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T Basavaraj

Ph.D., Scholar, Department of Vegetable Science, College of Horticulture, Bengaluru, Karnataka, India

Vishnuvardhana

Dean, College of Horticulture, Mysore, Karnataka, India

Shanwaz A

Ph.D., Scholar, University of Horticultural Sciences, Bagalkote, Karnataka, India

Correlation studies of advanced mutants of French bean (*Phaseolus vulgaris* L.) for horticulture traits

T Basavaraj, Vishnuvardhana and Shanwaz A

Abstract

Thirty-five advanced mutant lines of French bean (*Phaseolus vulgaris* L.) along with one commercial check were evaluated in Randomized Complete Block Design (RCBD) with two replications during *Kharif* 2017-18 at College of Horticulture Bengaluru. Genotypic and phenotypic correlation studies for 15 characters were assessed for association between different characters, direct and indirect effects of component traits on pod yield per plant and other horticultural traits *viz.*, plant Height, number of branches, number of leaves per plant, plant spread (N-S), plant spread (E-S), days to 50% flowering, pod length (cm), pod width (cm), number of flowers per plant, pod set percentage (%), Number of pods per cluster, number of pods per plant, number of seeds per pod, average pod weight (g) of French bean based on the evaluation of thirty three genotypes. A positive and significant correlation of pod yield with all the characters except days to flowering at both phenotypic and genotypic levels. Maximum emphasis should be given to characters plant height, number of branches, number of pods per cluster, number of pods per plant, and average pod weight for the improvement of pod yield per plant in French bean.

Keywords: French bean, correlation, genotypic, phenotypic, mutants

1. Introduction

French bean (*Phaseolus vulgaris* L.) having the diploid chromosome number of 22 belongs to the family Fabaceae is also known as snap bean, kidney bean, garden bean. It is an important protein sources in many developing countries including India (Markart, 1985) [6]. In India, French bean is being grown over an area of 2.97 lakh ha with annual production of 27.44 lakh tons. It is extensively grown in Himachal Pradesh, Punjab, Haryana, Uttaranchal, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. (Indiastat, 2022) [4]. Beans are the “meat of the poor”, contribute essential protein to the under nourished people. French bean is an important source of carbohydrate (61.4%), proteins (17.5-28.5%) and mineral matter (3.2-5.0%). It has significant amount of fiber and supplies minerals like iron, potassium, phosphorus, magnesium, copper etc. It constitutes 84% of the pulses and 65% of total plant and (of the scarce and expensive) animal sources of protein diets (FAO, 2008) [3]. It is consumed as green pod vegetable and as dry seeds. It is grown for edible pods. Pods and seeds are rich in proteins and are excellent source of vitamins and minerals.

Character association or correlation is a measure of the degree of association between two characters. Variability and correlation studies provide information on the extent of improvement possible in different characters, but they do not throw light on the extent and nature of relationship existing between yield and various contributory characters. Further, many of the yield contributing characters are interacted in desirable and undesirable direction. Hence, a knowledge regarding the association of various characters among themselves and with economic characters is necessary for making indirect selection for improvement of economic characters. The phenotypic correlations indicate the extent of the observed relationship between two characters. This does not give true genetic picture of the relationship because it includes hereditary as well as environmental influences. Genotypic correlation provides an estimate of inherent association between genes controlling any two characters. Hence, it is of greater significance and could be effectively utilized in formulating an effective selection scheme.

2. Material and Methods

Thirty-five advanced mutants of French bean (*Phaseolus vulgaris* L.) along with one commercial check “Arka Anoop” released by IIHR, were evaluated in Randomized Complete Block Design (RCBD) with 2 replications were evaluated during *Kharif* 2017-18 at RHREC

Corresponding Author:

T Basavaraj

Ph.D., Scholar, Department of Vegetable Science, College of Horticulture, Bengaluru, Karnataka, India

(Regional Horticulture Research and Extension center), UHS Campus, GKVK, Bengaluru. The experimental block was well prepared and crop was raised at plant spacing of 30 x 15 cm and recommended dose of fertilizers were applied for the crop at different growth stage. Standard cultural, manurial and plant protection practices were followed to ensure a healthy crop growth. correlation studies for 15 characters were assessed for association between different characters, direct and indirect effects of component traits on pod yield per plant and other horticultural traits viz., plant height, number of branches, number of leaves per plant, plant spread (N-S), plant spread(E-S), days to 50% flowering, pod length (cm), pod width (cm), number of flowers per plant, pod set percentage (%), number of pods per cluster, number of pods

per plant, number of seeds per pod, average pod weight (g). Correlation coefficient was calculated as suggested by Al-Jibouri *et al.* (1958) [2].

3. Results and Discussion

Indirect selection is desirable for the improvement of yield. Therefore, knowledge of association between yield and its component traits and inter-relationship among themselves may prove fruitful for planning an effective and successful breeding programme. In present study, the phenotypic and genotypic correlation coefficients were worked out in respect of fifteen characters for all possible combinations (Tables 1 & 2).

Table 1: Phenotypic correlation coefficients among growth, earliness and yield parameters in advanced mutants of French bean

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
X ₁	1	0.674**	0.765**	0.743**	0.769**	-0.549**	0.421**	-0.521*	0.651**	0.326*	0.335*	0.563**	0.641**	0.732**	0.899**
X ₂		1	0.492**	0.497**	0.501**	-0.297	0.349*	-0.303	0.501**	0.399*	-0.319	0.389*	0.489**	0.457**	0.701**
X ₃			1	0.501**	0.571**	-0.459	0.459**	0.437**	0.531**	0.351*	0.427**	0.471**	0.591**	0.469**	0.697**
X ₄				1	0.542**	-0.561	0.311	-0.293	0.337*	0.309	0.431	0.503**	0.609**	0.501**	0.673**
X ₅					1	-0.586	0.479**	-0.301	0.341*	0.307	0.441	0.402**	0.409*	0.504**	0.701**
X ₆						1	-0.303	0.309	-0.431**	-0.334	-0.317	-0.352*	-0.407*	-0.331*	-0.691**
X ₇							1	-0.467	0.311	0.317	-0.301	-0.301	0.674**	0.531**	0.401*
X ₈								1	0.314	0.307	0.311	-0.309	-0.897**	-0.491**	0.603*
X ₉									1	0.334*	0.431**	0.681**	-0.403*	0.431	0.723**
X ₁₀										1	0.331*	0.439	0.453**	0.343*	0.739**
X ₁₁											1	0.531**	0.532	0.437**	0.673**
X ₁₂												1	0.431	0.311	0.589**
X ₁₃													1	0.423**	0.631**
X ₁₄														1	0.679**
X ₁₅															1

X₁: Plant height, X₂: Number of branches, X₃: Number of leaves per plant, X₄: Plant spread (N-S), X₅: Plant spread(E-S), X₆: Days to 50% flowering, X₇: Pod length (cm), X₈: Pod width (cm), X₉: Number of flowers per plant, X₁₀: Pod set percentage (%), X₁₁: Number of pods per cluster, X₁₂: Number of pods per plant, X₁₃: Number of seeds per pod, X₁₄: Average pod weight (g), X₁₅: pod yield per plant (g)

Table 2: Genotypic correlation coefficients among growth, earliness and yield parameters in advanced mutants of French bean

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
X ₁	1	0.689**	0.791**	0.757**	0.771**	-0.551**	0.429**	-0.533*	0.673**	0.343*	0.349*	0.573**	0.649**	0.741**	0.903**
X ₂		1	0.495**	0.501**	0.511**	-0.307	0.359*	-0.315	0.511**	0.403*	-0.327	0.393*	0.495**	0.463**	0.719**
X ₃			1	0.511**	0.583**	-0.464	0.469**	0.443**	0.541**	0.359*	0.431**	0.479**	0.601**	0.473**	0.703**
X ₄				1	0.557**	-0.581	0.321	-0.293	0.341*	0.319	0.439	0.513**	0.611**	0.513**	0.681**
X ₅					1	-0.593	0.481**	-0.301	0.345*	0.317	0.447	0.422**	0.419*	0.514**	0.713**
X ₆						1	-0.315	0.311	-0.439**	-0.336	-0.321	-0.359*	-0.421*	-0.341*	-0.701**
X ₇							1	-0.477	0.315	0.319	-0.311	-0.313	0.683**	0.539**	0.413*
X ₈								1	0.318	0.317	0.319	-0.319	-0.901**	-0.501**	0.619*
X ₉									1	0.336*	0.437**	0.689**	-0.409*	0.439	0.712**
X ₁₀										1	0.339*	0.441	0.459**	0.349*	0.741**
X ₁₁											1	0.533**	0.539	0.441**	0.679**
X ₁₂												1	0.433	0.321	0.593**
X ₁₃													1	0.429**	0.639**
X ₁₄														1	0.683**
X ₁₅															1

X₁: Plant height, X₂: Number of branches, X₃: Number of leaves per plant, X₄: Plant spread (N-S), X₅: Plant spread(E-S), X₆: Days to 50% flowering, X₇: Pod length (cm), X₈: Pod width (cm), X₉: Number of flowers per plant, X₁₀: Pod set percentage (%), X₁₁: Number of pods per cluster, X₁₂: Number of pods per plant, X₁₃: Number of seeds per pod, X₁₄: Average pod weight (g), X₁₅: pod yield per plant (g)

A narrow difference between the genotypic and phenotypic correlation coefficients was observed for various traits in the present finding and this indicates the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits. High genotypic correlation coefficient suggested that there was inherent relationship between trait under study and environment had not played much role in reducing their actual association.

Study of association revealed positive and strong correlation of pod yield per plant with plant height number of primary branches, number of leaves per plant, plant spread (N-S), plant spread (E-W), pod length number of flowers per plant, number of pods per plant, number of seeds per pod, average pod weight, and pod yield per plant, pod set percentage and number of pods per cluster at both genotypic and phenotypic levels. Pod yield per plant was negatively and significantly

associated with days to 50 per cent flowering and pod width both at genotypic and phenotypic levels. Similar results were reported by Raffi and Nath (2004) ^[10] in French bean.

Plant height was negatively and significantly associated with days to 50 per cent flowering and pod width both at genotypic and phenotypic levels. Similar results were reported by Raffi and Nath (2004) ^[10] in French bean. Number of primary branches was positively and significantly associated with number of leaves per plant, plant spread (N-S), plant spread (E-W), number of flowers per plant, number of seeds per pod, average pod weight, pod yield per plant, number of primary branches, pod length, pod set percentage and number of pods per plant both at genotypic and phenotypic levels. These results were in accordance with Ravinaik *et al.* (2014) ^[12] in dolichos bean and Kumar *et al.* (2014) ^[5] in cluster bean. Number of leaves per plant was positively and significantly associated with plant spread (N-S), plant spread (E-W), pod length, pod width, number of flowers per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, average pod weight, pod yield per plant and pod set percentage both at genotypic and phenotypic levels. Similar findings were reported by Verma *et al.* (2014) ^[13] in French bean. Plant spread (N-S) was positively and significantly associated with Plant spread (E-W), number of pods per plant, number of seeds per pod, average pod weight, pod yield per plant and number of flowers per plant. Plant spread (E-W) was positively and significantly associated with pod length, number of pods per plant, average pod weight, and pod yield per plant, Plant spread, number of flowers per plant and number of seeds per pod both at genotypic and phenotypic levels. These results were in accordance with Raffi and Nath (2004) ^[10] in French bean.

Days to 50 per cent flowering was negatively and significantly associated with number of flowers per plant, pod yield per plant, number of seeds per pod, number of pods per plant, and average pod weight both at genotypic and phenotypic levels. These results are in accordance with Prashanth and Sreelatha (2014) ^[9]. Further, pod length was positively and associated with number of seeds per plant, average pod weight, pod yield per plant. Pod width was positively and significantly associated with pod yield per plant. Pod width was negatively and significantly associated with number of seeds per plant and average pod weight both at genotypic and phenotypic levels. Similar results were reported by Mehra (1984) ^[7], Nath and Korla (2004) ^[8], Rai *et al.* (2010) ^[11] and Verma *et al.* (2014) ^[13] in French bean. Number of flowers per plant positively and significantly associated with pod set percentage, number of pods per cluster, number of pods per plant and pod yield per plant.

Number of flowers per plant negatively and significantly associated with number of seeds per pod. Pod set percentage positively and significantly associated with number of seeds per pod, pod yield per plant, number of pods per cluster and average pod weight. These results are in accordance with Mehra (1984) ^[7], Raffi and Nath (2004) ^[10] in French bean. Number of pods per cluster was positively and significantly associated with number of pods per plant, average pod weight and average pod yield per plant. Number of pods per plant was positively and significantly associated with pod yield per plant. Number of seeds per pod was positively and significantly associated with average pod weight and pod yield per plant. Average pod weight was positively and

significantly associated with pod yield per plant. Similar results were reported by Mehra (1984) ^[7] in French bean.

4. Conclusion

It may be concluded that maximum emphasis should be given to characters plant height, number of branches, number of pod per cluster, number of pods per plant, and average pod weight for the improvement of pod yield per plant in French bean.

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