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Performance evaluation of French bean (*Phaseolus vulgaris* L.) varieties Arka Komal and Arka Sukomal in different agro-climatic zones of Assam

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Abstract

The present study was carried out to evaluate the performance of French bean varieties namely Arka, Komal and Arka Sukomal as compared to the check variety Serengeti in five different agro climatic zones of Assam during year 2021-22. During the study the varieties were evaluated for different growth and yield characters along with the consumer preference based on organoleptic value and economics of cultivation. Among the three varieties, Arka Sukomal was found to be significantly superior considering majority of the studied characters like longest crop duration (98.67 days), highest plant height (197.21 cm), maximum numbers of leaves (69.67) and pods per plant (62.86), highest pod weight (13.18 g) and highest pod length (19.95 cm). The results also revealed that the variety Arka Sukomal is the most preferred variety with a significantly high organoleptic score of 8.13 in 10 scale and at the same time Arka Sukomal is significantly the highest yielder (20.75 t/ha) and records the highest B:C ratio of 3.51. With these results, this can be recommended that as per the performance of the pole type French bean variety Arka Sukomal, which exhibited highest yield as well as highest organoleptic score, is over all the best performer and hence may be recommended for commercial cultivation in the 5 different agro climatic zones of Assam.

Keywords: Performance, French, Arka Komal, Arka Sukomal, *Phaseolus vulgaris* L.

Introduction

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) [2]. 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) [11]. And among the North eastern states Assam is the highest producer of beans with an annual production of 27.47 thousand metric tonnes (NHB database, 2018) [11].

There are two major types of French bean found in the market today- bush type and pole type. The majority of the available hybrid French bean are less preferred by the consumers due to presence of the smell while cooking and farmers are lacking the varieties with all the referred characters such as high yielding, disease resistance and at the same time with high cooking quality and organoleptic value. Indian institute of Horticultural Research, Bengaluru has been involved in development of different varieties of French bean varieties and Krishi Vigyan Kendras are evaluating some of these varieties in different districts belonging to different agro climatic zones of Assam. The present study was undertaken to evaluate the performance of French bean varieties Arka Komal and Arka Sukomal, developed by IIHR, Bengaluru in context of Assam.

Materials and Methods

The present study was undertaken in 5 agro-climatic zones of Assam (Table 1). The experimental areas considered) during 2021-22 involving three French bean varieties, Arka Komal, Arka Sukomal and a popular variety Serengeti considered as check. The experimental design considered was Randomized Block design with eight replications and three varieties.

Table 1: The experimental areas considered

Sl. No.	Agro-climatic Zone	KVKs involved in conducting the study
1	Upper Brahmaputra Valley Zone	Dibrugarh and Sivasagar
2	Central Brahmaputra Valley Zone	Nagaon, Morigaon
3	North Bank Plain Zone	Sonitpur, Darrang
4	Lower Brahmaputra Valley Zone	Kokrajhar
5	Hill Zone	Karbi Anglong

French bean varieties were cultivated considering the recommended package and practices and during the study, different growth characters of the plant as well as the pod were recorded along with the yield parameters, economics of cultivation and the consumer preference based on the organoleptic evaluation. The analysed results revealed that the mean sum of square due to treatment were significant at 5% level for almost all the traits.

The growth and yield parameters like, duration from sowing

to Harvest (days), days to 50% flowering, days from sowing to 1st harvest, crop duration (days), plant height (cm), number of leaves per plant, number of pods per plant, pod weight (g), pod diameter (cm), pod length (cm), pod colour, pod shape, organoleptic Organoleptic score in terms of taste (10 scale), fresh pod yield per plant (g), yield (t/ha) and B:C ratio were recorded.

Results and Discussion

The evaluated data from the study are represented in Table. 2 (General observation on timeline of growth and growth parameters), Table. 3 (Mean performance of French bean varieties with respect to Pod characters), Table. 4 (Mean performance of French bean varieties with respect to Consumer preference, Yield and Production economics) along with the significant differences present among the varieties and Table 5 (Correlation among different characters studied).

Table 2: General observation on timeline of growth and growth parameters

Name of the French bean Varieties	Duration from sowing to Harvest (days)	Days to 50% flowering	Days from sowing to 1st harvest	Crop duration (days)	Plant height (cm)	Number of leaves per plant	Number of pods per plant
Arka Komal	4.91	39.12 ^b	53.51 ^b	74.30 ^b	45.01 ^b	36.16 ^b	26.04 ^b
Arka Sukomal	5.03	45.42 ^a	61.34 ^a	98.67 ^a	197.21 ^a	69.67 ^a	62.86 ^a
Serengeti (Check)	5.23	41.76 ^b	53.00 ^b	79.63 ^b	48.72 ^b	40.08 ^b	32.44 ^b
SE(d)	0.234	1.54	2.034	2.906	7.207	4.203	4.985
C.D.	N/A	3.334	4.404	6.292	15.607	9.102	10.796

(Values with same superscript have no significant differences)

Timeline of growth and mean performance w.r.t. growth parameters

Among the three tested varieties, no significant difference could be observed with respect to time taken for germination of the seeds, whereas, the pole type variety Arka Sukomal was found to take longest time w.r.t. days to 50% flowering (45.42 days), longest time duration from sowing to 1st harvest (61.34 days) and longest crop duration (98.67 days) and all these records are significantly higher than the rest two varieties Arka Komal and Serengeti (check). Considering these three parameters, the later varieties show no significant variation (Arka Sukomal: 39.12 days to 50% flowering, 53.51 days to first harvest and 74.30 days of crop duration and Serengeti: 41.76 days to 50% flowering, 53.00 days to first harvest and 79.63 days of crop duration).

The pole type variety of French bean under the study recorded the significantly highest plant height (197.21 cm), highest number of leaves (69.67) and number of pods (62.86) per plant. The other two varieties, Arka Komal and Serengeti,

both being the shrub type French bean varieties, recorded no significant difference w.r.t. plant height (Arka Komal 45.01 cm and Serengeti 48.72 cm), number of leaves (Arka Komal 36.16 and Serengeti 40.08) and number of pods (Arka Komal 26.04 and Serengeti 32.44) per plant. The growth characters of French beans like plant height, 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 although may be sometimes effected by environmental condition, availability of nutrients and other management factors (Hema and Rana, 2020) [5]. 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 plant height were reported by Alghamdi (2007) [1], Neupane *et al.* (2008) [6], Yadav (2015) [12], Das (2017) [3] and Dhakal *et al.* (2020) [4].

Table 3: Mean performance of French bean varieties with respect to Pod characters

Name of the French bean Varieties	Pod weight (g)	Pod diameter (cm)	Pod length (cm)	Pod colour	Pod shape
Arka Komal	11.17 ^b	1.128 ^a	14.46 ^b	Pale (Light) Green	Flat, straight
Arka Sukomal	13.18 ^a	0.986 ^b	19.95 ^a	Green	Oval, Straight, slightly bent at tip
Serengeti (Check)	6.84 ^c	0.773 ^c	13.07 ^b	Shiny dark Green	Round, slender, slightly curved
SE(d)	0.582	0.035	0.784	-	-
C.D.	1.259	0.075	1.699	-	-

(Values with same superscript have no significant differences)

The fresh pod characteristics of French bean varieties

The average pod weight and pod diameter of the three varieties are significantly different from each other; the maximum pod weight being recorded by Arka Sukomal (13.18g), followed by Arka Komal (11.17g) and minimum

pod weight as recorded in case of the check variety Serengeti with the smallest pods weighing 6.84g per pod. Similarly, considering the diameter of the fresh pods, Arka komal was found to have the maximum pod diameter (1.128 cm) which is significantly higher than Arka Sukomal (0.986 cm) and

Serengeti (with significantly lowest value of pod diameter of 0.773 cm). The maximum (19.95 cm) length of pod was observed in Arka Sukomal which was found to be significantly superior over other two varieties, and other two varieties Arka Komal (pod length: 14.46 cm) and Serengeti (Pod length: 13.07 cm) were found to have pod lengths that are statistically at par with each other. Considering the pod

colour and pod shape Arka Sukomal pods are pale (light) green in colour and are flat type and straight in shape, whereas, Arka Sukomal pods are Green in colour with pod shape being oval, straight and slightly bent at tip. In case of check variety Serengeti, the fresh pods are found to possess shiny dark green colour with round, slender, slightly curved pod shape.

Table 4: Mean performance of French bean varieties with respect to Consumer preference, Yield and Production economics

Name of the French bean Varieties	Organoleptic score in terms of taste (10 scale)	Fresh pod yield per plant (g)	Yield (t/ha)	B:C ratio
Arka Komal	7.19 ^b	249.23 ^b	14.19 ^c	2.86 ^b
Arka Sukomal	8.13 ^a	734.79 ^a	20.75 ^a	3.51 ^a
Serengeti (Check)	6.49 ^c	266.74 ^b	15.56 ^b	3.10 ^b
SE(d)	0.295	77.157	0.701	0.129
C.D.	0.639	167.088	1.518	0.279

(Values with same superscript have no significant differences)

Consumer preference based on organoleptic score, yield and benefit: cost ratio

Based on the organoleptic scores given by the consumers based on taste (in 10 scale), the maximum value was recorded in Arka Sukomal (8.13), which is significantly superior than other two varieties, followed by Arka Komal (7.19) having significantly higher organoleptic score than that of check variety Serengeti (6.49). The variety Arka Sukomal was found to produce maximum weight of fresh pod per plant (734.79g per plant) and overall highest yield per hectare (20.75t/ha), both of which are significantly higher than Arka Komal

(Fresh pod yield: 249.23 g per plant and yield: 14.19 t/ha) and the check variety Serengeti (Fresh pod yield: 266.74 g per plant and yield: 15.56 t/ha), respectively. It is important to mention that among the three varieties under the study, the average yield of Arka Komal was significantly the lowest, whereas, the B: C ratio of Arka komal (2.86) is at par with the B: C ratio in case of Serengeti (3.10). But the significantly highest B: C ratio found in case of Arka Sukomal has proved this pole type variety as the most profitable one among all three in the different agro-climatic zones of Assam.

Table 5: Parameters Number of leaves per plant Fresh pod yield per plant

Parameters	Days to 50% flowering	Days to 1st harvest	Crop duration	Plant height	Number of leaves per plant	Number of pods per plant	Pod weight	Pod diameter	Pod length	Fresh pod yield per plant	Yield (t/ha)
Days to 1st harvest	0.885 ^{NS}										
Crop duration	0.976 ^{NS}	0.965 ^{NS}									
plant height	0.917 ^{NS}	0.997 [*]	0.982 ^{NS}								
number of leaves per plant	0.948 ^{NS}	0.987 ^{NS}	0.995 ^{NS}	0.996 ^{NS}							
number of pods per plant	0.965 ^{NS}	0.976 ^{NS}	0.999 [*]	0.990 ^{NS}	0.998 [*]						
pod weight	0.397 ^{NS}	0.779 ^{NS}	0.589 ^{NS}	0.730 ^{NS}	0.668 ^{NS}	0.625 ^{NS}					
pod diameter	-0.310 ^{NS}	0.169 ^{NS}	-0.094 ^{NS}	0.093 ^{NS}	0.008 ^{NS}	-0.048 ^{NS}	0.749 ^{NS}				
pod length	0.812 ^{NS}	0.991 ^{NS}	0.920 ^{NS}	0.977 ^{NS}	0.956 ^{NS}	0.937 ^{NS}	0.858 ^{NS}	0.302 ^{NS}			
fresh pod yield per plant	0.922 ^{NS}	0.996 ^{NS}	0.984 ^{NS}	1.000 ^{**}	0.997 [*]	0.991 ^{NS}	0.722 ^{NS}	0.083 ^{NS}	0.975 ^{NS}		
Yield (t/ha)	0.985 ^{NS}	0.952 ^{NS}	0.999 [*]	0.973 ^{NS}	0.989 ^{NS}	0.996 ^{NS}	0.551 ^{NS}	-0.140 ^{NS}	0.902 ^{NS}	0.975 ^{NS}	
B:C ratio	0.998 [*]	0.910 ^{NS}	0.987 ^{NS}	0.939 ^{NS}	0.965 ^{NS}	0.978 ^{NS}	0.449 ^{NS}	-0.256 ^{NS}	0.844 ^{NS}	0.942 ^{NS}	0.993 ^{NS}

When the correlation among the important growth and yield attributing characters were calculated out, plant height was found to have significant positive correlation with fresh pod yield per plant, similarly, number of leaves per plant showed significant positive correlation with fresh pod yield per plant and number of pods per plant. Significantly positive correlation is also present among crop duration, number of pods per plant and yield. Although not significant, yet high level of positive correlation of yield can be seen with Days to 50% flowering, Days to 1st harvest, plant height, number of leaves per plant, number of pods per plant, pod length, fresh pod yield per plant and B:C ratio. Similar results were also reported and supported by Singh *et al.*, (2009) [10], Patel *et al.*, (2011) [8], Prakash and Ram (2014) [9] and Hema and Rana (2020) [5].

Conclusion

On the basis of findings recorded from different locations of the state of Assam during the study, it may be concluded that,

the IIHR developed pole type French bean variety Arka Sukomal is found to be the highest yielder with highest consumer preference and at the same time it is found to be the most profitable variety with respect to all the yield attributing characters as well as highest B:C ratio among all three tested varieties under the study considering five different agro-climatic zones of Assam and therefore this variety may be considered for commercial cultivation of French bean in the state of Assam.

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