Original Research Article

Performance of different varieties of French Bean (*Phaseolus vulgaris* L.) under Prayagrajagro-climatic condition

ABSTRACT

The present investigation was carried out at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during the rabi season 2022-23 with a view to check performance of different varietiesof French Bean under Paryagrajagro climate condition and to estimate economic of different varietiesof French Bean . Varietiescomprised of**V1**(IET/2022/FBBVAR-1),**V3**(IET/2022/FBBVAR-3),**V4**(IET/2022/FBBVAR-4),**V5**(IET/2022/FBBVAR-5),**V6** (IET/2022/FBBVAR-6),**V7 (**Lakshmi), **V8(**Ellora No.11)Among different varietiesof French bean $\mathbf{V_3}$ performed best in terms of various parameters such as day to germination , plant height, no.of branches, no. of leaves, days to first flowering, first picking days to 50% flowering , number of pod per plant, pod weight, fruit yield per plant, yield per hectare, total soluble solids (TSS), protein(%), fiber(%), ascorbic acid(mg), and maximum benefit-cost(B:C) ratio was obtained in $\mathbf{V_3}$ IET/2022/FBBVAR-3**(5.9)**

Comment [MOU1]: Keywords?

1.INTRODUCTION

French beans*(Phaseolus vulgaris L.)*, come in two types: climbing pole beans and bush beans (also called snap beans, and formerly known as 'string beans' due to their fibrous strings, which are nearly nonexistent now due to selective breeding). Within these, varieties include green, cream, yellow, flecked, and purple French beans. Unlike runner beans, this legume only produces pods once and must be replanted. The primary difference French Bean and other green beans is the narrow pod and less string. French beans is popular as a dietary food. Also known as kidney bean, snap bean, navy bean, haricot bean, common bean. They come in multiple colours and sizes. Green pod are rich in Ca, K, P and Fe Seeds are highly protein.Major growing states are A.P, MH, T.N, Gujrat and W.B.

Comment [MOU2]: Specifythefamilygroup of French beans (*Phaseolusvulgaris*L.).

Comment [MOU3]: Abbreviations should be written in their full form when they are first used.

Growing French Bean in the Prayagraj region. poses several challenges. Firstly, the region experiances hot and dry summers, which can lead to water stress for French Bean plants, requiring efficient irrigation systems. Secondly, the high humidity during the monsoon can promote the spread of fungal diseases like powdery mildew and downy mildew, necessitating careful disease management practices. Additionally, the region is prone to pest infestations such as aphids and whiteflies, demanding proper pest control strategies. The soil in some areas may lack essential nutrients, requiring appropriate soil amendments and fertilization to support French Bean growth. Finally, extreme weather events like hailstorms and heavy rains can damage French Bean plants and reduce yield.

Addressing these challenges through proper water management, disease control, pest management, and soil improvement practices is crucial for successful French Bean cultivation in Prayagraj. Few local varieties have gained importance in Uttar Pradesh climatic conditions. Varietal evaluation in a group of cultivars is a prerequisite for a successful breeding program, Thus, study was done to evaluate the best performing varietiesas compared to local variety of French bean. There are many good performing varieties which are available in the market also. According to Prayagrajagro-climatic conditions French Bean can be grown successfully with higher yield. In view of the above-mentioned facts, the present study on the varietal evaluation of French Bean varieties under Prayagrajagro- dimatic condition.

Comment [MOU4]: Where are the source citations?

2.MATERIAL AND METHOD

Table 1. List of varieties

Comment [MOU5]: The table arrangement should be organized according to the specified format.

Notation	Name of varieties
V1	**IET/2022/FBBVAR-1**
V3	**IET/2022/FBBVAR-3**
V4	**IET/2022/FBBVAR-4**
V5	**IET/2022/FBBVAR-5**
V6	**IET/2022/FBBVAR-6**
V7	**Lakshmi**
V8	**ELLORA No.11**

Comment [MOU6]: Please provide a detailed description of the varieties that were used.

The present investigation was done to understand the plant growth,fruit yield and quality of pod of different varietiesof French Bean.The experiment was conducted in the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (U.P) during 2022 – 2023. The experiment was laid out in randomized block design (R.B.D.) with 8 varietiesand 3 replications.Varietiescomprised of **V1**(IET/2022/FBBVAR-1),**V3**(IET/2022/FBBVAR-3),**V4**(IET/2022/FBBVA4),**V5**(IET/2022/FBBVAR-5),**V6**(IET/2022/FBBVAR6),**V7(**Lakshmi),**V8(**Ellora No.11).of French bean. French bean was planted in the field at a spacing of 60cm×15cm in plot of 3.5×3M m size. Normal cultural practices and plant protection measures were followed during the cultivation process. Plants were selected at random from each plot of each variety as representative sample for recording the data.

Comment [MOU7]: Which varieties?

Comment [MOU8]: Specify the field in which the applications were carried out, such as open field, greenhouse environment, or controlled conditions. Materials and methods should be further elaborated. What are the normal cultural practices? What kind of practices were carried out? How often were the treatments carried out? If so, what were their characteristics and values? Were the climatic and atmospheric conditions, as well as edaphic factors, taken into account during the study? It is important to provide a detailed explanation of their impact on the study. The material and methods section should be reviewed and rewritten for clarity and logical structure.

3. RESULT AND DISCUSSION

3.1 Day to germination and plant height (cm)

Table 2 depicts the data pertaining to Day to germination and plant height Among the different varietiesof FrenchBean evaluated, variety (V1)(IET/2022/FBBVAR-1) show minimum day to germination (4.67 D.A.S)which are significantly different than the other varieties.Among the different varieties of French Bean evaluated, variety (V7) LAKSHMI show maximum plant height (204.33cm). which are significantly different than the other varieties.Environmental factors such as sunlight exposure, temperature, and soil fertility can also influence plant growth. Varieties that are well-suited to the specific environmental conditions of a particular region or have been selectively breed for longer plant height may demonstrate better performance in terms of plant height.

3.2 Number of Branches and number of leaves

Table 2 depicts the data pertaining thenumber of Branches and number of leaves Among the different varieties of French Bean evaluated, variety V3(IET/2022/FBBVAR-3)show maximum number of branches (14.47)which are significantly different than the other varieties . Among the different varieties of French bean evaluated, variety(V7) LAKSHMI show maximum number of leaves(247.50). which are significantly different than the other varieties .The superior performance of one varietiesover another in terms of vegetative growth no. of branches and no.of leaves can be attributed to a combination of genetic factors and environmental conditions. Varieties with genetic traits that promote no. of leaves, such as enhance the internode elongation or increased branching, can exhibit greater plant growth.. Varieties that are well-suited to the specific environmental conditions of a particular region or have been selectively bred for longer plant height may demonstrate better performance in terms of plant height.

3.3 Days to First flowering, 50%Flowering and Days to First Fruit Harvest

Table 3 depicts the data pertaining to Days to First flowering and 50%Flowering and Days to First Fruit Harvest. Among the different varieties of French Bean evaluated, variety (V1)IET/2022/FBBVAR-1 show minimum day to first flowering (36.00D.A.S) which are significantly different than the other varieties.Among the different varieties of French Bean evaluated, variety(V1)IET/2022/FBBVAR-1 show minimum day to 50% flowering (45.50 D.A.S) which are significantly different than the other varieties.Among the different varietiesday of 1stpickling.(V1)IET/2022/FBBVAR-1 show minimum day to first picking (46.00 D.A.S) which are significantly different than the other varieties.The better performance of one varietiesover another in terms of earliness in flowering and maturing can be attributed to genetic factors and environmental conditions. Varieties with genetic traits that promote early flowering, such as early maturation genes or shorter vegetative growth phases, can exhibit faster initiation of flowering. Additionally, environmental factors such as temperature, photoperiod, and nutrient availability can influence flowering and maturing time. Varieties that are genetically predisposed to respond more favourable to the prevailing environmental conditions, or those that have been selectively bred for early flowering, may show superior performance in terms of early initiation of flowering and maturing.

3.4 Number Pods Per Plant, pod Length, pod girth and 1 pod Weight(g).

Comment [MOU9]: The conclusion and discussion sections require rewriting to conform to the article's format. The discussion section lacks citations, making it unsuitable for a research paper. To support your work, include studies that either support or contradict your findings.

Table 3 depicts the data pertaining to number of pod per plant, fruit length, diameter and fruit weight. Among the different varieties of FrenchBean evaluated, variety (V3)IET/2022/FBBVAR-3 show maximum pod per plant (21.67g).which are significantly different than the other varieties. Among the different varieties of French Bean evaluated, variety (V)1 IET/2022/FBBVAR-1 show maximum pod length(19.53cm)which are significantly different than the other varieties. Among the different varieties of French Bean evaluated, variety V3 IET/2022/FBBVAR-3 show maximum pod girth (3.37cm)girth which are significantly different than the other varieties Among the different varieties of FrenchBeanevaluated,variety(V3)IET/2022/FBBVAR-3 show maximum fruit weight (7.37g) show maximumfruit weight. which are significantly different than the other varieties

3.5 Pod Yield (T/ha)

Table 3 depicts the data pertaining to Yield per ha Among the different varieties of French Bean evaluated, variety (V3)IET/2022/FBBVAR-3 show maximum yield (18.16T) which are significantly different than the other varieties The better performance of one Varietiesover another in terms of enhanced fruit yield can be attributed to genetic factors and environmental conditions. Varieties with genetic traits that promote higher flower-to-fruit conversion rates, increased branching, or enhanced reproductive capacity can result in a greater yield of fruits. Additionally, environmental factors such as pollination efficiency, availability of nutrients and water, and optimal growing conditions can significantly influence fruit production. Varieties that are genetically predisposed or have been selectively bred for higher fruit yield can demonstrate superior performance in terms of overall fruit production per plant.

3.6 T.S.S.[°Brix] ,Protein (%), fiber and Vitamin C Content (mg/100g)

Table 4 depicts the data pertaining to T.S.S.[°Brix] ,Protein(%),fiber andVitaminC Content (mg/100g) Among the different varieties of French Bean evaluated, variety(V1)IET/2022/FBBVAR-1 show maximum TSS (6.40°Brix) which are significantly different than the other varieties. Among the different varieties of French Bean evaluated, variety(V1)IET/2022/FBBVAR-1 show maximum protein content (1.52%) which are significantly different than the other varieties. Among the different varieties of French Bean evaluated, variety (V1)IET/2022/FBBVAR-1 show maximum fibercontent (3.89%). which are significantly different than the other varieties. Among the different varieties of French Bean evaluated, variety (V3)IET/2022/FBBVAR-3 show maximum VitaminC content (11.77mg) which are significantly different than the other varieties. The better performance of one Varietiesover another in terms of better Total Soluble Solids (TSS), protein , fiber and vitamin C content can be attributed to genetic factors and environmental conditions. Varieties with genetic traits that promote higher sugar accumulation and improved fruit quality can result in increased TSS , protein, fiber and vitamin C content. Additionally, environmental factors such as sunlight exposure, temperature, and nutrient availability can influence the synthesis and accumulation of sugars in fruits. Varieties that are genetically predisposed or have been selectively bred for higher TSS and vitamin C content may demonstrate superior performance in terms of producing fruits with a better sugar concentration and overall quality.

Table 2. Performance of different varities of French Bean in term of germination and growth parameter

Name of Varities	Day to germination (D.A.S)	Plant height 80(DAS)	No. of branches 80(DAS)	No. of leaves 80(DAS)
IET/2022/FBBVAR-1	**4.67**	48.67	10.00	**120.33**
IET/2022/FBBVAR-3	7.00	64.00	**14.47**	183.00
IET/2022/FBBVAR-4	7.00	45.47	12.53	188.07

Comment [MOU10]: Revise the table formats and overall template of the article to comply with the article guidelines.

IET/2022/FBBVAR-5	7.37	38.73	13.57	214.93
IET/2022/FBBVAR-6	7.00	42.80	12.20	170.07
Lakshmi	7.00	**204.33**	13.57	247.50
ELLORA NO.11	8.33	53.13	12.57	153.73
F-Test	**S**	**S**	**S**	**S**
SE(d)±	0.17	0.77	0.17	3.69
CD (5)	0.36	1.66	0.36	7.91
CV%	3.35	2.15	1.84	2.83

Table 3. Performance of different varities of French Bean in term of flowering and yield

Comment [MOU11]: The alignment of tables should not exceed the text.

Name of Varities	**Day of 1st flowering (D.A.S)**	**Day of 50 %flowering (D.A.S)**	**Day of First picking (D.A.S)**	**Pod per plant**	**Pod length (cm)**	**Pod Girth (cm)**	**1Pod weight (g)**	**Yield/ha (Tone)**
IET/2022/FBBVAR-1	**24.00**	**36.00**	**46.00**	17.27	13.00	2.23	7.13	12.32
IET/2022/FBBVAR-3	36.57	45.57	55.00	**24.37**	18.47	**3.37**	**7.37**	**18.16**
IET/2022/FBBVAR-4	40.80	49.13	55.37	15.30	18.20	2.63	5.90	9.21
IET/2022/FBBVAR-5	42.33	51.00	64.00	14.87	15.50	2.63	4.17	6.25
IET/2022/FBBVAR-6	46.67	55.67	67.33	15.47	16.53	2.33	5.53	8.60
Lakshmi	52.80	61.03	75.70	21.67	**19.17**	3.17	7.10	15.29
ELLORA NO.11	45.43	54.10	65.87	17.73	15.63	2.13	5.20	9.31
F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SE(d)±	**0.37**	**0.48**	**0.54**	**0.70**	**0.19**	**0.07**	**0.03**	**0.06**
CD (5)	**0.78**	**1.02**	**1.15**	**1.50**	**0.40**	**0.15**	**0.07**	**0.14**
CV%	**1.19**	**1.06**	**1.45**	**5.42**	**1.48**	**3.54**	**3.59**	**0.79**

Table 4.Quality parameter of different varities of French Bean

Name of Varities	**TSS (°Brix)**	**Fiber (%)**	**Protein (%)**	**Vit C (mg)**
IET/2022/FBBVAR-1	**6.40**	**3.89**	**1.52**	11.76
IET/2022/FBBVAR-3	5.83	3.86	1.48	**11.77**
IET/2022/FBBVAR-4	5.40	3.84	1.47	11.57
IET/2022/FBBVAR-5	5.03	3.86	1.41	11.55
IET/2022/FBBVAR-6	5.20	3.82	1.46	11.55
Lakshmi	5.53	3.85	1.49	11.60
ELLORA NO.11	5.30	3.88	1.48	11.56
F-Test	**S**	**S**	**S**	**S**
SE(d)±	**0.09**	**0.01**	**0.01**	**0.01**
CD (5)	**0.20**	**0.03**	**0.03**	**0.03**
CV%	**2.36**	**0.50**	**1.40**	**0.14**

Table 5. Benefit cost ratio (B:C)

Name ofVarities	**Yield (t/ha)**	**Cost of cultivation**	**Gross return (Rs/ha)**	**Net return (Rs/ha)**	**Benefit**

		(Rs/ha)			cost ratio
IET/2022/FBBVAR-1	12.32	120000	544400	424400	3.5
IET/2022/FBBVAR-3	**18.16**	120000	831200	711200	**5.9**
IET/2022/FBBVAR-4	9.21	120000	416000	296000	2.4
IET/2022/FBBVAR-5	6.25	120000	278800	158800	1.3
IET/2022/FBBVAR-6	8.60	120000	393200	273200	2.2
Lakshmi	15.29	120000	611600	491600	4.0
ELLORA NO.11	9.31	120000	372400	252400	2.1

3.6 Economics of Different Varietiesof French Bean

Maximum gross returns were recorded in V3 (IET/2022/FBBVAR-3) with Rs. 831200 and the minimum was recorded in V5 (IET/2022/FBBVAR-5) Rs.278800.Maximum net returns were recorded in V3 (IET/2022/FBBVAR-3) with Rs. 711200 and the minimum Rs 158800 was recorded in V5 (IET/2022/FBBVAR-5). Maximum BC ratio were recorded in V3 (IET/2022/FBBVAR-3) with 5.9 and the minimum 1.3 was recorded in V5 IET/2022/FBBVAR-5 depicted in Table 4.

4. CONCLUSION

From the above experimental finding it is concluded that the varietiesIET/2022/FBBVAR-3 performed best in terms of growth parameters like pod length, earliness in flowering and maturity and yield parameters like fruit length, fruit diameter, and fruit yield per ha. It showed best performance for quality parameters also TSS, protein, fiber and Vitamin C content. Maximum BC ratio was obtained in varietiesIET/2022/FBBVAR-3 with value of **5.9**

REFRENCE

Hema and Rana D. K. (2020). Evaluation of French Bean (Phaseolus vulgaris L.) Genotypes for Growth, Pod Yield and Quality under Sub-Tropical Condition of Garhwal Hills.

Zeliang, P.K., Kumar, M., Kumar, R., Meena, K.L., and Rajkowa, D.J. (2019) Varietal Evaluation of French bean for Higher Productivity and Nutritional Security under the Foot Hill Ecosystem of Nagaland, Indian Journal of Hill Farming June 2019, Special Issue, Page 14-18

Anjanappa M, Reddy NS, Krishnappa KS, Murali K and Pitchaimuthu M. (2000). Performance of french bean varieties under southern dry region of Karnataka. Karnataka Journal of Agriculture Science, 13(2): 503-505.

Comment [MOU12]: The bibliography needs to be revised and structured according to the article's format. There are too few references for a research paper. The study should be supported and explained with more references.

Comment [MOU13]: References are not included in the text.

Comment [MOU14]: Be cautious of Latin software.

Das K.(2017). Varietal performance of bush type french bean varieties (Phaseolus vulgaris L.) for growth, fresh pod yield and quality. M. Sc Thesis. Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Das R , Thapa U , Debnath S , Lyngdoh YA and Mallick D. (2014). Evaluation of french bean (Phaseolus vulgaris L.) genotypes for seed production. Journal of Applied and Natural Science, 6(2): 594 – 598.

George RAT.(1985). Vegetable Seed Production. Longman, London & New York, pp:193- 207.Muthal KM. 2013. Evaluation of french bean (Phaseolus vulgaris L.) varieties for Northern dry-zone of Karnataka. M.Sc. Thesis. University of Horticultural Sciences, Bagalkot.

Pawar SU, Kharwade ML and Awari HW. (2007). Effect of plant density on vegetative growth and yield performance of different varieties of french bean under irrigated condition.Karnataka Journal of Agricultural Science, 20(3): 684-685.

Prakash J and Ram RB. (2014). Genetic variability, correlation and path analysis for seed yield and yield related traits in french bean (Phaseolus vulgaris L.) under Lucknow conditions. International Journal of Innovative Science, Engineering and Technology. 1(6): 41-50.

Rana DK and Kumar A. (2008). Performance of various french bean (Phaseolus vulgaris L.) genotypes under mid-hill condition of Garhwal Himalaya. Progressive Horticulture, 40(2): 184-186.

Sarangi SK and De LC. (2010). Varietal evaluation of french bean (Phaseolus vulgaris L.) at mid-hills of Arunachal Pradesh. Indian Journal of Hill Farming, 23(2): 53-54.

Singh AK, Singh SB and Singh V. (2009). Influence of nitrogen doses on growth and green pod yield parameters of french bean varieties during kharif season under subtropical area of Jammu region. Legume Research, 32(2): 142-144.

Yadav BVS. (2015). Performance of vegetable french bean (Phaseolus vulgaris L.) as influenced by varieties and sowing dates under Southern Zone of Andhra Pradesh. M.Sc. Thesis. Dr. Y. S. R. Agricultural University, Y. S. R. District, Andhra Pradesh.

Comment [MOU15]: What is the appropriate format for organizing references? They should be organized in a single format.