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Short Communication

Selection strategy for yield improvement in rajmash (*Phaseolus vulgaris* L.)

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Rajmash (*Phaseolus vulgaris* L.) is one of the important leguminous crop and possess good nutritional value. Though, there exist variation in Indian genotypes the productivity is very low. In order to improve the yield through breeding techniques, there is urgent need to study the variability in this crop. The present studies, therefore, aimed to study variability, character association and path analysis in 16 genotypes of rajmash. Since seed yield is the sum of the contributions made by its individual components, this will help in deciding how much importance should be attached to an individual component during selections for higher seed yield.

Sixteen genotypes of rajmash were evaluated in randomised block design with three replications during *kharif*, 1998, 1999 and 2000 at National Agricultural Research Project (Plain Zone), Ganeshkhind, Pune. A spacing of 30 × 10 cm^2 was adopted in plots of 4 × 1.8 m^2. A recommended package of practices and plant protection measures were followed to raise a good crop. The data were recorded on five randomly selected competitive plants in each plot, for days to 50 per cent flowering, days to maturity, plant height, plant spread, number of primary branches/plant, number of pods/plant, number of seeds/pod, pod length, 100-seed-weight and seed yield. The variability parameters and path analysis were worked out on the basis of pooled data of three years, as per the method given by Burton [1] and Johnson *et al.* [2] and Dewey and Lu [3], respectively.

The mean performance (Table 1) revealed that the genotype ACPR-94040 produced the highest seed yield (2250 kg/ha) followed by ACPR-94039 (2108 kg/ha), ACPR-94036 (2031 kg/ha) and ACPR-94034 (1963 kg/ha). The high yield of genotypes ACPR-94040 and ACPR-94039 were attributed to high number of pods/plant and less days required for 50 per cent flowering. The genotypes ACPR-9, ACPR-94035, ACPR-94040 for days to 50 per cent flowering; Red Cloud, ACPR-9, ACPR-11 for days to maturity; ACPR-94038, ACPR-94037 and ACPR-94034 for plant height and plant spread; ACPR-11, ACPR-94035 and Vaghya for number of primary branches; ACPR-94040, ACPR-11 and ACPR-94039 for number pods per plant-ACPR-9, ACPR-94036, ACPR-5 for pod length and ACPR-94035, Red Cloud and ACPR-9 for test weight recorded high performance. This variability among these genotypes can used for exploiting these characters directly or through recombination breeding.

The studies on genotypic and phenotypic coefficient of variation indicated that the magnitude of GCV and PCV was of highest order in case of seed yield and was followed by number of pods per plant and plant height indicating presence of high amount of variation for these traits. Likewise, the plant spread, primary branches, seeds per pod, 100-seed-weight and pod length had GCV and PCV magnitudes of medium range. Earlier, Patil *et al.* [4] reported similar results. It was low for flowering and maturity. The magnitudinal differences in GCV and PCV were minimum in case of 100-seed-weight, days to maturity, seed yield, plant height and days to 50 per cent flowering, suggesting the little role of environment in expression of these characters. However, in case of primary branches/plant, plant spread, seeds/pod and pod length, high magnitudinal differences in GCV and PCV, suggesting the role of environment on expression of these characters. The heritability estimates were of high magnitude for seed yield, 100-seed-weighf, days to 50 per cent flowering, and days to maturity (more than 90%), where as for days to maturity, pods/plant, pods/plant, seeds/pod and pod length these estimates were below 54 to 79 per cent. According to Panse [5], such characters governed predominantly by additive gene action could be improved through individual plant selection. Association of high heritability with high genetic advance was also reported for plant height, number of pods/plant and 100-seed-weight [4, 6-7].

Table 1. Mean performance and estimates of variability parameters in rajmash

Strain	Days to 50% flowering	Days to maturity	Plant height (cm)	Plant spread (cm)	No. of primary branches	No. of pod/plant	No. of grains/pod	Pod length (cm)	100-seed weight	Seed yield (kg/ha)
ACPR-5	31.444	71.333	24.430	10.741	3.444	13.630	5.148	11.722	29.750	1361.11
APCR-9	28.111	71.444	30.259	11.407	3.704	10.704	5.333	12.389	43.650	1468.056
ACPR-11	32.000	71.444	31.741	12.741	4.000	16.407	4.852	11.611	37.700	1444.444
ACPR-94034	32.444	78.111	42.074	12.926	3.815	12.667	4.889	10.722	38.850	1797.222
ACPR-94035	31.556	78.222	39.296	11.778	3.852	13.259	4.778	11.407	44.250	1962.500
ACPR-94036	33.444	76.444	39.370	10.593	3.556	12.148	4.963	11.796	39.950	2030.556
ACPR-94037	33.000	74.889	42.111	10.778	3.259	9.926	4.926	10.778	39.950	1919.444
ACPR-94038	33.000	76.000	42.444	13.333	3.667	11.889	4.667	1.389	41.850	1844.444
ACPR-94039	28.444	74.556	31.777	10.704	3.222	14.889	4.407	9.667	39.200	2108.333
ACPR-94040	29.778	71.778	29.074	10.444	3.630	16.667	4.778	9.815	40.300	2250.000
Red Cloud	30.222	70.667	40.333	11.296	3.407	9.704	3.926	10.778	44.000	1468.056
PDR-5	32.333	72.556	33.778	9.926	3.148	10.185	4.481	10.056	37.250	1519.444
EC-49844	32.444	71.778	33.926	10.852	3.519	12.778	4.333	10.981	37.100	1404.167
Vaghya (c)	35.000	79.556	28.222	10.370	3.741	10.148	4.667	9.963	33.000	1112.500
HPR-35 (c)	30.556	70.000	28.889	10.630	3.037	9.852	4.185	10.722	40.550	1254.167
HUR-137 (c)	33.778	77.333	33.259	12.111	3.593	11.037	4.778	10.500	36.700	1008.333
Min	28.111	70.000	24.430	9.926	3.037	9.704	3.926	9.667	29.750	1008.333
Max	35.000	79.556	42.444	13.333	4.000	16.667	5.333	12.389	44.250	2250.000
Mean	31.722	74.132	34.436	11.289	3.537	12.243	4.694	10.894	39.022	1622.049
S.E. ±	0.374	0.767	2.296	0.827	0.288	0.955	0.235	0.446	0.741	68.056
C.D. at 5%	0.763	1.566	4.689	1.689	0.587	1.949	0.481	0.912	1.512	138.889
C.V. (%)	1.443	1.257	8.167	8.974	9.959	9.549	6.140	5.020	2.325	5.130
σ^2_g	3.529	9.489	30.446	0.686	0.031	4.708	0.101	0.517	14.390	0.058
σ^2_p	3.738	10.371	38.356	1.706	0.156	6.074	0.184	0.816	15.213	0.062
PCV (%)	6.095	4.344	17.985	11.570	11.150	20.131	9.143	8.291	9.995	21.221
GCV (%)	5.922	4.155	16.023	7.302	5.012	17.722	6.775	6.599	9.721	20.591
h^2 (broad seno)	0.944	0.915	0.794	0.398	0.202	0.775	0.549	0.634	0.946	0.942
G.A.	3.765	0.078	10.142	1.073	0.164	3.940	0.486	1.180	7.611	0.483
G.A. as per cent of mean	11.869	8.199	29.452	9.507	4.648	32.185	10.356	10.836	19.505	41.350

Table 2. Gentotypic and phenotypic correlations of different characters in rajmash

Characters		Days to maturity	Plant height	Plant spread	No. of primary branches	No. of pod/plant	No. of grains/pod	Pod length	100-seed-weight	Seed yield
Days to 50 % flowering	G	0.602**	0.279	0.191	0.334**	-0.294*	0.068	-0.073	-0.443**	-0.253
	P	0 588**	0.244	0.070	0.155	-0.253	0.066	-0.050	-0.420**	-0.229
Days to maturity	G		0.414**	0.332*	0.629**	-0.097	0.276	-0.167	-0.066	0.205
	P		0.374**	0.213	0.268	-0.128	0.217	-0.157	-0.064	0.190
Plant height	G			0.536**	0.184	-0.274	-0.143	0.146	0.611	0.413**
	P			0.401**	0.091	-0.206	-0.101	0.090	0.510**	0.391**
Plant spread	G				1.004**	0.188	0.343*	0.619**	0.334*	0.144
	P				0.431**	0.201	0.044	0.150	0.183	0.105
No. of primary branches	G					0.593**	0.838**	0.707**	0.101	0.224
	P					0.348*	0.026	0.186	0.019	0.064
No. of pod/plant	G						0.317*	-0.054	-0.120	0.553**
	P						0.134	0.001	-0.133	0.490**
No. of grains /pod	G							0.521	-0.250	0.296*
	P							0.538**	0.139	0.237
Pod length	G								0.196	0.024
	P								0.165	0.040
100-seed-weight	G									0.321*
	P									0.285*

*and **Significant at 5 and 1 per cent level, respectively.

The correlation coefficient between seed yield and plant height, number of pods/plant, number of seeds/pod and 100-seed-weight were positively significant indicating association between these characters. This is consonance with Shinde and Dumbre [8] and Patil *et al.* [4]. Likewise, among the other characters, days to 50 per cent flowering with maturity, primary branches /plant; days to maturity with plant height, spread, primary branches/plant; plant height with plant spread, 100-seed-weight; plant spread with primary branches,

number of seeds/pod, pod length and 100-seed-weight; number of primary branches with pods/plant, seeds/pod; pods/plant with seeds/pod and seeds/pod with pod length were positively and significantly correlated with each other suggesting the interdependency of these characters on each other.

Path coefficient analysis was used to partition the correlation coefficients into direct and indirect effects of different characters on seed yield. The perusal of path analysis (Table 3) revealed that 100-seed-weight had maximum positive direct effect (3.604) on seed yield followed by plant height (3.089), number of pods/plant (1.149), number of seeds/pod (0.458), days to maturity (0.440) and number of primary branches (0.168) indicating true and perfect relationship among these characters. Days to 50 per cent flowering had highest negative direct effect with negative correlation with yield suggesting its use in breeding programme for earliness in new rajmash types. It would be logical to expect that a genotype with more number of long pods; bearing big sized more seeds; and more number of branches will have a greater ability to produce more yield. Positive direct contribution of number of seeds/pod, number of pods/branch and number of branches/plant was reported by Shinde and Dumbre [8]. It may therefore, be argued that if other factors are held constant, an increase in these characters individually would be reflected in increased seed yield.

Backward regression technique indicated that the characters 100-seed-weight, number of branches/plant, number of pods/plant, number of seeds/pods, plant spread and plant height had joint contribution upto 89.2 per cent to the total variability of 92.4 per cent, suggesting that, plant breeders should give more emphasis on these characters in rajmash.

From the foregoing discussions it would be inferred that there exists good variation for all the ten characters studied. The genotypes ACPR-94034, ACPR-94035, ACPR-94036, ACPR-94039 and ACPR-94040 recorded high mean performance for more than five yield contributing characters. The characters 100-seed-weight, number of branches/plant, number of pods/plant, number of seeds/pods, plant spread and plant height were the major yield contributing characters in rajmash. The correlation and path coefficient studies indicated that the characters 100-seed-weight, plant height, number of pods/plant, number of seeds/pod, days to maturity, number of primary branches and days to 50 per cent flowering could directly contribute towards the seed yield. Therefore, due emphasis should be given to these characters in selection programme to develop high yielding types in rajmash.

Table 3. Direct (diagonal) and indirect (off digonal) effects of contributing characters on seed yield of rajmash

Character	Days to 50% flowering	Days to maturity	Plant height	Plant spread	No. of primary branches	No. of pod/plant	No. of grains/ pod	Pod length	100-seed eight	Correlation with seed yield
Days to 50 % flowering	-1.556	-0.098	-1.493	-0.011	-0.074	0.721	0.208	0.006	2.149	-0.252
Days to maturity	0.262	0.440	-0.806	-0.005	-0.057	0.437	-0.161	-0.207	0.321	0.205
Plant height	1.115	-0.225	3.089	0.027	0.121	-0.504	-0.189	0.110	-2.900	0.413**
Plant spread	-0.524	0.084	-1.729	-0.032	-0.101	0.123	0.237	-0.005	1.571	0.144
No. of primary branches	0.852	-0.246	1.864	0.025	0.168	-1.012	-0.200	0.152	-1.984	0.224
No. of pod/plant	-0.474	0.107	-0.444	-0.002	-0.058	1.149	-0.036	-0.107	0.677	0.553**
No. of grains/pod	-0.475	-0.138	-0.578	-0.012	-0.040	-0.127	0.458	0.144	1.114	0.296*
Pod length	0.022	0.267	-0.506	0.000	-0.046	0.558	-0.216	-0.297	0.172	0.024
100-seed-weight	-1.505	0.084	-2.721	-0.023	-0.121	0.721	0.341	-0.035	3.604	0.321*

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