Performance Evaluation of French Bean (*Phaseolus Vulgaris* L.) varieties for Growth, Yield and Quality Attributes under Cold Temperate Conditions of Gurez Valley

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ABSTRACT: Gurez is cold hilly and extreme northern temperate region of Kashmir valley which has short agriculture growing season due to harsh winter months. Gurez has rich diversity of flora and fauna due to its unique climatic conditions. Vegetables like Cole crops, Root Vegetables, Potato and Rajmash are grown in valley during summer months. Among different vegetable crops Beans have great scope for cultivation in valley owing to its short duration growing season. Beans are suited to climatic conditions of valley during summer season. In order to improve nutritional security of valley the present investigation was undertaken with objective of growing of beans in different altitudes of Gurez valley to find the best suitable variety for the valley.

The study was conducted at three different altitudes of valley Kanzalwan (Altitude 2386 meters), Izmarg Altitude (2407 meters) and Tulail (Altitude 3245 meters) of Gurez valley in which three bean varieties were grown during two consecutive years (2021-22 & 2022-23) to evaluate the best suitable variety for the region. It has been observed that variety V_1(Shalimar French bean-1) recorded maximum values with respect to growth , yield and quality attributes of beans as compared with other two varieties namely V_2 (Pusa Phalguni) and V_3 (Anupama).

Pooled data of two years revealed that V_1 recorded maximum values for plant height (49.93 cm), no. of branches per plant(11.63), no. of leaves plant^{-1} (42.20), no. of pods plant^{-1} (18.04), pod length (13.94 cm), pod girth (0.97cm), average pod weight (5.33g), pod yield plant^1 (165.81g/pl), pod yield hac^{-1} (172.47 qha^{-1}), T.S.S (8.72 Brix°), vitamin C (14.73 mg/100 g), protein content % (1.97), and anthocyanin content µg^{-1} (15.11) as compared with V_2 and V_3 varieties.

Keywords: French bean, Growth, Impact, Quality, Production, varieties, yield.

INTRODUCTION

Gurez is cold temperate valley of Jammu and Kashmir lying in Bandipora district which is about 2700 feet above mean sea level and is situated at the line of control with latitude 34.6494°N and longitude 74.7366° E. The valley has a very harsh climate and a short cultivation season. The villages are small hamlets but remain unconnected and inaccessible during winter months from the rest of the world due to heavy snowfall. Agriculture in this region is different from that in other rural areas of India, since farming is possible only for five to six months.

There are socio-economic constraints as well-, low productivity, nutritional in security, traditional bindings labour shortage, poor post-harvest management and marketing of produce. The region remains landlocked for over six months in a year due to heavy snow fall. Most of the population (>80%) of the region belongs to schedule tribe and are left with a limited period of a

year to earn their livelihood. Availability of locally grown fresh vegetables is restricted to summer months and therefore, there are seasonal differences in dietary intake of food. The availability of fresh vegetable decreases significantly during the winter months. Common bean is regarded as a nearly perfect food as it contains balanced mixture of different nutrients that promote better health and fight certain diseases. It is suitable during summer months under climatic conditions of Gurez and is performing well under such conditions. People are consuming more beans in Gurez valley and thus vegetable beans are preferred anything else. The scope of growing vegetable beans in Gurez valley seems to be good as the climate is suitable during summer when average temperature is 24-25°C .

French bean (*Phaseolus vulgaris* L.), is one of the favourite and important vegetables of Indian market as well as of the Indian farmers (Choudhary, 1987). It is native to central and southern America, from where it spread to India through Europe by 17th century. The

benefits of French bean being popular as a nutritious vegetable and at the same time a soil enriching crop has made it one of the most important vegetable crop very soon. As far as the country of India is concerned, the major French bean producing states are Maharashtra, Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and the North Eastern states (Vikaspedia, 2022) India has annual production of 2520 thousand metric tonnes (NHB database, 2021-22) .

Vegetable beans with excellent cooking quality, disease resistant and high yielding are most suitable for the cold temperate climatic conditions of Gurez valley where farmers are interested for pulse farming effectively since ancient times.

MATERIALS AND METHODS

The present study was carried out at experimental fields of Mountain Agriculture Research and Extension Station, Gurez SKUAST-Kashmir during two consecutive years 2021-22 and 2022-23 at three different locations. The study was conducted at three different locations of valley Kanzalwan (Altitude 2386 meters), Izmarg Altitude (2407 meters) and Tulail (Altitude 3245meters). Performance of three varieties namely Shalimar French bean-1, Pusa Phalguni and Anupama were evaluated. Data was complied from all three different locations of Gurez valley.

Pooled data of two years from all the three locations were recorded. The experiment was conducted in randomized complete block design (RCBD) with three replications. Each genotype was represented by a plot size of 3 × 2 meter dimensions with 10 lines at a spacing of 30×10 cm Observations were recorded on plant height, no. of branches, no of leaves and no. of pods per plant, pod length, pod girth, pod weight (g) and pod yield per hac were recorded as per standard measures. The common beans with well adaptability in Gurez has potential to improve economic conditions of tribal farmers of valley. The observations on plant height, No. of branches plant^{-1} were recorded manually on ten randomly selected representative plants from each plot of each replication separately as well as yield and yield attributing character were recorded as per the standard method. Yield attributes were also recorded at physiological maturity stage. The Pod yield was recorded from net plot area of each treatment and converted in yield per hac. The quality attributes were measured using standard procedures. The selected fruits were crushed and juice was passed through a double layer of mesh cloth, collected in a tube, shaken well for about 2 minutes and then TSS was determined with the help of hand refractometer and presented as °Brix. The total soluble protein was estimated as per the method described by Lowry *et al*. (1951). Lapornik *et al*. (2005) based on the principle of the transformation of the anthocyanin to the flavylium cation at the pH of extract decreasing to values between 0.5 and 0.8 was used to measure the anthocyanin content of the samples. Ascorbic acid content was determined by the method described by Ranganna (1986). The data obtained from various characters understudy were analyzed by the method of analysis of variance as described by Gomez and Gomez (1984).

| (a) Pusa Phalguni | (b) Shalimar French bean-1 | (c) Annupama |

Fig. 1
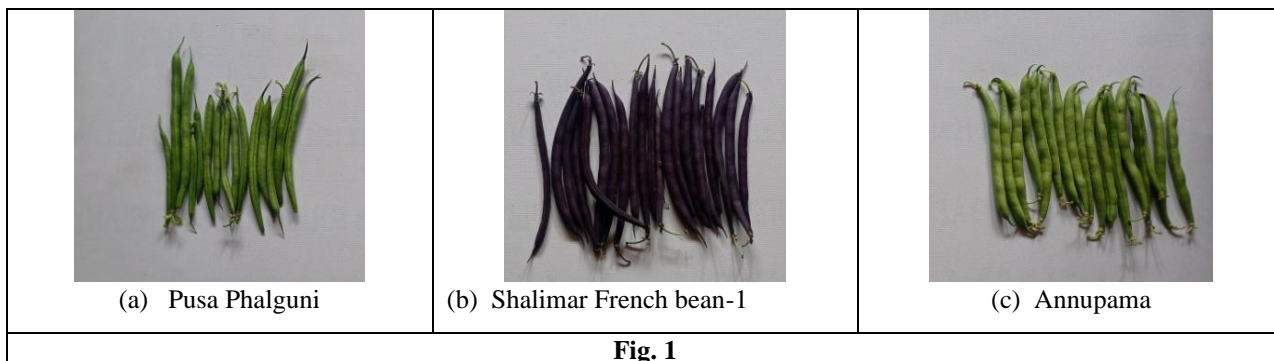
RESULTS AND DISCUSSION

A. Growth Attributes

The growth attributes like plant height, number of branches per plant number of leaves per plant, number of pods per plant were different significantly. Pooled data revealed that variety V_1 (Shalimar French Bean-1) recorded maximum values of growth attributes like plant height (49.93 cm), number of branches plant^{-1} (11.63), number of leaves per plant (42.38), number of pods per plant (18.04), where the values were significantly superior as compared with other varieties (V_2) Plant height (47.83 cm), number of branches plant^{-1} (10.00), number of leaves per plant (42.20), number of pods per plant (15.83), and (V_3) plant height (47.88 cm), number of branches plant^1 (9.91), number of leaves per plant (35.58), number of pods per plant (14.72) were calculated.

The growth attributes of French beans like plant height, number of branches, number of leaves and number of pods per plant are predominantly genetically determined characters and the significant differences in these characters are mostly because of the genetic differences among the varieties but performance of variety Shalimar French Bean-1 performed best and may be effected by environmental conditions, availability of nutrients and other management factors (Hema and Rana 2020).

Following the recommended practices in cultivation and management, the major factor effecting the plant growth characters remained to be the genetic factor. Similar results of genotypic influence on growth attributes were reported by Alghamdi (2007); Neupane *et al*. (2008); Yadav (2015); Dhakal *et al*. (2020).

B. Yield Attributes

The yield attributes like pod length, pod girth, pod weight, pod yield per plant and pod yield per hectare varied among three varieties. It was revealed that variety V_1 recorded maximum values of Pod length (13.94 cm), Pod Girth (0.97 cm), Pod weight (5.33 gms), Pod yield plant^{-1} (165.81gms) and Pod yield (172.47 qha^{-1}) where the values were significantly maximum as compared to variety V_2 Pod length (12.52 cm), Pod girth (0.89 cm), Pod weight (4.42 gms), Pod yield plant^{-1} (160.10gms) and pod yield (164.95 qha) and variety V_3 Pod length (11.40 cm), Pod girth (0.82 cm), Pod weight (4.12gms), Pod yield plant^{-1} (155.26gms) and Pod yield (159.72qha) respectively. Similar findings were reported by Das (2017).

C. Quality parameters

Pooled data of two years revealed that the Variety V_1 recorded highest values of quality attributes *viz*., T.S.S (8.72 Brix°), vitamin C content (14.73 mg/100 g), protein content % (1.97), and anthocyanin content µg^{-1} (15.11) as compared with variety V_2 and V_3 recording values of T.S.S (8.63 Brix°), (8.56 Brix°) vitamin C content (14.52 mg 100g^{-1}), (14.42mg 100g^{-1}), protein content (1.90%), (1.83%) and anthocyanin content (14.10µg^{-1}), (14.00) respectively and the values recorded with variety V_1 were significantly maximum as compared with other two varieties V_2 and V_3. Similar findings were reported by Das (2017).

Table 1: Observations of growth and growth attributes of French Bean varieties at three different altitudes of Gurez valley.

Treatments	Plant Height (cm)			No. of Branches			No. of Leaves			No. of Pods plant^{-1}		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
Variety (V_1)	49.46	50.41	49.93	11.21	12.04	11.63	42.15	42.25	42.20	17.67	18.42	18.04
Variety (V_2)	47.30	48.35	47.83	9.59	10.42	10.00	37.89	37.93	37.92	15.33	16.34	15.83
Variety (V_3)	47.94	47.82	47.88	9.72	10.09	9.91	35.98	35.19	35.58	14.56	14.89	14.72
C.D.	N.A	N.A	1.80	0.87	1.32	0.92	1.81	2.98	2.29	1.04	1.22	1.06
S.E (m)	0.64	0.78	0.58	0.28	0.42	0.29	0.58	0.959	0.74	0.33	0.39	0.34
S.E (d)	0.90	1.10	0.82	0.39	0.59	0.41	0.82	1.36	1.04	0.47	0.55	0.48

Table 2: Mean performance of French bean varieties with respect to Pod characters under cold temperate conditions of Gurez Valley.

Treatments	Pod length (cm)			Pod girth (cm)			Pod weight (gms)			Pod yield/plant (gms/pl)			Pod per hac (qtls)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
Variety (V_1)	13.54	14.34	13.94	0.98	0.95	0.97	5.28	5.39	5.33	166.41	165.21	165.81	173.04	171.90	172.47
Variety (V_2)	12.46	12.58	12.52	0.89	0.89	0.89	4.37	4.47	4.42	161.05	159.13	160.10	166.14	163.76	164.95
Variety (V_3)	11.47	11.41	11.44	0.83	0.85	0.82	4.04	4.19	4.12	155.61	155.51	155.26	160.42	158.83	159.62
C.D	1.29	0.83	1.02	N.A	1.32	0.09	0.47	0.43	0.45	4.82	4.10	3.21	3.65	3.34	2.31
S.E (m)	0.41	0.37	0.33	0.08	0.42	0.029	0.15	0.14	0.14	1.03	1.03	0.34	1.17	1.07	0.74
S.E (d)	0.58	1.10	0.46	0.035	0.59	0.041	0.22	0.19	0.19	1.47	1.46	0.48	1.66	1.51	1.05

Table 3: Mean performance of French bean varieties with respect to Pod quality attributes under cold temperate conditions of Gurez Valley.

Treatments	Pod T.S.S (Brix)°			Vitamin C content (mg/100g)			Protein content (%)			Anthocyanin content (µg⁻¹)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
Variety (V₁)	8.72	8.73	8.72	14.75	14.74	14.73	1.98	1.99	1.97	15.06	15.15	15.11
Variety (V₂)	8.65	8.66	8.63	14.52	14.52	14.52	1.90	1.92	1.88	14.07	14.14	14.10
Variety (V₃)	8.57	8.56	8.56	14.44	14.41	14.42	1.83	1.85	1.83	13.92	14.06	14.00
C.D	0.09	0.07	0.08	0.13	0.16	0.14	0.081	0.067	0.07	0.55	0.57	0.45
S.E (m)	0.03	0.024	0.027	0.043	0.050	0.046	0.025	0.021	0.024	0.17	0.18	1.95
S.E (d)	0.042	0.034	0.038	0.061	0.070	0.065	0.036	0.035	0.033	0.246	0.254	2.76

CONCLUSIONS

Among three Varieties of vegetable beans which were sown at three location of Gurez valley (lower, middle and upper zone) revealed that the variety V_1 (Shalimar French Bean-1) recorded maximum values of growth, yield and quality attributes as compared with other two varieties Pusa Phalguni and Anupama. The variety V_1 is therefore more suitable and recommended for cultivation in all the three different locations of Gurez valley. In future more different varieties of Vegetable beans will be evaluated for Gurez valley in order to improve the nutritional security of the region having a limited growing season.

Conflict of Interest. None.

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