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Enhancing ridge gourd productivity in northern Telangana: Impact of Arka Prasan variety through front line demonstrations

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Abstract
In Northern Telangana, ridge gourd is a favored crop due to its nutritional value and culinary uses, but growers face challenges with unstable yields and a lack of optimal practices. To address these issues, frontline demonstrations (FLDs) promoting the high-yielding Arka Prasan variety were conducted by KVK, Adilabad and KVK, Rudrur. The study aimed to bridge technology gaps and enhance yields to improve farmers income. Data were collected through benchmark surveys, structured interviews and secondary sources. The FLDs incorporated advanced cultivation techniques, including pandal cultivation, drip irrigation and mulching. The results from 2022-23 and 2023-24 indicated significant improvements in agricultural productivity and economic returns for the demonstration plots compared to traditional practices. The demonstration plots achieved an average yield of 13,664 kg ha^{-1}, a substantial increase over the 11,300 kg ha^{-1} yield from check plots, reflecting an 18.34% and 23.56% yield increase in 2022-23 and 2023-24 respectively. The cost of cultivation was also lower for the demo plots, averaging Rs. 1,19,150 ha^{-1}, compared to Rs. 1,24,288 ha^{-1} for the check plots. Consequently, economic returns were higher with average gross returns of Rs. 2,80,020 ha^{-1} and net returns of Rs. 1,56,408 ha^{-1} for demo plots, versus Rs. 2,19,483 ha^{-1} and Rs. 99,658 ha^{-1} for check plots. The benefit-cost ratio for demo plots averaged 2.35 significantly outperforming the 1.76 ratio for check plots. Despite these successes, high technology index values (48.00% in 2022-23 and 46.89% in 2023-24) indicate the need for improved extension services, farmer training and better dissemination of best practices. Targeted interventions could further enhance productivity and profitability fully realizing the potential of the Arka Prasan variety.

Keywords: Arka Prasan, frontline demonstration, ridge gourd, technology index, yield gap

Introduction
Ridge gourd (*Luffa acutangula* L.) is a regular and highly preferred vegetable among cucurbitaceous crops. Most of the world refers to the ridge gourd as the ribbed gourd, as Angled Luffa or Luffa gourd. It is a crop that is native to India that is cross-pollinated and has a diploid chromosome number (2n = 26). It was first appeared in several of India's coastal areas (Nishant *et al*., 2020) [5]. The ridge gourd has a tapering end and a dark green color. The pulp is edible once the skin is removed, and it will be white (Shadrach *et al*., 2023) [9]. Ridge gourd, a nutritional powerhouse, is rich in vitamin C, riboflavin, niacin, essential amino acids, and contains seeds with fixed oil comprising glycerides of palmitic, stearic and myristic acids (Swetha and Muthukumar, 2016) [12]. It has an adequate quantity of minerals and vitamins. Additional medicinal properties include being an effective blood purifier, having laxative qualities, curing jaundice, helping with diabetes, promoting weight reduction, having anti-inflammatory and antibacterial properties, boosting the immune system, being healthy for skin care and being good for the stomach. It is an ideal means of cooling off the body. A gelatinous substance called luffein is found in ridge gourds (Karthick *et al*., 2017) [2]. Ridge gourd is a flavorful vegetable with tender fruits commonly used in South Indian curries and chutneys. If harvest is delayed, the fruits become fibrous and unsuitable for culinary use. Rich in cellulose and high in water content, ridge gourd aids in relieving constipation. In the state of Telangana, gourds are cultivated across 24,164 acres with ridge gourd accounting for 3,688 acres.

This cultivation yields 38,824 metric tons of ridge gourd achieving an average productivity of 10.5metric tons per acre. Ridge gourd represents approximately 17% of the total gourd production in the region (Anonymous, 2023) [1].

In Northern Telangana State, vegetable growers seek high-yielding and early open-pollinated varieties of ridge gourd. The prevalent practice of intensive input usage among these growers often results in unstable yields and reduced profit margins. Additionally, insufficient information on quality inputs, particularly regarding varieties and improved management practices, contributes to lower yields and income. To address these issues, the ICAR-Indian Institute of Horticultural Research in Bangalore, India, has developed an early open-pollinated variety of ridge gourd named Arka Prasan. This variety is known for its early harvesting which comes to picking 42–45 days after sowing. Arka Prasan produces green long tender fruits that are highly regarded for their cooking qualities. It offers an average yield of 26.0 tons per hectare over a cultivation period of 120 – 135 days. This variety is intended to mitigate the challenges faced by growers in Northern Telangana by providing a more stable and profitable cultivation option. Frontline demonstrations serve as highly effective extension tool for showcasing the latest advancements, particularly high-yielding varieties (HYVs), and integrated crop management practices to farmers directly on their fields. Extension centers such as Krishi Vigyan Kendras play a pivotal role in this process, operating as field-based organizations focusing on evaluating, refining and disseminating successful technologies across diverse agro-climatic regions. This concerted effort leads to the adoption of improved practices, narrowing the gap between technology development and its implementation, ultimately resulting in enhanced yields for farmers and better returns to the growers.

In view of the extension activities required at field levels, KVK, Adilabad, and KVK, Rudrur, located in the Northern Telanagana Zone of Telangana conducted front-line demonstrations at different farmers fields to promote high-yielding varieties of ridge gourd during the years 2022–23 and 2023–24 to reduce the technology as well as the extension gaps to improve the yields and the farmers income.

Materials and Methods

The present study was carried out by Krishi Vigyan Kendra (KVK), Adilabad, and KVK, Rudrur (working under the administrative control of Professor Jayashankar Telangana State Agricultural University) for two consecutive years from 2022–23 to 2023–24 in the farmers field in different locations of erstwhile Adilabad and Nizamabad districts of Northern Telangana state. The front-line demonstration had begun with a benchmark survey in different villages in the district. Diversified information was collected through structured personnel interviews of practicing ridge gourd growers in the districts. Secondary information was collected from mandal horticultural officers, experienced vegetable growers, vendors of rythubazars, and other key stakeholders in the Ridge Gourd value chain (Poshadri *et al.*, 2020) [6]. Identified issues included traditional cultivation methods with intensive inputs, inadequate fertilizer usage, insufficient plant protection measures, and high cultivation costs leading to reduced profits. Subsequently, KVK, Adilabad, and KVK, Rudrur, initiated a Frontline Demonstration (FLD) study to promote the adoption of the high-yielding, early-harvesting Arka Prasan variety. This involved implementing pandal cultivation alongside drip irrigation and mulching to maximize yields and income. Production costs, yields, and economic metrics from FLD participants and other farmers plots were collected for comparison. The study evaluated yield, cultivation costs and net returns including the benefit-cost ratio to gauge the impact of the FLD on ridge gourd cultivation practices and economic outcomes as previously reported by Raghuveer, *et al.*, (2020) [7]. A total of 40 farmers actively involved in ridge gourd cultivation were selected consisting of 20 participants from demonstration groups across 10 villages and 20 non-participating farmers (check). Frontline demonstrations focusing on the Ridge gourd Arka Prasan variety were carried out during the Kharif seasons from 2022–23 to 2023–24, implementing comprehensive package practices outlined in Tables 1. Both participant and non-participant groups were equally represented for data analysis and interpretation. The technology index, denoting the technical viability resulting from frontline demonstrations, was employed in the efforts to promote the Arka Prasan variety in the Northern Telangana Zone. The evaluation encompassed assessments of technology and extension gaps, the technology index (Sagar and Chandra, 2004) [8]. as well as additional costs, returns, and effective gains, drawing from previous research by Sunil Kumar *et al.*, (2021) [11]. The following calculations were used as previously reported by Shankar, *et al*., (2022) [10]

$$Yield\ gap\ I = Potential\ yield\ (\text{kg/ha}) - Demonstration\ Yield\ (\text{kg/ha})$$

$$Yield\ gap\ II = Demonstartion\ yield\ (\text{kg/ha}) - Farmer's\ practice\ Yield\ (\text{kg/ha})$$

$$\text{Technology Index} = \frac{\text{Potential Yield (kg/ha)} - \text{Demonstration Yield (kg/ha)}}{\text{Potential Yield (kg/ha)}} X\ 100$$

Table 1: Frontline Demonstration on Popularization of the Ridge Gourd Variety Arka Prasan

S. No.	Particulars	Details	
1	Crop & Season	Ridge Gourd & kharif	
2	Farming situation	Irrigated Black soils	
3	Problem diagnosed	Low yields are attributed to unstable varieties	
4	Title of the FLD	Popularization of the Ridge Gourd Variety Arka Prasan	
5	No. of locations	05	Area: 2.0 ha
6	Treatments **Check –** Regular hybrids Spraying of non-recommended chemicals Imbalanced fertilizer application (N:P:K fertilizers @ 30:45:15 kg/acre) and no boron spray Without installation of Fruit fly traps		

	Demo – Arka Prasan Variety Pandal system of planting Application of FYM @ 10 t/acre along with RDF (N: P: K fertilizers @ 28:32:20kg/acre) Foliar spray of Boron@1g/lit at 2-4 leaf stage and 50days after sowing Need based application of chemicals like Neem oil (10000ppm) @0.5 ml/lit and Fipronil @2ml/lit against sucking pests. Installation of Yellow sticky traps @ 20/acre Installation of fruit fly traps @ 10/acre and need based application of chemicals

Results and Discussion

The provided data set (Table 2) offers a comparative analysis of the promotion of the Arka Prasan variety through FLD in the Northern Telangana zone of India through demonstration plots (Demo) versus check plots (farmers practice) over two consecutive years (2022–23 and 2023–24). The key parameters evaluated include yield (kg ha^{-1}), cost of cultivation (Rs. ha^{-1}), and gross returns (Rs. ha^{-1}), net returns (Rs. ha^{-1}), and the benefit-cost (B: C) ratio. This analysis aims to determine the effectiveness of the demonstration plots in improving productivity and economic returns compared to traditional practices represented by the check plots.

The demonstration plots reported a yield of 13,520 kg ha^{-1}, significantly higher than the check plots, which produced 11,425 kg ha^{-1}. during the year 2022–23. This represents an increase of approximately 18.34% in yield due to the improved variety of Arka Prasan over hybrids cultivated by traditional practices. The trend of higher productivity during the year 2023–24 in the demonstration plots continued with a yield of 13,808 kg ha^{-1} compared to 11,175 kg ha^{-1} in the check plots, marking an increase of approximately 23.56% which is 5.22% higher than the previous year 2022-23. Lamptey and Koomson (2021) [3] have demonstrated similar yield increase in tomato crop in frontline demonstrations. The average yield over the two years was 13,664 kg ha^{-1} for the demo plots and 11,300 kg ha^{-1} for the check plots. This consistent increase in yield indicates that the practices employed in the demonstration plots significantly enhance crop productivity.

The cost of cultivation for the demo plots, using Arka Prasan was Rs. 1,17,700 ha^{-1}, slightly lower than the Rs. 1,26,625 ha^{-1} for the check plots where private hybrids were used as seed material. This suggests that the demo plots not only achieved higher yields but also managed to do so at a reduced cost during the year 2022–23. The cost of cultivation for the demo plots during the year 2023-24 increased to Rs. 1,20,600 ha^{-1}, while the check plots incurred a cost of Rs. 1,21,950 ha^{-1}. Although the demo plots experienced a slight increase in costs, they remained lower than the check plots. The average cost of cultivation over the two years was Rs. 1,19,150 ha^{-1} for the demo plots and Rs. 1,24,288 ha^{-1} for the check plots. The lower cultivation costs in the demo plots indicate more efficient resource use and cost management.

The gross returns during the year 2022–23 for the demo plots were Rs. 2,78,175 ha^{-1} substantially higher than the Rs. 2,22,050 ha^{-1} for the check plots. Consequently, the net returns for the demo plots were Rs. 1,51,550 ha^{-1} compared to Rs. 1,04,350 ha^{-1} for the check plots, showing a significant advantage for the demo plots. The demo plots again outperformed during 2023–24 with gross returns of Rs. 2,81,865 ha^{-1} compared to Rs. 2,16,915 ha^{-1} for the check plots. The net returns for the demo plots were Rs. 1,61,265 ha^{-1} significantly higher than the Rs. 94,965 ha^{-1} for the check plots. Over the two years, the average gross returns were Rs. 2,80,020 ha^{-1} for the demo plots and Rs. 2,19,483 ha^{-1} for the check plots. The average net returns were Rs. 1,56,408 ha^{-1} for the demo plots and Rs. 99,658 ha^{-1} for the check plots (Table 2). These figures highlight the superior economic performance of the demonstration plots.

The Benefit-Cost (B: C) ratio is a critical indicator of economic efficiency, reflecting the return on investment for every unit of currency spent. The benefit-cost (B: C) ratio is a critical indicator of economic efficiency, reflecting the return on investment for every unit of currency spent. The B:C ratio for the demo plots was 2.36:1 significantly higher than the 1.75:1 for the check plots during 2022–23. This indicates that the demo plots generated Rs. 2.36:1 for every rupee spent, compared to Rs. 1.75:1 for the check plots. Similar results were reported in mustard by Sagar and Chandra (2004) [8] in frontline demonstration. The demo plots maintained a higher B: C ratio of 2.33:1 while the check plots had a ratio of 1.77:1 during 2023–24. The average B: C ratio over the two years was 2.35:1 for the demo plots and 1.76:1 for the check plots. This consistently higher B: C ratio for the demo plots underscores their superior economic efficiency and profitability.

Table 2: Comparative C: B analysis of Popularization of the Ridge Gourd Variety Arka Prasan

	Yield (kg ha^{-1})		Cost of Cultivation (Rs. ha^{-1})		Gross Returns (Rs. ha^{-1})		Net returns (Rs. ha^{-1})		B:C Ratio	
	Demo	**Check**	**Demo**	**Check**	**Demo**	**Check**	**Demo**	**Check**	**Demo**	**Check**
2022-23	13520	11425	117700	126625	278175	222050	151550	104350	2.36	1.75
2023-24	13808	11175	120600	121950	281865	216915	161265	94965	2.33	1.77
Average	13664	11300	119150	124288	280020	219483	156408	99658	2.35	1.76

The data clearly illustrates that the demonstration plots outperformed the check plots across all key metrics, including yield, cost of cultivation, net returns, and B: C ratio. The higher yields in the demo plots suggest that the improved agricultural practices, technologies, or crop management strategies implemented in these plots were effective. The reduction in the cost of cultivation for the demo plots further highlights their efficiency. Lower costs, coupled with higher yields, resulted in significantly higher gross and net returns for the demo plots. The superior B: C ratio achieved by the demo plots indicates that they are more economically viable and provide better returns on investment. Several factors could contribute to the enhanced performance of the demo plots. These may include the use of high-yielding crop varieties, better soil fertility management, efficient use of water and fertilizers and effective pest and disease control measures. Additionally, the demonstration plots likely benefited from closer monitoring and support from agricultural extension services, which can play a crucial role in improving farming practices and outcomes.

Table 3: The yield gap and technology index of Ridge Gourd variety Arka Prasan

Year	Yield gap-I (q ha^{-1})	Yield gap-II (q ha^{-1})	Technology index (%)
2022-23	12480	2095	48.00
2023-24	12192	2634	46.89
Average	12336	2365	47.40

The Yield Gap-I indicates the difference between the potential yield and the actual yield obtained in the demonstrations. For 2022-23, the yield gap-I was 12480 kg/ha, and for 2023-24 it was slightly lower at 12192 kg/ha (Table 3). The persistently high yield gap-I over the two years suggests that the full potential of the Arka Prasan variety was not realized in the demonstration fields. Several factors could contribute to this, such as suboptimal farming practices, climatic conditions, soil fertility issues, or pest and disease pressures. Yield Gap-II measures the difference between the yield achieved in the demonstrations and that obtained through farmers' traditional practices. In 2022-23, the yield gap-II was 2095 kg/ha, increasing to 2634 kg/ha in 2023-24. The positive yield gap-II in both years indicates that the Arka Prasan variety outperformed the conventional methods used by farmers, highlighting its superiority in terms of yield (Table 3). The Arka Prasan variety consistently outperformed traditional farmer practices, as evidenced by the positive yield gap-II in both years. This suggests that adopting this variety could lead to higher productivity and potentially better economic returns for farmers.

The technology index, which represents the percentage deviation of the demonstration yield from the potential yield, was 48.00% in 2022-23 and slightly improved to 46.89% in 2023-24 (Table 3). Although there is a marginal improvement, the high values of the technology index suggest that there is significant room for improvement in the adoption and application of the technology (Arka Prasan variety) in the fields. The technology index further underscores the need for better extension services, farmer training, and possibly improved agricultural inputs and practices. The high technology index indicates that there is a significant disparity between the potential yield and the yield achieved in demonstrations. This highlights the need for more effective dissemination of knowledge and practices associated with the Arka Prasan variety. To close the yield gaps, targeted interventions are required. These could include improved farmer education on best practices for cultivating Arka Prasan, enhanced pest and disease management strategies, better soil health management, and possibly the introduction of complementary technologies such as drip irrigation. In summary, while the Arka Prasan variety demonstrates a clear advantage over traditional practices, realizing its full potential will require concerted efforts to improve agricultural practices and technology adoption among farmers.

Conclusion

The promotion of the Ridge Gourd variety Arka Prasan through frontline demonstrations (FLDs) in the Northern Telangana zone has demonstrated significant improvements in agricultural productivity and economic returns compared to traditional farming practices. The data from the years 2022-23 and 2023-24 clearly illustrate that the demonstration plots outperformed the check plots across all key metrics, including yield, cost of cultivation, net returns, and benefit-cost (B:C) ratio. The yield from the demonstration plots was consistently higher, with an average yield of 13,664 kg ha^{-1} compared to 11,300 kg ha^{-1} for the check plots. This represents an average increase of 18.34% in 2022-23 and 23.56% in 2023-24, highlighting the superior productivity of the Arka Prasan variety. The cost of cultivation was also lower for the demo plots, averaging Rs. 1,19,150 ha^{-1} over two years compared to Rs. 1,24,288 ha^{-1} for the check plots, indicating more efficient resource use. Economic returns were significantly better for the demo plots, with average gross returns of Rs. 2,80,020 ha^{-1} and net returns of Rs. 1,56,408 ha^{-1}, compared to Rs. 2,19,483 ha^{-1} and Rs. 99,658 ha^{-1} for the check plots, respectively. The B:C ratio for the demo plots was 2.35, substantially higher than the 1.76:1 for the check plots, emphasizing their superior economic efficiency and profitability. However, the high technology index values (48.00% in 2022-23 and 46.89% in 2023-24) indicate that the full potential of the Arka Prasan variety is not being realized. This suggests a need for improved extension services, better farmer training, and more effective dissemination of best practices. Addressing these issues through targeted interventions, such as enhanced pest and disease management, better soil health practices, and possibly the adoption of complementary technologies like drip irrigation, could help close the yield gaps and further boost productivity and profitability. In conclusion, while the Arka Prasan variety has shown clear advantages over traditional practices, realizing its full potential will require concerted efforts to enhance agricultural practices and technology adoption among farmers.

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