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Genetic estimation for yield and yield attributing traits among diverse genotype of French bean (*Phaseolus vulgaris* L.)

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Abstract

Crop improvement totally depends upon the various factors one of them is genetic estimation includes the examination of various parameters for understanding yield and yield attributing traits responsible for crop development. The present experiment was carried out *Rabi* season of 2012-13 at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P. (India) on 21 diverse genotypes in order to assess the quantitative differences among genotypes for yield and yield attributing trait. Observations for pod yield per plant showed that HOR-137 (62.5g) ranked first. PDR-14 (62.35 g) and EC-592938 (62.25 g) represented as good pod yield per plant also genotype RLFB-58 (39.57 g) showed lowest pod yield per plant. Pod yield per hectare is the final and economical characteristics of the crop therefore it is most important for crop improvement. The pod yield per hectare ranged from 87.93 (RLFB-58) to 138.88 (HOR-137). The maximum pod yielder was HOR-137 (138.88 q/ha), whereas minimum pod yield per hectare was recorded with genotype RLFB-58 (87.93 q/ha). In the present investigation, HOR-137, PDR-14 and EC-592938 were found to be the high yielder which may be used as for the development of high yielding varieties.

Keywords: French bean, quantitative and yield

Introduction

Indian agro-climatic are the most favorable for the cultivation of several types of horticultural crops such as fruits, vegetables, flower, medicinal, aromatic and plantation crops. Vegetables are highly beneficial for the health as they contain valuable vitamins, minerals in sufficient amount. India is the largest producer, consumer and importer of pulses in the world accounting ~33 per cent of the global production. The major pulse producing states are Madhya Pradesh, Rajasthan, Uttar Pradesh, Maharashtra, Bihar, Andhra Pradesh, Haryana, Tamil Nadu, West Bengal, Punjab, Gujarat, which account for 68 per cent of the total pulse production of the country. Besides India, pulses are also grown in Africa, America, Australia, Malaya, East and West Indies, Pakistan, Bangladesh, Sri Lanka, etc. French bean (*Phaseolus vulgaris* L.) is a leguminous crop belonging to the family Leguminosae with the chromosome number of $2n=2x=22$ and originated in Central and South America. It is a nutritious vegetable which is consumed as tender green pods, shelled beans, and dry beans. It is also called Rajma in Hindi and snap bean, kidney bean, and haricot bean in English. French bean having good nutritional value contains protein 1.7g, carbohydrate 5.0g, fat 0.1g, fibre 1.8g and is also rich in minerals and vitamins. It also possesses some medicinal properties which is useful in controlling diabetics and certain cardiac problems and it has both carminative and reparative properties against constipation and diarrhoea respectively. The average yield of pulses in general and french bean in particular is very low as compared to that of cereals because of the absence of suitable high yielding varieties having synchronous maturity, instability under changing environmental conditions and susceptibility to different pests and diseases. So, there is an urgent need to develop high yielding varieties accompanied with resistance to prevent diseases with early maturity so that maximum production could be achieved which will ultimately boost the total pulse production at the national level. Phenotypic expression of the plant is mainly governed by the genetic makeup of the plant and environment effect. Hence, the study of genetic variability for yield and yield contributing characters of available genotypes are essential.

Material Methods

The present experiment was carried out *Rabi* season of 2012-13 at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P. (India). The vegetable research farm is about 10 km away from Varanasi Railway Station in South - eastern part of the Varanasi city in the BHU Campus and it is geographically situated at 25° 10' North Latitude and 83° 03' East longitude. The altitude of this location is about 123.23 meter above mean sea level. The experiment was conducted in Randomized Complete Block Design (RCBD) with 21 genotypes of French bean in three replication. The spacing between plants were maintained at 40 x 20 cm² with plot size of 3 x 2 m = 6.0 m² along with border of 30 cm from each side of plot. Each plot containing 75 plants with appropriate the cultural operation done. All the genotypes were collected from ICAR- Indian Institute of Vegetable Research, Varanasi. The genotypes are Arka Anoop, Arka Komal, EC-592938, EC-5995960, HAFB-3, HUR-15, LVFB-2, PDR-14, RLFB-58, VHP-9, Arka Suvidha, Contender, EC-593020, EC-599750, HOR-137, Kentucky Wonder, Pant Bean-3, RCFB-64, Swarna Priya, VL-Bean3, and VRF-BB1. The following parameters of whom observations were taken for yield and yield contributing traits viz., days to first flowering, percent fruit set per cluster, pod length, pod width, pod weight, number of seeds per pod, seed length, seed width, weight of 100 seeds, seed yield per plant, pod yield per plant, pod yield per hectare. Replication wise mean values were subjected to RCBD analysis (Panse and Sukhtame 1985) [5] among all the genotypes and tested using 'F' test. Genetic variability among genotypes and the extent of environmental effects on various characteristics different genetic parameters were also estimated.

Result and discussion

The experiment was conducted on 21 diverse genotype of French bean for assessment of quantitative differences among genotypes for yield and yield attributing trait under the agro-climatic condition of Varanasi (Uttar Pradesh) India. The population was found to be significant for traits namely, days to first flowering, percent fruit flower per cluster, pod length, pod width, number of seeds per pod, seed length, seed width, 100 seed weight, seed yield per plant, pod yield per hectare as presented in Table 1. The precise analysis of the findings of the present experiment indicates that the genotype differed among themselves in terms of growth, flowering, fruit characters and yield related traits. Lowest mean value of days to first flowering is most desirable for earliness. On the basis of earliness LVFB-2 was found good. Days to first flowering in general were after the sowing of 45 days. Similar findings were also reported by Lavatre, *et al.*, (2003) [3]. The percent fruit set per cluster more varied from genotype to genotype. It had a prominent role to decide the total yield of the plant. The data represent that percent fruit set per cluster was found varied from Pant Bean-3 (38.43) to Swarna Priya (76.51). These difference in varietal characters could be due to genetic makeup of the plants reported by Pandey, *et al.* [4] the pod length varied genotype to genotype which is genetically controlled character. Results revealed that the genotype Arka Suvidha (16.50 cm) having the maximum length of pod followed by EC-593020 and PDR-14 (16.33 cm) whereas VRF-BB1 (10.28 cm) showed lowest length of pod. Similar results were reported by Singh, *et al.*, (2007) [7]. The pod

width of individual genotypes was recorded after randomly picking the pod. From the recorded results it can be concluded that the genotype RLFB-58 (1.26 cm) was found to be maximum and the minimum pod width was recorded in genotype Kentucky Wonder and HAFB-3 (0.88 cm). Baudino, *et al.*, (2004) [1] and Singh, *et al.*, (2007) [7] reported same type of the results. On the basis of mean values maximum pod weight was recorded by PDR-14 (6.75 g), followed by HOR-137 (6.65 g) and HUR-15 (6.55 g) whereas minimum pod weight was recorded with genotype RLFB-58 (3.85 g). These results were in accordance with Singh, *et al.*, (2011) [8], Rai, *et al.*, (2010) [6] and Pandey, *et al.*, (2011) [4]. The number of seeds per pod is one of the most important characters for yield contributing traits, if the number of seeds per pod increases then yield increases in same proportion and vice versa. The highest number of seeds per pod was recorded by LVFB-2 (6.81) followed by Arka Suvidha, EC-592938, HAFB-3 and HUR-15 (6.13). Whereas lowest number of seeds per pod was recorded with genotype Contender, Kentucky Wonder and Swarna Priya (2.73). Singh, *et al.*, (2007) [7] observed similar findings.

The seed length is important character for quality of French bean. The highest seed length was observed in genotype VL-Bean-3 (1.88 cm) and minimum seed length was recorded in genotypes Arka Komal and RCFB-64 (1.22 cm). Jasmine *et al.*, (1998) [2] has reported the seed length affect directly quality of French bean. The seed width is directly contributing trait for test weight/seed index. Genotype VL-Bean 3 (0.96 cm) ranked first for maximum followed by HOR-137 (0.87cm) and minimum was recorded in genotype Arka Komal and RCFB-64 (0.60 cm). Singh, *et al.*, (2007) [7] reported similar results. On the basis of observations, data of 100 seeds weight was revealed that PDR-14 (58.15 g) ranks first followed by VHP-9 (55.43 g), whereas minimum value found in Contender (17.35 g). Lavatre, *et al.*, (2003) [3] observed significantly difference for 100 seeds weight between 45 genotypes. The seed yield per plant is the outstanding trait which directly correlates to yield per hectare of French bean. The highest seed yield per plant was recorded by Swarna Priya (158.37 g) followed by Contender and VRF-BB1 (139.37 g), whereas minimum seed yield per plant was recorded with genotype LVFB-2 (79.43 g). The mean value of seed yield per plant was found to be 109.27 g. These results are in line of earlier workers viz., Jasmine *et al.*, (1998) [2] and Baudino, *et al.*, (2004) [1].

Observations for pod yield per plant showed that HOR-137 (62.5g) ranked first. PDR-14 (62.35 g) and EC-592938 (62.25 g) represented as good pod yield per plant also genotype RLFB-58 (39.57 g) showed lowest pod yield per plant these findings are in accordance with Lavatre, *et al.* (2003) [3]. Pod yield per hectare is the final and economical characteristics of the crop therefore it is most important for crop improvement. The pod yield per hectare ranged from 87.93 (RLFB-58) to 138.88 (HOR-137). The maximum pod yielder was HOR-137 (138.88 q/ha), followed by PDR-14 (138.56 q/ha), and EC-592938 (138.35 q/ha), and whereas minimum pod yield per hectare was recorded with genotype RLFB-58 (87.93 q/ha). These results are in accordance with Singh *et al.* (2007) [7] and Rai *et al.* (2010) [6]. All findings are depicted in Table 2. For the better performance of the variety there should be proper consideration to environment condition as it plays a great impact on development of crop. Which boost up the scope for commercial recommendation of its cultivation.

Table 1: Analysis of variance (ANOVA) of 21 genotypes of French bean for 12 characters

Source of variance	Degree of freedom	Days to fist flowering	Percent fruit flower/cluster	Pod length	Pod width	Pod weight	Number of seeds /pod	Seed length	Seed width	100 seed weight	Seed yield/ plant	Pod yield/ plant	Pod yield / hectare
Replication	2	10.99	21.24	0.74	0.01	0.17	0.05	0.01	0.00	7.46	65.68	14.92	73.72
Treatment	20.00	5623*	8230*	508*	3*	86*	60*	6*	1*	4391*	29187*	8148*	40240*
Error	40	6.75	11.04	0.60	0.00	0.11	0.07	0.01	0.00	5.55	38.16	9.96	49.20

*Significant at 5%

Table 2: Mean performance of plant characters of 21 diverse genotypes of French bean

Genotype	DFP	PFPC	PL	PW	PWt	NSPP	SL	SW	SWt	SYP	PY/Y	PY/H
Arka Anoop	48.29	50.43	14.63	1.20	6.00	4.43	1.76	0.84	45.23	104.39	60.4	134.23
Arka Suvidha	46.93	61.33	16.50	1.13	5.25	6.13	1.64	0.78	43.53	107.58	58.44	129.87
Arka Komal	46.25	67.67	12.38	1.23	6.00	3.41	1.22	0.60	31.63	99.47	60.12	133.61
Contender	46.25	67.33	10.91	1.10	5.50	2.73	1.46	0.74	17.35	139.37	58.95	130.99
EC-592938	47.95	64.25	13.78	0.93	6.50	6.13	1.30	0.66	35.71	133.01	62.25	138.35
EC-593020	51.01	46.93	16.33	0.90	6.40	3.75	1.58	0.68	35.71	97.14	58.42	129.83
EC-5995960	49.65	50.11	16.19	1.10	4.20	5.79	1.59	0.71	50.67	103.72	40.15	89.24
EC-599750	46.40	66.31	10.87	1.16	5.75	3.07	1.26	0.62	38.77	108.55	55.60	123.70
HAFB-3	49.99	50.72	13.27	0.88	5.75	6.13	1.54	0.70	34.69	105.00	61.40	136.44
HOR-137	47.27	53.46	16.26	1.20	6.65	5.79	1.75	0.87	43.19	110.65	62.50	138.88
HUR-15	51.01	42.63	14.66	0.92	6.55	6.13	1.55	0.69	34.01	88.24	60.10	133.56
Kentucky Wonder	47.04	76.17	11.66	0.88	5.85	2.73	1.43	0.64	37.75	111.97	53.40	118.67
LVFB-2	44.89	65.80	15.99	1.13	5.95	6.81	1.64	0.78	43.53	79.43	61.45	136.57
Pant Bean-3	49.99	38.43	15.99	0.86	5.56	3.41	1.58	0.73	53.05	87.23	60.12	133.61
PDR-14	48.97	58.20	16.33	1.40	6.75	5.11	1.63	0.70	58.15	120.48	62.35	138.56
RCFB-64	45.57	67.67	12.66	1.25	6.02	3.41	1.22	0.60	31.63	101.72	54.55	121.33
RLFB-58	45.23	52.37	11.76	1.26	3.85	3.07	1.50	0.73	31.63	108.40	39.57	87.93
Swarna Priya	46.93	76.51	10.74	1.23	6.00	2.73	1.75	0.76	46.59	158.37	52.45	116.56
VHP-9	47.09	65.63	14.42	1.07	5.64	3.07	1.59	0.76	55.43	103.04	52.88	117.51
VL-Bean 3	47.95	42.33	14.22	0.99	6.25	4.77	1.88	0.96	40.13	87.63	60.14	133.64
VRF-BB1	48.29	67.33	10.28	1.02	5.82	4.09	1.48	0.67	44.89	139.37	55.78	123.96
Average	47.76	58.65	13.80	1.09	5.82	4.41	1.54	0.72	40.63	109.27	56.72	126.04
SEm±	1.50	1.92	0.45	0.04	0.19	0.15	0.05	0.02	1.36	3.57	1.82	4.05
CD at 5 %	4.29	5.48	1.28	0.10	0.55	0.42	0.14	0.06	3.89	10.19	5.21	11.57
CD at 1 %	5.74	7.34	1.71	0.14	0.73	0.57	0.19	0.09	5.20	13.64	6.97	15.49

DFP: Days to fist flowering; PFPC: Percent fruit flower/cluster; PL: Pod length; PW: Pod width; PWt: Pod weight; NSPP: Number of seeds /pod; SL: Seed length; SW: Seed Width; SWt: 100 seed weight; SYP: Seed yield/ plant; PY/Y: Pod yield/ plant; PY/H: Pod yield / hectare

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