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RESEARCH ARTICLE

Front line demonstration: An effective way of dissemination of technology of yard long bean in Dakshina Kannada district of Karnataka, India

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Abstract

Front line demonstrations (FLD) on high-yielding yard-long bean variety Arka Mangala were conducted at KVK Dakshina Kannada during 2021-22, 2022-23, and 2023-24 with 30 farmers. The FLD was conducted with farmers' active participation to disseminate improved yard-long bean technology to achieve production potential. The improved technology consisted of the incorporation of high-yielding variety, foliar spray of vegetable special (2 g/lit.), drenching of Arka Microbial Consortium (20 g/lit), balanced use of fertilizer application, integrated pests, and disease management. Front line demonstration data were recorded to Plant height (cm), No. of branches, Pod length (cm), No. of pods/plant and Yield q/ha as compared to the farmer's local practice. The improved variety Arka Mangala results recorded the maximum green pod yield with 202.83 q/ha and 114.67 q/ha in the Local variety. In addition to the high yield of variety Arka Mangala, lower values of technology gap, extension gap, and index existed. The improved technology gave higher gross and net returns with a higher benefit-cost ratio in yard long bean compared to farmer's practices. FLD made a positive and significant impact on Yard long bean yield compared to the local variety. Most of the 'Low Yielding-Local Varieties' would be replaced in adopted villages of Dakshina Kannada.

Keywords: Benefit-cost ratio, Front line demonstration, Pod length, Yard long bean, and yield

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Introduction

Yard long bean (*Vigna unguiculata* ssp. *sesquipedalis* L.) is one of the economically important leguminous vegetable crops known as vegetable cowpea. It is also called as Chinese long bean, string bean, snake bean, snap pea with chromosome number 2n = 2x = 22 (Sarada and Rao, 2020). It is one of the most popular and cosmopolitan vegetable crops grown in many parts of India (Meena *et al*., 2016). It is a vigorous climbing annual vine. It is a variety of cowpeas grown primarily for its strikingly long (35–75 cm) immature pods and has been used very similar to that of green beans. Yard long bean is mainly grown for its immature pods, young leaves, and mature dry seeds (Afrose *et al*., 2023). The varieties of yard-long beans are usually distinguished by the different colors of their mature seeds. It is a rich and inexpensive source of vegetable protein. It enriches soil fertility by fixing atmospheric nitrogen. Because of its quick growth habit, it has become an essential component of sustainable agriculture in marginal lands of the tropics. The Yard long bean is a nutritious vegetable which supplies protein (3.5 g), calcium (72.0 mg), phosphorus (59 mg), iron

(2.5 mg), carotene (564 mg), thiamine (0.07 mg), riboflavin (0.09 mg) and vitamin C (24 mg) per 100 g of edible pods. This crop meets the greater demand for the vegetable, especially in South India and some parts of North India (Yadav et al., 2004).

Lack of awareness about the multifarious uses of yard-long beans and availability of production technology *viz.* suitable high-yielding variety, as well as poor knowledge about production practices, are ascribed as the main reason for the low popularity and productivity of yard-long beans in Karnataka. The productivity of yard-long beans per unit area could be increased by adopting recommended scientific and sustainable management production practices using suitable high-yielding varieties through FLD. Frontline demonstrations are the new concept of field growing of new variety with the main objective to demonstrate newly released crop production technologies and their management practices in the farmer's field under a different agro-climatic region of the country in diverse farming situations. While demonstrating the technologies in the farmer's field, the scientist is required to study the factors contributing to higher crop production. As there is a field constraint of production, thereby to generate production data and farmer's feedback information. Considering the above considerations, a Frontline Demonstration of High yielding Yard Long Bean Variety Arka Mangala was conducted systematically in a farmer's field to depict the worth of a new variety and convince the farmer to adopt improved production management practices to enhance the productivity of Yard long bean and to identify the technology gap, extension gap, and technology index.

Materials and Methods

ICAR-Krishi Vigyan Kendra, Dakshina Kannada, carried out Front Line Demonstrations (10 per year) from 2021-22, 2022-23, and 2023-24 with 30 farmers to spread the technology to farmers. Each frontline demonstration was laid out in a 0.4 ha area, which was taken as a demo, while an adjacent 0.4 ha was taken as a control for comparison with the farmer's practice. The farmers were selected randomly based on surveys, diagnostic visits, and farmer meetings conducted by KVK. Variety "Arka Mangala" of Yard Long was developed by ICAR-IIHR and was used in the FLD program. Arka Mangla was tested through FLD with Foliar spray of Arka Vegetable special (2 g/lit.), Drenching of Arka Microbial Consortium (20 g/lit), recommended doses of fertilizers, integrated pest and disease management and interventions compared with Local variety grown with farmers practices. The materials and inputs required under the study concerning FLD and farmer's practice are given in Table 1.

Table 1: Technological Interventions under FLD and farmers' practice

Sl. No.	*Particulars*	*Demonstration*	*Farmers practice*
1	Sowing time	Jan-Feb	Dec-Jan
2	Seed rate	3 Kg/ha	12 Kg/ha
3	FYM	25 t/ha	10-12 t/ha
4	Spacing	120 × 90 cm	90 X 60 cm
5	Fertilizer	NPK 25:75:60 Kg/ha	NPK 15:15:15 @ 50Kg/ha
6	Micronutrients	Arka Vegetable Special 2g/lit of water @ 15 days interval for 5 times	No micronutrients application
7	Microbial Consortia	Arka Microbial Consortia @5Kg/500 kg of FYM	Not practiced
8	Plant protection	Yellow and Blue sticky traps to manage aphids	Not practiced

Critical inputs, namely Arka Mangala quality seed, Arka Vegetable Special (Micronutrient Mixture), Arka Microbial Consortium, Yellow and blue sticky traps for plant protection measures were provided in FLD plots, and non-monetary inputs like timely sowing in lines and timely weeding and irrigation were performed. The KVK Scientists facilitated the FLD farmers in performing field operations during training and visits. Two off-campus trainings have been organized for the group of beneficiaries Farmers. The farmer's practice of Local variety was taken as a control (check). Field days were also conducted in each cluster to show the results of the frontline demonstration to the farmers of the same village and neighboring villages. Print and visual media were also used to disseminate the technology. In general, the soils of the area under study were acidic with an average soil pH of 5.43 was recorded. The acidic pH of the soil might be attributed mainly to the leaching of the bases due to the existing high rainfall conditions and some extent, due to the acidic parent materials. These soils are non-saline (free of soluble salts) with average electrical conductivity ranges between 0.14 dSm^{-1}. The average organic carbon content of the soil with 8.1 g kg^{-1} and was found to be high in all plots. This is attributed to the addition of plant residues and farmyard manure to surface horizons (Harish Shenoy, 2019) and receives an annual rainfall of about 3000 mm and above in hot humid climatic conditions.

Data on Yield and Yield attributing characters, expenditure incurred by the farmer (Farmer's practice), and expenditure of demonstration plots were collected and analyzed. Gross income was calculated based on local market prices of Yard Long Bean and net income by subtracting the total cost of cultivation from gross income. The B: C ratio was computed by dividing gross returns by the cost of cultivation.

To estimate the technology gap, extension gap, and technology index, the following formulae were used as suggested by (Sagar and Chandra, 2004; Dayanand et al., 2012; Kumar, 2013; Kumar, 2014a; Kumar 2014b and Samui et al., 2000).

$$\text{Percent increase in yield} = \frac{\text{Demonstration yield} - \text{Farmers yield} \times 10(}{\text{Farmers yield}}$$

Figure 1: Field day of high yielding yard long bean var Arka Mangala

Technology Gap=Pi (Potential yield) – Di (Demonstration yield)

Extension Gap = Di (Demonstration yield) – Fi (Farmers yield)

Technology index = [(Potential yield – Demonstration yield/ Potential yield) × 100]

Results and Discussion

The data were pooled on different parameters and the results obtained were discussed accordingly. The Technological Interventions under FLD and farmer's practice details are given in Table 1. All the FLD farmers fully adopted the recommended package of practices where as non-FLD farmers adopted the routine practices (Figure 1).

Yield and yield attributing characters

Demonstration of high yielding yard long bean var. Arka Mangala led to a marked effect on total fruit yield. The yield performance indicators are presented in Table 2. The cumulative effect of the demonstrated package over three years revealed the maximum plant height (272.4 cm) compared to the farmer's practice (185.03 cm) and the number of branches (10.25) compared to the farmer's practice (8.71). The difference in green pod length of Arka Mangala and the Local variety was observed, maximum length was recorded in Arka Mangala (81 cm) whereas minimum in the Local variety (40.33 cm). The average number of pods per plant was recorded as maximum with 42, 40.50, and 41.50 in Arka Mangala compared to Local variety with 32.50, 30, and 33.50 in control plots during 2021-22, 2022-23 and 2023-24, respectively. The cumulative effects of technological intervention over three years revealed an average number of pods per plant in Arka Mangala noted 41.33 compared to 32 number pods per plant in the local variety. The total fruit yield per hectare under the demonstrated package recorded 200, 190, and 218.5 q/ha, while 114, 120, and 110 q/ha in control plots during 2021-22, 2022-23, and 2023-24, respectively. The cumulative effects of technological intervention over three years revealed an average total fruit yield per ha of 202.83 q/ha in the demo compared to 114.67 q/ha in control plots. Similarly, the total yield per hectare of Yard Long Bean is increased by 77.46% over the yield obtained under farmer's practice. The year-to-year fluctuations in yield and cost of cultivation can be explained based on variations in the prevailing social, economic, and microclimatic conditions of that location. The above findings were like the findings of Yusuf et al. (2013), Chaitanya et al. (2020) and Meena et al. (2016)

Economic parameters

Economic indicators, i.e., gross cost of cultivation, gross returns, net returns, and BC ratio of Frontline Demonstration, are presented in Table 3. The data revealed that net returns from the demonstration plot were substantially higher than the control plot, i.e. farmer's practice during all the years of demonstration. Average net returns from the demonstration plot were Rs. 6,07,550/ha compared to Rs 2,22,080/ha in control. The average gross expenditure from the demonstration plot recorded Rs.1,05,450/ha compared to Rs. 1,00,587 /ha in control. The average gross returns from

Table 2: Yield and yield attributing characters of Yard Long Bean

Year	Plant height (cm)		No. of branches		Pod length (cm)		No. of pods/plant		Yield q/ha		% increase over check
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check	
2021-22	272.0	172.00	10.0	8.5	75	41	42.0	32.50	200.0	114.0	75.43
2022-23	265.0	192.50	9.5	9.2	82	37	40.50	30.00	190.0	120.0	58.33
2023-24	280.2	190.60	11.25	8.42	85	43	41.50	33.50	218.5	110.0	98.63
Average	272.4	185.03	10.25	8.71	81	40.33	41.33	32.00	202.83	114.67	77.46

Table 3: Cost economics of FLD on Demonstration of High yielding Yard long bean variety Arka Mangala

Year	Yield q/ha		Gross cost of cultivation (Rs. /ha)		Gross returns (Rs. /ha)		Net returns (Rs. /ha)		Benefit Cost Ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2021-22	200.0	124.0	92,500	88,800	6,00,000	2,48,000	5,07,500	1,59,200	6.4	2.8
2022-23	190.0	120.0	1,01,750	9,6800	6,65,000	3,00,000	5,63,250	2,03,200	6.5	3.1
2023-24	218.5	140.0	1,22,100	1,16,160	8,74,000	4,20,000	7,51,900	3,03,840	6.2	3.6
Average	202.83	114.67	1,05,450	1,00,587	7,13,000	3,22,667	6,07,550	2,22,080	6.3	3.2

Table 4: Yield, extension gap, technology gap and technology index of FLD on demonstration of High yielding Yard Long Bean var Arka Mangala

Year	Yield q/ha		Potential Yield q/ha		Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
	Demo	Check	Demo	Check			
2021-22	200.0	114.0	250	165	86	50	20
2022-23	190.0	120.0			70	60	24
2023-24	218.5	110.0			108.5	31.5	12.6
Average	202.83	114.67			88.16	47.16	18.86

the demonstration plot were Rs. 7,13,000 /ha compared to Rs. 3,22,667 /ha in control plots.

Economic analysis of the yield performance revealed that the benefit-cost ratio of demonstration plots was observed to be significantly higher than control plots, i.e., farmer's practice. The benefit-cost ratios demonstrated were recorded as 6.4, 6.5, and 6.2, and control plots 2.8, 3.1 and 3.6 during 2021-22, 2022-23, and 2023-24, respectively. The cumulative effect of technological interventions over three years revealed an average benefit-cost ratio of 6.30 in demonstration plots compared to 3.2 in control plots.

Extension gap

Extension gaps of 86, 70, and 108.5 q/ha were observed during 2021-22, 2022-23 and 2023-24, respectively. On average extension gap under the three-year FLD programme was 88.16 q/ha. This emphasized the need to educate the farmers through various techniques for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of the latest production technologies along with high-yielding variety will subsequently change this alarming trend of galloping extension gap.

Technology gap

The technology gap, the difference between potential yield and yield of demonstration plots, was 50, 60, and 31.5 q/ha during 2021-22, 2022-23, and 2023-24, respectively (Table 4). On average technology gap under the three-year FLD programme was 47.16 q/ha. This may be due to the soil fertility, managerial skills of individual farmers, and climatic conditions of the selected area. Hence, location-specific recommendations are necessary to bridge these gaps (Meena et al., 2015a; Meena et al., 2015b; Meena et al., 2016; Babu and Rao, 2018; Chaitanya et al., 2020).

Technology Index

The technology index showed the feasibility of demonstrated technology at the farmer's field. The technology index varied from 12.6 to 24 (Table 4). An average technology index of 18.86 percent was observed during the three years of the FLD program, which shows the effectiveness of technical interventions. This accelerates the adoption of demonstrated technical interventions to increase the yield performance of the yard-long bean variety Arka Mangala.

Conclusion

Based on the result obtained in the present study it can be concluded that the yield gap between conventional practices and improved production technology of yard-long bean variety (Arka Mangla) cultivation can be reduced by organizing further FLD at farmer's fields in different areas. Frontline demonstration organized by KVK with yielding variety, *i.e.,* Arka Mangala - Yard Long Bean, enhanced the crop yield vertically and ensured the rapid spread of recommended technologies horizontally. The FLDs made a positive and significant impact on Yard long bean yield compared to the local variety. Most of the 'Low Yielding-Local Varieties' would be replaced due to FLDs in adopted villages of Dakshina Kannada.

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Conflicts of interest

All the authors have no conflicts with others.

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सारांश

फ्रंट लाइन डेमॉन्स्ट्रेशन पर उच्च उत्पादकता वाली यार्ड लॉन्ग बीन किस्म 'अर्का मंगला' का प्रदर्शन फ्रंट लाइन डेमॉन्स्ट्रेशन का आयोजन केवीके दक्षिण कन्नड़ में 2021-22, 2022-23 और 2023-24 में 30 किसानों के साथ किया गया। फ्रंट लाइन डेमॉन्स्ट्रेशन किसानों की सक्रिय भागीदारी के साथ उच्च उत्पादकता वाली यार्ड लॉन्ग बीन तकनीक का प्रसार करने के उद्देश्य से आयोजित किया गया था ताकि उत्पादन की संभावनाओं को प्राप्त किया जा सके। सुधारित तकनीक में उच्च उत्पादकता वाली किस्म, सब्जी विशेष का फोलियर स्प्रे (2 ग्राम/लीटर), अर्का माइक्रोबियल कांसोर्टियम का ड्रींचिंग (20 ग्राम/लीटर), उर्वरक का संतुलित उपयोग, और एकीकृत कीट और रोग प्रबंधन शामिल था। फ्रंट लाइन डेमॉन्स्ट्रेशन डेटा में पौधों की ऊँचाई (सेमी), शाखाओं की संख्या, फल का आकार (सेमी), प्रति पौधा फल की संख्या और उपज (क्विंटल/हेक्टेयर) को किसान की स्थानीय प्रथा से तुलना की गई। सुधारित किस्म 'अर्का मंगला' ने 202.83 क्विंटल/हेक्टेयर के साथ अधिकतम हरे फल की उपज प्राप्त की, जबकि स्थानीय किस्म ने 114.67 क्विंटल/हेक्टेयर की उपज दिखाई। उच्च उपज के अलावा, अर्का मंगला किस्म में तकनीकी अंतराल, विस्तार अंतराल, और सूचकांक के निम्न मान पाए गए। सुधारित तकनीक ने यार्ड लॉन्ग बीन में किसान की प्रथाओं की तुलना में अधिक सकल और शुद्ध लाभ के साथ उच्च लाभ-लागत अनुपात दिया। फ्रंट लाइन डेमॉन्स्ट्रेशन ने स्थानीय किस्म के मुकाबले यार्ड लॉन्ग बीन की उपज पर सकारात्मक और महत्वपूर्ण प्रभाव डाला। दक्षिण कन्नड़ के अपनाए गए गांवों में अधिकांश 'कम उत्पादकता वाली स्थानीय किस्मों' को बदला जाएगा।