



Evaluation of Promising Genotypes of French Bean (*Phaseolus vulgaris* L.) Suitable for India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

French bean (*Phaseolus vulgaris* L) is an important leguminous vegetable grown throughout the world. Both green fleshy pods and dry seeds are used for consumption purpose. Being a meat of the poor, the crop is widely grown in India. In spite of having lot of importance, this crop suffers from poor yield resulting from very old and local varieties being grown by the farmers in North

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Eastern Region. It was the need of the hours to introduce some high yielding, stress tolerant varieties newly developed elsewhere. In view of this an investigation was undertaken at the Department of Horticulture, AAU, Jorhat on eighteen (18) french bean genotypes received from All India Coordinated Research Project on Vegetable crops. The research work involved conduct of 3 station trials, 3 state zonal trials in Assam, multilocation trials throughout the country. The trials were conducted following Randomized Block Design with three replications. The data were collected on yield and its attributes. Field observations were also made on incidence of rust and bacterial blight. In station and zonal trials, among all genotypes, Arka Anup and Arka Subidha were found to be better for green pod yield ranging from 95 – 110 q/ha. The multilocation trials conducted in different national centres exhibited average pod yield of 149.1 q/ha in Arka Anup and 141.9 q/ha in Arka Subidha. On an average there was 20 – 25% yield increase over the best check variety 'Contender'. Arka Anup was a flat poded variety whereas Arka Subidha was a round poded variety. The edible green pods were getting ready for picking at 60 - 70 days after sowing. Field observation on incidence of diseases indicated resistance reaction to rust and bacterial blight in both these varieties. In the national level also they have been found better and hence released and notified by the Central Seed Sub Committee for different states of the country covering North, Central and South India. Considering yield performance and other desirable characteristics, extensive cultivation of these varieties may be done in Assam and better performing states also.

Keywords: French bean; Arka Anup; Arka Subidha; green pod yield.

1. INTRODUCTION

French bean (*Phaseolus vulgaris* L) is the most important leguminous crop grown worldwide for human consumption [1]. In the North Eastern Region including Assam, it is an important vegetable and is grown in a wide range of agro-climatic conditions ranging from plains to high hills. Beans, being 'the meat of the poor' [2], contribute essential protein (22%) to the undernourished people living in hills. The green pods are nutritionally rich containing on an average 1.7% protein, 4.5% carbohydrate, 1.8% fibre, calcium 50 mg, magnesium 28 mg and iron 1.7 mg per 100 g of pod [3]. In India including North Eastern Region, both pole and bush type beans are grown as vegetable crop for their green pods and for dry seeds [4]. The foliage is used as fodder for animals [5] and to restore soil fertility. Being a leguminous crop it harbours symbiotic *Rhizobium* bacteria in its root nodules which fixes atmospheric nitrogen in the soil (<https://link.springer.com>). Pole type beans require bamboo sticks or jeng as support for climbing [6,7]. This involves more cost of cultivation for this crop. Farmers however depending upon their economic condition grow both bush and pole type varieties as per classification [8]. Some bush type varieties like 'Contender' and 'Pusa Parvaty' were introduced in this region long back during 1970's but due to lack of efforts to maintain genetic purity, desired yield and quality have not been achieved particularly in the plain areas [9]. In view of this, an attempt was therefore made to search for the

alternative varieties which would give higher yield with desirable quality and resistance to biotic stresses.

2. MATERIALS AND METHODS

All total eighteen (18) elite breeding lines and varieties of bush type french bean were received from different coordinating centres of the country through All India Coordinated Research Project (AICRP) on Vegetable crops. The genotypes included are presented in Table 1. With these materials including 'Contender' and 'Pusa Parvaty' as national and local check varieties, the field experiment was conducted as station trials during winter seasons at the Horticultural farm of the Assam Agricultural University, Jorhat consecutively for 3 years. The seeds were sown in first fortnight of December every year. The experiment was laid out in a randomized block design with 3 replications. The size of the plot was 3.6 m x 3.0 m with a spacing of 40 cm between rows and 20 cm between plants. The FYM and NPK were applied as per package of practices recommended for french bean in Assam. Five randomly selected plants from each plot of genotype were used for recording of data on different quantitative characters such as days to 50% flowering, days to edible pod maturity, plant height (cm), number of pods per plant, pod length (cm), pod width (cm), single pod weight (g) and green pod yield per plant (g). Recording of observations for qualitative and other characters was made as per descriptor [10]. Analysis of variance for these characters was

Table 1. List of genotypes included in the experiment

Sl. No.	Genotypes	Sl. No.	Genotypes	Sl. No.	Genotypes
1	FBBVar-1	7	FBBVar-7	13	HAFB-4
2	FBBVar-2	8	DWDFB-1	14	RCMBF-1
3	FBBVar-3	9	DWDFB-53	15	Arka Anup
4	FBBVar- 4	10	DWDFB-57	16	Arka Subidha
5	FBBVar-5	11	MFB-2	17	Pusa Parvaty (C)
6	FBBVar-6	12	IVFB-1	18	Contender (C)

done following standard statistical procedure [11]. Two better performing genotypes identified on the basis of green pod yield and its attributes were tested in 3 agro-climatic zones of Assam. The reports on the performance data of these varieties were collected from AICRP centres and incorporated in this paper.

3. RESULTS

3.1 Green Pod Yield, Component Characters and Crop duration in Station Trials

The mean pod yield performance of the genotypes in the three years' station trials revealed significant differences among the genotypes. From the mean green pod yield data the better performing genotypes among 18 were found to be Arka Anup and Arka Subidha. The mean green pod yield (q/ha) for Arka Anup and Arka Subidha along with the best check variety 'Contender' is presented in Table 2. The pod yield in Arka Anup and Arka Subidha was 99.3 and 96.4 q/ha respectively whereas it was 78.4 q/ha in the best check variety 'Contender'. Arka Anup showed better performance than the best check variety 'Contender' for pods/plant (29.4), pod length (16 cm), pod width (1.9 cm) and

single pod weight (9.0 g) whereas Arka Subidha showed better performance for pods/plant (19.6), plant height (26 cm), pod length (22.8 cm) and single pod weight (8.3 g). Both the varieties however took longer duration for flowering and edible pod maturity except Arka Anup showing shorter duration (77.8 days) for pod maturity than the best check 'Contender'.

3.2 Green Pod Yield Performance in Zonal Trials

The yield performance of these two varieties in 3 agro-climatic zones of Assam is presented in Table 3. The mean yields (q/ha) over 3 zones were 106.86 and 109.47 in Arka Anup and Arka Subidha respectively which were better than the check variety 'Contender' (85.5).

3.3 Green Pod Yield Performance in Multilocation Trials

Table 4 shows the yield performance of Arka Anup and Arka Subidha in different AICRP centers in comparison to best check variety 'Contender'. Arka Anup showed better yield performance than the check in IIHR, Almora, Barapani, Solan, HARP and Jabalpur. Arka

Table 2. Pod yield performance of Arka Anup and Arka Subidha at AAU, Jorhat

Entries/Trials	Arka Anup	ArkaSubidha	Contender ©	CD (5%)	CV (%)
Station Trials	Green Pod Yield (q/ha)				
IVT ^a	99.5	100.0	88.0	10.2	15.0
AVT-I ^b	102.3	98.5	68.3	18.5	15.2
AVT-II ^c	96.0	90.6	79.0	10.6	16.3
Mean	99.3	96.4	78.4	-	-
PC increase over check	26.5	23.0	-	-	-
Mean Over Trials					
Days to 50% flowering	39	43	36	2.7	3.0
Days to edible pod maturity	77.8	80.2	79.9	-	-
Plant height(cm)	17	26	23	4.1	18.2
Pods/plant	29.4	19.6	18.2	2.5	6.8
Pod length (cm)	16.0	22.8	14.8	1.5	4.2
Pod width (cm)	1.9	1.1	1.2	0.02	1.5
Single pod weight (g)	9.0	8.3	6.7	-	-

a: Initial Varietal Trial, b: Advance Varietal Trial – I, c: Advance Varietal Trial-II

Subidha was better in IIHR, Ranichauri, Almora, Bhubaneswar, Barapani, Solan, HARP, Srinagar and Jabalpur. The overall mean yield performance was 149.1 q/ha in Arka Anup and 141.9 q/ha in Arka Subidha which were better than the check variety (118.1 q/ha).

3.4 Morphological Characters, Disease Reaction and Others

The morphological and other characteristics of these two varieties are presented in Table 5. From the table it is apparent that Arka Anup is characterized by green stem pigmentation, sparse pod pubescence, curved and flat pod shape, creamy seed colour, resistance reaction to bacterial blight and low level of root rot incidence. Arka Subidha is characterized by light green stem pigmentation, smooth pod pubescence, straight and round pod shape, brown seed colour, resistant reaction to rust and bacterial blight and moderate root rot incidence.

4. DISCUSSION

4.1 Variation and Improvement in Yield and Other Component Characters

Genotypic variation for different agromorphological characters is a prime requirement for any breeding programme. The variation observed in different characters could be utilized in the variety improvement programme [12]. The present study with 18 genotypes for 3 years revealed highly significant variation among the genotypes for different characters. From the mean yield performance estimated over years in the station trials the genotypes showing high mean green pod yield were Arka Anup (99.3 q/ha) and Arka Subidha (96.4 q/ha) which were comparatively better than the best check variety 'Contender' (78.4 q/ha). The increase in green pod yield over the best check variety was 26.4% in Arka Anup and 23% in Arka Subidha as presented in Table 2. For most of the other

characters except days to edible pod maturity and single pod weight, there was significant difference among the genotypes. The higher green pod yield of Arka Anup might be due to higher pods per plant (29.4), pod length (16 cm), pod width (1.9 cm) and single pod weight (9.0 g). In Arka Subidha, higher pod yield was due to higher pods per plant (19.6), plant height (26 cm), pod length (22.8 cm), pod width (1.1 cm) and single pod weight (8.3 g) in comparison to the best check variety 'Contender'. Arka Anup was some days earlier in flowering and edible pod maturity than the check variety whereas Arka Subidha was later. Similar results were reported by various workers [12] in pole type common beans.

4.2 Differential Response of Genotypes to Environmental Variation

The results presented in Table 3 revealed that there was differential response of the genotypes in different zones of Assam. This was due to variation in soil and climatic conditions. Overall mean pod yield was 106.86 q/ha in Arka Anup and 109.47 q/ha in Arka Subidha in the zonal trials which was significantly higher than the check variety (85.5 q/ha). The percentage increase in green pod yield over the check variety was 24.99 % in Arka Anup and 28.03 % in Arka Subidha. The reports of differential response of genotypes to varying environmental conditions in beans have also been made by various workers [5,13].

4.3 Increase in Yield in Different Multilocation Trials in the National Level

The trialwise pod yield performance of Arka Anup and Arka Subidha in better performing AICRP centres is presented in Table 4. The mean pod yield performance of the varieties over centres was 149.1 q/ha in Arka Anup which was 22.41% higher than the best check variety

Table 3. Performance of French bean genotypes in different climatic zones of Assam

SI No.	Zones	Demonstration Plots	Pod Yield in (q/ha)		
			Arka Anup	ArkaSubidha	Contender ©
1	UBVZ ^a	Farmer's Field I	110.3	118.7	80.5
2	LBVZ ^b	Farmer's Field II	120.5	122.5	90.5
3	NBPZ ^c	KVK, Napam	89.8	87.2	85.5
4	Mean		106.86	109.47	85.5
5	(%) increase over check		24.99	28.03	

a: Upper Brahmaputra Valley Zone, b: Lower Brahmaputra Valley Zone, c: North Bank Plain Zone

Table 4. Performance of Arka Anup and Arka Subidha in AICRP Centres other than Jorhat

SI No.	Name of the Centres	Trial	Pod Yield Performance (q/ha)		
			Arka Anup	Arka Suvidha	Contender ©
1	IIHR ^a	IET ^b	189.0	-	179.0
		AVT-I	95.4	-	67.6
		AVT-II	-	188	157
2	Ranichauri	AVT-II	-	125	110
3	Almora	IET	130.55	-	121.3
		AVT-I	95.4	90.8	67.6
4	Bhubaneswar	AVT-II	-	66.3	65.0
5	Barapani	AVT-I	109.9	114.0	101.0
6	Solani	AVT-I	158.1	158.3	131.2
		AVT-II	-	88.2	82.8
7	HARP	AVT-I	341.8	273.9	235.0
		AVT-II	-	129.1	102.3
8	Srinagar	AVT-II	-	185.2	129.2
9	Jabalpur	IET	73.1	73.1	72.0
Average yield of varieties over centres			149.1	141.9	118.1
(%) increase in yield of the varieties over check			22.41	20.15	

a: Indian Institute of Horticultural Research, b: Initial Evaluation Trial

Table 5. Morphological and other characters of the French bean genotypes

SI. No.	Characteristics	Description	
		Arka Anup	Arka Subidha
1	Early Plant vigour	Good	Good
2	Plant growth habit	Bush	Bush
3	Stem pigmentation	Green	Light green
4	Flower wing colour	White	White
5	Leaflet length (cm)	11.6	11.8
6	Leaflet width (cm)	8.2	8.6
7	Leaflet shape	Linear lanceolate	Linear lanceolate
8	Pod colour	Light green	Light green
9	Orientation of pods	Prostate	Prostate
10	Leaf peak shape	Short beak	Straight
11	Pod pubescence	Sparse	Smooth
12	Pod shape	Curved	Straight
13	Pod curvature	Slightly curved	Straight
14	No. of marketable pod harvest	3	4
15	Green pod yield per plant (g)	200	180
16	Seed colour	Creamy	Brown
17	Seed mottling	Absent	Absent
18	Seed length (mm)	20	19
19	Seed width (mm)	10	9
20	No. of seeds per plant	8	10
21	100 seed weight (g)	1.0 – 1.2	1.1 – 1.3
22	Abiotic stress susceptibility	No or very low	No or very low
23	Biotic notes	Restt. to bacterial blight	Restt. to rust & bact. blight
24	Root rot incidence	Low	Moderate
25	Cost-benefit ratio	4.3	4.7

'Contender'. The mean pod yield performance of Arka Subidha was 141.9 q/ha which was 20.2 % higher than the best check variety [14,15]. The results were in close conformity with the findings of various workers [14,15].

4.4 Morphological Characterization, Disease Reaction and B:C Ratio

Table 5 shows the morphological and other characteristics of the two varieties. Arka Anup was having dark green leaf pigmentation whereas Arka Subidha had light green pigmentation. Pod shape is flat and little curved in Arka Anup and it is round and straight in Arka Subidha. Field study for occurrence of diseases has indicated that both the varieties were resistant to bacterial blight. Arka Subidha was resistant to rust also. Root rot incidence was low in previous one whereas it was moderate in later one. The estimated B:C ratios for these varieties

were found to be 4.3 for Arka Anup and 4.7 for Arka Subidha which were similar to earlier findings [16]. The report of growing french bean as cash generating crop in hills has also been made from different places [17]. Considering all these facts, Arka Anup and Arka Subidha have been recommended for commercial cultivation in Assam and North Eastern States of India. In the national level also these two varieties have been released and notified by the Central Seed Sub Committee for different states covering North, Central and South India. They may be used in the breeding programmes also for further improvement.



Fig. 1. Arka Anup



Fig. 2. Arka Subidha

5. CONCLUSION

From the investigation it could be concluded that Arka Anup and Arka Subidha were the better performing french bean varieties which have been recommended for release in the state of Assam. Accordingly, varieties may be adopted for commercial cultivation in Assam and North East India. In the national level, both the varieties have been released and notified for different states such as Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Madhya Pradesh, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala and Lakha Deep. The varieties have been conserved at NBPGR, New Delhi (Accession Nos. IC 585622 and IC 393734 respectively). In view of the yield performance, consumer preference and taste, the varieties are gaining popularity in the state of Assam. They may be used for breeding programmes also for further improvement. The seeds of the varieties are available at IIHR, Bangalore.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Singh SP. Improvement of small seeded race Mesoamerican cultivars, In S.P. Singh (ed.) Common Bean Improvement in the Twenty First Century, Kluwer, Dordre. 1999;225 – 274.
2. Pandey YR, Gautam DM, Thapa RB, Sharma MD, Paudyal KP; 2011. Variability of French Bean in the Western Mid Hills of Nepal. *Kasetsart J. Nat. Sci.* 2008;45:780 – 792.
3. Shanmugavelu KG. Production technology of Vegetable Crops. Oxford and IBH Private Ltd. New Delhi. 1989;446 – 461.
4. Nath P, Srivastava VK, Dutta OP, Swamy KRM. French bean. In *Vegetable Crops, Improvement & Production*, PNASF. 2008;110- 113.
5. Pandey YR, Gautam DM, Thapa RB, Sharma MD, Paudyal KP. Response of pole type French bean (*Phaseolus vulgaris* L.) genotypes for sowing dates in the mid hills of Western Nepal. *Nepal J. of Science and Technology.* 2012;13(2):15 – 20.
6. Pramanik K, Sahu GS, Acharya GC, Tripathy P, Dash M, Koundinya AV, Jena C, Kumar DS, Mohapatra PP, Pradhan J, Karubakee S. Estimating phenotypic stability for relevant yield and quality traits in French bean (*Phaseolus vulgaris* L.) using AMMI analysis. *Heliyon.* 2024;10(5).
7. Ibram AA, Taidi YH, Benoit CLL, Jean BNT, Adamou I. Diallel analysis of common bean (*Phaseolus vulgaris* L.) genotypes for seed dietary fibre, carbohydrate, calcium and phosphorus contents. *Journal of Applied Genetics.* 2024;1-0.
8. Swarup V. Leguminous vegetable – French Bean. In *Vegetable Science and Technology in India*, Kalyani Publishers. 2006;479 – 488.
9. Ram HH. French bean, In *Vegetable Breeding, Principles and Practices*. Kalyani Publishers. 2005;256 -273.
10. IBPGR. Descriptor list of *Phaseolus vulgaris*. International Bureau of Plant Genetic Resources, Rome. 1982;32.
11. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers, ICAR, New Delhi; 1978.
12. Kalauni S, Pant S, Lutei BP, Bhandari B. Evaluation of pole type French bean (*Phaseolus vulgaris* L.) genotypes for Agro-morphological variability and yield in the mid hills of Nepal. *International J. of Horticulture.* 2019;9(3):15-23.
13. Chauhan A, Lad DB, Bhagat AA, Gondhali BV. Evaluation of French bean (*Phaseolus vulgaris* L.) genotypes under different environments during rabi season. *The Pharma Innovation Journal.* 2023; 12(8):1489 – 1494.

14. Kumar PA, Smitha GB, Hanuman BC, Rekha MV, Nagaraja R. Impact of Frontline demonstration on French bean variety Arka Sarath. Int. J. Pure. App. Biosci. 2018;6(4):324-327.
15. Patu K, Zeliang AK, Kumar R, Meena KL, Rajkhowa DJ. Varietal evaluation of French bean for higher productivity and nutritional security under the foot hill ecosystem of Nagaland. Indian J. of Hill Farming. 2019;14 – 18.
16. Phukan RM, Das S. Assessing the performance of French bean genotypes under Red River region of Assam State, India. Journal of Emerging Technologies and Innovative Research. 2021;8(11):114 – 116.
17. Nanpane RK, Vaidya ML. Development of improved production technology of *Phaseolus* beans to the hills of mid western Nepal, In proceeding of the first stakeholders meeting, NGLRP, Rampur, Nepal. 2002;5-11.

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