Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 40-44

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.007

Assessment of Genetic Variability Components in French Bean (*Phaseolus vulgaris* L.) under Valley Condition of Garhwal Hills

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Keywords

Bean, Genotypic, Heritability, Phenotypic and Variability

Article Info

Accepted:
04 February 2021
Available Online:
10 March 2021

A B S T R A C T

Seventeen diverse strains of French bean were used to evaluate the variability component. The field trial was carried out at Horticultural Research Centre, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India) during summer season, 2016. The experiment was laid out in randomized block design with three replications. The traits like fresh weight of nodules, number of pods per plant, yield of green pods per plant, per plot and number of picking were high for genotypic and phenotypic coefficient of variation. Most of the traits showed high heritability under studied. The selection of high yielding strains should be emphasised on the basis of number of pod per plant, pod weight, pod length, pod diameter and number of pickings.

Introduction

French bean belongs to the Leguminaceae family which represent one of the most valuable clusters among the vegetable due to their economical as well as their vast nutritional values. Among the family, French bean (*Phaseolus vulgaris* L. 2n=2x=22) is highly popular, highly cultivated specie and short duration crop in the hills of Uttarakhand. It is known by various names such as, snap bean, kidney bean, haricot bean(George, 1985) and also called "Raj mash" in Hindi. French bean had introduced to India during 17th century form Europe. It is originated from Central America and Peruvian Andes in South America (Vavilov, 1950). There are four most cultivated species of French bean *viz. P. vulgaris, P. coccineus, P. lunatus and P. acutifolius* var *latifolius.* All the species are in this group is self-pollinated, except *P. coccineus* which is generally cross pollinated in nature. French bean possess several medicinal values like diabetes, cardiac problems, bladder burn carminative and reparative properties against constipation and diarrhoea respectively (Duke, 1981).

For the improvement of any kind of characters, the variation in traits and selection is a key point. The estimation of present genetic variation in crop species is very important for initiating effective breeding plan to create new variety and improve the present variety in different areas (Patil *et al.*, 2012 and Belaj *et al.*, 2002). The characters having a high values of GCV showed high potential for the effective selection in population (Burton and De Vane, 1953). For starting an effective breeding programme, the genetic variability along with heritability should be considered for assessing the maximum and accurate effect of selection because the degree to which variability of a character is transmitted to progeny is of utmost importance. Heritability is transmissibility of traits from parent to offspring (Falconer, 1981) and heritability also showed heritable portion of phenotypic variance. Heritability provides the real knowledge on the magnitude of inheritance of traits from parents to off spring. The genetic advance is very useful in finding the real gain expected under selection (Larik *et al.*, 2000, Nwangburuka & Denton, 2012 and Ogunniyan & Olakojo, 2015).The information on heritability alone may not very helpful in identifying traits for enforcing selection; therefore, heritability estimates incorporation with genetic advance is more reliable than alone (Johnson *et al.*, 1955). From all the above mention facts the study was conducted to assess the component of genetic variability in seventeen strains of French bean in valley condition of Srinagar Garhwal.

Materials and Methods

The experiment was carried out at Horticultural Research Centre, Chauras Campus, Department of Horticulture, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India) during *summer* season, 2016. The Horticultural Research Centre is situated in Alaknanda valley which lies between 78°47'30" E longitude and 30°13'0" N latitude, at an elevation 540 meter above MSL, in the lesser Himalayan region. Seventeen strains *viz.*, Amar, Ananaya, ArkaKomal, Contender, Giri-1, Giri-2, Giri-3, H-12, H-22, H-30, Pauri-1, Pauri-5, S-7, S-8, S-9, S-10 and S-11 of French bean were collected from various regions of India. The experiment was laid out in randomized block design with three replications. The entire experimental field was divided into three blocks each block consist of seventeen beds of equal size of 2 x 2 m size with 40cm x 10cm spacing. All the intercultural operation and plant protection measures recommended for the successful crop growth were followed and irrigation were given according to crop requirement for better growth and development of the plants. During the experiment eighteen different yield and yield related characters were recorded. Five plants from each treatment per replication were selected and tagged for recording the various observations. Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (1985). Estimation of variability components was done following Burton and De Vane (1953). Heritability and expected genetic advance was calculated according to Burton (1952) and Johnson *et al.*, (1955).

Results and Discussion

Genotypic and phenotypic coefficient of variation

Estimation of genetic variability and their component is presented in Table 1. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for most of the traits studied in this research work, the results of study indicating that, the variation present in the strains was not only genetic but also

influenced by environmental factors. In general view, the quantitative traits very quickly influenced by environmental factors, meanwhile the qualitative traits is very less influenced by environmental factors. The PCV and GCV values were a bit lower ranging from 4.45% to 39.38% and 4.36% to 39.37% respectively. According to Deshmukh *et al.*, (1986), the PCV and GCV values more than 20% are considered to be higher, values between 10%-20% to be moderate, while value less than 10% are considered to be low.

Table.1 Estimation of genetic variability components over mean for various quantitative and qualitative traits in French bean strains

Characters	Range	Variance		Coefficients of variance (%)		Heritability h^2 (%)	Genetic advance (GA)	Genetic advance over mean GAM (%)
		GV	PV	GGV	PCV			
Days taken to first germination	6.42-11.38	4.21	4.36	16.55	16.86	95.66	3.51	28.45
Plant height (cm)	37.25-63.54	35.90	35.78	13.55	13.61	98.90	12.38	24.85
Number of primary branches/plant	3.62-6.38	1.58	1.68	19.28	12.78	96.36	2.35	35.25
Days taken to first flowering	33.40-41.92	5.89	5.95	6.15	6.22	99.36	4.73	15.85
Number of nodules per plant	6.62-13.55	2.47	2.69	14.30	14.39	97.89	3.13	25.98
Fresh weight of nodules/plant (mg)	73.25-145.36	675.70	675.86	24.54	24.52	99.00	53.66	46.55
Dry weight of nodules/plant (mg)	12.50-42.43	125.82	125.97	39.37	39.38	99.48	23.01	78.84
Days taken to first pod set	41.94-46.70	8.88	8.95	6.68	6.78	97.93	6.07	16.47
Days taken to first pod picking	54.80-61.61	3.82	3.97	4.36	4.45	96.78	4.00	5.78
Number of pods per plant	10.33-21.55	11.37	11.43	24.55	24.60	99.59	7.23	49.58
Pod weight (g)	7.48-12.55	3.65	3.70	20.16	20.25	99.78	3.94	38.36
Pod length (cm)	10.92-14.62	4.45	4.56	13.79	13.86	98.25	3.58	26.43
Pod diameter (cm)	0.78-1.89	0.28	0.39	29.31	30.64	93.63	0.63	57.90
Yield of green pods per plant (g)	93.58-247.18	2090.28	2090.39	30.95	30.95	99.14	94.34	63.70
Yield of green pods per plot (kg)	6.40-20.80	15.75	15.85	31.78	31.85	99.42	7.86	65.91
Number of picking	2.40-5.41	0.68	0.75	24.52	24.96	95.66	1.55	49.85
Yield of green pod per hectare (q/ha)	180.30-412.30	6378.90	8095.55	27.66	30.79	77.36	144.77	48.27
TS S (°Brix)	5.10-7.63	0.48	0.56	11.38	11.90	92.70	1.19	20.87

The GCV and PCV values were higher for fresh weight of nodules/plant (24.54% and 24.52%), dry weight of nodules/plant (39.37% and 39.38%), number of pods per plant (24.55% and 24.60%), pod weight (20.16% and 20.25%), pod diameter (29.31% and 30.64%), yield of green pods per plant (30.95% and 30.95%), yield of green pods per plot (31.78% and 31.85%), number of picking (24.52% and 24.96%) and yield of green pod per hectare (27.66% and 30.79%). The high values of PCV and GCV suggested that there

is a possibility of improvement through direct selection for these traits. Similar results were also obtained by Kumar *et al.,* (2014), Singh *et al.,* (2014b) and Verma *et al.,* (2014a)in French bean.

The moderate GCV and PCV were recorded for the traits *viz.,* days taken to first germination (16.55% and 16.86%), plant height (13.55% and 13.61%), number of primary branches/plant (19.28% and 12.78%), number of nodules per plant (14.30% and 14.39%), pod length (13.79% and 13.86%) and total soluble solids (11.38% and 11.90%). It implies equal importance of additive and non-additive gene action and substantial amount of variability for these traits. Kumar *et al.,* (2014), Singh *et al.,* (2014b) and Verma *et al.,* (2014a) also observed similar results in French bean. The GCV and PCV for days taken to first flowering (6.15% and 6.22%), days taken to first pod set (6.68% and 6.78%) and days taken to first pod picking (4.36% and 4.45%) were low.

Heritability and genetic advance

The heritability values is one of the key factors in the assumption to be achieved through the selection process; the joint view of high heritability and high genetic advance is a key marker of higher proportion of additive genetic variance and consequently a high genetic gain is expected from selection (Singh and Rai, 1981). In the present research work, the heritability ranged from 77.36% to 99.78% (Table 1). According to classification of Singh (2000), the heritability values higher than 80% are high, values 60% to 79% are moderately high, values from 40% to 59% are medium and values less than 40% are low. The high heritability was found for almost all the character studied except yield of green pod per hectare (77.36%) which was found to be moderately high.

The genetic advance as percent of mean (GAM) was ranging from 5.78% to 78.84%. Johnson *et al.,* (1955) classified genetic advance as a percentage of mean as value between 0 to 10% are low, 10 to 20% are moderate and above 20% are high. The high genetic advance over mean (Table 1) was observed for almost all the traits studied. The traits days taken to first flowering (15.85%) and days taken to first pod set (16.47%) were recorded moderate GAM while, days taken to first pod picking (5.78%) was found low GAM. Based on this measure, the traits under study have high heritability value coupled with high-to-moderate genetic advance as a percentage of the mean (ranging from 15.85% to 77.36%). Rai *et al.,* 2010; Kumar *et al.,* 2014; Prakash and Ram (2014) and Jayprakash *et al.,* 2015 also recorded similar results in French bean.

On the basis of results obtained from the present field trail, it can be concluded that the French bean strains used has wide range of genetic variation with very narrow differences between GCV and PCV, high heritability and genetic advance over mean for almost all the traits, so the selection would be more reliable and feasible.

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How to cite this article:

Tanuja, D. K. Rana and Rathi, D. S. 2021. Assessment of Genetic Variability Components in French Bean (*Phaseolus vulgaris* L.) under Valley Condition of Garhwal Hills. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 40-44. doi: https://doi.org/10.20546/ijcmas.2021.1003.007