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Evaluation of Common Bean (*Phaseolus vulgaris* L) Germplasm Under Temperate Conditions of Kashmir Valley

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Summary

Forty two genotypes of Rajmash (41 exotic and one local check) were evaluated in a Randomized block design with two replications for morphological and yield parameters as per the descriptor developed by CIAT and USDA. Most of the accessions were dry pulse type with only one accession being snap type with succulent pods without any fibers. In terms of plant growth about 70% accessions were Indeterminate Bush type and 30% were indeterminate climbing. Similarly, for traits like flower color, pod color, Seed coat pattern & seed size, the accessions were grouped in to two distinct classes, while as more than two classes were observed in case of seed coat color, seed brilliance, seed shape and pod color at maturity. In all these traits, highest frequency was observed in case of use category, pod color & seed coat pattern (97.56%) followed by pod color at maturity (95.20%). Heritability estimates were high for all the traits ranging from 79.472% for seeds/pod to as high as 94.367% in case of days to maturity. Genetic advance was also high in case of most of the traits especially plant height, seed yield, number of pods/plant, leaf area. The analysis correlation coefficients (Table) revealed that grain yield was significantly correlated with number of pods/plant (0.732) followed by 100 seed (0.430), leaf area (0.371), seeds/pod (0.355) and plant height (0.329) but was negatively correlated with days to flowering, days to maturity and pod length.

Key Words: common bean, *Phaseolus vulgaris,* correlation, PCV, GCV

Introduction

Pulses are the second most important food crops after cereals. In 2008, total global pulse production stood at 56.97 million tones from an area of 72.45 million hectares and average productivity of 780.81 kg/hectare (1). India is the largest producer and consumer of pulses with about 33 % share in area and 26 % share in production. In 2007, total pulse area in India stood at 23.25 million hectares and production at 14.60 million tones with average yield of 625kg/ha (2). In J&K pulses are grown over an area of 9000 hectares with a production of 4800 tonnes and yield of 524 kg/hectare (3). The total pulse area in J&K has witnessed a declining trend from 35570 hectares in 1991-92 to 26750 hectares in 2001-2002. The main cause of such decline has been the low yield of existing varieties, non availability of high yielding varieties and cultivation under low input system.

Rajmash or common bean is regarded as "grain of hope" as it is an important component of subsistence agriculture and feeds about 300 million people in tropics and 100 million people in Africa alone. Besides it is emerging as an important income generation especially in Central America where beans are No. 1 income generators among field crops. Globally, with 21 million tones, it accounts for about half of the total pulse production (4). Beans also offer an alternative for diversification of agricultural system but poor yield renders them poor competitors of cereals, oilseeds and other cash crops. Therefore, there is an urgent need to enhance the yielding ability of bean cultivars to make pulse cultivation a profitable venture.

Breeding of superior high yielding varieties is an important component of any approach aimed at improving pulse situation at national and international level. In the national and international bean breeding programmes, only a small proportion of the genetic variability has been utilized by bean breeders (5, 6). Ample germplasm resources are available in national and international gene banks which used for identification and development of high yielding bean cultivars. The current study was an attempt to evaluate exotic germplasm resources of beans to identify superior genotypes for temperate conditions of Kashmir valley.

Experimentals

The present study was undertaken at the Research Farm of Faculty of Agriculture, SKUAST-K, Wadura (34° 17' North and 74° 33 E at altitude of 1594 m amsl) during 2010. Forty two genotypes of Rajmash (41 exotic and one local check) were evaluated in a Randomized block design with two replications due to less quantity of seed received from donor organizations. Out of the forty two exotic accessions 18 were from USA, 10 from Colombia, 7 from Canada and one each from Argentina, Australia, Tanzania and Germany. The local check Shalimar Rajmash 1 is a high yielding variety released by SKUAST-K and is a cross between Canadian Red and Local Red.

Each genotype was represented by a single line of 2 meter length. The plants were space planted for optimal expression of traits and lack of prior knowledge about growing

habit of the genotypes. Data was collected from five randomly selected competitive plants on various quantitative traits, maturity, yield and yield contributing traits as per the descriptors developed by CIAT, Colombia, USDA-ARS and other organizations. Variability parameters were estimated as per the methodology of Aljibouri et al (7) and the correlation coefficients were worked out following Dewey and Lu (8).

Results and Discussion

Out of the 42 germplasm accessions, one accessions namely G51135 (CIAT) did not mature and hence in final analysis only 40 genotypes were considered. Data related to various qualitative traits is presented in Table 1. Most of the accessions were dry pulse type with only one accession being snap type with succulent pods without any fibers. In terms of plant growth about 70% accessions were Indeterminate Bush type and 30% were indeterminate climbing. Similarly, for traits like flower color, pod color, Seed coat pattern & seed size, the accessions were grouped in to two distinct classes, while as more than two classes were observed in case of seed coat color, seed brilliance, seed shape and pod color at maturity. In all these traits, highest frequency was observed in case of use category, pod color & seed coat pattern (97.56%) followed by pod color at maturity (95.20%).

The germplasm was also evaluated for nine quantitative traits. Characterization of germplasm in respect of economic traits is important as it helps in the quantification and organization of genetic diversity (9). The analysis of variability parameters for the nine quantitative traits revealed that there was significant variability in the material as indicated by a wide range of mean values (Table 2) and high coefficient of variation. The phenotypic coefficient of variation was invariably greater than genotypic coefficient of variation indicating significant influence of environment, understandably due to the fact that all of the traits studied are quantitative in nature.

Heritability estimates were high for all the traits ranging from 79.472% for seeds/pod to as high as 94.367% in case of days to maturity. Genetic advance was also high in case of most of the traits especially plant height, seed yield, number of pods/plant, leaf area etc. similar results have been reported in beans by Dursum (10) and Khagani et al (11). These parameters including high mean, high coefficient of variation, heritability and genetic advance are efficient indicators of the nature of variability for economic traits and the possible breeding progress expected under selection. But since most of the economic traits are complex in nature, it is essential to know the relationship between various traits to arrive at an optimal selection index for indirect selection, as the direct selection for seed yield is invariably not so fruitful.

The analysis correlation coefficients (Table) revealed that grain yield was significantly correlated with number of pods/plant (0.732) followed by 100 seed (0.430), leaf area (0.371), seeds/pod (0.355) and plant height (0.329) but was negatively correlated with days to flowering, days t o maturity and pod length. Similar results have been reported by Ulukan et al(12), Salehi et al (13) and Sabokdast and Khayalparast (14)Thus these traits with significant correlation with seed yield can be used to devise an optimally reliable selection index to bring about improvement in seed yield. Among other traits days to flowering was negatively correlated with other traits except days to maturity, plant height and leaf area, as was the case with days to maturity. Significant positive correlation was also recorded for seeds/pod and plant height; plant height and days to maturity; seeds/pod and pod length and 100 seed weight and plant length.

Thus traits having higher genetic variability, heritability, higher expected genetic gain under selection and are significantly correlated with grain yield can be reliably used to improve grain yield through indirect selection. Moreover, the genotypes with desirable attributes for various yield component traits could be crossed in to a combinational breeding programme to converge all the desirable traits in to a single line that could be used as a future commercial variety.

Table 1 : Data on various morphological and yield parameters of CIAT Bean Lines

Entry	Use of Category	Country	Seed coat color	Seed coat pattern	Seed Brilliance	Seed shape	Plant growth	Color of flowers	Pod color
G 51420	Dry	Colombia	Purple	Absent	Dull	Oval	Bush	Purple	Green
G 14949	Dry	USA	Red	do	Shiny	Kidney	Bush	Purple	Green
G 51498	Dry	Colombia	Do	do	Medium	Kidney	Bush	White	Green
G 51138	Dry	Colombia	Do	do	Shiny	Kidney	Climbing	White	Green
G 51145	Dry	Colombia	Do	do	Dull	Cuboid	climbing	Purple	Green
G 6050	Dry	USA	Do	do	shiny	Oval	Bush	Purple	Green
G 6415	Dry	USA	Pink	do	Medium	Kidney	Bush	White	Green
G 6416	Dry	USA	Red	do	Shiny	Kidney	Bush	White	Green
G 3601	Dry	USA	Do	do	Shiny	Kidney	Bush	Purple	Green
G 4069	Dry	USA	Do	do	Medium	Kidney	Bush	White	Green
G 4081	Dry	USA	Do	do	shiny	Kidney	Bush	White	Green
G 4450	Dry	USA	Do	do	shiny	Kidney	Bush	Purple	Green
G 5359	Dry	USA	Red	Do	shiny	Kidney	Bush	Purple	Green
G 5038	Dry	USA	Red	do	shiny	Kidney	Bush	Purple	Green
G 9162	Dry	USA	Red	do	shiny	Kidney	Bush	Purple	Green
G 6592	Dry	Canada	Purple	do	Dull	Kidney	Bush	Purple	Green
G 7179	Dry	Colombia	Purple	do	Dull	Kidney	Bush	Purple	Green
G 22211	Dry	USA	Pink	do	Dull	Kidney	Bush	White	Green
G 22171	Dry	Argentina	Red	do	Dull	Kidney	Bush	Purple	Green
G 17638	Dry	USA	Red	do	Shiny	Kidney	Bush	Purple	Green
G 24175	Dry	Tanzania	Purple	do	Medium	Kidney	Bush	Purple	Green

G 1854	Dry	Colombia	Pink	do	Medium	Kidney	Bush	White	Green
G 687	Dry	Australlia	Purple	do	Medium	Kidney	Bush	Purple	Green
G 3599	Dry	USA	Red	do	Shiny	Kidney	Bush	White	Green
G 2212	Dry	USA	Pink	do	Medium	Kidney	Bush	White	Green
G 2456 2A	Dry	USA	Red	do	Shiny	Oval	Climbing	White	Green
G 51415	Dry	Colombia	Purple	do	Shiny	Kidney	Climbing	White	Green
G 51416	Dry	Colombia	Purple	do	Medium	Kidney	Bush	Green	Green
G 11699	Dry	USA	Red	do	Medium	Kidney	Bush	Green	Green
G 14474	Dry	USA	Red	do	Medium	Kidney	Bush	Green	Green
G 51426	Dry	Colombia	Red	do	Shiny	Kidney	Bush	Green	Green
G 51413	Dry	Colombia	Brown	do	Dull	Kidney	Climbing	White	Green
PHA-12327	Dry	Germany	Purple	do	Medium	Oval	Bush	Purple	Yellow
BG-030893	Dry	Spain	Purple	do	Shiny	Oval	Determinate Climbing	Purple	Green
BG-013965	Dry	Spain	Red	do	Dull	Oval	Determinate Climbing	Purple	Green
BG-005475	Dry	Spain	Purple	do	Shiny	Kidney	Determinate Climbing	Purple	Green
BG-022512	Dry	Spain	Black	do	Dull	Oval	Climbing	Purple	Green
BG-003246	Dry	Spain	Brown	Mottled	Medium	Kidney	Climbing	Purple	Green
BG-013953	Dry	Spain	Purple	Absent	Medium	Oval	Climbing	Purple	Green
BG-027085	Snap	Spain	Brown	Absent	dull	Kidney	Bush	Purple	Green
Shalimar Rajmash-1 (c)	Dry	J&K	Red	Absent	Shiny	Kidney	Bush	Purple	green

Table 2 : Data on various quantitative and yield parameters of CIAT Bean Lines

Entry	Days to flowering	Days to maturity	Plant height (cm)	Leaf area (cm^2)	No. of pod/plant	Pod length (cm)	Seeds/pod	100-seed weight	Seed yie (q/ha)
G 51420	41	88.00	61.00	80.00	8.50	11.10	3.86	46.98	22.01
G 14949	37	85.00	68.33	117.66	13.66	12.11	4.03	43.33	34.08
G 51498	38	80.00	66.66	83.58	9.33	13.46	4.25	39.45	22.34
G 51138	50	102.00	121.75	67.64	7.00	11.02	6.03	31.16	18.78
G 51145	50	122.00	82.50	88.68	8.33	8.85	4.36	60.30	31.27
G 6050	38	89.00	69.25	81.62	7.00	11.77	3.82	42.54	16.24
G 6415	43	86.00	72.50	79.45	10.25	11.64	4.02	43.14	25.38
G 6416	38	84.00	77.00	87.62	5.50	14.06	4.20	42.72	14.09
G 3601	39	83.00	43.33	74.75	10.00	12.36	3.63	43.89	22.78
G 4069	35	82.00	39.50	66.58	4.66	11.89	4.00	36.32	9.67
G 4081	37	79.00	78.66	83.01	5.50	15.29	5.41	41.23	17.54
G 4450	43	86.00	55.00	68.38	6.33	12.37	4.63	36.29	15.21
G 5359	41	87.00	68.25	89.90	8.25	11.34	3.00	38.90	13.76
G 5038	41	87.00	61.25	79.16	10.25	11.58	4.12	42.59	25.72
G 9162	46	90.00	65.25	101.08	6.25	12.23	4.08	40.09	14.62
G 6592	46	96.00	89.25	85.91	9.25	13.70	5.06	38.53	25.78
G 7179	49	102.00	82.33	73.93	8.25	13.40	4.93	40.41	23.50
G 22211	40	97.00	87.00	85.96	8.75	14.14	5.37	38.39	25.79
G 22171	42	86.00	62.50	74.25	7.00	12.03	3.50	37.73	13.22
G 17638	38	86.00	48.33	71.75	7.25	12.94	5.03	45.62	23.79
G 24175	49	96.00	61.50	64.00	5.75	11.67	4.16	37.83	12.94
G 1854	39	95.00	63.00	64.80	9.33	14.06	4.03	34.89	18.76
G 687	37	85.00	49.00	52.75	7.66	16.86	3.21	36.09	12.69
G 3599	41	86.00	64.00	77.83	6.33	11.25	3.53	42.58	13.60
G 2212	46	90.00	82.50	83.28	9.33	14.12	5.01	40.22	26.84
G24562A	38	85.00	87.30	58.43	11.25	11.35	4.12	27.38	18.14
G 51415	36	93.00	96.00	68.25	8.33	14.57	4.20	45.80	22.91
G 51416	46	91.00	84.50	75.08	16.00	11.15	3.73	40.65	34.64
G 11699	40	86.00	59.50	57.16	6.75	12.13	2.92	42.41	11.93
G 14474	40	86.00	56.66	40.38	6.00	11.65	4.00	39.66	13.59

G 51426	37	77.00	44.00	61.50	7.25	12.18	4.70	43.01	20.95
G 51413	47	104.00	54.33	45.66	8.00	11.14	2.62	51.43	15.41
PHA-12327	47	96.00	234.75		6.94	12.74	4.95	60.52	29.73
BG-030893	53	121.00	87.25	120.74	4.74	10.43	3.97	45.43	12.21
BG-013965	53	118.00	94.33	94.93	8.91	12.24	4.11	32.27	16.90
BG-005475	56	124.00	81.74	81.43	6.13	12.16	4.64	32.80	13.34
BG-022512	53	113.00	110.71	66.11	8.84	11.09	3.68	34.47	16.03
BG-003246	53	118.00	78.41	93.48	7.12	12.85	4.34	41.02	18.11
BG-013953	53	116.00	89.13	84.72	7.25	13.26	5.01	33.55	17.41
BG-027085	45	103.00	67.18	76.31	6.76	12.88	5.21	29.72	14.95
Shalimar Rajmash-1	58	108	70.43	75.30	6.13	14.74	5.12	43.12	19.35

Table 3: Variability parameters for nine quantitative traits in common bean exotic collections

Parameter	Days to flowering	Days to maturity	Plant height	Leaf Area	No. of pod/plant	Pod length	Seed/pod	100 seed weight	Seed yield/plant
Mean	43.872	94.829	76.069	76.687	7.958	12.483	4.258	40.694	13.583
Range	37.58	77.122	234.75	120.74	16.00	16.86	6.03	60.52	24.25
S.D.	6.249	13.110	30.229	16.347	2.223	1.474	0.728	6.743	4.416
σ^2 g	34.071	162.213	813.481	229.018	4.010	1.907	0.422	37.639	16.132
σ^2 e	4.988	9.682	143.181	38.207	0.932	0.267	0.109	7.837	3.37
PCV	14.243	13.824	39.738	21.316	27.934	11.808	17.097	16.570	32.511
GCV	13.304	13.430	37.494	19.733	25.163	11.062	15.256	15.076	29.569
h^2	87.229	94.367	85.033	85.702	81.141	87.718	79.472	82.766	82.719
Genetic Advance	11.229	23.485	52.951	28.860	3.715	2.663	1.191	11.496	7.524
GA as % of Mean	25.594	26.875	69.610	37.633	46.692	21.337	27.990	28.251	55.399

Table 4: Genotypic Correlation for nine quantitative traits in exotic accessions of beans

Trait	Days to flowering	Days to maturity	Plant height	Leaf Area	No. of pod/plant	Pod length	Seed/pod	100 seed weight	Seed yield/plant
Days to flowering	1.00	0.871	0.353	0.173	-0.140	-0.224	0.241	-0.015	-0.031
Days to maturity		1.00	0.322	0.256	-0.147	-0.235	0.183	-0.003	-0.041
Plant height			1.00	0.189	0.037	-0.019	0.353	0.254	0.329
Leaf Area				1.00	0.120	-0.141	0.152	0.124	0.371
No. of pod/plant					1.00	-0.114	-0.156	-0.026	0.732
Pod length						1.00	0.288	-0.215	-0.039
Seed/pod							1.00	-0.144	0.355
100 seed weight								1.00	0.430
Seed yield									1.00

Table 5: frequency distribution of 41 accessions of *Phaseolus vulgaris*

S.No	Descriptor	Code	Absolute frequency	Relative %
1	Use category			
	Dry	1	40	97.56
	Snap	2	1	2.44
	Green shelled	3	-	-
	Popping	4	-	-
2	Plant growth			
	Determinate bush	1	-	-
	Indeterminate bush	2	29	70.33
	Indeterminate prostrate	3	-	-
	Indeterminate climbing	4	12	29.27
	Determinate climbing	5	-	-
3	Color of the flower			
	White	1	18	43.90
	Green	2	-	-

	Lilac	3	-	-
	White with lilac	4	-	-
	White with red	5	-	-
	Dark lilac	6	-	-
	Carmine red	8	-	-
	Purple	9	23	56.10
	Others	99		
4	Pod color			
	Dark purple	1	-	-
	Carmine red	2	-	-
	Purple stripe green	3	-	-
	Carmine stripped green	4	-	-
	Pale red stripped green	5	-	-
	Dark pink	6	-	-
	Normal green	7	40	97.57
	Shiny green	8	-	-
	Dull green	9	-	-
	Golden yellow	10	1	2.44
	Pale yellow	11	-	-
	Others	99	-	-
5	Seed coat colour			
	White	1	-	-
	Green	2	-	-
	Yellow	3	-	-
	Brownish	4	3	7.31
	Pink	5	4	9.75
	Red	6	21	51.22
	Purple	7	12	29.26
	Black	8	1	2.44
	Others	99	-	-
6	Seed coat pattern			
	Absent	0	40	97.56
	Mottled	1	1	2.44
	Stripped	2	-	-
	Specked	3	-	-
	Spotted	4	-	-
	Bloched	5	-	-
	Others	99	-	-
7	Seed brilliance			
	Dull	3	10	24.39
	Medium	5	13	31.70
	Shiny	7	18	43.90
8	Seed shape			
	Round	1	-	-
	Oval	2	8	19.51
	Cubiod	3	1	2.44
	Kidney	4	32	78.05
	Truncate	5	-	-
9	Seed size			
	Small (<25 g)	1	-	-
	Medium (25-40g)	2	18	43.90
	Large (>40 g)	3	23	56.10
10	Pod color at maturity			
	Yellow	1	39	95.12
	Golden yellow	2	1	2.44
	Brown	3	1	2.44S

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