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Evaluation of Planting Dates and Varieties of Pole Type French Bean (*Phaseolus vulgaris* L.) in Southern Odisha

Dipankar Jana, Smaranika Mohanta, Subhrajyoti Chatterjee, Arvind T., Preety Behera

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ABSTRACT

For any crop production, the time for sowing seeds and different promising varieties is important for economical yield. Suitable varieties availability is a major lacking factor as a pole type French bean cultivation in Odisha during off-time. Very little information is available on different aspects of pole type cultivation of French bean cultivation in the Southern part of Odisha. The present investigation was conducted at Post Graduate Research Farm, Centurion University of Technology and Management, Paralakhemundi, Odisha during early *rabi* 2022. The experiment was carried out the for the performance study of four different planting dates (3rd September, 18th September, 2nd October and 17th October) and five French bean varieties (Ayoka-427, Gloria, Akamsha, Raikia Bean, Moraleda) in Split Plot Design with three replications. The result of the experiment revealed the effect of planting dates in the highest plant height, minimum days took to first flowering, days to 50% flowering, maximum primary branch number, number of green pods per cluster, number of green pods per plant, average green pod weight, green pod length, pod width, pod yield per plant and green pod yield per hectare was observed on 17th October which was noted statistically similar or followed by the planting date 2nd October. Among the varieties, Ayoka-427 and Raikia Bean excelled in other varieties in different growth parameters, flowering, yield and yield attributes. Hence it can be concluded that Ayoka-427 and Raikia Bean may be suggested to the farmers to cultivate in October month under the Southern part of Odisha.

Keywords Pole type, French bean, Planting dates, Varieties, Growth, Flowering, Yield.

INTRODUCTION

French bean (*Phaseolus vulgaris* L., 2n=2x=22), an important oldest Leguminous vegetable crop originated in middle America (Mexico and Central America) and in the Andes of South America (Brucher 1988). It is also known as kidney bean, pole bean, common bean, dry bean, green bean, string bean, tepary bean, snap bean, haricot bean, bush bean, dwarf bean and rajma (dry seed). It is majorly cultivated for its tender pods as vegetables, dried seeds used as pulses and foliage is used as fodder for animals (Pandey *et al.* 2012). It is used as a folk medicine for bladder burn,

Dipankar Jana[1], Smaranika Mohanta[2]*, Subhrajyoti Chatterjee[3], Arvind T.[4], Preety Behera[5]

[2, 3]Assistant Professor (Horticulture), [4] Assistant Professor (Plant Pathology), Centurion University of Technology and Management, Odisha 761211, India

Email : smaranika.mohanta@cutm.ac.in
*Corresponding author

dysentery, dermatitis, rheumatism, sciatica, tenesmus, diabetes and kidney problems (Duke 1981) and due to low glycaemic index, it is suitable for consumption for diabetic patients (Hosseinpour-Niazi *et al.* 2015). The demand for fresh pods prevails around the year but supply is restricted to winter months (Chatterjee *et al.* 2015). 'Raikia' is one type of pole French bean locally cultivated as a rainfed crop from year to year in some hilly regions of Odisha and has more demand in South Odisha due to its fleshy and good yielding in off-season and prized for its taste. Due to low temperatures in the high hills of G. Udayagiri of Kandhamal district and R. Udayagiri of Gajapati district, the "Raikia" French bean is cultivated in off-season using trellis planting systems. It fetches very good prices in the local market as well as while exporting to the coastal part of Odisha. Odisha is not self-sufficient for domestic consumption of French bean and extremely depends upon supply from other adjacent states during on-season and off-season. Due to heavy rainfall in *kharif* season, pole type French bean cultivation is not possible in plain and coastal areas of Odisha. Farmers have very few varietal options in pole type French bean due to the lack of high-yielding improved varieties, availability in local areas and some genotypes are susceptible to diseases and pests. Further, the productivity of French bean in Odisha is very low, due to unscientific cultivation and farmer's dependency on the local market for seeds that are poor in germination and quality. They do have not adequate knowledge about different varieties except "Raikia bean" released by public and private organizations in pole type beans which are suitable in *kharif* and early *rabi* season. Thus, it is very essential to evaluate the planting dates and performance of different varieties of pole type French bean in Southern Odisha with the objective of finding out of growth, flowering and yield of pole type French bean varieties.

MATERIALS AND METHODS

A field experiment was conducted at Post Graduate Research Farm, Centurion University of Technology and Management, Paralakhemundi, Odisha during the early *rabi* season of 2022. The experiment was laid out in Split Plot Design (SPD) with three replications and twenty treatment combinations. The main plot treatments consisted of four planting dates (3rd September, 18th September, 2nd October and 17th October) while sub-plot treatments consisted of five varieties (Ayoka-427, Gloria, Akamsha, Rakia Bean and Moraleda). The sowing of seeds of these varieties was done on raised beds of 4.5 m × 2.3 m size with a spacing of 70 cm from row to row and 40 cm from plant to plant with a seed rate of 25 kg ha^{-1}. The main plots were separated by a sub-plot 75 cm and the irrigation channel 75 cm distance. The recommended FYM @ 20 t ha^{-1} and fertilizers dose 50:80:50 kg NPK ha^{-1} were applied for the growing of pole type French bean. Farm yard manure is well decomposed, half the amount of nitrogen as urea (46% N) and potash as Muriate of Potash (60% K_2O) and a full dose of phosphorus as single super phosphate (16 % P_2O_5) were mixed at the time of field preparation as basal application. The rest half amount of nitrogen and potash were applied as top dressing 30 and 45 days after sowing. The observations on various traits were recorded from randomly five selected plants for twelve parameters such as growth parameters (plant height (cm) and number of primary branches per plant), flowering parameters (days to first flowering and days to 50% flowering), number of green pods per cluster, days to 1st harvest of green pod, average green pod weight (g), green pod length (cm), green pod width (mm), number of green pods per plant, green pod yield per plant (g), green pod yield per hectare (t ha^{-1}). The data were analyzed statistically by following the standard ANOVA techniques and the difference between the treatment means was tested as for their statistical significance with an appropriate critical difference (CD) value at 5% level of significance (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Effect of planting dates and varieties on growth parameters

Planting dates significantly influenced the plant height has been presented in Table 1. The highest plant height and maximum number of primary branches per plant was recorded in the second fortnight of October which was statistically followed by the planting date 2nd October. Results revealed that the plant height increased with delay in sowing. The shortest plant height and the minimum number of primary branches per plant were

Table 1. Effects of planting dates and varieties on growth, flowering and yield.

Treatments	Plant height (cm)	Number of primary branches per plant	Days to first flowering	Days to 50% Flowering	Number of green pods per cluster	Number of green pods per plant	Average green pod weight (g)	Green pod length (mm)	Green pod yield per plant (g)	Green pod yield per ha (t ha^{-1})
					Planting dates					
3rd September	254.5^{c}	2.5^{b}	42.9^{c}	52.1^{c}	2.6^{d}	43.3^{d}	8.3^{c}	14.2^{b}	235.3^{d}	7.0^{d}
18th September	259.0^{c}	2.6^{b}	39.4^{b}	47.1^{b}	3.1^{c}	49.1^{c}	9.0^{c}	14.1^{b}	478.8^{c}	12.9^{c}
2nd October	270.5^{b}	2.9^{a}	33.4^{a}	41.5^{a}	3.5^{b}	56.1^{b}	10.0^{b}	15.2^{a}	736.9^{b}	18.6^{b}
17th October	286.2^{a}	3.3^{a}	32.9^{a}	40.5^{a}	4.0^{a}	62.3^{a}	11.0^{a}	15.3^{a}	872.2^{a}	22.4^{a}
SEm (±)	1.5	0.1	0.2	0.5	0.1	0.5	0.2	0.3	10.9	0.2
CD (0.05)	5.2	0.3	0.7	1.8	0.2	1.8	0.7	0.9	37.8	0.6
					Varieties					
Ayoka-427	260.2^{cd}	3.3^{a}	33.5^{a}	42.0^{a}	4.1^{a}	65.1^{a}	8.6^{b}	15.9^{b}	642.2^{a}	17.3^{a}
Gloria	270.3^{b}	2.5^{b}	35.9^{b}	43.2^{ab}	3.0^{c}	51.1^{c}	7.6^{c}	12.0^{d}	548.0^{c}	14.2^{c}
Akamsha	255.0^{d}	2.5^{b}	37.2^{c}	44.1^{b}	3.1^{c}	47.0^{d}	7.7^{c}	13.0^{c}	543.1^{c}	13.9^{d}
Raikia Bean	285.5^{a}	3.1^{a}	41.8^{d}	54.0^{c}	2.7^{d}	42.7^{e}	16.1^{a}	19.8^{a}	579.2^{bc}	15.8^{b}
Moraleda	266.8^{cd}	2.7^{b}	37.3^{c}	43.3^{ab}	3.5^{b}	57.6^{b}	7.9^{c}	12.8^{c}	591.5^{b}	14.8^{c}
SEm (±)	3.9	0.1	0.3	0.5	0.1	0.4	0.2	0.2	13	0.2
CD (0.05)	11.4	0.2	1	1.4	0.2	1	0.6	0.7	37.5	0.5

obtained on the planting date of 3rd September which was statistically at par with 18th September. Sowing of seeds in the month of September received more rainfall which was not supportive of good growth and development as compared to October sowing. It was indicated the suitability of October planting than September planting for early *rabi* French bean in this region. A similar result was noted in growth parameters by Kamble *et al.* (2007) in French bean, Bayrak *et al.* (2022) in Dry bean, Wakweya *et al.* (2016) and Uddin *et al.* (2017).

The data revealed that different varieties were statistically significant in plant height and the number of primary branches per plant has been presented in Table 1. The highest plant height was recorded in the variety Raikia Bean and the highest number of primary branches per plant was recorded in Ayoka-427 which was noted statistically at par with the variety Raikia Bean. Different responses of varieties on plant height may result may be due to differences in their inherent genetic configuration. Similar results were reported by Uddin *et al.* (2017) in French beans. Angadi and Patil (2017) observed that highly significant differences showed in the number of branches plant^{-1} in French bean.

Effects of planting dates and varieties on flowering Traits

Early flowering leads to early production of crops which can fetch higher market prices (Mohanta and Mandal 2019). Early flowering and early maturing varieties are preferable for the off-season cultivation of French bean as hike the market price at that time. The data on different planting dates and varieties effects revealed a significant variation for the trait days to first flowering, days to 50% flowering and number of flowers per cluster have been represented in Table 1.

The minimum days taken to first flowering, days to 50% flowering and maximum number of flowers per cluster in planting dates were recorded on 17th October which was noted statistically at par with planting on 2nd October. The maximum days to first flowering and number of days taken for 50% flowering and the minimum number of flowers per cluster was recorded on the planting date 3rd September. A similar result was noted in days taken to the first flowering Kakon *et al.* (2017) in French bean and Bayrak *et al.* (2022) in dry bean.

Days to first flowering indicate earliness of a

variety. The result was observed that minimum day to first flowering, days to 50 % flowering and number of flowers per cluster was taken by the variety Ayoka-427, which was followed by the variety Gloria and variety Moraleda. Whereas, the maximum day to first flowering and maximum days to 50% flowering was recorded in the variety Raikia Bean. Sahu (2014) observed that in French bean "Raikia" took more time for flowering because of its trailing growth habit. The minimum number of flowers per cluster was recorded in the variety Raikia Bean. A similar report was noted by Whankate *et al.* (2021) in French bean.

Effects of planting dates and varieties on yield and yield attributing traits

The different planting dates and varieties were statistically significant in the number of green pods per cluster, days to first harvest of the green pod and average green pod weight, green pod length, green pod width, green pod yield per plant and green pod yield per hectare (t ha^{-1}) have been presented in Table 1. Planting dates and varieties play an important role in determining the yield of any crop including French bean.

Among the planting dates, the highest number of green pods per cluster was noted on the 4th planting 17th of October closely followed by the 3rd planting date on the 2nd of October and the 2nd planting date 18th of September. Days to first harvest of green pod is a very important parameter for earliness which fetches the higher market price. The minimum days to first fruit harvest were recorded when planted on 17th October, which was statistically at par with the planting date on 2nd October. Planting on 1st week of September was noted maximum days to first harvest of green pod. The result revealed that French bean seed sowing in October given early pod harvesting as compared to September harvesting, it might be due to early termination of the vegetative phase and initiation of the reproductive stage as compared to early sown crop. These outcomes are consistent with those of Saglam *et al.* (2000) in pole bean. Single pod weight and number of pods per plant significantly increase the yield per hectare. Average green pod weight was noted significantly influenced by different planting dates. The maximum average green pod weight was recorded when planted on 17th October which was followed by 2nd October planting. The minimum average green pod weight was recorded on 3rd September, which was noted statistically at par with when planting on 18th September. These results are consistent with those of Bayrak *et al.* (2022) in dry bean were of similar opinions with respect to average green pod weight. Green pod width and length determine the shape and size of pod. The maximum green pod length was recorded when planted on 17th October which was statistically at par with 3rd planting date 2nd October. The minimum green pod length was recorded on 18th September which was further statistically at par with planted on 3rd September. Similar reports on French bean given by Begum *et al.* (2003), Sharma *et al.* (2013) and Rao (2022). With regard to pod width, the results revealed that the planting date 17th October was recorded higher green pod width, which was followed by when planted on 2nd October. Data revealed the October planting gave maximum results on fruit parameters as compared to September planting. The cause could be the result due to higher rainfall and late towards the *rabi* due to decrease temperature the fruit quality may be better. Moniruzzaman *et al.* (2007) in French bean, Pandey *et al.* (2012) in French bean and Bayrak *et al.* (2022) in dry bean reported similar findings in pod length. Yield is a complex quantitative trait which is controlled by many growth and yield traits. Maximum green pod yield per plant was observed when sown on 17th October which was followed by 2nd October. While minimum green pod yield per plant was recorded on 3rd September. The results corroborate the findings of Kharbamon *et al.* (2015) in Indian bean. Data revealed that due to rainfall, temperature effect under early sown, the plant growth, fruit development like pod weight, pod width and pod length and food material accumulation was very low which directly affect yield. Green pod yield per hectare was significant differences among planting dates in green pod per hectare. The maximum green pod yield per hectare was obtained, when seed sowing was done on 17th October, which was followed by planting on 2nd October. The minimum green pod yield per hectare was recorded when planting was done on 3rd September. The climate prevailing (rainfall) during late sowings (October month) was per-

haps favorable for better growth and development of crops as compared to September sowing. October sowing lead to the formation of higher photosynthates and translocation to sink 'the pods', which ultimately resulted in higher green pod yield per plant. The reduction of yield under early sown conditions poor development of yield attributes, i.e. number of pods per plant and pod weight. The results are in agreement with the findings of Kharbamon *et al.* (2015) on Indian bean.

Significant differences were observed among varieties of French bean for the number of green pods per cluster, days to the first harvest of the green pod and average green pod weight, green pod length, green pod width, green pod yield per plant and green pod yield per hectare (t ha^{-1}). The variety Ayoka-427, has proved itself as the best, with respect to the number of green pods per cluster, which was followed by the variety Moraleda. Muthal *et al.* (2018) also noted a similar result in the number of green pods per cluster. Ayoka-427 varieties recorded fewer days to first harvest pods per plant, which was followed by the variety Gloria and Raikia Bean varieties recorded more days to first harvest pods per plant as compared to other varieties. The results are in agreement with the findings of Pandey *et al.* (2011) in French bean. The maximum average green pod weight was recorded in the variety Raikia Bean, which was followed by the variety Ayoka-427. The lower average green pod weight was obtained in Gloria, which was noted statistically at par with the variety Moraleda and Akamsha. Differential response of varieties to average green pod weight might be due to their genetic character and adaptability to the growing environment. Similar variations in the average pod weight of French bean genotypes were reported by Dhakal *et al.* (2020) in French bean, Baruah *et al.* (2022) and Subedi *et al.* (2022) in French bean. Among all the varieties, Raikia Bean was observed the longest green pods length and pod width, which was followed by the variety Ayoka-427. The shortest green pod length and width were noted in Gloria. Whankate *et al.* (2021) in French bean, Baruah *et al.* (2022) in French bean and Choudhary *et al.* (2020) in Indian bean also observed significant results in green pod length and width. Among the French bean varieties, Ayoka-427 recorded maximum green pod yield per plant, which was followed by Moraleda and was statistically similar to Raikia Bean. The minimum green pod yield per plant recorded in variety Gloria, was further statistically at par Akamsha. The results are in agreement with the observations recorded by Jena (2003) in French bean variety is the most potent factor in any crop production program and also greatly vary in their performance on yield under different agro-climatic condition noted by Luitel *et al.* (2021). Green pod yield per hectare was significantly influenced by different varieties. The maximum green pod per hectare was recorded in variety Ayoka-427 which produced pod yield per hectare which was followed by variety Raikia Bean. The lower Average Green pod per hectare was obtained in Akamsha. Noor *et al.* (2014) and Luitel *et al.* (2021) observed significant variation found in green pod yield per hectare Similar findings were reported by Muthal *et al.* (2018) in French bean, Choudhary *et al.* (2020) in Indian bean and Dhakal *et al.* (2020) in French bean. The inherent genetic configuration coupled with environmental influences might be responsible for the difference in different yield parameters in these five varieties.

CONCLUSION

From this study, it concluded that appropriate planting dates and improved varieties can substantially increase productivity. The maximum green pod yield per hectare was observed in the second fortnight of October planting with the variety Ayoka-427 and the variety Raikia under the Southern part of Odisha.

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