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Stability Analysis for Seed Yield and Its Components in Rajmash (*Phaseolus vulgaris* L.) Genotypes to Different Environments

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ABSTRACT

In the present investigation analysis of variance for ten genotypes of Rajmash (Phaseolus vulgaris L.) evaluated in four diverse environmental conditions during kharif, 2015, revealed that the genotypic variations differences were significant for all the characters. G x E interactions were significant for days to 50 per cent flowering, plant spread, number of pods plant^{-1}`, number of seeds pod^{-1}, seed yield ha^{-1} , when tested against pooled deviation. The linear components of G x E interactions were significant for days to 50 per cent flowering, plant height, plant spread, pods plant^{-1}, seeds pod^{-1} , 100-seed weight, seed yield plant^{-1} and seed yield ha^{-1}, when tested against pooled deviation and pooled error. Based on the stability parameter of Eberhart and Russel model[4], the genotypes, GRB-701 (days to 50 per cent flowering , seeds pod^{-1} and 100 seed weight), Varun (primary branches per plant), Vaghya (harvest index) and GRB-902(plant height, plant spread, pods plant^{-1}, secondary branches plant^{-1} and seed yield plant^{-1} showed stability for normal environments.GRB-702 was considered as stable and average responsive to the all environments for yield and yield contributing characters.

Key words: *G x E interaction, linear components, pooled deviation, stability parameters, Phaseolus vulgaris (L.)*

INTRODUCTION

Rajmash or common bean is regarded as "Grain of hope" as it is an important component of subsistence agriculture. Globally, with 19 million tones produced from about 28 Mha, In India Rajmash is grown over an area of about 1.29 lakh ha with a production of about 2.5 million tonnes. Beans also offer an alternative for diversification of agricultural system, but poor yield renders them poor competitors of cereals, oilseeds and other legumes.

Although there are many stability parameters, Eberhart and Russel[4] model's parameter S^2di appeared to be very important. Since the variance of S^2di is a function of number of environments, hence several environments with minimum replications per environment are advocated to be necessary to obtain reliable estimates of S^2di. To identify the stable genotypes having adaptability over a wide range of agro-climatic conditions is of major significance in crop improvement.

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With the statistical techniques developed to estimate stability parameters. It is possible to detect genotypic differences for wide adaptability in crop improvement. In the present investigation, an attempt has been made to study the stability of ten genotypes over four environments in Rajmash bean.

MATERIALS AND METHODS

The present study was undertaken during *kharif*, 2015 at four diverse environments. Ten diverse genotypes of Rajmash bean including one check *i.e.*, Varun was used to study the stability analysis for seed yield and yield attributing components in four environments. The experiment was laid in a Randomized Block Design with three replications at each environment. The experimental plot consisted of four rows each of 4.00 m length. The materials were provided the cropping geometry of 30 cm between the rows and plant to plant spacing of 10 cm. The experiment was well prepared and standard recommended package of practices were followed to raise a good crop. The four different environments were created by undertaking sowing in different meteorological weeks.

RESULTS AND DISCUSSION

Analysis of variance for stability:

The phenotypic stability of ten genotypes studied in four different environmental conditions was worked out following the linear model proposed by Eberhart and Russel[4]. The estimated parameters were mean of the trait (X), linear regression (bi) and mean square deviation from regression (S^2di), where X provides a measure of the performance of a variety as compared to other entries, the bi and S^2di values are the measure of the G x E interaction. In general, if G x E interactions is non-significant or where this G x E interaction is either linear or predominantly linear as compared to its non-linear component, the prediction of stability of a genotype over environments becomes more reliable.

The analysis of variance (MSS) for 12 characters *viz*. days to 50 per cent flowering, days to maturity, plant height, plant spread, primary branches plant^{-1}, secondary branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, 100-seed weight, harvest index, seed yield plant^{-1} and seed yield ha^{-1} was done. The analysis revealed that genotypes exhibited highly significant differences for all the characters under study (Table 1).

Pooled analysis of variance over four different environment showed significant genotypic variance and E + (G x E) for all the characters *viz.*, days to 50 per cent flowering, days to maturity, plant height, plant spread, primary branches plant^{-1}, secondary branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, 100-seed weight, seed yield plant^{-1}, harvest index and yield ha^{-1} when tested against pooled deviation, pooled error and G x E interactions. Environmental variances were found significant for the characters *viz.*, plant height, secondary branches plant^{-1}, seeds pod^{-1} and harvest index against pooled error. Partitioning of G x E interaction showed that, G x E (linear) effect were significant for the characters *viz*., days to 50 per cent flowering, plant height, plant spread, pods plant^{-1}, seeds pod^{-1}, 100-seed weight, seed yield plant^{-1} and seed yield ha^{-1}, when tested against pooled deviation and pooled error. Environment (linear) effects were also significant for all the traits when tested against pooled deviation and pooled error. Park[11] and Panwar *et al*[10]., revealed significant differences due to genotypes, environments and genotype x environment interactions in Rajmash as well as linear components of G x E interactions (E and G x E) were highly significant proving their contribution in the expression of seed yield per plant. These results are in conformity with those of Chiriboga[2], Guv[6], Ramalho *et al*[14]., Ram and Dhar[13] and Harer *et al*[7]., in Rajmash.

Kavitha *et al*[8]., reported significant mean sum of square due to genotypes indicating presence of genetic variation among the genotypes for seed yield in cowpea. Patel *et al*[12]., in mungbean showed that G x E interactions was highly significant for seed yield.

Stability analysis:

In the present investigation the means for days to 50 per cent flowering varied between 31.48 days (Phule Suyash) and 36.41 days (GRB-804) with an average of 33.54 days over four environments (Table 2.) The genotypes, GRB-803, GRB-9810, Phule Suyash and Vaghya were early flowering across the four environments. The genotype GRB-701 had regression coefficient greater than unity (bi > 1) and was suitable for favourable environment. The genotype Vaghya, had more stability across the environment and identified as early maturity genotype with low mean days to 50 per cent value, significant regression coefficient nearer to unity and non-significant deviation from regression, indicating average stability over all the environments. The linear and non-linear components of G x E interaction were found to be significant. The genotypes, GRB-701, GRB-702, GRB-804 and GRB-902 had significant deviation from regression, indicates unpredictable genotypes with early maturity. Similar, results were reported for character days to 50 per cent flowering and days to maturity by Singh *et al*[15]., and Panwar *et al*[10]., in Rajmash.

Mean plant height ranged from 50.53 cm (Phule Suyash**)** and 55.68 cm **(**GRB-902) with the population mean of 53.06 cm. G x E interaction with environment (linear) and G x E (linear) components were significant revealing their role in expression of plant height (Table 2.). Similar results were also reported by Nigussie[9] in French bean at five locations of Eastern Amhara. An estimate of regression coefficient for plant spreads ranged from 0.61 to 1.50. The regression coefficient was less than unity (bi < 1) for genotype, GRB-702, exhibited higher mean regression coefficient significantly lower than unity and non-significant deviation from regression indicating its suitability for poor environment. The regression coefficient was more than unity (bi > 1) for genotypes GRB- 902 and Vaghya with high mean and minimum deviation from regression indicating below average stability and are suitable for favorable environments. G x E interaction with environment (linear) and G x E (linear) components was significant and showed their role in expression of plant spread. This is in agreement with the results of Begum *et al*[1]., in groundnut.

Primary branches per plant ranged between 2.56 (GRB-804**)** to 2.85 **(**GRB-902) with a mean of 2.71. The genotype GRB-803, GRB-902, GRB-9810 and Phule Suyash exhibited higher mean, non-significant regression coefficient, close to unity and non-significant deviation from regression, indicating its stability for all environments. Secondary branches per plant ranged between 4.56 **(**GRB-803**)** to 4.88 **(**GRB-702**)** with a mean of 4.74. Environmental (linear) was found highly significant for primary and secondary branches per plant. Similar results were reported by Chaudhary and Haque[3] in chickpea.

Pods per plant ranged from 11.20 (Phule Suyash) to 15.02 (GRB-902) with a mean of 13.11. The genotype Varun exhibited higher mean and non-significant regression coefficient close to unity and non-significant deviation from regression values indicating average stability (Table 2.). The genotype GRB-701 and GRB-702 exhibited higher mean and non-significant regression coefficient significantly lower than unity and non-significant deviation from regression indicating its stability for poor environment. The variances for linear and non-linear G x E interaction were found to be significant which confirmed the results of Guv *et al*[6]., Singh *et al*[15]., and Harer *et al*[7]., in Rajmash.

The number of seeds per pod ranged from3.98 **(**Phule Suyash**)** to 4.16 GRB-702**)** with a mean of 4.05 (table 2.). The genotype GRB-

902, GRB-9810, HPR-35 and Vaghya exhibited higher mean and non-significant regression coefficient close to unity and non-significant deviation from regression values indicating average stability. Both linear components (environment and G x E) were highly significant with their major contribution in expression of this trait. Ram and Dhar[13], found significant for (E and G x E) interactions in Rajmash.

100-seed weight ranged between 31.93 g (GRB-9810) to 34.80 g (GRB-702) with a mean of 33.35 g. An estimate of regression coefficient ranged from 0.14 to 2.72.The regression coefficient was more than unity (bi > 1) for genotypes GRB-701 and GRB-902 had high mean and minimum deviation from regression, indicating below average stability, suitable for favorable environments (Fig.9). The genotype HPR-35 and Varun had high mean, regression coefficient, close to unity and minimum deviation from regression, indicating their stability for all environments. G x E interaction and its linear component of environment were found to be highly significant indicating its role in expressing the character. Singh *et al*[15]., Nigussie[9] reported significant G x E interaction for 100-seed weight in French bean.

For the trait harvest index an estimate of regression coefficient ranged from 0.56 to 1.57. The regression coefficient was more than unity (bi > 1) for genotype Vaghya, which had high mean and minimum deviation from regression, indicating below average stability, suitable for favorable environments(Table 2.). The genotypes GRB-701, GRB-702, GRB-803, GRB-902, GRB-9810 and HPR-35 had high mean regression coefficient close to unity and minimum deviation from regression indicating their stability for all environments. Genotype x Environment interaction was observed to be absent for this trait, indicating that this character was not influenced by changing environments. Similar observations were reported by Nigussie[9] in Rajmash.

Seed yield per plant ranged between 10.46 g (Phule Suyash) to 19.60 g (GRB-902) with a population mean of 16.55 g. The regression coefficient values ranged from 0.61 to 1.22. (Table 2.) The genotype Varun had regression coefficient values less than unity with high mean and minimum deviation from regression indicating their above average stability suitable for stress environments (Fig.11).The regression coefficient was more than unity (bi > 1) for genotype GRB-902 had high mean and minimum deviation from regression indicating below average stability suitable for favorable environments. The genotype GRB-701, GRB-702 and Vaghya had high mean, regression coefficient closes to unity and minimum deviation from regression, indicating their stability for all environments. Both linear components of G x E interactions (environment and G x E) were highly significant proving their contribution in the expression of seed yield per plant. Yield per ha ranged between 1028.58kg (Phule Suyash) to 2040.91 kg (GRB-902) with a population mean of 1668.36kg. The regression coefficient values ranged from 0.65 to 1.34. The genotype Varun had regression coefficient values less than unity (bi < 0.85) and had high mean and minimum deviation from regression, indicating its above average stability and suitability for stress environments (Fig.12). The regression coefficient was more than unity for genotypes GRB-701, GRB-902 and GRB-9810 and had high mean and minimum deviation from regression indicating below average stability and suitability for favorable environments. The genotype GRB-702 had high mean, regression coefficient close to unity and minimum deviation from regression indicating its stability over environments. . These results are in conformity with those of Guv[6], Ram and Dhar[13] and Harer *et al*[7]., in Rajmash.

Table 1: ANOVA for stability as per Eberhart and Russell Model (1966) for seed yield and yield components in Rajmash

S. No.	Sources	G	E	G x E	E+ G x E	E (L)	G x E (L)	P.D. (Pooled deviation)	P.E. (Pooled error)
1	Days to 50% flowering (No.)	9.167 ++**##	0.145	0.452 * ##	1.649++ ** ##	37.257 ** ##	0.917 **##	0.198	0.117
2	Days to maturity (No.)	10.618 ++**##	0.037	0.115##	1.433 ++**##	39.877 **##	0.130##	0.097 ##	0.035
3	Plant height (cm)	10.763 ++**##	0.716 *	0.483	3.729 ++**##	98.833 **##	0.819*#	0.284	0.345
4	Plant spread (cm)	3.231++**##	0.031	0.130 *	1.180 ++**##	31.891 **##	0.261 **#	0.058	0.078
5	Primary branches per plant (No.)	0.025++**##	0.008	0.007	0.029 ++**##	0.674 **##	0.005	0.007	0.006
6	Secondary branches per plant (No.)	0.038++**##	0.024 +*#	0.008	0.031 ++**##	0.720 **##	0.008	0.008	0.006
7	Pods per plant (No.)	4.741++**##	0.178	0.382 *#	1.518 ++**##	35.240 **##	0.799 **##	0.155	0.148
8	Seeds per pod (No.)	0.014	0.024 **#	0.014 *	0.024 **##	0.341 **##	0.028 **##	0.006	0.008
9	100 seed weight (g)	4.331++**##	0.023	0.103##	0.140 *##	1.431 **##	0.172 *##	0.061 ##	0.017
10	Harvest index (%)	363.002 ++**##	1.306 *	0.613	3.840++ **#	98.638 **##	0.790	0.472	2.024
11	Seed yield per plant (g))	27.463 ++**##	0.588	0.528	7.130 ++**##	199.663 **##	0.885 * #	0.314	0.400
12	Yield(kg/ha)	320185.200 ++**##	2084.914	4343.761 *##	66482.960 ++**##	1877207.000 **##	8538.602 **##	2021.706 #	1102.235

+ , ++ = Significant at 5 and 1 % level of significance, respectively against the G x E interaction
*, ** = Significant at 5 and 1 % level of significance, respectively against the pooled deviation
#, ## = Significant at 5 and 1 % level of significance, respectively against the pooled error

Table 2: Stability parameters for twelve different characters in Rajmash (*Phaseolus vulgaris* L.) genotypes

S. No	Genotypes	Days to 50 % flowering (No.)			Days to maturity (No.)			Plant height (cm)			Plant spread (cm)			Primary branches per plant (No.)			Secondary branches per plant (No.)		
		Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di
1	GRB - 701	33.68	2.26*	0.073	74.28	1.19	0.110*	52.93	1.01	-0.380	13.65	0.67	0.061	2.61	1.42	-0.001	4.73	0.62	0.010
2	GRB - 702	35.00	1.27	-0.015	74.61	1.15	0.101*	54.86	0.90	-0.270	14.36	0.61	-0.011	2.71	0.97	-0.005	4.88	0.91	-0.005
3	GRB- 803	31.50	0.62*	-0.120	71.23	0.61*	-0.014	51.25	0.87	-0.301	12.75	1.08*	-0.073	2.75	0.85	-0.002	4.56	0.44	-0.004
4	GRB –804	36.41	0.74	0.980*	71.73	1.08	0.340**	52.71	0.74	-0.290	13.03	1.01	-0.021	2.56	1.07	0.030**	4.63	0.86	0.003
5	GRB- 902	33.75	0.96	0.233	74.33	0.84	0.090*	55.68	1.52	0.500	15.50	1.20	-0.070	2.85	0.85	-0.002	4.85	1.39	0.001
6	GRB- 9810	33.43	0.70*	-0.120	74.65	1.10	-0.032	52.88	1.00	-0.070	13.31	1.50	0.060	2.76	0.80	-0.003	4.70	0.77	-0.001
7	HPR - 35	34.01	1.11	-0.080	73.85	0.93	0.022	51.71	0.89	0.020	13.71	1.16	0.010	2.73	0.57	-0.004	4.76	1.31	-0.006
8	PhuleSuyash	31.48	0.54*	-0.083	71.15	0.89	0.010	50.53	0.60	-0.234	12.78	0.68*	-0.070	2.71	1.10	-0.001	4.73	1.14	0.003
9	Vaghya	32.33	0.79*	-0.120	74.00	1.12	0.010	53.51	1.04	0.050	14.06	1.19	0.040	2.66	0.92	-0.003	4.71	1.21	-0.006
10	Varun (check)	33.80	1.00	0.034	70.70	1.09	-0.012	54.55	1.45	-0.010	14.80	0.90	-0.071	2.71	1.45	0.001	4.81	1.34	-0.002
	Mean	33.54			73.05			53.06			13.79			2.71			4.74		

*, ** = Significant at 5 and 1% level of significance, respectively

Table 3:

Sr. No	Genotypes	Pods per plant (No.)			Seeds per pod (No.)			100-seed weight (g)			Harvest index (%)			Seed yield per plant (g)			Seed yield (kg/ha)		
		Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di	Xi	bi	S^2di
1	GRB - 701	13.26	0.76	-0.051	4.00	2.28	-0.001	33.45	1.92	0.010	50.43	0.79	-1.913	18.04	1.13	0.280	1845.16	1.15	1170
2	GRB - 702	14.10	0.77	-0.140	4.16	0.09	0.001	32.33	0.89	0.063*	51.07	1.02	0.120	19.38	1.07	-0.260	1951.50	0.94	-665
3	GRB- 803	12.45	0.77	-0.090	4.01	0.31	-0.006	34.80	1.78	0.081**	46.53	0.85	-1.091	16.11	0.69	-0.290	1553.33	0.77	-182
4	GRB –804	12.58	0.75	-0.024	4.00	0.59	-0.010	33.38	2.72	0.150**	42.00	0.56	-1.530	15.60	0.61	0.281	1545.00	0.65	1826
5	GRB- 902	15.02	1.78*	-0.080	4.11	0.68	-0.003	34.37	2.03	0.033	53.44	0.94	-1.910	19.60	1.22	-0.070	2040.91	1.22	1403
6	GRB- 9810	13.34	1.60	0.120	4.06	0.64	-0.004	31.93	0.14*	-0.015	48.48	0.89	-1.913	16.03	1.17	-0.320	1678.91	1.34*	-1045
7	HPR - 35	12.21	0.85	0.050	4.06	0.59	-0.010	34.56	0.48	0.016	36.00	0.92	-1.303	15.58	1.08	-0.310	1586.91	1.13	-651
8	PhuleSuyash	11.20	0.18	0.440*	3.98	2.96*	-0.010	32.10	0.29	0.010	21.85	1.57*	-1.951	10.46	1.15	0.133	1028.58	1.01	7438**
9	Vaghya	12.96	1.35	-0.110	4.10	1.17	0.005	32.78	-0.93	0.104**	48.39	1.31	-1.420	16.44	1.03	-0.265	1629.50	0.94	-513
10	Varun (check)	13.98	1.18	-0.080	4.03	0.70	-0.010	33.79	0.72	-0.013	50.06	1.13	-1.892	18.25	0.84	-0.240	1823.83	0.85	-570
	Mean	13.11			4.05			33.35			44.82			16.55			1668.36		

*, ** = Significant at 5 and 1% level of significance, respectively

CONCLUSION

The genotypes, GRB-701 (days to 50 per cent flowering and seeds pod^{-1}), GRB-902 and Varun (plant height and secondary branches plant^{-1}), GRB-902 and Vaghya (plant spread), Varun (primary branches plant^{-1}), GRB-902 and GRB-9810 (pods plant^{-1}), GRB-701 and GRB-902 (100-seed weight), Vaghya (harvest index), GRB-902 (seed yield plant^{-1}) and GRB-701, GRB-902 and GRB-9810 (seed yield ha^{-1}) had below average stability indicating their suitability for normal environments. Considering their mean performance and the average stability into consideration, it could be derived that GRB-702 was well adapted to all the environments. Genotype x Environment interactions were significant for days to 50 per cent flowering, plant spread, number of seeds per pod, seed yield per hectare.

REFERENCES

1. Begum, S., Samad, A., Khaleda, S. and Alam A.K., Genotype x Environment interaction for some quantitative traits in grountnut. Bangaladesh *J. Sci.Indust. res*., **33(1):** 13-16 (1998).
2. Chiriboga V.C.E.,. Adaptability and stability of eight varieties of French bean in five locations of the Ecuadoria high lands. Ph.D.thesis.TheUniversidad Central del Ecuador, Quito, Ecuador. (1978).
3. Choudhary, R.N. and Haque, M.F., Stability of yield and its components in Chickpea. Legume research. *Inter. J.*, **33(3):** (2010).
4. Eberhart, S.A. and Russell, W.A., Stability parameters for comparing varieties. *Crop Sci*., **6:** 36-40 (1966).
5. Finlay, K.W. and Wilkinson, G.N., Analysis of adaptation in a plant breeding programme. *Australian J. Agric. Res.*, **14:** 742-754 (1963).
6. Guv, J.W., Studies on stability of rust resistant bean lines in different locations. Bull. Toichung district. *Agril. Improv. Stn*., **19:** 3-10 (1988).
7. Harer, P.N., Bhor, T.J. and Lad, D.B., Stability for seed yield and numbers of pods in Rajmashvarieties. *J. Maharashtra Agric.Univ.*, **25:** 88-99 (2000).
8. Kavitha, R., Khatri, R. S. and Sargawan, R.S., Stability analysis for grain yield in cowpea. Adv. *Arid Legume Res.*, 379-382 (2003).
9. Nigussie, K., Genotype and Environment interaction of released common bean varieties in Eastern Amhara region. Ethiopia M. Sc. (Agri.) thesis submitted to Haramaya University, Ethiopia. (2011).
10. Panwar, K.S., Chaudhary, H.K. and Thakur, S.R., Stability in seed yield of French bean genotypes in high hill, dry temperature region of North Western Himalayas. *Indian J. Agri. Sci.*, **65(5):** 341-345 (1995).
11. Park, S.J., Cultivar by environment interactions, yield stability and grouping of test locations for field bean cultivar trial in Ontario. *Canadian J. of Plant Sci*., **67(3):** 653-659 (1987).
12. Patel, J.D., Naik, M.R., Chaudhari, S.B., Vaghela, K O. and Kodapully, V.C., Stability analysis for seed yield in green gram (*Vigna radiate* L. Wilczenk) *Agric.Sci. Digest.* **29(1):** 67-71 (2009).
13. Ram, H.H. and Dhar, S., Stability analysis for yield and its components under different fertility regimes in French bean (*Phaseolus vulgaris* L.). *Vegetable Sci.*, **26:** 6-11 (1999).
14. Ramalho, M.A.P., Abreu, A.F.B. and Righetto, G.V., Interaction of common bean cultivars with sowing date in differentlocation in Minas State. Pesquisa Agropecuaria Brasileira. **28(10):** 1183-1189 (1993).
15. Singh, D.N., Nandi, A. and Tripathy, P., Performance of French bean cultivars in North central plateau zone of Orisa. *Indian J. Agric. Sci*., **63(10):** 658-659 (1993).