Assessment of Rajmash (*Phaseolus vulgaris* L) genotypes for important quantitative traits under different environmental conditions during kharif season

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ABSTRACT

Ten genotypes of Rajmash bean were studied to assess their performance in randomized block design with three replications over four environments in field during kharif 2015 at College of Agriculture, Pune, Maharashtra. The crop was grown under four different sowing dates (environments) viz E_1: 20 June 2015, E_2: 10 July 2015, E_3: 30 July 2015 and E_4: 20 August 2015. It was done to identify adaptable genotypes suitable for kharif season. The results revealed that the genotype Phule Suyash and GRB-803 consistently recorded early flowering. The genotype Varun and Phule Suyash recorded early maturity in each environment. The genotype GRB-902 recorded maximum plant height (55.68 cm) and plant spread (15.50 cm), maximum number of primary branches (2.85) and highest seed yield per plant (19.60 g). The genotype GRB-702 recorded 19.38 g seed yield per plant. Among the ten genotypes evaluated in different environmental conditions genotypes, GRB-902 and GRB-702 were found promising and performed better in all environments than the other genotypes.

Keywords: Rajmash; genotypes; traits; adaptability; environment

INTRODUCTION

Rajmash is also known as haricot bean, salad bean, runner bean and common bean. In India both bushy and trailing type Rajmash is found. 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 Among food legumes the French bean is the third most important worldwide famous crop superseded by soybean and peanut.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, it is mainly grown in Maharashtra, 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. 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 organize 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 physiologists and adaptability to a wide range of environment is a major criterion for selection in French bean (Evans 1976). 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 sets of environmental conditions such as poor or rich environments. The stability depends upon adaptability of the genotype. Stability in the yield and its 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 beneficial to the farmers.

Sowing time is a major non-monetary input affecting growth and grain yield (Sadhukhan et al 2008, Patange et al 2011, Kalita et al 2016) and is considered an important factor to explore the maximum yield. Genotypes may also differ in the productivity (Patange et al 2011, Kalita et al 2016). The proper growth of a genotype is determined by its growing environment. Different genotypes may perform differently under diverse environments. Therefore performance of genotypes under different sowing windows is needed

to be tested. Present investigations were therefore planned to identify adaptable genotypes suitable for kharif season.

MATERIAL and METHODS

The experiment comprised ten varieties of Rajmash (*Phaseolus vulgaris* L) evaluated in randomized block design with three replications over four environments in the field. Each genotype was planted in four rows of 30 cm x 10 cm spacing. The field experiment was conducted on normal fertile soil. The crop was grown during kharif 2015 season under four different sowing dates (environments) viz E_1: 20 June 2015, E_2: 10 July 2015, E_3: 30 July 2015 and E_4: 20 August 2015 at the instructional farm of the College of Agriculture, Pune, Maharashtra. The land was prepared by ploughing followed by two cross harrowings. The basal dose of 60 kg N and 80 kg P_2O_5 per hectare was applied in all four sowings. The observations were recorded on number of days taken to 50 per cent flowering, number of days to maturity, plant height, plant spread, number of primary branches per plant and seed yield per plant. The data were collected on five randomly selected plants per replication in each plot. Mean sum of squares for individual environments and testing the genotype differences were calculated as suggested by Panse and Sukhatme (1985).

RESULTS and DISCUSSION

The mean sum of squares due to treatments under each environment for all characters studied in E1, E_2, E_3 and E_4 are presented in Table 1. The differences due to treatments were highly significant for all characters except for number of primary branches per plant (E4).

The data on the effect of different environments on various yield attributing and yield characters are given in Table 2.

Genotypes GRB-803 (32.00), Phule Suyash (32.00) and and Vaghya (33.00) took minimum number of days to 50 per cent flowering under E_1 (20 June 2015); GRB-702 (25.66 days) under E_2 (10 July 2015); GRB-803 (31.46) and Phule Suyash (31.20) under E_3 (30 July 2015) and GRB-701 (30.33), GRB-803 (30.53) and Phule Suyash (30.73) under E_4 (20 August 2015). The number of days to 50 per cent flowering decreased with the delay in sowing. Singh et al (2005) reported that heat units consumed by chickpea for 50 per cent flowering were higher in first sowing that is 15 November 2005. The performance of GRB-803 and Phule Suyash was better among all the genotypes for the character number of days to 50 per cent flowering.

In case of number of days to maturity, GRB-803, Phule Suyash and Varun (check) took minimum days (72.00 each) under E_1 (20 June 2015); GRB-803 (71.60 days) and Varun (check) (71.40 days) under E_2 (10 July 2015); GRB-804 (70.80), Phule Suyash (70.80) and Varun (check) (70.26) under E_3 (30 July 2015) and Varun (check) (69.13) under E_4 (20 August 2015). The number of days to maturity decreased with the delay in sowing. The performance of GRB-803 and Phule Suyash was at par with Varun (check) for days to maturity.

In case of plant height, GRB-902 (58.13 cm) and Varun (check) (57.20 cm) under E_1 (20 June 2015); GRB-902 (57.86 cm) and Varun (check) (56.33 cm) under E_2 (10 July 2015); GRB-702 (54.53 cm), GRB-902 (54.60 cm) and Varun (check) (53.20 cm) under E_3 (30 July 2015) and GRB-702 (52.86 cm), GRB-902 (52.13 cm) and Vaghya (51.80 cm) under E_4 (20 August 2015) resulted in maximum plant height as compared to other genotypes. The performance of GRB-902 and GRB-702 was found better for the character plant height. Singh et al (2020) reported that the plant height of Rajmash was significantly affected by different sowing dates at Ludhiana, Ballowal Saunkhri and Gurdaspur in Punjab.

For plant spread, GRB-902 proved significantly superior over all other genotypes with 16.86 and 16.06 cm spread under E_1 (20 June 2015) and E_2 (10 July 2015) respectively whereas in case of E_3 (30 July 2015), GRB-902 resulted in maximum plant spread (15.06 cm) which was at par with Varun (check) (14.40 cm) and in case of E_4 (20 August 2015), GRB-902 again resulted in maximum plant spread (14.00 cm) which was at par with GRB-701 (13.06 cm), GRB-702 (13.60 cm) and Varun (check) (13.73 cm). The plant spread decreased with the delay in sowing.

Number of primary branches under E_2 (10 July 2015) were lower in GRB-804 (2.40) followed by Vaghya (2.66) whereas all other genotypes were having more number of primary branches and were at par with one another. Under E_4 (20 August 2015), GRB-902 proved better with 2.73 number of primary

Table 1. Analysis of variance for different characters in Rajmash in four different environments

Character	Mean sum of squares due to											
	E_1 (20 June 2015)			E_2 (10 July 2015)			E_3 (30 July 2015)			E_4 (20 August 2015)		
	Replication	Treatment	Error	Replication	Treatment	Error	Replication	Treatment	Error	Replication	Treatment	Error
Number of days to 50% flowering	1.45	7.38**	1.18	0.02	8.71**	0.01	0.14	9.19**	0.08	0.11	6.27**	0.11
Number of days to maturity	0.10	7.82**	0.16	0.02	8.67**	0.01	0.28	10.24**	0.10	0.02	6.12**	0.12
Plant height (cm)	0.80	11.31**	1.17	5.15*	14.30**	1.52	1.96	7.11**	0.79	0.66	3.90**	0.63
Plant spread (cm)	0.24	2.75*	0.22	0.07	2.69*	0.08	0.02	2.59*	0.19	0.02	2.80*	0.42
Number of primary branches/plant	0.01	0.01	0.03	0.03	0.06	0.01	0.02	0.02	0.01	0.02	0.04	0.01
Seed yield/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% LoS, **Significant at 5% LoS

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

Genotype	Number of days to 50% flowering					Number of days to maturity					Plant height (cm)				
	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
GRB-701	35.46	35.26	34.00	30.33	33.68	75.40	75.06	71.40	72.26	74.28	55.06	53.66	52.13	50.86	52.93
GRB-702	36.33	25.66	35.00	33.00	35.00	75.73	75.33	74.73	72.66	74.61	56.86	55.20	54.53	52.86	54.86
GRB-803	32.00	32.00	31.46	30.53	31.50	72.00	71.60	70.93	70.40	71.23	53.00	52.13	50.33	49.53	51.25
GRB-804	37.00	36.53	36.20	34.93	36.16	73.33	72.33	70.80	70.46	71.23	54.06	53.40	52.46	50.96	52.71
GRB-902	35.00	34.46	33.00	32.53	33.75	75.00	75.00	74.46	72.86	74.33	58.13	57.86	54.60	52.13	55.68
GRB-9810	34.00	34.00	33.40	32.33	33.43	75.80	75.46	74.33	73.00	74.65	55.00	53.26	52.80	50.46	52.88
HRR-35	35.00	35.00	33.66	32.40	34.01	75.00	74.46	73.33	72.60	73.85	54.06	51.78	50.80	50.20	51.71
Phule Suyash	32.00	32.00	31.20	30.73	31.48	72.00	72.00	70.73	69.86	71.15	52.00	50.53	50.33	49.26	50.53
Vaghya	33.00	33.00	32.20	31.13	32.33	75.00	75.00	73.73	72.26	74.00	56.13	53.86	52.26	51.80	53.51
Varun (check)	35.00	34.46	33.33	32.40	33.80	72.00	71.40	70.26	69.13	70.70	57.20	56.33	53.20	51.46	54.55
Mean	34.48	34.34	33.44	32.00	33.54	74.12	73.76	72.77	71.55	73.05	55.15	53.80	52.34	50.95	53.06
SE±	0.88	0.10	0.23	0.27	0.25	0.33	0.10	0.26	0.29	0.17	0.88	1.00	0.73	0.65	0.74
$CD_{0.05}$	1.86	0.22	0.50	0.57		0.70	0.22	0.55	0.61		1.86	2.11	1.53	1.36	

Table 2. Contd.....

Genotype	Plant spread (cm)					Number of primary branches/plant					Seed yield/plant (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
GRB-701	14.40	14.20	12.93	13.06	13.65	2.86	2.73	2.46	2.40	2.61	20.80	20.10	16.93	14.33	18.04
GRB-702	15.20	14.40	14.26	13.60	14.36	2.86	2.80	2.66	2.53	2.71	22.90	20.03	18.23	16.36	19.38
GRB-803	14.00	13.26	12.26	11.46	12.75	2.86	2.86	2.66	2.60	2.75	17.96	17.06	15.60	13.83	16.11
GRB-804	14.26	13.33	12.80	11.73	13.03	2.86	2.40	2.60	2.40	2.56	16.90	16.80	15.53	13.20	15.60
GRB-902	16.86	16.06	15.06	14.00	15.50	3.33	2.93	2.73	2.73	2.85	23.53	20.80	17.56	16.53	19.60
GRB-9810	14.73	14.46	12.66	11.40	13.31	2.93	2.80	2.66	2.66	2.76	19.80	17.00	14.50	12.83	16.03
HRR-35	15.20	14.00	13.40	12.26	13.71	2.80	2.80	2.73	2.60	2.73	19.10	16.40	12.40	12.63	15.58
Phule Suyash	13.60	13.06	12.46	12.00	12.78	2.86	2.80	2.73	2.46	2.71	14.46	10.80	9.26	7.33	10.46
Vaghya	15.26	15.00	13.26	12.73	14.06	2.86	2.66	2.60	2.53	2.66	19.73	17.40	14.86	13.76	16.44
Varun (check)	15.86	15.20	14.40	13.73	14.80	2.93	2.80	2.73	2.40	2.71	20.43	19.60	17.33	15.60	18.25
Mean	14.94	14.30	13.35	12.60	13.79	2.88	2.76	2.66	2.53	2.71	19.56	17.60	15.40	13.64	16.55
SE±	0.38	0.24	0.36	0.53	0.13	0.13	0.10	0.10	0.05	0.04	0.87	1.20	0.74	0.65	0.32
$CD_{0.05}$	0.80	0.50	0.76	1.12		NS	0.21	NS	0.11		1.83	2.53	1.55	1.38	

E_1: 20 June 2015, E_2: 10 July 2015, E_3: 30 July 2015, E_4: 20 August 2015

branches which was significantly higher than all other genotypes. However the genotypes did not differ among themselves for this character under E_1 (20 June 2015) and E_3 (30 July 2015).

GRB-702 (22.90 g) and GRB-902 (23.53 g) gave maximum seed yield per plant under E_1 (20 June 2015). Under E_2 (10 July 2015), GRB-701 (20.10 g), GRB-702 (20.03 g), GRB-902 (20.80 g) and Varun (check) (19.60 g) resulted in maximum seed yield per plant and were at par with one another. The trend was almost parallel to E_2 (10 July 2015) in case of E_3 (30 July 2015) and E_4 (20 August 2015). GRB-701, GRB-702 and GRB-902 performed better than all other genotypes which were at par with Varun (check) for the trait seed yield per plant. The yield decreased with the delay in sowing. Choudhary and Haque (2010) and Pillai et al (2010) reported significant differences among genotypes in different environments and seasons. Ujjammanavar et al (2006) also reported that the yield of Rajmash was reduced significantly when the sowing was delayed. In Bangladesh, January sowing gave the highest grain yield of Rajmash whereas the crop sown in February failed to produce any grain (Begum et al 2003).

In overall it can be concluded that GRB-803 and Phule Suyash (number of days to 50% flowering), GRB-803 and Phule Suyash (number of days to maturity), GRB-702 and GRB-902 (plant height), GRB-902 (plant spread), GRB-902 (number of primary branches/plant) and GRB-701, GRB-702 and GRB-902 (seed yield/plant) were the better genotypes of Rajmash.

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