human experimentation.

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