

Influence of Sowing Dates on Growth and Yield of French bean (*Phaseolus vulgaris* L.) Varieties under Rayalaseema Region of Andhra Pradesh

B. Venkata Subbaiah Yadav¹, B. Srinivasulu², P. Syam Sundar Reddy³ and M. Balakrishna⁴

¹Dept. of Vegetable Science H.C & R.I, Anantharajupet, Rly. Kodur, Y.S.R. Kadapa (Dist), Andhra Pradesh-516105, India

²Dept. of Horticulture Horticultural Research Station, DCMS Buildings, Kamala nagar, Ananthapuramu (Dist), Andhra Pradesh-515001

³Dept. of Horticulture H.C & R.I, Anantharajupet, Rly. Kodur, Y.S.R. Kadapa (Dist), Andhra Pradesh-516105

⁴Dept. of Soil Science H.C & R.I, Anantharajupet, Rly. Kodur, Y.S.R. Kadapa (Dist), Andhra Pradesh-516105
E-mail: ¹subbaiah.bairagani@gmail.com

Abstract—An experiment was conducted during rabi 2013-14 to study the performance of French bean (*Phaseolus vulgaris* L.) varieties at variable sowing dates. The study was conducted in a randomized block design with factorial concept with four sowing dates viz., second fortnight of October, first fortnight of November, second fortnight of November and first fortnight of December and four varieties viz., Aparna, Arka Anoop, Arka Sharath and Arka Suvidha. There were sixteen treatment combinations replicated thrice. Significant variation was observed for all characters in present investigation due to different sowing dates and varieties of French bean. Among the different sowing dates, first fortnight of November recorded higher plant height (44.48 cm) and number of primary branches plant⁻¹ (6.37) at harvest. First fortnight of December recorded minimum number of days to first flowering (32.37) and first pod picking (44.82). Maximum number of pods plant⁻¹ (26.32) were recorded with second fortnight of October sowing which was superior to all other dates of sowing. The green pod yield was significantly higher (167.51 g plant⁻¹ and 94.68 q ha⁻¹, respectively) when the crop was sown during second fortnight of October. However the pod length (15.14 cm) and pod width (0.92 cm) were found to be higher from first fortnight of November sown crop. Arka Sharath recorded maximum plant height, number of primary branches plant⁻¹, number of pods plant⁻¹ and pod length (43.69 cm, 6.32, 24.09 and 15.33 cm respectively) at harvest. Arka Suvidha was found to be early with respect to number of days to first flowering and first pod picking (33.08 and 46.23 respectively). While Arka Anoop recorded maximum pod width (1.01 cm). Highest green pod yield per plant and per hectare (156.27 g and 87.37 q) was obtained with Arka Sharath.

1. INTRODUCTION

French bean (*Phaseolus vulgaris* L.) known by various names viz., bush bean, common bean, haricot bean, kidney bean, navy bean, pole bean, rajma, and snap bean. India ranks first in dry bean production (4.89 million MT from 11.0 million ha) and fourth in green bean production (0.586 thousand MT harvested from 0.209 million ha) [1]. (Anonymous, 2010).

Having short duration and being a nutritious legume vegetable crop with dual uses both for green pods and dried seeds and owing to its higher productivity and remunerative price in the market, French bean is spreading to non-traditional areas and has become popular with some of the pulse growers of Andhra Pradesh. Though, French beans are cultivated in a limited extent in certain areas of coastal Andhra Pradesh, it is relatively a new crop to the farmers in Rayalaseema region of Andhra Pradesh. Not much information is available on its varietal suitability, best time of sowing and crop response to resource situation. The farmers who have been cultivating this crop during rabi season often failed to get good crop due to improper time of sowing and cultivation of local varieties. Selection of a high yielding variety suitable to the growing environment and identification of optimum sowing time are of paramount importance for getting high and sustainable yield with high quality produce.

2. MATERIAL AND METHODS

A field experiment was conducted at H.C&R.I, Anantharajupet is situated in the Rayalaseema region of Andhra Pradesh at 13°59'44.3688" North latitude, 79°19'45.4296" East longitude at an elevation of 162 m above MSL. The study was conducted in a randomized block design with factorial concept with four sowing dates viz., second fortnight of October (S₁), first fortnight of November (S₂), second fortnight of November (S₃) and first fortnight of December (S₄) and four varieties viz., Aparna (V₁), Arka Anoop (V₂), Arka Sharath (V₃) and Arka Suvidha (V₄). There were sixteen treatment combinations replicated thrice. The experimental field was ploughed once with mould board plough and harrowed twice to bring the soil to fine tilth. Stubbles and weeds were removed from the experimental site. Ridges and furrows were opened at a spacing of 60 cm. Plot size of 4.5 m²

was maintained for each treatment seeds were sown with a spacing of 60 cm between rows and 20 cm between plants sown in the field at 4-5 cm deep two seeds per hill. Thinning was done 15 days after sowing by retaining one seedling per hill. Recommended dose of manures (well decomposed FYM @ 20 t ha⁻¹) along with chemical fertilizers (30 kg N, 80 kg P₂O and 60 kg K₂O ha⁻¹) were applied to the soil at the time of last ploughing and neem cake @ 250 kg ha⁻¹ was applied while forming ridges. Nitrogen @ 30 kg ha⁻¹ was top dressed at 30 DAS. N, P and K fertilizers were applied in the form of Urea, Single super phosphate and Muriate of potash, respectively. The data were recorded on five randomly taken plants for plant height, number of primary branches plant⁻¹, number of days to first flowering and first pod picking, number of pods plant⁻¹, pod length (cm), pod width (cm), pod yield plant⁻¹ (g) and pod yield ha⁻¹ (q). The data recorded at harvest. Data were analysed statistically by following the method of analysis of variance proposed by [**]Panse and Sukhatme (1985). Critical difference was calculated wherever 'F' test was found significant at 5 per cent probability level and values were furnished.

3. RESULTS AND DISCUSSION

3.1 Plant height (cm)

The experimental results revealed that crop sown during first fortnight of November recorded higher plant height (44.48 cm) at harvest which was on par with second fortnight of October sowing (43.80 cm). The plant height decreased with delay in sowing. The lower plant height was recorded with first fortnight of December (36.06 cm) which was on par with second fortnight of November (38.97 cm) (Table 1).

The increase in plant height in early sown crop was due to more growing period and favourable temperatures (18.1-29.8°C) and the decrease in plant height in late sown crop was due to lower temperatures (17.3-18.1°C) prevailed during early growth phase of the crop. These results are in conformity with the findings of [6] in French bean.

Among French bean varieties, Arka Sharath recorded higher plant height (43.69 cm) at harvest which was on par with Arka Anoop (42.22 cm) and Arka Suvidha (41.02 cm). Aparna recorded lower plant height (36.38 cm) (Table 1).

Differential response of varieties to plant height might be due to their genetic character and adaptability to growing environment. [11] were of similar opinion with respect to this trait in French bean.

3.2 Number of primary branches plant⁻¹

With regard to sowing time, the crop sown during first fortnight of November recorded more number of primary branches plant⁻¹ (6.37) at harvest which was closely followed by the crop sown during second fortnight of October (6.32) while, less number of primary branches plant⁻¹ was recorded

during first fortnight of December (5.62) followed by second fortnight of November (5.93) (Table 1).

Maximum number of primary branches plant⁻¹ in early sowings may be due to the fact that early sowing resulted in better vegetative growth because of more growing season and favourable environment. The number of primary branches plant⁻¹ decreased with delay in sowing owing to less plant height. These results were also in line with the earlier findings of [3] in French bean.

The French bean variety, Arka Sharath recorded significantly more number of primary branches plant⁻¹ (6.32) at harvest which was statistically similar with Aparna (6.07). Whereas, Arka Anoop recorded less number of primary branches plant⁻¹ (5.87) followed by Arka Sharath (5.98) (Table 1).

Branching is basically a genetic character but environmental conditions and farming practices also influence the number of branches plant⁻¹. The results of the present study indicated that number of branches plant⁻¹ was significantly affected by varieties. [9] made similar reports in French bean.

3.3 Days to first flowering

Among different sowing dates of French bean, first fortnight of December sown crop recorded minimum number of days to first flowering (32.37) followed by second fortnight of November (33.78) (Table 1). The second fortnight of October recorded maximum number of days to first flowering (36.70) followed by first fortnight of November (35.48).

The reason for variation in days to first flowering in French bean may be attributed to variation in growing environment particularly the temperature due to different sowing times. Days taken to first flowering decreased with delay in sowing. [7] reported that the earlier planting resulted in longer time for flowering, compared with late planting in French bean.

The shortest period for first flowering was observed with Arka Suvidha (33.08 days) whereas, longest period for first flowering was observed with Aparna (36.20 days). Arka Anoop and Arka Sharath took 34.18 days and 34.87 days, respectively for first flowering (Table 1).

Days to first flowering indicate earliness or tardiness of a variety. In the present study, the variety Arka Suvidha was earliest in first flowering. The reason for early flowering in Arka Suvidha might be because of its suitability to the growing environment and higher capacity of plants to make available assimilates to the reproductive site during sensitive phase before initiation. Similar observations were made by [2] in French bean.

3.4 Days to first pod picking

Number of days required for first pod picking decreased with delay in sowing. Among different sowing dates, first fortnight of December recorded significantly less number of days to first pod picking (44.82) over the other sowing dates viz.,

second fortnight of November (46.70) and first fortnight of November (48.65). Second fortnight October recorded more number of days to first pod picking (50.13) (Table 1).

In the present study, it was observed that early sowing took more time for first flowering and first pod picking while, late sowing took less time for first flowering and first pod picking. The possible reason for early pod picking in late sown crop of French bean might be due to early termination of vegetative phase and initiation of reproductive stage as compared to early sown crop. Similar results were elucidated by [7] in French bean.

The French bean variety, Arka Suvidha recorded less number of days for first pod picking (46.23) when compared to other varieties. Arka Anoop (47.48), Arka Sharath (48.00) and Aparna (48.58) were the other varieties in the order of number of days taken for first pod picking (Table 1).

The varieties, Arka Suvidha and Arka Anoop which were in forefront with respect to first flowering had yielded an early crop compared to other varieties. Earliness for the first pod picking in Arka Suvidha and Arka Anoop may be due to their greater capacity for accumulation of more synthates in less time that favoured induction of early flowering and fruiting and/or due to the genetic make-up of the varieties as reported by [5] in *Dolichos* bean.

3.5 Number of pods plant⁻¹

Significant variation was observed among different sowing dates of French bean (Table 2). The data recorded on this trait with respect to sowing dates revealed that the maximum number of pods plant⁻¹ was produced by the crop sown during second fortnight of October (26.32) over other sowing dates such as first fortnight of November (24.88) and second fortnight of November (21.45). The minimum number of pods plant⁻¹ was produced by the crop sown during first fortnight of December (17.18). Second fortnight of October and first fortnight of November were on par with each other.

In the present study, more number of pods plant⁻¹ was obtained with early sown crop whereas, less number of pods plant⁻¹ was obtained with late sown crop. The variation in pod number might be due to variation in climatic factors owing to different sowing times. These results are in consonance with the findings of [13] in French bean.

Regarding varieties, it was noted that Arka Sharath produced highest number of pods plant⁻¹ (24.09) which was significantly superior over other varieties (Table 2). The variety, Arka Anoop produced lowest number of pods plant⁻¹ (21.70) and it was statistically on par with Arka Suvidha (21.98) and Aparna (22.06).

The reason for more number of pods plant⁻¹ in Arka Sharath and Aparna may be attributed to more number of primary branches plant⁻¹ and due to genetic makeup of the variety. Similar results were also reported by [11] in French bean.

3.6 Pod length (cm)

Maximum pod length was observed during first fortnight of November sown crop (15.14 cm) followed by second fortnight of October (14.80 cm) and second fortnight of November (14.21 cm) which were on par with each other. Minimum pod length was observed during first fortnight of December sown crop (13.65 cm) (Table 2).

The maximum pod length in early sowings of second fortnight of October and first fortnight of November may be due to favourable temperatures for pod development, more number of ovules fertilized and also due to more vegetative growth as compared to late sowings where less number of ovules fertilized and plants were not vigorous. These findings agree with the reports of [3] in French bean.

The variety Arka Sharath recorded maximum pod length (15.33 cm) (Table 2). Arka Anoop (15.10 cm) and Arka Suvidha (14.77 cm) remaining statistically at par were next to Arka Sharath with regard to pod length. The variety Aparna recorded minimum pod length (12.59 cm).

The variation in length of pods of French bean varieties observed in the present study may be due to their inherited traits and to some extent by environmental factors. The variability for pod length in different varieties of French bean was also reported by [4].

3.7 Pod width (cm)

The experimental results revealed that first fortnight of November sown crop recorded higher pod width (0.92 cm) which was identical with October second fortnight sown crop (0.89) (Table 2). The lower pod width recorded with first fortnight of December sowing (0.81 cm) was identical with second fortnight of November sowing (0.85 cm).

The pod width was found high in early sowing as compared to late sowing. The reason might be the effect of low temperatures which retarded the plant growth as well as pod growth. [7] also reported similar findings in French bean.

Among French bean varieties, Arka Anoop recorded higher pod width (1.01 cm) followed by Arka Suvidha (0.86 cm) which was statistically similar with Arka Sharath (0.82 cm). Aparna recorded lower pod width (0.78 cm) (Table 2).

The variation in pod width of French bean varieties was most probably due to their inherited traits and to some extent by environmental factors. [4] stated similar reports in French bean crop.

3.8 Green pod yield plant⁻¹ (g)

Time of sowing had a profound influence on green pod yield of French bean. Sowing during second fortnight of October recorded significantly maximum green pod yield plant⁻¹ (167.51 g) which was on par with sowing during first fortnight of November (163.93 g) while, minimum green pod yield plant⁻¹ was recorded with first fortnight of December

(98.43 g) followed by second fortnight of November sown crop (127.69 g) (Table 2).

The climate prevailing during early sowings i.e., second fortnight of October and first fortnight of November was perhaps favourable for better vegetative growth of plant and lead to the formation of higher photosynthates which ultimately resulted in higher fresh pod yield plant⁻¹ in French bean. Green pod yield plant⁻¹ decreased with delay in sowing. The reduction in yield under late sown conditions could be attributed to poor development of yield attributes, i.e., number of clusters plant⁻¹, number of pods cluster⁻¹, number of pods plant⁻¹, pod length, pod width and pod weight due to low minimum temperatures prevailed during reproductive phase of the crop. [12] opined similar results in French bean.

Among the French bean varieties, Arka Sharath recorded maximum green pod yield plant⁻¹ (156.27 g) followed by Arka Anoop (145.19 g) which was statistically similar with Arka Suvidha (136.82 g). The variety Aparna recorded minimum green pod yield plant⁻¹ (119.28 g) (Table 2).

Different varieties of French bean, having different genetic potential are known to respond differentially to similar management practices and exactly the same was also noticed in the present study. The superiority of Arka Sharath and Arka Anoop over the other varieties with respect to yield components and yield may be due to their genetic potential to utilize the growth resources effectively and translocate photosynthates from source to sink. These results are in consonance with the findings of [4] in French bean and [5] in Dolichos bean.

3.9 Green pod yield ha⁻¹ (q)

Sowing during second fortnight of October resulted in maximum green pod yield (94.68 q ha⁻¹) closely followed by first fortnight of November (92.28 q ha⁻¹). Sowing during first fortnight of December resulted in minimum green pod yield (53.70 q ha⁻¹) followed by second fortnight of November (72.34 q ha⁻¹) in French bean (Table 2).

Higher green pod yield ha⁻¹ was obtained with early sowings whereas, lower green pod yield ha⁻¹ was obtained with late sowings in French bean. The reports of [8] in French bean agree with the findings of present study.

The variety Arka Sharath recorded higher green pod yield (87.37 q ha⁻¹) which was on par with Arka Anoop (82.23 q ha⁻¹) (Table 2). Aparna recorded lower green pod yield (66.22 q ha⁻¹) followed by Arka Suvidha (77.18 q ha⁻¹). Green pod yield ha⁻¹ was the computed value from the green pod yield plot⁻¹ and is directly correlated.

[8] reported similar results in French bean.

It is because of those divine blessings I got this opportunity to work under the inspiring and expert guidance of my major adviser and chairman of the advisory committee Dr. B. Srinivasulu and members Dr. P. Syam Sundar Reddy and M.

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Table 1: Influence of sowing dates and varieties on growth and floral characters in French bean

Treatment	Plant height (cm)	Number of primary branches plant ⁻¹	Days to first flowering	Days to first pod picking
Date of sowing				
Second fortnight of October (S ₁)	43.80	6.32	36.70	50.13
First fortnight of November (S ₂)	44.48	6.37	35.48	48.65
Second fortnight of November (S ₃)	38.97	5.93	33.78	46.70
First fortnight of December (S ₄)	36.06	5.62	32.37	44.82
S.Em±	1.29	0.10	0.10	0.14
CD (P<0.05)	3.73	0.30	0.30	0.42
Varieties				
Aparna (V ₁)	36.38	6.07	36.20	48.58
Arka Anoop (V ₂)	42.22	5.87	34.18	47.48
Arka Sharath (V ₃)	43.69	6.32	34.87	48.00
Arka Suvidha (V ₄)	41.02	5.98	33.08	46.23
S.Em±	1.29	0.10	0.10	0.14
CD (P<0.05)	3.73	0.30	0.30	0.42

Table 2: Influence of sowing dates and varieties on yield and yield attributes in French bean

Treatment	Number of pods plant ⁻¹	Pod length (cm)	Pod width (cm)	Green pod yield plant ⁻¹ (g)	Green pod yield ha ⁻¹ (q)
Date of sowing					
Second fortnight of October (S ₁)	26.32	14.80	0.89	167.51	94.68
First fortnight of November (S ₂)	24.88	15.14	0.92	163.93	92.28

Second fortnight of November (S ₃)	21.45	14.21	0.85	127.69	72.34
First fortnight of December (S ₄)	17.18	13.65	0.81	98.43	53.70
S.Em±	0.57	0.36	0.02	3.83	2.21
CD (P≤0.05)	1.65	1.04	0.06	11.06	6.37
Varieties					
Aparna (V ₁)	22.06	12.59	0.78	119.28	66.22
Arka Anoop (V ₂)	21.70	15.10	1.01	145.19	82.23
Arka Sharath (V ₃)	24.09	15.33	0.82	156.27	87.37
Arka Suvidha (V ₄)	21.98	14.77	0.86	136.82	77.18
S.Em±	0.57	0.36	0.02	3.83	2.21
CD (P≤0.05)	1.65	1.04	0.06	11.06	6.37

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