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A success story from semi-arid Bundelkhand: Adoption of standardized improved tomato production technologies under Front Line Demonstrations (FLDs)

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Abstract

Tomato is one of the important solanaceous crops significantly contributing to the farmer's income. Bundelkhand is a semi-arid region characterized by poor soil nutritional profile, erratic rainfall, and low crop productivity. However, tomato yields in the Bundelkhand region remain below potential due to the lack of availability of quality seed, non-adoption of standardized agronomical practices. To address the constraints of Bundelkhand farmers, Front Line Demonstrations (FLDs) on tomato were conducted during 2024-25 to demonstrate the impact of scientific tomato cultivation practices on farmers' fields. The FLDs on tomato emphasized the improved package of practices including improved varieties, scientific way of nursery raising, nutrient, irrigation and disease management. Results revealed a significant increase in yield (59.09%), net returns under improved practices (Rs 514944.44/ha), and benefit-cost ratio under FLDs compared to farmers' traditional practices were 2.87. The success of FLDs led to higher adoption of standardized tomato production technologies, resulting in enhanced productivity and profitability. This success story highlights the critical role of FLDs in technology dissemination and standardization of tomato cultivation practices in the semi-arid Bundelkhand region.

Keywords: Tomato, Front Line Demonstrations (FLDs), standardization, Bundelkhand, adoption, improved practices (IP), Farmers Practices (FP)

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the widely cultivated vegetable crops in India, well known for its economic importance and nutritional property. Tomato is cultivated in all states of India but Karnataka, Madhya Pradesh, Andhra Pradesh are the top tomato producing states ^[1]. Only Madhya Pradesh contributes 14.6% of the country's total tomato production ^[2]. In Uttar Pradesh, district of eastern U.P. like Ballia, Varanasi, Ghazipur are known for significant cultivation area and high productivity. Bundelkhand districts under Uttar Pradesh are known for low tomato productivity due to unfavorable climatic conditions and lack of improved production practices. The standardized and improved agronomic practices of tomato cultivation significantly increase the yield and boost farmer's income. Despite its potential, the per hectare productivity of tomato in the Bundelkhand region remains low due to high temperature at growth stage of crop, poor soil fertility, moisture stress, harsh climatic conditions, lack of improved cultivar seed, imbalanced use of fertilizers, and inadequate plant protection measures. In Bundelkhand

regions, farming is generally based on traditional practices, with minimal scientific intervention and agronomical practices ^[3]. Due to lack of improved practices of tomato and other vegetable production, Bundelkhand regions leading to low yields and unstable income. However, standardization of improved cultivation practices through effective extension approaches is very essential for enhancement of tomato yield potential and income stability in semi-arid zones like Bundelkhand ^[4]. Bundelkhand region covers 14 districts of Uttar Pradesh and Madhya Pradesh as given in the geographical Fig. 1. In these districts of the Bundelkhand tomato productivity remains below the national average due to lack of improved production practices. In regions like Bundelkhand, front line demonstrations (FLDs) play an effective role to demonstrate standardized production technologies and encourage their adoption by the poor and marginal farming communities of Bundelkhand ^[5]. Therefore, the present study was undertaken by the scientific team of Rani Lakshmi Bai Central Agricultural University, Jhansi to assess the significant impact of front line demonstrations (FLDs) for

enhancing the tomato productivity and profitability in the semi-arid regions like Bundelkhand.

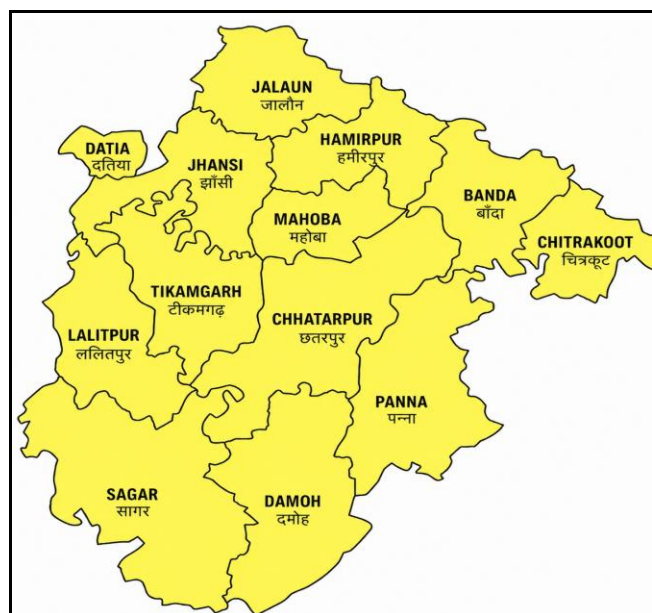


Fig 1: Geographical distribution of the semi-arid region of Bundelkhand

Materials and Methods

Front Line Demonstrations on tomato using improved varieties were conducted in selected villages of the Bundelkhand region during winter season of the year 2024-25. The front line demonstrations on tomato were laid out on farmers' fields, covering a representative area, while adjacent plots under farmers' existing practices served as local checks to compare the farmers and improved practices. Recommended tomato production practices including balanced dose of fertilizers were demonstrated. Regular visits, trainings, and field days were organized to enhance farmers' knowledge and skills.

A front line demonstration of tomato was conducted in the year 2024-25. In this FLD, tomato genotypes Kashi Aman and RLBCAU tomato lines/selections RTS-19, RTS-21, RTS-23, RTS-26, RTPC-4 was carried out in the field of vegetable growers of Bundelkhand region. About 44 farmers were selected from 15 villages, namely Madawra, Lakara, Gadhmau, Dandiyapura, Nana Bhau ka Bagicha, Pali-Pahadi, Dunara, Tehrauli, Baruwa sagar, Pahadi-Bujurg, Simirdha, Tikari-Ratausa, Civil Line, Parwai, and Simra to conduct tomato FLD under improved practices.

Tomato seedlings were raised in the University for Frontline Demonstration and 20-25 days old nursery were distributed to each farmer and were trained about improved production techniques by the FLD team. Crop production inputs viz. NPK 19:19:19, Micronutrients and insecticides were provided to each farmer. As per direction of FLD Team, farmers raised tomato nursery on bed and each plant in the field was staked well to avoid lodging at fruiting stage. After 15 days of the tomato planting, their field was visited by FLD Team, who advised them about dose and application of fertilizers and micronutrients, irrigation,

disease and pest management to exploit maximum yield under improved practices. Second tomato field visit was done at the time of flowering and fruiting to suggest about good practices to protect fruits from fruit borers. The yield and benefit like yield quintal/ha, gross return Rs/ha, Net return Rs/ha, B: C ratio, of the farmers practices (FP) and Improved practices (IP) were calculated from each FLD plot.

The following formulae were used to calculate the gross return (Rs/ha), net return (Rs/ha) and B: C ratios are mentioned here:

- **Formula for Gross Return (Rs/ha):** Total value of all produce (ripe tomato fruits) obtained from a one-hectare area based on prevailing market prices.
Gross return (Rs/ha) = Yield ((q/ha) x Market price (Rs/q)
- **Where:** Yield (q/ha): The total produce (main product + by-product) per unit area, typically measured in quintals (1 q = 100 kg).
- **Market Price (Rs/q):** The price per quintal for the produce in the local market (mandi rate).
- **Formula for Net Return (Rs/ha):** Calculating the net return in agriculture (Rs/ha) involves subtracting the total cost of cultivation from the gross income generated from the sale of the produce.
Net Return (Rs/ha) = Gross Return (Rs/ha) - Total cost of cultivation (Rs/ha)
- **Formula for Benefit Cost (B: C) ratio:** The Benefit-Cost (B: C) ratio in agronomy is calculated by dividing the gross returns (total revenue) by the total cost of cultivation, determining the economic efficiency of a farming practice.
B: C ratio = Net return (Rs/ha) / Total cost of cultivation (Rs/ha)

Results and Discussion

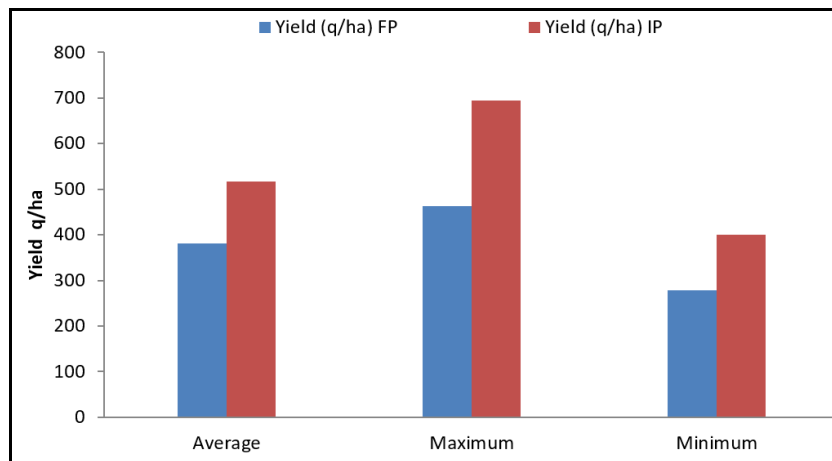
The front line demonstration plots of the tomato recorded higher yield over farmers' practices due to adoption of standardized cultivation practices such as plantation on ridge, stacking of plants, application of N: P: K 19:19:19 instead of granular NPK and use of micronutrient. Economic analysis revealed higher net returns and benefit-cost ratio under FLDs. Improved visibility of crop performance motivated Bundelkhand farmers to adopt recommended practices ^[6].

The FLDs on tomato recorded a substantially higher yield compared to farmers' practices. On an estimate the average yield at farmers practices (FP) ranged from 277.8 to 463 q/ha with an average yield of 381.6 q/ha (Table 1). Under improved practices (IP) the average yield on farmers' fields were ranged from 400.00 to 694.44 q/ha with average yield of 516.69 q/ha (Fig. 2). The increased yield under demonstrations can be attributed to the adoption of standardized improved technologies such as quality planting material, balanced fertilization, stacking, and effective pest and disease management ^[7]. The yield enhancement clearly demonstrated the yield gap existing due to non-adoption of recommended practices.

Table 1: The data obtained for yield and benefit related parameters

FLD Tomato	Yield (q/ha)		Gross returns (Rs/ha)		Net Return (Rs/ha)		B: C Ratio		Yield gains (%)
	FP	IP	FP	IP	FP	IP	FP	IP	
Maximum	462.96	694.44	462962.96	694444.44	283462.96	514944.44	1.58	2.87	59.09
Minimum	277.78	400.00	277777.78	400000.00	98277.78	220500.00	0.55	1.23	13.64
Average	381.57	516.69	381569.76	516694.91	202069.76	337194.91	1.13	1.88	35.54

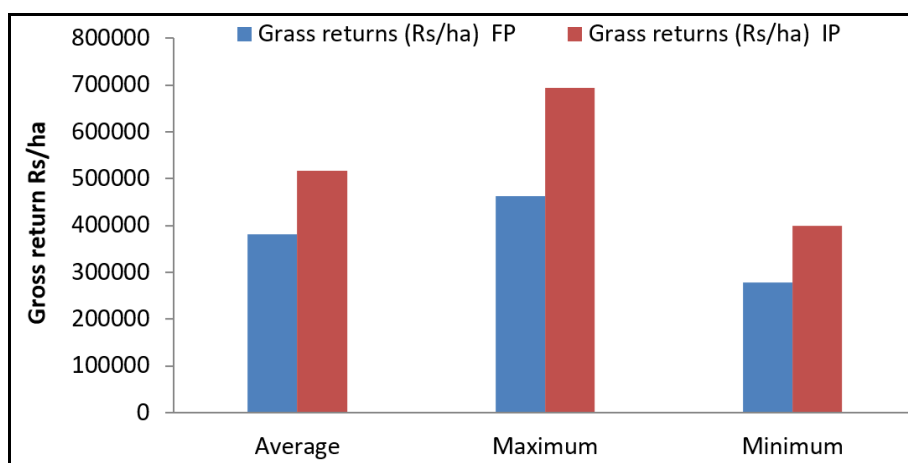
(FP: Farmers practices; IP: Improved practices)

**Fig 2:** Yield q/ha under farmers practices (FP) and Improved practices (IP)

The gross return Rs/ha at FP ranged from Rs. 277777.78/ha to 462962.96 Rs/ha with an average gross return of Rs 381569.76/ha, whereas under IP the average gross return Rs/ha was found 516694.91 Rs/ha ranging from 400000.0 RS/ha to 694444.44 Rs/ha (Fig. 3). The third important component (Net return Rs/ha) was also calculated under FP and IP. The net return under FP ranged from 98277.78 to 283462.96 Rs/ha with an average net return of 202069.76 Rs/ha. In Improved practices, net return ranged from 220500.00 to 514944.44 Rs/ha with mean net returns of 337194.91 Rs/ha (Fig. 4). Significant increase in the gross and net return under improved practices due to scheduled application of balanced fertilizers, time of required irrigation and integrated crop management by the adoption of scientific practices and proper monitoring by FLDs team are very essential ^[8].

Benefit and Cost (B: C) ratio were also calculated in both FP and IP practices. On an estimate, B: C ratio ranged from 0.55 to 1.58 under FP, while in improved practices B: C

ratio ranged from 1.23 to 2.87 (Fig. 5). The yield gain under IP over the FP is one of the important parameter was also calculated to justify the importance of improved practices. The minimum yield gain (%) over the FP was 13.64% followed by 59.09% with an average yield gain over FP of 35.54% (Fig. 6). On an observation, ridge-based planting and stacking under improved practices increased plant life and yield. In tomato the effect of staking techniques was studied and found that adoption of tomato variety with single-string staking techniques enables farmers to enhance productivity, reduce costs, and promote sustainable agricultural systems. Economic analysis revealed that the cost of cultivation under FLDs was marginally higher due to improved inputs; however, this was more than compensated by significantly higher yields and better marketable produce. The net returns and benefit-cost ratio under FLDs were considerably higher than those obtained under farmers' practices, indicating the economic viability of standardized tomato production technologies ^[9].

**Fig 3:** Gross return Rs/ha under farmers practices (FP) and improved practices (IP)

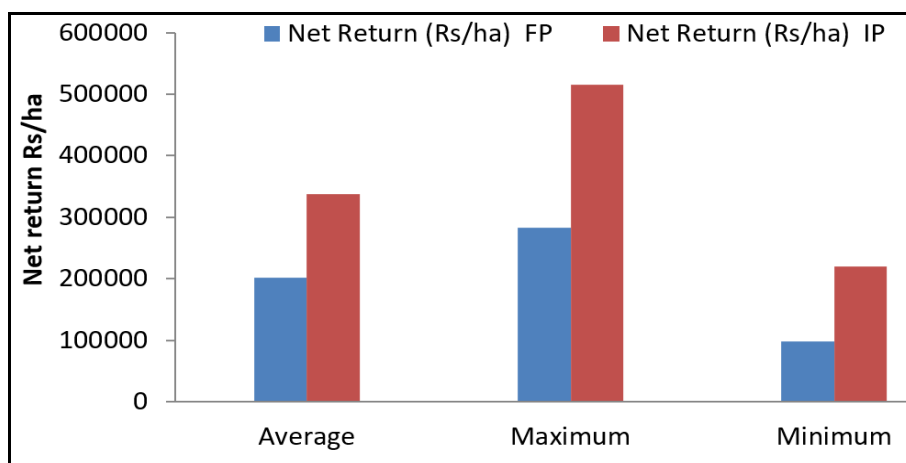


Fig 4: Net returns Rs/ha under farmers practices (FP) and improved practices (IP)

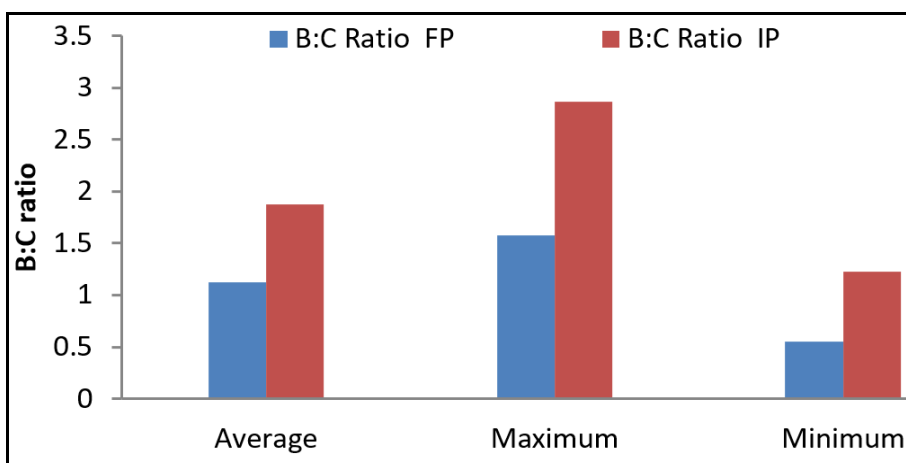


Fig 5: Benefit and Cost (B: C) ratio under farmers practices (FP) and improved practices (IP)

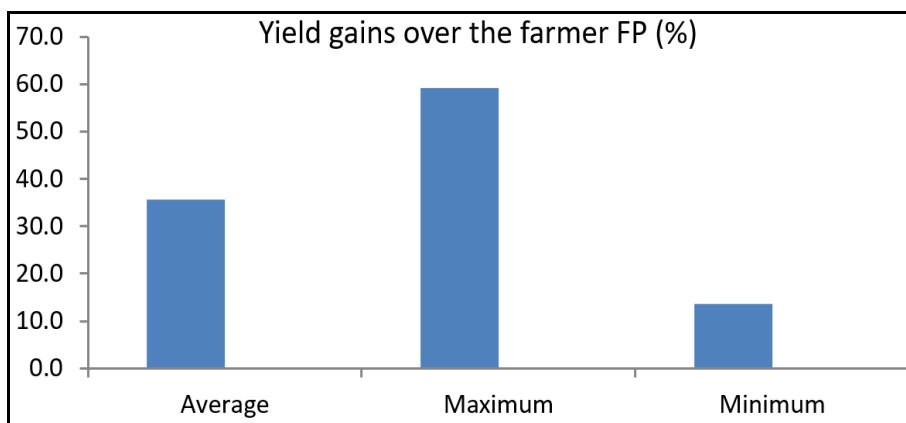


Fig 6: Yield gain over the farmers practices (FP)%

Technology Adoption and Farmer Response

The impact of front line demonstrations created confidence among the farmers selected in various villages for tomato cultivation by adopting improved practices. The FLDs team activities such as farmer-scientist interaction, monitoring at every important stage of crop helped to encourage farmers to understand scientific way of tomato cultivation in semi-arid zone of Bundelkhand. As a result 44 farmers from 15 villages adopted improved practices, recommended doses of fertilizer, and crop protection measures. The demonstrations played a key role in standardizing tomato cultivation

practices in the Bundelkhand region. The successful demonstration of FLDs proved that the acute semi-arid zone of Bundelkhand, tomato productivity can be significantly improved by scientific suggestions and effective monitoring strategies.

Conclusion

The Front Line Demonstrations on tomato using scientific inventions showcased the standardized tomato production practices under semi-arid regions of Bundelkhand. Further, the scientific practices resulted in higher yields, better

economic returns, and increased adoption of suggested practices among farmers. Moreover, the success story of tomato front line demonstrations in Bundelkhand region served as a potential extension tool for bridging the promotion of technology adaptation and yield gap. Improved tomato cultivation practices may enhance the sustainability of tomato cultivation in resource-constrained regions like Bundelkhand and other similar agro-climatic zones across the country.

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