

Variation in response of French bean genotypes towards pre-sowing seed treatment with VAM for seed yield

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ABSTRACT

Pre-sowing seed treatment of seeds of eight French bean genotypes viz., Sonali, Selection 9, Deepali, Abhay, Victoria, Arka Suvidha, Arka Anoop and Falguni was done with VAM (*Vesicular-arbuscular mycorrhiza*) and crop was grown from both treated and untreated control seeds during winter season of 2012-13 and 2013-14 following Split-Plot Design with three replications. Observations were recorded on plant height, seed yield and its attributes. Significant enhancement in plant height was recorded for all the genotypes with varying magnitudes as influenced by VAM. Response of the genotypes did not follow any definite pattern for expression of length and breadth of pod and seed as well as for number of pods produced per plant. Genotype specific response could also be noticed for 100-seed weight and seed yield per plant toward pre-sowing seed treatment with VAM.

Keywords: French bean, seed yield and VAM

French bean (*Phaseolus vulgaris* L.) is one of the most important leguminous vegetable crop. It is a nutritious vegetable and can be grown under different cropping patterns of hills and plains in India. It is extensively grown in Himachal Pradesh, Punjab, Haryana, Uttaranchal, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu and West Bengal.

French bean is affected by inadequate availability of nutrients in soil and requires large quantity of phosphorus for its optimum growth and yield. To boost up the capability of plant to utilize such nutrients effectively integrated in the soil, seed inoculation with VAM and PSB has been recognized to be very effective. Therefore, role of VAM in improving plant growth through increased uptake of phosphorus has been established, especially in the soils of low fertility (Gerdemann, 1975). The low level productivity of French bean has been attributed mainly to inadequate fertilizer application. The modern day crop cultivation has been intensified with the use of chemical fertilizers, but the tremendous price hike of inorganic fertilizers has lead to increased cost of production. Use of inorganic fertilizers not only increases the cost of production, but also degrades soil fertility status and causing environmental pollution (Ramana *et al.*, 2010). Considering the influence of price hike in the cost of inorganic fertilizers and its ruthless use on both socio-economic condition of the farmers and maintenance of soil health, replacement of at least a portion of such higher dose of inorganic fertilizer by organic ones has become relevant in the present context of crop

production. Enhancement in phosphorus uptake and growth of leguminous plants through application *Vesicular-arbuscular mycorrhizal* fungi have been reported by Ezawa *et al.*, (1995).

AMF [*Arbuscular mycorrhizal fungi*] have been shown to differentially colonize plant roots, causing a variety of effects on plant growth, biomass allocation, and photosynthesis (Fidelibus *et al.*, 2000). Lukiwati and Simanungkalit (2002), Jalaluddin (2005), Avis *et al.* (2008) studied the effect of VAM (*Glomus mossae*) on growth and productivity of legumes, wherein significant influence VAM was observed, when compared with non-mycorrhizal plants. Mycorrhizal plants performed better than non-mycorrhizal plants. The VAM inoculated plants outperformed than non-inoculated plants in terms of growth and productivity parameters as well as in nutrient uptake (Tabassum *et al.*, 2012). The present study was undertaken to investigate response of VAM on seed yield and its attributes.

MATERIALS AND METHODS

The field experiment was conducted during the winter seasons of 2012-2013 and 2013-2014 following Split-Plot Design with three replications at District Seed Farm 'D' Block, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal. It is situated between 23°N latitude, 89°E longitude and an altitude of 9.75 meters above the mean sea level. Nature of soil of experimental site is sandy loam, almost neutral (pH-6.4) with good drainage facility. Pre-sowing treatment of seeds of all the eight genotypes was done with VAM (*vesicular arbuscular mycorrhiza*) @ 2 kg

ha⁻¹ for assessment of varying response of individual genotypes with regard to seed yield and its attributes. Seeds were mixed thoroughly with paste of inoculum made with water, shade dried properly and then sown in field. Sowing was done in four meter rows with five lines each for individual genotypes and treatment within a replication. Row to row and plant to plant spacing was maintained as 40 cm and 25 cm respectively. Recommended agronomic practices were followed including cultural operations, as and when required. Observations were recorded on plant height at first seed-pod harvest, number of pods per plant, length and breadth of pod and seed, 100 seed weight and seed yield per plant.

RESULTS AND DISCUSSION

Genotypes varied significantly amongst themselves for the characters studied in both the years. Average influence of VAM was also significant for change over control in both the years for all the characters. Significant influence of VAM was also recorded on individual genotypes for expression of those characters excepting breadth of both seed-pod and seed.

Plant height

Plant height was recorded as maximum for Deepali in first year followed by that of Abhay, Arka Suvidha and Arka Anoop, though the magnitudes were statistically at par (Table 1). It was Arka Suvidha in second year followed by Arka Anoop, Abhay, Selection 9 and Deepali, variation in performance among later four genotypes was recorded to be non-significant. Average influence of VAM could also be noticed as significant in enhancing plant height over uninoculated control in both the years. All the genotypes responded in similar manner towards pre-sowing seed inoculation with VAM in enhancing plant height, but with varying rate, exception could be noticed for Falguni in first year for which non-significant influence of VAM was noticed. Position of the genotypes were changed with the advancement in plant growth in major cases may be due to phenotypic expression of its varying potentiality. Observation of Ramana *et al.* (2010) on significant enhancement in plant height was recorded in French bean after inoculation with either VAM or PSB or its combination over control may corroborate the findings of the present investigation.

Number of pods per plant

Significantly highest number of pods was harvested after Falguni irrespective of the years of experimentation followed by that of Sonali, Abhay and Arka Anoop, while it was of lowest number produced after Selection 9, the difference in magnitude of this parameter for

Sonali and Abhay was non-significant in both the years. Position of genotypes over the years for expression of this parameter remained same, only slight change could be noticed among Deepali, Victoria and Arka Suvidha (Table 1). Enhancement in this parameter in second year in comparison to that of first year could be noticed for Abhay, Victoria, Arka Suvidha, Arka Anoop and Falguni, while the reversed scenario was exhibited by the rest three genotypes, which indicated its preference to changed climatic conditions during crop growth of respective years of the experimentation. Number of seeds/pod (Table 3) varying response of the genotypes.

Pod length

Longest pods, on an average, were harvested from Selection 9 in both the years, contrary to the average number of pods per plant, may be due to the expression of its genetic potentiality. Selection 9 was followed by Arka Anoop, Arka Suvidha and Deepali in both the years, difference in pod length between Arka Suvidha and Deepali in second year was found to be non-significant (Table 1). Influence of VAM in enhancing pod length, on an average, was noticed in both the years. All the genotypes responded in similar manner towards application of VAM as seed inoculant over the years of experimentation with different rates of enhancement.

Pod breadth

Breadth of pod was maximum for Selection 9 in both the years followed by that of Arka Suvidha, Arka Anoop, Abhay, Deepali and Sonali; performance of Arka Suvidha and Arka Anoop were statistically at par with each other in first year, while exactly similar performance could be noticed for Arka Suvidha and Abhay in second year (Table 1). It is to be noted that Victoria consistently produced pods with lowest breadth over the years preceded by that of Falguni, though non-significant with each other. Apparent enhancement in this parameter could be noticed for all the genotypes in both the years, though non-significant.

Seed length

The genotypes could be ranked according to its average length of seed as Arka Suvidha > Selection 9 > Abhay > Arka Anoop > Deepali > Sonali > Falguni > Victoria over the years of experimentation (Table 2). Over all seed length was found to be enhanced due to pre-sowing inoculation with VAM irrespective of the years of experimentation. Individual genotypes also responded in similar manner towards application of VAM in both the years with varying magnitudes, exception was noted for Abhay and Falguni in first year and only for Falguni in second year, for which enhancement in seed length was found to be non-significant.

Seed breadth

The order of genotypes for average seed breadth was almost similar to that for average seed length over the years of experimentation, it was as Arka Suvidha > Selection 9 > Abhay = Arka Anoop e” Deepali, position of Sonali and Falguni was changed over the years (Table 2). Performance of Deepali and Sonali could be noticed as statistically *at par* in first

year, while it was similar for Sonali and Victoria in second year. Overall average seed breadth was found to be significantly enhanced through application of VAM as seed inoculant in both the years. Though non-significant, apparent enhancement in this parameter could also be noticed for individual genotypes after application of VAM as seed inoculant.

Table 1: Influence of VAM on plant height and some yield attributes [2012-13(I) and 2013-14(II)]

Genotypes	Plant height (cm)						Number of pods per plant					
	I			II			I			II		
	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean
Sonali	36.67	39.64	38.15	35.57	38.53	37.05	29.00	33.93	31.47	27.20	34.60	30.90
Selec. 9	39.02	46.71	42.86	41.55	44.72	43.14	17.07	21.87	19.47	18.93	22.07	20.50
Deepali	43.25	46.03	44.64	41.32	45.19	43.26	22.27	26.27	24.27	21.07	24.13	22.60
Abhay	41.08	47.74	44.41	40.22	46.41	43.31	26.93	31.53	29.23	28.67	32.60	30.63
Victoria	36.37	38.72	37.54	39.25	41.56	40.40	22.87	25.33	24.10	26.20	32.20	29.20
Arka Suvidha	43.07	45.51	44.29	46.31	48.29	47.30	22.00	25.40	23.70	24.33	27.47	25.90
Arka Anoop	42.01	45.53	43.77	42.71	45.35	44.03	25.07	28.33	26.70	28.13	30.53	29.33
Falguni	39.63	41.12	40.38	39.25	43.27	41.26	36.93	38.70	37.82	41.80	45.93	43.87
Mean	40.14	43.87	42.01	40.77	44.16	42.47	25.27	28.92	27.09	27.04	31.19	29.12
	V	T	V × T	V	T	V × T	V	T	V × T	V	T	V × T
SEd (±)	0.546	0.327	0.926	0.823	0.276	0.782	0.649	0.247	0.700	0.668	0.307	0.869
LSD(0.05)	1.171	0.694	1.964	1.765	0.586	1.658	1.392	0.524	1.484	1.433	0.651	1.843
Genotypes	Pod length (cm)						Pod breadth (cm)					
	I			II			I			II		
	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean
Sonali	12.37	12.94	12.65	12.63	13.17	12.90	0.67	0.72	0.70	0.69	0.73	0.71
Selection 9	14.93	15.91	15.42	15.20	16.13	15.67	0.89	0.91	0.90	0.91	0.93	0.92
Deepali	13.11	13.37	13.24	13.41	13.91	13.66	0.77	0.81	0.79	0.79	0.82	0.81
Abhay	11.79	12.34	12.07	11.93	12.90	12.41	0.79	0.83	0.81	0.83	0.87	0.85
Victoria	12.03	12.81	12.42	12.26	13.14	12.70	0.64	0.69	0.67	0.69	0.71	0.70
Arka Suvidha	13.20	13.70	13.45	13.42	13.85	13.63	0.85	0.87	0.86	0.89	0.91	0.90
Arka Anoop	13.53	13.90	13.72	13.70	14.39	14.05	0.83	0.87	0.85	0.82	0.87	0.85
Falguni	12.41	12.91	12.66	11.54	11.88	11.71	0.67	0.70	0.68	0.68	0.71	0.69
Mean	12.92	13.48	13.20	13.01	13.67	13.34	0.76	0.80	0.78	0.79	0.82	0.80
	V	T	V × T	V	T	V × T	V	T	V × T	V	T	V × T
SEd (±)	0.065	0.029	0.084	0.071	0.041	0.116	0.006	0.005	0.016	0.009	0.005	0.015
LSD(0.05)	0.139	0.063	0.179	0.152	0.087	0.246	0.013	0.012	NS	0.021	0.012	NS

Hundred seed weight

100 seed weight (at around 8% moisture content) was recorded as highest for Arka Suvidha irrespective of the years of experimentation followed by that of Selection 9, Arka Anoop, Abhay and Deepali, while it was of significantly lowest value for Victoria preceded by Falguni and Sonali, though difference in this parameter for Sonali and Falguni was found to be statistically non-significant. The same gradation of genotypes over the years for 100 seed weight may be strict expression of its genetic potential. It is to note that VAM exerted its significant influence in enhancing this parameter over uninoculated control, when average was made over the genotypes (Table 2). All the genotypes also responded (Table 3) determining seed index.

Seed yield per plant

Seed yield per plant was recorded as maximum for Arka Suvidha in both the years, similar to 100 seed weight, and length and breadth of seed. It was statistically followed by Arka Anoop, Falguni, Abhay, Selection 9 and Sonali in first year, of which similar performance was noticed for first two and last two genotypes; while it was followed by Falguni, Arka Anoop, Abhay, Selection 9 and Sonali in second year. Significantly lowest seed yield per plant was recorded for Victoria preceded by Deepali consistently over the years, which may be due to reflection of its genetic potential for expression of this ultimate important character.

Table 2: Influence of VAM on seed yield and its attributes [2012-13(I) and 2013-14(II)]

Genotypes	Plant height (cm)						Number of pods per plant					
	I			II			I			II		
	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean
Sonali	1.22	1.26	1.24	1.19	1.24	1.22	0.54	0.55	0.55	0.51	0.53	0.52
Selection 9	1.40	1.45	1.43	1.42	1.47	1.45	0.67	0.69	0.68	0.68	0.70	0.69
Deepali	1.24	1.28	1.26	1.26	1.29	1.28	0.55	0.56	0.56	0.55	0.57	0.56
Abhay	1.31	1.34	1.33	1.32	1.35	1.34	0.61	0.64	0.62	0.62	0.65	0.64
Victoria	1.00	1.10	1.05	1.03	1.12	1.08	0.48	0.50	0.49	0.49	0.52	0.51
Arka Suvidha	1.48	1.52	1.50	1.51	1.54	1.53	0.70	0.71	0.71	0.71	0.73	0.72
Arka Anoop	1.29	1.34	1.32	1.31	1.35	1.33	0.60	0.63	0.62	0.62	0.65	0.64
Falguni	1.16	1.18	1.17	1.17	1.19	1.18	0.52	0.54	0.53	0.54	0.55	0.55
Mean	1.26	1.31	1.29	1.28	1.32	1.30	0.58	0.60	0.59	0.59	0.61	0.60
	V	T	V × T	V	T	V × T	V	T	V × T	V	T	V × T
SEd (±)	0.007	0.005	0.014	0.005	0.003	0.010	0.004	0.001	0.005	0.004	0.003	0.009
LSD(0.05)	0.015	0.010	0.030	0.012	0.007	0.021	0.010	0.004	NS	0.009	0.006	NS
Genotypes	100 seed weight (g)						Seed yield per plant (g)					
	I			II			I			II		
	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean	T ₀	T ₁	Mean
Sonali	19.02	20.91	19.97	19.52	21.29	20.41	27.294	34.754	31.024	27.400	35.897	31.648
Selection 9	36.02	37.15	36.58	36.55	38.31	37.43	28.659	35.305	31.982	30.100	37.020	33.560
Deepali	24.75	25.91	25.33	24.83	26.36	25.60	25.433	28.414	26.923	24.000	27.567	25.783
Abhay	26.07	28.27	27.17	27.60	29.93	28.77	32.604	35.940	34.272	33.520	37.673	35.597
Victoria	15.83	17.48	16.66	16.77	18.02	17.39	18.238	23.189	20.714	20.457	26.567	23.512
Arka Suvidha	42.13	43.65	42.89	43.15	45.11	44.13	39.919	45.867	42.893	43.353	50.533	46.943
Arka Anoop	32.52	34.67	33.60	33.82	35.70	34.76	32.369	39.265	35.817	34.767	39.723	37.245
Falguni	18.62	20.29	19.46	19.43	20.91	20.17	33.700	37.549	35.625	38.477	43.500	40.988
Mean	26.87	28.54	27.71	27.71	29.45	28.58	29.777	35.035	32.406	31.509	37.310	34.410
	V	T	V × T	V	T	V × T	V	T	V × T	V	T	V × T
SEd (±)	0.249	0.079	0.224	0.199	0.071	0.200	0.517	0.322	0.911	0.833	0.359	1.016
LSD(0.05)	0.535	0.168	0.475	0.428	0.150	0.425	1.109	0.683	1.932	1.778	0.761	2.154

Note: T₀-Control, T₁-VAM

Table 3: Change (%) after VAM inoculation for seed yield and some yield attributes

Genotypes	Number of pods		100 seed weight		Seed yield per plant	
	I	II	I	II	I	II
Sonali	17.01	27.21	9.94	9.10	27.33	31.01
Selection 9	28.13	16.55	3.13	4.81	23.19	22.99
Deepali	17.96	14.56	4.69	6.15	11.72	14.86
Abhay	17.08	13.72	8.45	8.43	10.23	12.39
Victoria	10.79	22.90	10.44	7.49	27.15	29.87
Arka Suvidha	15.45	12.88	3.62	4.53	14.90	16.56
Arka Anoop	13.03	8.53	6.61	5.55	21.30	14.26
Falguni	4.78	9.89	8.98	7.63	11.42	13.06

Significant enhancement in seed yield (Table 3) crop growth period of respective years. Observations of Milad *et al.* (2011) and Bhattarai *et al.* (2011) on enhancement in seed yield of bean varieties through seed inoculation with VAM along with *Rhizobium* support the result recorded in present investigation.

VAM was found to exert significant influence on enhancement in plant growth due to treatment as well as for production of seed irrespective of the genotypes and years of experimentation, though genotype specific response was noted for major characters studied. Recommendation to the farming community, therefore, can be made for use of VAM as pre-sowing seed treatment, considering reduced application of inorganic fertilizer, thereby lower cost involved in production as well as for better maintenance of soil health.

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