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## Evaluation of French bean (*Phaseolus vulgaris* L.) genotypes under different environments during *rabi* season

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### Abstract

The present investigation was undertaken at Botany division, College of Agriculture, Pune during *rabi* season in Randomized Block Design with 3 replications for 16 genotypes of French bean for twelve quantitative traits, based on the stability parameters using Eberhart and Russel model to assess seed yield potential for different genotypes under three different sowing dates *viz.* E<sub>1</sub> (15/10/2021), E<sub>2</sub> (5/11/2021) and E<sub>3</sub> (25/11/2021). Based on mean performance of genotypes under study showed differential stability performance for all the twelve characters, indicated that Raj-20-8 had least number of days to 50 percent flowering (36.33 days). Genotype Phule Rajmah recorded the maximum number of pods per plant (14.84). Genotype Phule Rajmah (5.27) and Varun (5.02) had recorded maximum mean number of seeds per pod. Highest number of seed per pod (4.16) recorded in E<sub>3</sub> environment over all three environments followed by E<sub>2</sub> (4.14) and E<sub>1</sub> (4.04). Genotype GRB- 912 (38.32) had highest 100-seed weight. Genotype Phule Rajmah was found highest harvest index (65.38) followed by EC-21754 (62.00). Genotype P. Rajmah (9.31 cm) had longest pod length followed by Varun (9.25 cm) and shortest in Shimla-1 (7.63). The maximum mean seed yield per plant was observed in Phule Rajmah (24.80) followed by GRB-910 (23.83). Across all the three environment mean seed yield per plant was greater in E<sub>3</sub> (16.32 g) followed by E<sub>2</sub> (15.78 g) and E<sub>1</sub> (15.34 g) environment. On the basis of results obtained in present investigation sowing of French bean under environment E<sub>3</sub> (25<sup>th</sup> November) was most favorable for most of the characters under study, during *rabi* season.

**Keywords:** Stability, French bean, genotypes, variability

### Introduction

French bean is botanically known as '*Phaseolus vulgaris*' belongs to the family Leguminosae. However, now it has been added under Fabaceae. Rajmah is also called grain of hope, Kidney bean, Common bean, Snap bean and French bean. French bean is one of the most popular and widely grown vegetables in India. The green immature pods are cooked and eaten as a vegetable. Immature pods are marketed fresh, frozen or canned, whole or cut. It is also an important pulse crop, with high yielding ability as compared to gram and pea. It is grown mainly in Maharashtra, Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and NE states. Due to the huge growth in crop demand, chemical fertilizers are being used extensively with little regard for the quality and health of the soil, which is essential for achieving sustainable yield. Thus, in addition to other parameters, a suitable amount of nutrients from organic and inorganic sources is necessary to increase the output and quality of Rajmah beans.

The innovative idea of choosing varieties by evaluating them in the poor and challenging areas, where the farmer operates is necessary to study because genotypes and environments interact, the many habitats would affect yield and making selection for a variety challenging. An important topic for plant breeders and agronomists to discuss is the interaction of genotypes and environments (G x E). Different soil types among farmers have an impact on yields. Rainfall patterns and planting dates were recognized as sources of environmental influence that induced G x E interaction by Eberhart and Russell (1966) [2]. Therefore, choosing a genotype cannot be based solely on production; however, farmers would benefit from an approach that combines yield and stability over a wide geographic area. Statistics on yield stability made care to choose cultivars that will produce regularly. In recent years, stability analysis has emerged as one of the crucial techniques for plant breeders in predicting response of diverse genotypes across changing environments. In present study an attempt has been made to assess seed yield potential for different genotypes of French bean under three different sowing dates *viz.* E<sub>1</sub> (15/10/2021), E<sub>2</sub> (5/11/2021) and E<sub>3</sub> (25/11/2021) and also to

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identify the genotypes suitable for different predictable environments.

### Materials and Methods

The present investigation was carried out to evaluate 16 genotypes of French bean under three different sowing dates *i.e.*, E1 (15/10/2021), E2 (5/11/2021) and E3 (25/11/2021) at College of Agriculture, Pune during *rabi* season, 2021 in randomized block design (RBD) with three replications. Each genotype was represented by 2 x 4m length with spacing of 15 x 30 cm. The standard package of practices was used to grow the crop with fertilizer dose of NPK in the ratio 60:80:00. The collected data was subjected for testing the genotypic difference by Panse and Sukhatme (1985) [5]. The phenotypic stability of sixteen genotypes across the environments was worked out by linear model Eberhart and Russel (1966) [2].

### Results and Discussion

The results of mean values of the genotypes for different characters under three sowing dates are presented in Table 1. The treatment differences were significant for all the characters under study including days to 50 percent flowering, days to maturity, plant height, plant spread, number of primary branches, number of secondary branches, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, harvest index and seed yield per plant. This indicated that the genotypes included in present investigation was diverse. The mean values of the genotypes for different characters under three sowing dates are presented in Table.2.

#### Days to 50 percent flowering

The earliest genotype across the three settings was Raj 20-8 (36.33 days), which was followed by EC-21754 (37.33 days) and Phule Rajmah (37.67 days). Genotypes Raj 20-8, Varun and EC-21754 (32.33) flowered first in environment E1, followed by the genotypes GRB-912 and Phule Rajmah, whereas genotypes GRB-903, GRB-911 Raj 20-4 and Kullu-2 (37.33 days) blossomed last overall. Genotypes Phule Rajmah (37.33) was the first to flower in environment E2 followed by EC-21754 (37.67) while Kullu-2 (41.67) flowered last among all the genotypes. Genotypes Kullu-2 (46.33 days) flowered late among all the genotypes in environment E3. Raj 20-8 (40.33 days) and Shimla-1 (41 days) was earliest in E3. It is concluded from the experiment that mean number of days to 50 percent flowering was significantly influenced by date of sowing. Raj 20-8 is the earliest to 50 percent flower among all the genotypes (36.33 days). It is revealed that all genotypes in environment E1 have flowered earliest as compared to E2 and E3. In environment E3 genotypes took longest time to 50 percent flower. Thus, it can be concluded delayed sowing led to more time to 50 percent flowering. In E1 genotypes GRB-910, GRB-903, GR-1, GRB-911, HPR-35, RAJ 20-4 and Kullu-2 were at par. In E2 genotypes GRB-910, GRB-903, GR-1, RAJ 20-4, Kullu-2 and GRB-907 were at par. In E3 genotypes GRB-903, GR-1, GRB-911 and Kullu 2 were at par. Similar, results were reported by Nimbalkar *et al* (2002) [3] and Nwadike *et al* (2013) [4] for days to 50 percent flowering and days to maturity.

#### Days to maturity

Among evaluated genotypes GRB-909 (77.00 days), EC-21754 (77.78 days), GRB-912 (78.11 days) were earliest

genotypes to mature in overall mean in all three environments, while Kullu-2 (84.67 days), Shimla-3 (84.22 days), Raj 20-4 (83.67 days) were late to mature.

In environment E1, genotypes EC-21754 (72.33 days), GRB-912 (73.33 days), Phule Rajmah (74.33 days) took least days to mature and genotypes Kullu-2 (79.67 days), GRB-903 (79.33 days) were matured late. Genotypes in environment E2 which were earliest to mature were EC-21754 and GRB-912 (79 days), while Shimla-3 (85.33 days) was late to mature. Genotype GRB-909 (78 days) followed by GRB-903 (79.67 days) were the earliest to mature in E3 and genotypes Kullu-2 (89.33) and Shimla-3 (89 days) took the longest time to mature in E3. It is found that mean number of days to maturity was greatly influenced by the date of sowing. Genotype GRB 909 (77.00 days) was the earliest to mature in all the three sowing dates. It is revealed that all genotypes in environment E1 have matured earliest followed by E2 and E3. Thakur *et al.* (2001) [11] also reported the similar results.

#### Plant height (cm)

Among all the genotypes Kullu-2 (55.20 cm) recorded the maximum plant height and GRB-912 (40.51 cm) recorded minimum plant height. In environment E1 genotypes Kullu-2 (55.20 cm) recorded the maximum plant height followed by Phule Rajmah (53.47 cm) and GRB-907 (51.54 cm) and genotype GRB-912 (40.51 cm) and GRB-909 (41.40 cm) recorded minimum plant height. In environment E2 genotypes Kullu-2 (55.55 cm) followed by Phule Rajmah (54.79 cm) and Varun (52.64 cm) recorded the maximum plant height and EC-21754 (42.28 cm) recorded minimum plant height. Genotype Phule Rajmah (55.75 cm) recorded the maximum plant height in environment E3 and GRB-912 (44.66 cm) recorded the shortest height.

The increasing trend was observed in plant height of the genotypes as the sowing date delays. Among the overall mean across all different environment genotype Kullu-2 followed by Phule Rajmah and GRB-907 recorded the maximum plant height, while genotype GRB-912 followed by EC-21754 and GRB-909 recorded the minimum plant height. In environment E1 genotypes Varun, Phule Rajmah, Raj 20-8, HPR-35, GRB-911, Kullu-2, Shimla-3 and GRB-907 were at par. In E2 genotypes Varun, Phule Rajmah, Kullu-2, Shimla-1 and GRB-907 were at par. In E3 genotypes Varun, Phule Rajmah, GRB-911, Kullu-2 and GRB-907 were at par. These results are in conformity with Singh, P. (2007) [9].

#### Plant spread (cm)

In E1 GRB-903 (26.21 cm) exhibited the maximum plant spread among all other genotypes and GRB-910 (19.78 cm) recorded the minimum plant spread. In E2 similar fashion in spread was followed as GRB- 903 (25.86 cm) followed by GRB-911 (25.01 cm) recorded maximum spread and GRB-910 (19.89 cm) recorded minimum plant spread. In E3 the genotypes GRB-903 (26.16 cm) exhibited maximum plant spread and HPR-35 (13.96 cm) recorded minimum plant spread. The spread of plants has shown similar trends, as there is not much influence of delayed sowing on the plants. GRB-903 (26.16 cm) had maximum spread in all the three environments and Shimla-2 (15.63 cm) had the minimum plant spread. Though the difference across the environments was observed among all three environment, genotypes sown in E2 environment had less plant spread as compared to E1 and E3.

In environment E1 genotypes GRB-912, Varun, Phule Rajmah, Raj 20-8, GRB-903, GR-1, GRB-911 was at par. In E2 genotypes GRB-909, GRB-912, Varun, Phule Rajmah, Raj-20-8, GRB-903, GR-1 and GRB-911 were at par. In E3 genotypes GRB-912, Varun, Phule Rajmah, Raj 20-8, GRB-903, GR-1, EC-21754 and GRB-911 were at par. Similar results were reported by Ravi *et al.* (2022)<sup>[7]</sup> in Cluster bean.

#### Number of primary and secondary branches

In environment E1 genotypes GRB-907 (4.07) and Phule Rajmah (4.07) recorded the maximum number of primary branches followed by EC-21754 (4.00) and Kullu-2 (3.13) and GR-1 (3.47) recorded the least. In E2 GRB-907 (4.13), EC-21754 (4.13) and Phule Rajmah (4.13) recorded the maximum number of primary branches and Kullu-2 (3.27) recorded the minimum number of primary branches per plant. In E3 genotypes GRB-907 (4.27) and GRB-910 (4.27) recorded the highest number of primary branches, while the genotypes Kullu-2 (3.28) recorded the least number of primary branches.

In overall mean across all three environments Phule Rajmah (4.18) recorded the maximum number of primary branches followed by GRB 907 (4.16) and EC-21754 (4.11). Genotype Kullu-2 (3.22) recorded minimum number of primary branches followed by Shimla-3 (3.49). Among three environment in E1 genotypes Phule Rajmah (6.07) exhibited the highest number of secondary branches followed by EC-21754 (5.73) and Varun (5.67). Genotype Shimla-1 (4.20) and GRB-907 (4.20) exhibited least number of secondary branches per plant. In E2 genotypes Varun (5.87) followed by EC-21754 (5.73) recorded maximum number of secondary branches and Shimla-1 (4.33) followed by Shimla-3 (4.67) recorded least. In E3 genotypes Phule Rajmah (6.27) followed by Varun (6.07) and GRB-909 (6.00) recorded the maximum number of secondary branches per plant and Shimla-1 (4.40) recorded minimum number of secondary branches per plant. Wankhate *et al.* (2019)<sup>[13]</sup> also reported the similar findings for number of primary and secondary branches per plant.

#### Number of pods per plant

In first date of sowing (E1) number of pods per plant ranges from Shimla-3 (7.27) to Phule Rajmah (14.47) with the population mean of 11.32. Genotypes Phule Rajmah (14.47) followed by GRB- 910 (14.33) and EC-21754 (14.13) recorded the maximum number of pods per plant and Shimla-3 (7.27) exhibited the lowest number of pods per plant.

In second date of sowing (E2) number of pods per plant ranges from Shimla-3 (7.27) to Phule Rajmah (14.67) with population mean of 11.50. Genotypes Phule Rajmah (14.67) followed by GRB-910 (14.47) and EC-21754 (14.40) exhibited the maximum number of pods, while the Shimla-3 (7.27) exhibited the minimum number of pods per plant.

In third date of sowing (E3) number of pods per plant ranges from Shimla-3 (8.27) to Phule Rajmah (15.40) with the population mean of 11.95. Genotypes Phule Rajmah (15.40) followed by GRB-910 (15.07) recorded the highest number of pods per plant, while the Shimla-3 (8.27) recorded the lowest number of pods per plant. Raffi. *et al* (2004)<sup>[6]</sup> reported the similar findings.

#### Number of seeds per pod

In first date of sowing (E1) number of seeds per pod ranges from GR-1 (3.33) to Phule Rajmah (5.13) with the population

mean of 4.04. Genotypes Phule Rajmah followed by Varun (4.87) and GRB-910 (4.67) recorded the highest number of seeds, while GR-1 (3.33) followed by Shimla-1 (3.40) recorded the least number of seeds per pod

In second date of sowing (E2) number of seeds per pod ranges from GR-1 (3.40) to Phule Rajmah (5.33) with the population mean of 4.14. Genotypes Phule Rajmah (5.13) followed by Varun (5.13) and GRB-910 (4.87) exhibited the highest number of seeds per pod while the GR-1 (3.40) recorded the lowest number of seeds per pod.

In third date of sowing (E3) number of seeds per pod ranges from GR-1 (3.53) to Phule Rajmah (5.33) with the population mean of 4.16. Genotypes Phule Rajmah (5.33) followed by Varun (5.07) and GRB-910 (4.80) exhibited the maximum number of seeds per pod while GR-1 (3.53) recorded the minimum number of seeds per pod. These findings were similar to Singh (2007)<sup>[9]</sup> and Raffi *et al* (2004)<sup>[6]</sup>.

#### Pod length (cm)

In first date of sowing (E1) pod length ranges from Shimla-1 (7.50 cm) to Phule Rajmah (9.37 cm) and population mean is 8.15 cm. Genotypes Phule Rajmah (9.37 cm) followed by Varun (9.20 cm), GRB-903 (8.40) and GRB- 910 (8.33) exhibited the maximum pod length, while Shimla-1 recorded the minimum pod length.

In second date of sowing (E2) pod length ranges from Shimla-1 (7.63 cm) to Varun (9.26 cm) and population mean is 8.20 cm. Genotypes Varun (9.27 cm) followed by Phule Rajmah (9.23 cm), GRB-912 (8.40 cm) and GRB- 910 (8.40 cm) at par and exhibited maximum pod length, while Shimla-1 followed by Shimla-3 (7.90) and Kullu-2 (7.73) exhibited the minimum pod length. In third date of sowing (E3) pod length ranges from Shimla-1 (7.77) to Phule Rajmah (9.30 cm) with population mean 8.27 cm. Genotypes Phule Rajmah (9.33 cm) followed by Varun (9.30 cm) and GRB- 910 (8.46) exhibited maximum pod length, while Shimla-1 (7.77 cm) recorded minimum pod length. Nwadike *et al* (2013)<sup>[4]</sup> and Satish *et al* (2017)<sup>[8]</sup> reported similar results.

#### Harvest index (%)

In first date of sowing (E1) harvest index ranges from Shimla-3 (33.00%) to Phule Rajmah (65.21%) with the population mean of 50.26%. Genotypes Phule Rajmah followed by GRB-910 (58.70%) and GRB-911 (54.11%) recorded the highest Harvest index, while Shimla-3 (33.00%) exhibited the lowest harvest index.

In second date of sowing (E2) harvest index ranges from Shimla-3 (33.08%) to Phule Rajmah (65.18%) with the population mean of 50.36%. Genotypes Phule Rajmah (65.21%) followed by GRB-910 (59.07%) and GRB-911 (54.14%) recorded the highest harvest index, while Shimla-3 (33.08%) exhibited the lowest harvest index.

In third date of sowing (E3) harvest index ranges from Shimla-3 (33.15%) to Phule Rajmah (65.76%) with the population mean of 50.52%. Genotypes Phule Rajmah (65.76%) followed by GRB-910 (59.24%) and GRB-911 (54.15%) exhibited the highest harvest index, while Shimla-3 (33.15%) exhibited the lowest harvest index. Satish *et al.* (2017)<sup>[8]</sup> reported similar findings for harvest index.

#### 100-seed weight (g)

In first date of sowing (E1) 100-seed weight ranges from GRB-909 (25.44 g) to GRB-912 (38.21 g) with population

mean of 33.28 g. Genotypes GRB-912 (38.12 g) followed by EC-21754 (37.41 g) and GR-1 (35.18 g) recorded the highest 100-seed weight, while GRB-909 (25.44 g) exhibited the lowest 100-seed weight.

In second date of sowing (E2) 100-seed weight ranges from GRB-909 (25.47 g) to GRB-912 (38.27 g) with the population mean of 33.50 g. Genotypes GRB-912 (39.27 g) followed by EC-21754 (37.50 g) and GR-1 (35.21 g) exhibited the highest 100-seed weight, while GRB-909 (25.47 g) exhibited the lowest 100 seed weight.

In third date of sowing (E3) 100-seed weight ranges from GRB-909 (25.49 g) to GRB-912 (38.47 g) with the population mean of 33.52 g. Genotypes GRB-912 (38.47 g) followed by EC-21754 (37.50 g) and GR-1 (35.41 g) recorded the highest 100-seed weight, while GRB-909 (25.50 g) recorded the lowest 100-seed weight. Thirugnanavel *et al* (2018) [12] reported similar findings for 100-seed weight.

**Seed yield per plant (g)**

In first date of sowing (E1) seed yield per plant ranges from Shimla-3 (8.20 g) to Phule Rajmah (24.40 g) with population mean 15.34 g. Genotypes Phule Rajmah (24.40 g) followed

by GRB-910 (22.43 g) and EC-21754 (18.78 g) recorded the maximum seed yield per plant, while Shimla-3 (8.20 g) recorded minimum seed yield per plant.

In second date of sowing (E2) seed yield per plant ranges from Shimla-3 (8.31 g) to Phule Rajmah (24.47 g) with population mean 15.78 g. Genotypes Phule Rajmah (24.47 g) followed by GRB-910 (23.93 g) and Varun (19.05 g) recorded the maximum seed yield per plant, while Shimla-3 (8.31 g) exhibited minimum seed yield per plant.

In third date of sowing (E3) seed yield per plant ranges from Shimla-1 (8.73 g) to Phule Rajmah (25.54 g) with population mean 16.31 g. Genotypes Phule Rajmah (25.54 g) followed by GRB-910 (25.14 g) and GRB-911 (19.75 g) recorded the maximum seed yield per plant, while Shimla-1 (8.73 g) exhibited minimum seed yield per plant. In E1 genotypes GRB-910, Varun, Phule Rajmah, GRB-903, HPR-35, EC-21754 and GRB-911 were at par. In E2 genotypes GRB-910, Varun, Phule Rajmah, GRB-903, EC-21754, GRB-911, GRB-907 was at par. In E3 GRB-910, Varun, Phule Rajmah GRB-903, EC-21754, GRB-911 and GRB-907 were at par. Wankhate *et al* (2019) [13] reported similar results.

**Table 1:** ANOVA for stability as per Eberhart and Russell Model (1966) [2] in French bean for twelve characters in three different environments (E1, E2 and E3)

Sr. No.	Characters	Mean sum of square due to								
		E1			E2			E3		
		Rep	Treat	Error	Rep	Treat	Error	Rep	Treat	Error
1	Days to 50 percent Flowering	9.50	148.14*	1.16	0.50	102.5*	7.5	0.00	126.58*	6.66
2	Days to Maturity	1.04	254.14*	8.29	0.041	268.64*	3.29	0.16	470*	6.50
3	Plant height (cm)	0.063	881.89*	5.07	0.44	667.30*	7.95	5.56	144.41*	11.96
4	Plant spread (cm)	0.49	1036.36*	1.66	0.21	1006.57*	2.16	0.1163	1037.75*	2.82
5	No. of primary branches	0.021	3.079*	0.69	0.105	3.06*	0.88	0.07	3.88*	0.62
6	No. of secondary branches	0.051	14.30*	1.06	0.16	9.91*	1.03	0.01	15.33*	0.97
7	No. of pods per plant	0.005	211.65*	1.67	0.130	220.55*	2.82	0.03	228.81*	2.52
8	No. of seeds per pod	0.046	12.25*	0.833	0.12	15.09*	1.50	0.015	12.93*	1.66
9	Pod length	0.031	12.33*	0.65	0.11	10.83*	1.03	0.003	10.34*	1.08
10	100 seed weight (g)	0.91	529.93*	8.49	0.04	501.20*	3.87	0.57	497.72*	4.35
11	Harvest Index (%)	0.13	2828.73*	5.94	0.10	2837.45*	2.91	0.93	2873.22*	4.69
12	Seed yield per plant (g)	0.43	974.55*	3.52	0.15	1023.11*	4.92	0.19	1116.4*	5.40

\*, \*\*: Significant at 5 and 1 percent level of significance, respectively.

**Table 2:** Mean performance of French bean genotypes for twelve different characters over three sowing dates

Genotypes	Days to 50% flowering (No.)				Days to Maturity (No.)				Plant height (cm)				Plant spread (cm)			
	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean
GRB-910	36.33	40.67	43.67	40.22	80.33	84.00	86.00	83.44	43.77	46.13	49.83	46.57	19.78	19.89	19.81	19.82
GRB-909	34.33	38.67	42.67	38.56	75.00	78.00	78.00	77.00	41.50	43.87	45.04	43.46	19.30	19.63	19.65	19.53
GRB-912	33.33	38.00	42.00	37.78	73.33	79.00	82.00	78.11	40.51	43.60	44.66	42.92	21.07	21.07	21.23	21.10
Varun	32.33	38.00	43.33	37.89	76.00	80.00	82.00	79.33	51.35	52.64	52.34	52.11	22.41	22.45	22.50	22.45
P. Rajmah	33.67	37.33	42.00	37.67	74.33	82.33	85.33	80.67	53.47	54.79	55.75	54.67	21.23	21.33	21.78	21.50
RAJ 20-8	32.33	36.33	40.33	36.33	74.67	80.00	84.33	79.67	48.46	48.47	49.60	48.84	19.37	19.59	19.81	19.60
GRB-903	37.33	40.67	44.67	40.89	79.33	80.00	79.67	79.67	43.80	47.72	48.30	46.61	26.21	25.86	26.16	26.08
GR-1	36.33	40.33	45.67	40.78	75.67	83.33	86.00	81.67	42.69	45.46	46.64	44.93	24.27	24.31	24.48	24.35
HPR-35	36.33	39.33	44.00	39.89	76.67	83.67	86.33	82.22	48.15	46.61	45.08	46.61	13.57	13.80	13.96	13.77
EC 21754	35.67	37.67	42.00	37.33	72.33	79.00	82.00	77.78	42.42	42.28	45.15	43.28	19.60	19.65	19.79	19.68
GRB 911	37.33	39.67	44.33	39.89	76.33	82.00	86.33	81.56	47.72	47.77	50.63	48.71	24.92	25.01	25.23	25.05
RAJ 20-4	37.33	40.00	42.67	40.00	78.67	84.00	88.33	83.67	45.60	48.30	48.46	47.45	19.50	19.25	19.51	19.41
Kullu- 2	37.33	41.67	46.33	41.78	79.67	85.00	89.33	84.67	55.20	55.55	55.22	55.32	19.21	19.30	19.40	19.29
Shimala- 3	34.33	38.33	41.33	38.00	78.33	85.33	89.00	84.22	47.87	47.90	48.11	47.96	17.30	17.34	17.48	17.37
Shimala- 1	34.33	37.33	41.00	37.55	75.33	79.67	86.00	80.33	44.43	49.12	50.80	48.11	15.42	15.73	15.75	15.63
GRB-907	35.33	40.00	44.00	39.78	74.33	79.00	84.00	79.11	51.54	52.01	53.82	52.46	16.10	16.53	16.59	16.40
Mean	34.94	39.00	43.12	39.02	76.27	81.52	84.67	80.81	46.78	48.27	49.34	48.12	19.95	20.04	20.19	20.06
S.E. ±	0.16	0.41	0.38		0.43	0.27	0.38		0.33	0.42	0.36		0.19	0.16	0.20	
C.V. (%)	0.56	1.28	1.09		0.69	0.41	0.55		0.88	1.07	0.89		1.65	1.43	1.73	
C.D. @ 5%	0.33	0.83	0.79		0.87	0.55	0.76		0.68	0.86	0.74		0.55	0.48	0.58	

Genotypes	Primary branches per plant (No.)				Secondary branches per plant n				Number of pods per plant (No.)				Number of seeds per pod no.			
	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean
GRB-910	3.87	4.00	4.27	4.04	5.07	5.60	5.93	5.53	14.33	14.47	15.07	14.62	4.67	4.87	4.80	4.78
GRB-909	3.73	4.00	4.07	3.93	5.33	5.53	6.00	5.62	9.80	10.27	10.73	10.27	4.00	4.13	4.13	4.09
GRB-912	3.53	3.67	3.87	3.69	4.47	4.53	4.93	4.64	10.40	10.60	11.53	10.84	4.00	4.07	4.07	4.04
Varun	3.87	3.93	4.13	3.98	5.67	5.87	6.07	5.87	12.20	12.47	13.20	12.62	4.87	5.13	5.07	5.02
P. Rajmah	4.07	4.13	4.33	4.18	6.07	5.27	6.27	5.87	14.47	14.67	15.40	14.84	5.13	5.33	5.33	5.27
RAJ 20-8	3.67	3.87	3.93	3.82	5.13	5.20	5.47	5.27	10.00	10.07	10.47	10.18	3.73	3.80	3.80	3.78
GRB-903	3.87	3.93	4.00	3.93	4.73	4.93	5.13	4.93	12.40	12.93	13.53	12.96	4.33	4.47	4.33	4.38
GR-1	3.47	3.67	3.93	3.69	4.80	4.87	5.07	4.91	10.40	10.80	10.20	10.47	3.33	3.40	3.53	3.42
HPR-35	3.60	3.53	3.67	3.60	4.87	5.00	5.00	4.96	11.60	10.93	10.67	11.07	4.20	4.27	4.20	4.22
EC 21754	4.00	4.13	4.20	4.11	5.73	5.73	5.93	5.80	14.13	14.40	14.47	14.33	3.47	3.53	3.73	3.58
GRB 911	4.00	3.93	4.07	4.00	5.07	5.07	5.27	5.13	12.80	13.13	13.93	13.29	4.07	4.00	4.20	4.09
RAJ 20-4	3.80	3.93	4.07	3.93	4.40	4.53	4.73	4.56	9.27	9.47	9.60	9.44	4.13	4.27	4.33	4.24
Kullu-2	3.13	3.27	3.28	3.22	4.47	4.53	4.67	4.56	10.80	11.00	11.00	10.93	3.47	3.53	3.47	3.49
Shimala- 3	3.47	3.47	3.53	3.49	4.47	4.67	4.67	4.60	7.27	7.27	8.27	7.60	3.87	3.86	3.80	3.84
Shimala- 1	3.53	3.60	3.68	3.60	4.20	4.33	4.40	4.31	8.20	8.27	9.20	8.56	3.40	3.46	3.60	3.49
GRB-907	4.07	4.13	4.27	4.16	4.20	4.80	5.13	5.07	13.07	13.13	14.00	13.40	4.07	4.13	4.20	4.13
Mean	3.73	3.82	3.95	3.83	4.92	5.03	5.29		11.32	11.50	11.95	11.58	4.04	4.14	4.16	4.11
S.E. ±	0.12	0.14	0.12		0.15	0.15	0.15		0.19	0.25	0.24		0.13	0.18	0.19	
C.V. (%)	4.09	4.48	3.64		3.84	3.70	3.40		2.08	2.67	2.43		4.12	5.34	5.66	
C.D. @ 5%	0.25	0.28	0.24		0.31	0.31	0.30		0.39	0.51	0.48		0.28	0.37	0.39	

Genotypes	Pod length (cm)				Harvest index (%)				100 seed weight (g)				Seed yield per plant (g)			
	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean	E1	E2	E3	Mean
GRB-910	8.33	8.40	8.47	8.40	58.70	59.07	59.24	59.00	35.18	35.54	35.58	35.43	22.43	23.93	25.14	23.83
GRB-909	7.90	8.00	8.13	8.01	46.28	46.22	46.24	46.24	25.44	25.47	25.50	25.47	10.11	10.70	11.72	10.85
GRB-912	8.27	8.40	8.43	8.36	52.21	52.45	52.47	52.37	38.21	38.27	38.47	38.32	15.08	15.37	16.64	15.70
Varun	9.20	9.27	9.30	9.25	47.78	48.02	48.70	48.16	33.27	33.30	33.40	33.32	18.62	19.05	19.51	19.06
P. Rajmah	9.37	9.23	9.33	9.31	65.21	65.18	65.76	65.38	32.46	32.57	32.53	32.52	24.40	24.47	25.54	24.80
RAJ 20-8	7.80	7.70	7.90	7.80	48.63	48.84	48.87	48.77	34.18	34.21	33.28	33.89	12.46	12.48	13.33	12.76
GRB-903	8.40	8.37	8.43	8.40	49.73	49.80	49.87	49.80	34.23	34.36	34.15	34.25	18.02	18.93	19.10	18.68
GR-1	7.73	7.83	7.93	7.83	41.51	41.57	41.61	41.56	35.18	35.21	35.41	35.27	12.46	13.96	12.77	13.07
HPR-35	7.83	7.83	7.87	7.84	49.73	49.96	50.00	49.89	34.09	34.32	34.64	34.35	17.03	15.46	14.76	15.75
EC 21754	8.20	8.37	8.40	8.32	61.90	61.96	62.07	62.00	37.41	37.43	37.50	37.45	18.78	18.88	19.16	18.94
GRB 911	8.30	8.27	8.40	8.32	54.11	54.09	54.15	54.12	34.67	34.68	34.58	34.64	17.85	18.83	19.75	18.81
RAJ 20-4	7.80	7.90	7.90	7.87	51.35	51.54	51.59	51.49	36.47	36.54	36.57	36.51	13.12	14.20	14.59	14.59
Kullu- 2	7.73	7.77	7.87	7.79	51.14	51.17	51.25	51.19	33.48	34.53	34.62	34.21	12.58	12.74	13.07	12.80
Shimala- 3	7.70	7.90	7.90	7.83	33.00	33.08	33.15	33.07	27.43	28.49	28.87	28.26	8.20	8.31	9.11	8.54
Shimala- 1	7.50	7.63	7.77	7.63	40.83	40.81	41.20	40.95	29.66	29.99	30.00	29.88	8.57	8.63	8.73	8.64
GRB-907	8.27	8.33	8.37	8.32	52.10	52.03	52.12	52.08	31.17	31.17	31.30	31.22	15.69	16.52	18.13	16.78
Mean	8.15	8.20	8.27	8.20	0.36	50.36	50.52	50.38	33.28	33.50	33.52	33.43	15.34	15.78	16.32	15.85
S.E. ±	0.12	0.15	0.15		0.89	0.25	0.32		0.43	0.29	0.31		0.28	0.33	0.35	
C.V. (%)	1.81	2.26	2.30		0.74	0.62	0.78		1.60	1.07	1.14		2.24	2.57	2.60	
C.D. @ 5%	0.25	0.31	0.32			0.52	0.66		0.88	0.60	0.64		0.52	0.67	0.71	

## Conclusion

The genotypes under study showed differential stability performance for all the twelve characters. The result of mean performance of different genotypes over three environments indicated that Raj-20-8 had least number of days to 50 percent flowering (36.33 days). In first sowing (E1) all the genotypes have recorded lowest number of days to 50 percent flowering. GRB- 909 (77days) was earliest to mature followed by genotype EC-21754 (77.78 days). Genotype Kullu-2 (55.32 cm) was the tallest among all the genotypes followed by Phule Rajmah (54.67cm). Genotype Phule Rajmah (4.18) recorded maximum mean number of primary branches while Kullu-2 (3.22) had minimum number of primary branches. Genotype Phule Rajmah (14.84) recorded the maximum number of pods per plant and genotype Shimla-3 (7.60) had the least number of pods per plant. The highest mean of number of pods per plant was recorded in E3 (14) followed by E2 (13.13) and E1 (13.06). The genotype Phule Rajmah (5.26) and Varun (5.02) had recorded maximum mean number

of seeds per pod and minimum in GR-1 (3.4) genotype. Highest number of seed per pod (4.16) recorded in E3 over all three environments followed by E2 (4.13) and E1 (4.06). Genotype GRB- 912 (38.31) had highest 100-seed weight. Genotype Phule Rajmah (65.38%) was found highest harvest index followed by EC-21754 (62.00). Genotype Phule Rajmah (9.31 cm) had the longest pod length followed by Varun (9.25 cm) and shortest in Shimla-1 (7.63 cm). The maximum mean seed yield per plant was observed in Phule Rajmah (24.80) genotypes. Across all three environment, mean seed yield per plant was greater in E3 (16.32 g) followed by E2 (15.78 g) and E1 (15.34 g).

The present investigation concluded that environment E3 that is sowing date 25<sup>th</sup> November was most favorable for most of the characters under study.

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