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Effect of bio-fertilizers on growth, yield and quality of french bean (*Phaseolus vulgaris* L.)

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Abstract A field experiment was conducted at S.V.Agricultural college, Tirupati campus of Acharya N.G.Ranga Agriculture University during the *rabi* season 2006 on sandy loam soil. The results reported that Application of 75 per cent RDF + VAM@ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1} significantly increased the plant height (cm), number of branches per plant, leaf area (cm^2) and dry weight (g) of plant in the variety Arkasuvidha (V_2) followed by selection 9 and Arka komal. The number of clusters per plant, number of pods per plant, number of pods per cluster, number of seeds per pod, 100 seed weight (g), pod length, pod yield per plant (g) and pod yield per hectare (t/ha), crude protein and fibre content (%) was significantly increased by the application of 75 per cent RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1} in Arkasuvidha (V_2) variety.

Key words : French bean, yield, biofertilizer

Introduction

French bean (*Phaseolus vulgaris* L.) is known as common bean or kidney bean. Among all the beans, it is the most extensively grown bean because of its short duration and nutritive values. It is a valuable source of protein, vitamins and minerals.

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The low level productivity of French bean has been attributed mainly to inadequate fertilization. The modern day intensive crop cultivation requires the use of chemical fertilizers. But the price of inorganic fertilizers has gone up considerably which inturn has increased the cost of production. Use of inorganic fertilizers not only increased the cost of production but also decreased over all soil fertility causing environmental pollution. Use of biofertilizers will give the quality produce for human consumption by way of reduction the chemical residues and also increase the resistance in plants against pest and diseases. Use of biofertilizers not only reduce the risk of environmental pollution but also reduce the cost of cultivation. However, due to hike in the prices of chemical fertilizers and also with a view to maintain the ecosystem of soil, it has become necessary to minimize the use of chemical fertilizers by adding organic ones to the soil more particularly biofertilizers of microbial origin.

Materials and Methods

Investigation on the effect of biofertilizers with graded doses of inorganic fertilizers on growth, yield attributes and yield of French bean (*Phaseolus vulgaris* L.), CVs, Arkakomal, Arkasuvidha and selection – 9 was carried out at Horticulture garden, S.V. Agricultural College, Tirupati during the year 2006. Soil texture is sandy clay loam, Soil pH 7.5, E.C (dSm^{-1}) 0.14 , Organic carbon (%) 0.45, Available Nitrogen (kg ha^{-1}) 185.5, Available phosphorus (kg ha^{-1}) 20.5, Available potassium (kg ha^{-1}) 347.The experiment was laid out in randomized block design with factorial concept with four treatments and three varieties replicated thrice. Method of application biofertilizers was soil application. The treatments consisted of biofertilizers, VAM and PSB with three levels of recommended dose of fertilizers (25, 50 and 75 %) and were compared with 100 % RDF only (control). Observations on plant height (cm), number of branches per plant, leaf area (cm^2), dry weight of plant (g) at fortnightly interval and number of clusters per plant, number of pods per plant, number of pods per cluster,

number of seeds per pod, 100-seed weight (g), pod length, pod yield per plant and pod yield per hectare, crude protein and crude fibre content (%)were recorded.

Results and Discussion

The results of the present study indicate that among the treatments soil application of 75 % RDF + VAM @ 2 kg ha^{-1} + PSB @2.5 kg ha^{-1} (B_3) recorded increased plant height (cm), number of branches per plant, leaf area (cm^2) and dry weight (g) of plant in all varieties (Table 1) .

The increase was found to be rapid between 15-45 DAS as compared to 45-60 DAS, However height was recorded at 60 DAS in all varieties. However, the maximum plant height 49.56 cm branches per plant 10.13, leaf area 1041.50 cm^2 and dry weight of plant 21.14 g was recorded at 60 DAS followed by B_2 treatment with 50 % RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1} in Araka Suvidha (V_2) and least was recorded in treatment B_1 (25 % RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1}) of 36.65 cm, 8.57, 669.20 cm^2 and 18.12g, Least plant height (cm), number of branches per plant, leaf area (cm^2) and dry weight of plant (g) was recorded in Arka komal (V_1) variety.

The interaction effect of biofertilizers and varieties was significant in relation to plant height (cm), number of branches per plant, leaf area (cm^2) and test weight of plant. Maximum was recorded in B_3V_2 46.11 cm, 9.72, 968.33 cm^2 and 20.03 g which was significantly superior than the other treatment followed by B_2V_2 and B_3V_3. Least interaction effect was recorded in B_1V_1 (31.43 cm, 8.22, 648.20 cm^2 and 17.64 g). The increase in

Table 1: Plant height (cm), number of branches per plant, leaf area (cm^2),dry weight of plant (g) as influenced by soil application of VAM and PSB.

Varieties	Plant height (cm)				Branches per plant				Leaf area (cm^2)				Dry weight of plant (g)			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
B_1	31.43	40.84	37.68	36.65	8.22	9.09	8.42	8.57	648.20	750.70	698.70	699.20	17.64	18.82	17.91	18.12
B_2	40.12	46.74	43.85	43.57	8.76	9.96	9.62	9.44	792.50	898.30	840.70	843.83	18.45	20.68	19.67	19.60
B_3	42.66	49.56	46.12	46.11	9.26	10.13	9.78	9.72	892.20	1041.50	971.30	968.33	19.03	21.14	19.94	20.03
B_4	37.92	43.26	40.23	40.47	8.58	9.44	8.93	8.98	758.80	886.50	821.10	822.13	18.16	19.25	18.61	18.67
Mean	38.03	45.10	41.97		8.70	9.65	9.18		772.92	894.25	832.95		18.32	19.97	19.03	
	SEm±		C.D. (0.5%)		SEm±		C.D. (0.5%)		SEm±		C.D. (0.5%)		SEm±		C.D. (0.5%)	
B	0.205		0.426		0.039		0.081		1.086		2.251		0.094		0.195	
V	0.178		0.369		0.034		0.070		0.940		1.950		0.082		0.170	
B x V	0.356		0.738		0.067		0.140		1.880		3.900		0.163		0.338	

V_1 : Arka Komal
V_2 : Arka Suvidha
V_3 : Selection-9

B_1 : 25% RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1}
B_2 : 50% RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1}
B_3 : 75% RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1}
B_4 : 100% RDF only (Control)

Table 2 : Number of clusters per plant, pods per plant, pods per cluster and seeds per pod as influenced by soil application of VAM and PSB.

Varieties	Clusters per plant				Pods per plant				Pods per cluster				Seeds per pod			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
B_1	1.43	2.11	1.57	1.70	4.78	7.63	5.13	5.84	1.38	1.81	1.47	1.55	4.02	4.80	4.32	4.38
B_2	1.87	2.78	2.51	2.38	7.06	10.44	9.21	8.90	1.65	2.17	2.01	1.94	4.45	6.73	5.84	5.67
B_3	2.24	2.92	2.64	2.60	7.97	11.65	9.67	9.76	1.88	2.26	2.08	2.07	5.11	7.20	6.22	6.17
B_4	1.71	2.38	2.02	2.04	5.85	9.04	7.26	7.38	1.56	1.93	1.72	1.73	4.16	5.41	4.51	4.69
Mean	1.81	2.55	2.18		6.41	9.70	7.81		1.61	2.04	1.82		4.43	6.03	5.22	
	SEm±		C.D. (5%)		SEm±		C.D. (5%)		SEm±		C.D. (5%)		SEm±		C.D. (5%)	
B	0.029		0.060		0.106		0.221		0.016		0.033		0.067		0.138	
V	0.025		0.052		0.092		0.191		0.014		0.029		0.058		0.120	
B x V	0.050		0.104		0.184		0.382		0.028		0.058		0.116		0.240	

Table 3: Pod length (cm), 100-seed weight (g), Pod yield per plant (g), and Pod yield per hectare (t/ha) as influenced by soil application of VAM and PSB.

Varieties	Pod length (cm)				100-seed weight (g)				Pod yield per plant (g)				Pod yield (t/ha)			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
B_1	11.68	14.06	11.96	12.56	25.68	29.88	26.51	27.35	50.48	65.14	53.62	56.41	4.487	5.790	4.765	5.014
B_2	12.87	15.64	14.93	14.48	28.28	33.75	32.28	31.43	59.62	79.00	72.62	70.41	5.300	7.023	6.455	6.260
B_3	14.45	16.17	15.23	15.28	30.58	34.77	33.02	32.80	66.93	81.86	76.00	74.93	5.950	7.277	6.755	6.660
B_4	12.36	14.78	13.72	13.62	27.41	31.41	29.10	29.30	55.81	69.43	62.20	62.48	4.960	6.171	5.528	5.553
Mean	12.84	15.16	13.96		27.98	32.45	30.22		58.21	73.86	66.11		5.174	6.565	5.875	

	SEm±	C.D. (5%)	SEm±	C.D. (5%)	SEm±	C.D. (5%)	SEm±	C.D. (5%)
B	0.045	0.093	0.168	0.348	0.421	0.874	0.064	0.133
V	0.039	0.081	0.145	0.302	0.365	0.757	0.056	0.115
B x V	0.066	0.137	0.291	0.603	0.730	1.514	0.111	0.231

plant height as compared to the control might be due to the improvement in soil physical condition provided for plant growth and also due to increased availability of nutrients especially N, P_2O_5 and K_2O from the early stages of crop. Phosphorus fertilization improved the root system in french bean which in turn helped more assimilation of nutrients resulting in increased growth. This findings corroborates with the findings of Srivastava and Ahlawat (1995) in pea, Shailesh *et al.* (1996) on cowpea. Increase in number of branches per plant due to PSB inoculation could be due to the conversion of unavailable phosphorus to the available form particularly during the early crop growth phase which would have helped in the absorption of all major and minor nutrients required for the plants to put forth early vigour in vegetative growth. Another mechanism by which phosphobacteria augment the number of branches and plant height due to the biosynthesis of growth promoting substances like vitamin-B_{12} and auxin. These findings corroborates with the findings of Dubey *et al.* (1999) in soybean The statistically analysed data (Table 2) pertaining to number of clusters per plant, pods per plant, pods per cluster and number of seeds per pod indicated that significant differences observed among the treatments.

Treatments B_3 (75 % RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1}) recorded maximum number of clusters per plant, pods per plant, pods per cluster and seeds per pod (2.60, 9.76, 2.07 and 6.17) and least was recorded in B_1 treatment. Among the varieties, Arkasuvidha (V_2) was registered maximum clusters per plant, pods per plant, pods per cluster and seeds per pod 2.55, 9.70, 2.04 and 6.03 followed by selection – 9 (V_3) 2.18, 7.81, 1.82 and 5.22 and Arka Komal (V_1) 1.81, 6.41, 1.61 and 4.43. Variety V_2 Arkasuvidha was significantly superior to other varieties.

The data related to length of pod (cm), 100 seed weight (g), pod yield (g), per plant and pods yield per hectare (t ha^{-1}) as influenced by various treatments in different varieties are furnished in Table 3. Among different biofertilizers, application of 75 % RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1} recorded maximum pod length (15.28 cm), 100 seed weight (32.809), pod yield per plant (74.93 g) and pod yield per hectare (6.66 t ha^{-1}) which was significantly higher than the other treatments. Least was recorded in 25 % RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.6 kg ha^{-1}. With regard to varieties, V_2 (Arka suvidha) recorded maximum pod length (cm), 100 seed weight (g), pod yield per plant (g) and pod yield per hectare (t ha^{-1}) and least was recorded in V_1 (Arkakomal).

Increased yield by the PSB could be due to the greater availability of nutrients in the soil and better nodulation under the influence of inoculation resulted better growth and development which might be attributed to better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance on the plant system. This findings corroborate with the findings of Menaria *et al.* (2004) in soybean, Naagar *et al.* (2004) in cluster bean. Increase in yield by dual inoculation of VAM and PSB might be due to increased number of leaves and leaf area which determines the photosynthetic efficiency of plants, dry matter production and ultimately the yield. Soil application of biofertilizers in combination with chemical fertilizers at different levels exerted a significant influence on quality parameters such as crude fibre and crude protein.

The results of the present study indicated in (Table 4) and (Table 5) that among the treatments, application of 75% RDF + VAM @ 2 kg ha^{-1} + PSB @ 2.5 kg ha^{-1} (B_3)

Table 4: Crude protein content (%) of French bean as influenced by soil application of VAM and PSB

Treatments	Varieties			
	V_1	V_2	V_3	Mean
B_1	1.84	2.78	1.98	2.20
B_2	2.67	3.08	2.94	2.90
B_3	2.78	3.22	3.07	3.02
B_4	2.16	2.92	2.75	2.61
Mean	2.36	3.00	2.68	
	SEm±		C.D. (5%)	
B	0.035		0.073	
V	0.030		0.063	
B x V	0.061		0.126	

recorded significantly lower content of crude fibre and high content of protein in all varieties. However, variety (V2) Arka Suvidha registered least crude fibre content of 0.63% and maximum protein content of 3.22% respectively. This results might be due to physiological influence of *Rhizobium*, VAM and phosphobacteria on the activity of number of enzymes along with the inorganic nutrients such as nitrogen, which is the chief constituent of protein, could have altered the contents to the desired levels. The results obtained are in line with the findings of Vimala *et al.* (2000) in pea. The increase in protein due to increased supply of P by VAM and PSB and due to profuse nodulation leading to increased N fixation which in turn had positive effect on photosynthetic organs and rate. This is in agreement with the findings of Jain *et al.* (1999) in chick pea and Naagar *et al.* (2004) in cluster bean.

Table 5: Crude fibre content (%) of French bean as influenced by soil application of VAM and PSB

Treatments	Varieties			
	V_1	V_2	V_3	Mean
B_1	2.32	1.82	1.93	2.02
B_2	1.42	1.02	1.17	1.20
B_3	1.31	0.63	0.81	0.92
B_4	2.12	1.66	1.78	1.85
Mean	1.79	1.28	1.42	1.85
	SEm±		C.D. (5%)	
B	0.027		0.056	
V	0.023		0.049	
B x V	0.047		0.097	

सारांश

आचार्या एन.जी.सी. रंगा कृषि विश्वविद्यालय के एस.वी. कृषि महाविद्यालय तिरूपति में रवी ऋतु 2006 में बलुई दोमट मिट्टी में प्रक्षेत्र प्रयोग किया गया। और पाया गया कि 75 प्रतिशत PDF + VAM @2 कि. ग्रा./हे. + PSB @ 2.5 कि.ग्रा./हे. का प्रयोग से पौध की लम्बाई, प्रति पौध शाखाओं की संख्या, पत्ती का क्षेत्र (सेमी^{2}) और शुष्क भार (ग्राम) पौध में अर्कासुविधा (V_2) प्रजाति तत्पश्चात चयन–9 और अर्का कोमल में सार्थक वृद्धि हुई। प्रति समूह में फली की संख्या, प्रति फली में बीज की संख्या, 100 ग्राम बीज भार (ग्राम), फली की लम्बाई, प्रति पौध फली की उपज (ग्राम), और प्रति हे. फली का उपज शुष्क प्रोटीन एवं रेशा की मात्रा (%) में 75 प्रतिशत RDF + VAM @2 किलो ग्राम/हे. + PSB @ 2.5 कि.ग्रा./हे. का प्रयोग से सार्थक रूप से वृद्धि पाई गयी।

References

Dubey S K 1999. Comparative effectiveness of different methods of inoculation in soybean (*Glycine max* L.) in a vertisol. Indian Journal of Agricultural Sciences 69(6): 461-464.

Jain P C, Kushwaha P S and Dhakad U S 1999. Response of chick pea (*Cicer arietinum* L.) to phosphorus and biofertilizers. Legume Research 22(4): 241-244.

Menaria B L and Singh P 2004. Effect of chemical and biofertilizers on yield attributing characters and yield of soyabean (*Glycine max* L.). Legume Research 27(3): 231-232.

Naagar K C and Meena N L 2004. Effect of phosphorus, sulphur and phosphate solubulizing bacteria on yield components, yield and quality of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) Legume Research 27(1): 27-31.

Shailesh K, Mishra and Solanki R B 1996. Effect of *Rhizobium* inoculation, nitrogen and phosphorus on growth and seed yield of cow pea (*Vigna sinensis* Savl). Indian Journal of Horticulture 53(3): 220-224.

Srivastava T K and Ahlawat I P S 1995. Response of pea (*Pisum sativum* L.) to phosphorus, molybdenum and biofertilizers. Indian Journal of Agronomy 40(4): 630-635.

Vimala B and Natarajan S 2000. Effect of nitrogen, phosphorus and biofertilizers on pod characters, yield and quality in pea (*Pisum sativum* L. spp. hortense). South Indian Horticulture 48(1-6): 60-63.