Performance of Rajmash genotypes for yield and yield attributing traits in different environment during *Kharif* Season

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Abstract: The experiment comprised ten genotypes of Rajmash evaluated in Randomized Block Design with three replications over four environments in the field. The experimental trial was conducted during *Kharif,* 2015 season under four different sowing dates (environments) *viz*. E_1-20th June 2015, E_2-10th July, 2015, E_3-30th July, 2015 and E_4- 20th August, 2015.The present investigation was therefore, planned to identify adaptable genotype suitable for *Kharif* season .The results revealed that the genotype Varun and Phule Suyash recorded early maturity in each environments. The genotype GRB-902 was recorded maximum secondary branches per plant(4.85), maximum number of pods per plant (15.02), maximum number of seeds per pod (19.60), maximum harvest index (51.70%) , highest seed yield per plant (19.60 g). However, the genotype HRR-35 was recorded maximum 100- seed weight (34.56 g) in each environment. While, the genotype GRB-702 was noticed maximum secondary branches, maximum number of pods per plant, maximum number of seeds per pod, highest seed yield per plant. Based on mean performance of ten Rajmash genotype for yield and yield attributing traits genotype GRB-902 and GRB-702 was performed better in all environments than the other genotypes.

Keywords: Stability, Adaptability, Environment and Rajmash genotypes.
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1. Introduction

French bean is botanically known as '*Phaseolus vulgaris'* (2n=2X=22) and belong to family Leguminosae. Rajmash or common bean is regarded as "Grain of Hope". However, in recent past, French bean is placed under the family *Fabaceae*. It is native of Southern Mexico and Central America. Among food legumes the French bean is the third most important worldwide famous crop, superseded by soybean and peanut. In India, both bushy and trailing types Rajmash are found. Being a short duration crop French bean can be grown under different cropping patterns of hills and plains of India. In India, it is mainly grown in Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Bihar, Tamil Nadu and Jammu and Kasmir. In Maharashtra, it is mainly grown in Satara, Pune, Sangli and Kolhapur districts and Marathwada region. Rajmash producing areas are located in tropical and temperate regions with a temperature around 21^{0}C. The optimum temperature for better growth is 16-24^{0}C. It is highly susceptible to frost. French bean pods and mature dry seeds are used for human consumption. It is also used as fodder for animals. It helps to increase the nitrogen level in the soil with *Rhizobium* bacteria. As dry bean it is rich in nutrients like Carbohydrates, Protein, Vitamin A, Sodium, Calcium, Phosphorus, Iron,

Vitamin C, Thiamine and Riboflavin *etc*. Rajmash also possesses some medicinal properties which are useful in controlling diabetics and certain Cardiac problems and it is a good natural cure for bladder burn. There is need to organized strong and efficient breeding programme to develop high yielding and good quality varieties of French bean, which comes under pulse crops. At present development of strict ideotype as identified by the physiologist and adaptability to a wide range of environment is a major criterion for selection in French bean. (Evans, 1979). The ability of individual populations or species to change in form or function in such a way to survive better under given environmental conditions is termed as adaptability (Allard, 1960). Some genotypes do well only under certain set of environmental conditions such as poor or rich environments. The stability depends upon adaptability of the genotype stability in the yield and it's components is, therefore, one of the most desirable characters for the adaptability of all genotypes. The low yield of this crop in India is mainly attributed to the lack of stable high yielders and environmental variations. Genotype cannot, therefore, be selected based on yield alone, but a method that combines yield and stability across a geographical area would be benefit to farmers. The present investigation was therefore, planned to identify adaptable genotype suitable for *Kharif* season.

2. Materials and methods

The experiment comprised ten genotypes of Rajmash evaluated in Randomized Block Design with three replications over four environments in the field. Each genotype was planted in four rows of 30 X 10 cm spacing. The field experiment was conducted at normal fertile soil. The crop was grown during *Kharif* ,2015 season under four different sowing dates (environments) viz. E_1- 20th June, 2015, E_2- 10th July, 2015, E_3- 30th July, 2015 and E_4- 20th August, 2015. The land was prepared by ploughing followed by two cross harrowing. The basal dose 60 Kg N, 80 Kg P_2O_5 per hectare was applied at all four sowings. The observations were recorded on pods per plant, seeds per pod, 100- seed weight (g), secondary branches per plant, harvest index (%), seed yield per plant(g) and seed yield (kg). The data was collected on randomly selected five plants per replication in each plot for each character. Mean sum of squares for individual environments and testing the genotypes differences were calculated as suggested by Panse and Sukhatme (1985).

3. Results and Discussion

The mean sum of squares due to treatments under each environment for all characters in E_1, E_2, E_3 and E_4 are presented in (Table 1). The differences due to treatments were highly significant for all characters except secondary branches per plant (E_1,E_2 and E_3) and seeds per pod(E_1, E_2 and E_3) and 100-seed weight (E_4). Park (1987) and Panwar *et. al*. (1995) revealed significant differences due to genotypes, environment and genotype x environment interaction in Rajmash.

The mean values of the genotypes for different characters studied under four different sowing dates are presented in (Table 2). The results revealed that the first environment (E_1) pods per plant ranged from 10.93 (Phule Suyash) to 17.26 (GRB-902) with population mean 14.37. The genotype Phule Suyash (10.93) recorded least pods per plant while GRB-902 (17.26) showed highest pods per plant followed by GRB-9810 (15.73) and Varun (15.26). In second environment (E_2) pods per plant ranged from 11.80 (Phule Suyash) to 15.76 (GRB-902) with a population mean 13.59 days. The genotype Phule Suyash (11.80) showed least pods per plant, while GRB-902 (15.76) showed highest pods per plant followed by Varun (14.86) and GRB -702 (14.53). In third environment (E_3), ranged from 11.46 (HPR-35) to 14.33 (GRB-902) with a population mean 12.55. The genotype, HPR-35 (11.46), showed least pods per plant, while GRB-902(14.33)

showed highest pods per plant followed by GRB-702(13.53) and Varun (13.26). In fourth environment (E_4), ranged from 10.40 (Phule Suyash) to 13.26 days (GRB-702) with a population mean 11.93. The genotype, Phule Suyash (10.40) showed least pods per plant , while GRB-702(13.26) showed highest pods per plant followed by GRB-902(12.73) and Varun (12.53). Mean performance over four environments ranged from 11.20 (Phule Suyash) to 15.02 (GRB-902) days with population mean 13.13. Among the genotypes GRB-902 and GRB-702 consistently recorded maximum pods per plant than rest of the genotypes in each of the environments. Similar results were reported by Guv *et. al.* (1988), Singh *et al* (1993) Harer *et al* (2000), Nigussie (2011) for number of pods per plant.

On the basis of results of first environment (E_1) seeds per pod ranged from 4.06 (GRB-803 and GRB-804) to 4.26 (GRB-702 and Phule Suyash) with a population mean 4.16. The genotypes GRB-803 and GRB-804 (4.06) showed lowest seeds per pod, while GRB-702 and Phule Suyash (4.26) showed highest seeds per pod. In Second environment (E_2) varied from 4.00 (GRB-9810 and Varun) to 4.20 (GRB-701 and Vaghya) with a population mean 4.09. The genotype GRB-9810 and Varun (4.00) showed lowest seeds per pod followed by HPR-35 and Phule Suyash (4.13). The performance of third environment (E_3), ranged from 3.93 (GRB-701, GRB-803 and GRB-804) to 4.20 (GRB-902 and Vaghya) with a population mean 4.04. The genotypes GRB-701, GRB-803 and GRB-804 (3.93) showed lowest seeds per pod, while GRB-902 and Vaghya (4.20) showed highest seeds per pod followed by GRB-702 (4.13). In fourth environment (E_4) ranged from 3.53 (Phule Suyash) to 4.20 (GRB-702) with population mean 3.91. The genotype Phule Suyash (3.53) showed lowest pods per plant while GRB-702 (4.20) showed highest seeds per pod followed by GRB-803, GRB-902, GRB-9810 and HPR-35 (4.00).Mean performance over four environments ranged from 3.98 (Phule Suyash) to 4.16 (GRB-702) with population mean 4.05. Among the genotypes GRB-702 and GRB-902 consistently recorded maximum seeds per pod in each of the environments. Islam and Newaz (2001) and Nigussie (2011) also confirmed the earlier findings.

In the first environment (E_1) 100- seed weight ranged from 31.93 g (GRB-9810) to 35.00 g (GRB-803 and GRB-902) with a population mean 33.56 g. The genotype GRB-9810 (31.93 g) showed lowest while GRB-803 and GRB-902 (35.00 g) showed highest 100-seed weight followed by HPR-35 (34.60 g). In second environment (E_2), for 100-seed weight ranged from 32.00 g (GRB-9810) to 35.20 g (GRB-803) with a population mean 33.51 g. The genotype GRB-9810 (32.00) showed lowest, while GRB-803 (35.20) showed highest 100- seed weight followed by HPR-35 (34.66 g). In third environment (E_3), ranged from 31.86 g (GRB-9810) to 34.86 g (GRB-803) with a population mean 33.21 g. The genotype GRB-9810 (31.86 g) showed lowest, while GRB-803 (34.86 g) showed highest 100-seed weight followed by HPR-35 (34.70 g). In fourth environment (E_4), ranged from 31.93 g (GRB-9810) to 34.30 g (HPR-35) with a population mean 33.12 g. The genotypes GRB-9810(31.93 g) showed lowest, while HPR-35 (34.30 g) showed highest 100- seed weight followed by GRB-803 (34.13 g). Mean performance over four environments ranged from 31.93 g (GRB-9810) to 34.80 g (GRB-803) with population mean 33.35 g. Among the genotypes GRB-9810 consistently recorded maximum 100- seed weight in each of the environments. Senapati and Roy (1998) reported similar results in groundnut. Bouslama *et al* (1990) in chickpea and Varman and Manoharan (1993) in groundnut.

In the first environment (E_1) secondary branches per plant ranged from 4.66 (GRB-803) to 5.06 (GRB-702 and Varun) with a population mean 4.89, Genotype GRB-803 (4.66) showed lowest while GRB-702 and Varun (5.06)

showed highest secondary branches per plant followed by GRB- 902(5.03). In second environment (E2) ranged from 4.53 (GRB-803) to 5.06 (GRB-902) with population mean 4.82. The genotype GRB-803 (4.53) showed lowest, while GRB-902 (5.06) showed highest secondary branches per plant followed by GRB-701, GRB-702 and Varun(4.93). In third environment (E3), population mean for secondary branches per plant was 4.70, which ranged from 4.60 (GRB-803) to 4.80 (GRB-702 and Phule Suyash). The genotype GRB-803 (4.60) showed lowest, while GRB-702 and Phule Suyash(4.80) showed highest secondary branches per plant. In fourth environment (E4), ranged from 4.40 (GRB-804) to 4.73 (GRB-702) with a population mean 4.54. The genotype GRB-804(4.40) showed lowest, while GRB-702 (4.73) showed highest secondary branches per plant followed by GRB-701, GRB-902 and Varun (4.60). Mean performance over four environments ranged from 4.56 (GRB-803) to 4.88 cm(GRB-702) with population mean 4.74. Among the genotypes GRB-902 and GRB-702 consistently recorded maximum secondary branches per plant in each environment.

In first environment (E_1) harvest index ranged from 25.19 per cent (Phule Suyash) to 55.61 per cent (GRB-902) with population mean 47.02 per cent. In second environment (E_2) harvest index ranged from 23.04 per cent (Phule Suyash) to 53.95 per cent (GRB-902) with population mean 45.50 per cent. In third environment (E_3) harvest index ranged from 20.46 per cent (Phule Suyash) to 52.50 per cent (GRB-902) with population mean 44.12 per cent. In fourth environment (E_4) ranged from 18.70 per cnet (Phule Suyash) to 51.70 per cent (GRB-902) with a population mean 42.73 per cent. Mean performance over four environments ranged from 21.85 per cent (Phule Suyash) to 53.44 per cent (GRB-902) with population mean 44.82 per cent. Among genotypes GRB-902 consistently recorded maximum harvest index in each of the environments, while Phule Suyash consistently recorded minimum harvest index in each of the environments. Similar, results were reported by Nigussie (2011) in Rajmash and Varman and Manoharan (1993) in groundnut.

In first environment (E_1) seed yield per plant ranged from 14.46 g (Phule Suyash) to 23.53g (GRB-902) with a population mean 19.56g. In second environment (E_2) seed yield per plant ranged from 10.80 g (Phule Suyash) to 20.80g (GRB-902) with a population mean 17.60g. The performance of third environment (E_3) seed yield per plant ranged from 9.26 g (Phule Suyash) to 17.56g (GRB-902) with a population mean 15.40g. In fourth environment (E_4) ranged from 7.33 g (Phule Suyash) to 16.53g (GRB-902) with a population mean 13.64g. Mean performance over four environments ranged from 10.46g (Phule Suyash) to 19.60g (GRB-902) with a population mean 16.55g. Among the genotypes GRB-902 and GRB-702 consistently recorded maximum seed yield per plant in each of the environments.

In first environment (E_1) seed yield per hectare ranged from 1380.66 kg/ha (Phule Suyash) to 2345.00 kg/ha (GRB-902) with a population mean 1940.60 kg/ha. In second environment (E_2) seed yield per hectare ranged from 1044.66 kg/ha (Phule Suyash) to 2238.66 kg/ha(GRB-902) with a population mean 1784.83 kg/ha. The performance of third environment (E_3)seed yield per hectare ranged from 937.33 kg/ha (Phule Suyash) to 1903.33 kg/ha (GRB-902) with a population mean 1584.70 kg/ha. In fourth environment (E_4) seed yield per hectare ranged from 571.66 kg/ha (Phule Suyash) to 1676.66 kg/ha (GRB-902) with a population mean 1363.33 kg/ha. Mean performance over four environments ranged from 1028.58 kg/ha (Phule Suyash) to 2040.91 kg/ha (GRB-902) and GRB-702 consistently recorded maximum seed yield per hectare in each of the environments. Piana *et al.* (1994), Harer *et. al*. (2000), Sarma *et al*. (1993), Zimmermann (1994) and Mussana *et al* (2015) reported the similar results for seed yield in Rajmash.

4. Conclusion

Different genotypes showed differential reaction to the various environments studied. The differences due to treatments were highly significant for all characters except secondary branches per plant (E_1,E_2 and E_3) and seeds per pod(E_1, E_2 and E_3) and 100-seed weight (E_4)
The estimation of environmental indices revealed that environment E_1 (20^{th} June) was favorable for the characters secondary branches per plant, pods per plant, seeds per pod 100-seed weight, harvest index and seed yield per plant . Environment E_2 was favorable for harvest index and seed yield per plant and environment E_3 and E_4 was found totally unfavorable for all the traits. On the basis of results genotype GRB-902 was recorded maximum secondary branches per plant(4.85), maximum number of pods per plant (15.02), maximum number of seeds per pod (19.60), maximum harvest index (51.70%) , highest seed yield per plant (19.60 g). However, the genotype HRR-35 was recorded maximum 100- seed weight (34.56 g) in each environment. While, the genotype GRB-702 was noticed maximum secondary branches and maximum number of pods per plant.

Table 1 Analysis of variance for six yield and yield contributing characters in four different environments.

Sr.No.	Characters	Mean Sum of Squares due to											
		E_1			E_2			E_3			E_4		
		Rep	Treat	Error	Rep	Treat	Error	Rep	Treat	Error	Rep	Treat	Error
1	Pods per plant (No.)	0.58	8.42**	0.31	0.08	4.69**	0.39	0.24	2.58*	0.49	1.23**	1.96	0.57
2	Seeds per pod (No.)	0.20	0.01	0.03	0.03	0.01	0.01	0.01	0.03	0.02	0.02	0.10	0.03
3	100-seed weight (g)	0.02	4.69**	0.04	0.11	3.35*	0.07	0.02	3.66**	0.04	0.10	2.20	0.03
4	Secondary branches per plant (No.)	0.20	0.06	0.03	0.07	0.08	0.01	0.01	0.01	0.01	0.01	0.02	0.01
5	Harvest index (%)	8.54**	256.50**	9.29	0.62	271.61**	3.94	4.73*	271.16**	6.91	2.12	295.24**	4.13
6	Seed yield per plant (g)	3.43	21.71**	1.13	0.83	25.13**	2.18	2.47	19.67**	0.82	0.32	20.60**	0.64

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

Table 2. Mean performance of Rajmash genotypes of yield and yield contributing characters over four environments.

Sr. No.	Genotypes	Pods per plant (No.)					Seeds per pod (No.)					100 – Seed weight (g)				
		E_1	E_2	E_3	E_4	Mean	E_1	E_2	E_3	E_4	Mean	E_1	E_2	E_3	E_4	Mean
1	GRB-701	14.00	14.00	12.73	12.33	13.26	4.20	4.20	3.93	3.66	4.00	34.00	33.60	33.23	33.00	33.45
2	GRB-702	15.06	14.53	13.53	13.26	14.10	4.26	4.06	4.13	4.20	4.16	32.33	32.73	32.00	32.26	32.33
3	GRB-803	13.46	12.86	11.73	11.73	12.45	4.06	4.06	3.93	4.00	4.01	35.00	35.20	34.86	34.13	34.80
4	GRB-804	13.80	12.53	12.20	11.80	12.58	4.06	4.06	3.93	3.93	4.00	34.33	33.40	33.00	32.80	33.38
5	GRB-902	17.26	15.76	14.33	12.73	15.02	4.20	4.06	4.20	4.00	4.11	35.00	34.50	34.00	34.00	34.37
6	GRB-9810	15.73	13.50	12.60	11.53	13.34	4.20	4.00	4.06	4.00	4.06	31.93	32.00	31.86	31.93	31.93
7	HRR - 35	13.60	12.26	11.46	11.53	12.21	4.13	4.13	4.00	4.00	4.06	34.60	34.66	34.70	34.30	34.56
8	Phule Suyash	10.93	11.80	11.66	10.40	11.20	4.26	4.13	4.00	3.53	3.98	32.13	32.23	31.90	32.16	32.10
9	Vaghya	14.60	13.80	12.00	11.46	12.96	4.13	4.20	4.20	3.86	4.10	32.26	33.00	32.86	33.00	32.78
10	Varun (ch)	15.26	14.86	13.26	12.53	13.98	4.13	4.00	4.06	3.93	4.03	34.00	33.83	33.73	33.60	33.79
	Mean	**14.37**	**13.59**	**12.55**	**11.93**	**13.13**	**4.16**	**4.09**	**4.04**	**3.91**	**4.05**	**33.56**	**33.51**	**33.21**	**33.12**	**33.35**
	SE(m)±	0.45	0.51	0.57	0.61	0.22	0.14	0.11	0.11	0.14	0.04	0.18	0.22	0.17	0.15	0.14
	CD at 5%	0.96	1.07	1.21	1.29		NS	NS	0.24	0.30		0.37	0.46	0.37	0.32	

Contd…

SN	Genotypes	Secondary branches per plant (No.)					Harvest index (%)					Seed yield per plant (g)				
		E_1	E_2	E_3	E_4	Mean	E_1	E_2	E_1	E_1	E_1	E_1	E_1	E_3	E_4	Mean
1	GRB-701	4.73	4.93	4.66	4.60	4.73	52.26	50.84	20.80	20.80	20.80	20.80	20.80	16.93	14.33	18.04
2	GRB-702	5.06	4.93	4.80	4.73	4.88	52.98	52.87	22.90	22.90	22.90	22.90	22.90	18.23	16.36	19.38
3	GRB-803	4.66	4.53	4.60	4.46	4.56	48.26	46.26	17.96	17.96	17.96	17.96	17.96	15.60	13.83	16.11
4	GRB-804	4.73	4.66	4.73	4.40	4.63	43.60	42.02	16.90	16.90	16.90	16.90	16.90	15.53	13.20	15.60
5	GRB-902	5.03	5.06	4.73	4.60	4.85	55.61	53.95	2353	2353	2353	2353	2353	17.56	16.53	19.60
6	GRB-9810	4.86	4.66	4.73	4.53	4.70	50.41	49.21	19.80	19.80	19.80	19.80	19.80	14.50	12.83	16.03
7	HRR - 35	5.00	4.86	4.66	4.53	4.76	37.94	36.69	19.10	19.10	19.10	19.10	19.10	12.40	12.63	15.58
8	Phule Suyash	4.93	4.73	4.80	4.46	4.73	25.19	23.04	14.46	14.46	14.46	14.46	14.46	9.26	7.33	10.46
9	Vaghya	4.86	4.86	4.66	4.46	4.71	51.33	48.85	19.73	19.73	19.73	19.73	19.73	14.86	13.76	16.44
10	Varun (ch)	5.06	4.93	4.66	4.60	4.81	52.66	50.63	20.43	20.43	20.43	20.43	20.43	17.33	15.60	18.25
	Mean	**4.89**	**4.82**	**4.70**	**4.54**	**4.74**	**47.02**	**45.40**	**19.56**	**19.56**	**19.56**	**19.56**	**19.56**	**15.40**	**13.64**	**16.55**
	SE±	0.41	0.11	0.09	0.07	0.05	2.48	1.62	0.87	0.87	0.87	0.87	0.87	0.74	0.65	0.32
	CD at 5%	0.30	0.24	NS	0.15		5.22	3.40	1.83	1.83	1.83	1.83	1.83	1.55	1.38	

References

[1].Bouslama M.A., Garoi G. and Harrabi M. (1990). Stability analysis of some chickpea genotypes in Tunsia. Agril. Mediterranea, 120 (1):74-78.

[2].Guv J.W. (1988). Studies on stability of rust resistant bean lines in different locations. Bull.

[3].Toichung district. Agril. Improv. Stn., 19: 3-10.

[4].Harer P.N., Bhor T.J. and Lad D.B. (2000). Stability for seed yield and numbers of pods in Rajmash varieties. J. Maharashtra Agric.Univ., 25: 88-99 .

[5].Islam A.K. and Newaz M.A. (2001). Genotype environment interaction for seed yield and yield contributing characters in dry bean (P. vulgaris L.) Bangladesh J. Plant Breed. Genet. 14: 43- 48.

[6].Mussana S., Ugen-Adrogu, M. and Mawejje D. (2015). Yield stability of some bush snap bean genotypes in Uganda. Director Research, Journal of Agricultural and Food Science (DRJAFS). Vol.3 (4), 74-82.

[7].Nigussie K. (2011). Genotype and Environment interaction of released common bean varieties in Eastern Amhara region. Ethiopia M. Sc. (Agri.) Thesis submitted to Haryana Agril. University, Ethiopia.

[8].Panwar K.S., Chaudhary H.K. and Thakur S.R. (1995). 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.

[9].Panse V. G. and Sukhatme P. G. (1985). Statistical methods for Agricultural workers ICAR, New Delhi, India.

[10]. Park S.J. (1987). 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.

[11]. Piana C.F.B, Silva L.G.C. and Barreto J.N. (1994). An application of segmented linear regression to the study of genotype x environment interaction. Biometrics, 41(4):1093.

[12]. Sarma R. N., Roy A., Borthakur A. and Sarma S.K. (1993). Genotype stability for grain yield in Rajmash (Phaseolus valgaris L.) Annals of Agric. Res. 14(3):339-341.

[13]. Senapati B. K. and Roy K. (1998) Correlation coefficient among stability parameters of yield and yield contributing traits in groundnuts. Legume Res. 21 (1):37-40.

[14]. Singh D.N., Nandi, A. and Tripathy P. (1993). Performance of French bean cultivars in North central plateau zone of Orisa. Indian J. Agric. Sci., 63(10): 658-659.

[15]. Varman P.V. and Monoharan V. (1993). Stability analysis in bunch groundnut, Madras Agric. J 83(12):665-667.

[16]. Zimmermann M.J.O. (1994). Adaptability and yield stability in common bean genotype, Pesquisa Agropecuaria Brasileria, 29(1):25-32.