E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(12): 775-778
Received: 14-10-2025
Accepted: 17-11-2025

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Impact assessment of front-line demonstrations on productivity, profitability and water use efficiency of sesame (*Sesamum indicum L.*) in Tonk District of Rajasthan India

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DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i12k.4480

Abstract
Sesame (*Sesamum indicum* L.) is an important oilseed crop predominantly cultivated under rainfed conditions in the semi-arid regions of India. Despite its high oil content, nutritional value, and export potential, the productivity of sesame remains low due to the continued adoption of traditional cultivation practices, use of low-yielding local varieties, imbalanced fertilization, and inadequate crop management practices. Front Line Demonstrations (FLDs) conducted by Krishi Vigyan Kendras (KVKs) serve as an effective extension tool to demonstrate the yield potential of improved production technologies under real farming situations. The present study was undertaken to assess the impact of FLDs on sesame productivity, technology gap, extension gap, economic returns, and water-use efficiency in Tonk district of Rajasthan over five consecutive kharif seasons from 2020 to 2024.

A total of 85 FLDs covering an area of 90 ha were conducted using improved sesame varieties RT-351 and RT-372 along with a complete package of recommended practices, including quality seed, line sowing, seed and soil treatment, soil-test-based fertilizer application, effective weed and pest management, and timely technical guidance. The performance of demonstration plots (DP) was compared with farmers' practice (FP). Results revealed that sesame yield under FLDs ranged from 4.4 to 6.6 q ha^{-1}, whereas yields under farmers' practice were considerably lower, ranging from 3.0 to 5.2 q ha^{-1}. The percentage increase in yield over farmers' practice varied from 21.78 to 46.60 per cent. The technology gap ranged from 1.05 to 3.6 q ha^{-1}, while the extension gap varied between 1.1 and 1.4 q ha^{-1}, indicating substantial scope for yield enhancement through improved technologies. Economic analysis revealed higher net returns (Rs 21,101–Rs 29,668 ha^{-1}) and benefit–cost ratio (2.09-2.94) under FLDs compared to farmers' practice. Seasonal water use varied due to rainfall variability; however, water-use efficiency was consistently higher under improved practices. The study concludes that FLDs significantly enhance sesame productivity, profitability, and resource-use efficiency, and their wider adoption is essential for sustainable sesame production in rainfed semi-arid regions.

Keywords: Sesame, Front Line Demonstrations, Technology gap, Economics, Water-use efficiency, Rajasthan

Introduction
Sesame (*Sesamum indicum* L.), commonly known as "*Til*", is one of the oldest cultivated oilseed crops, with a long history of domestication in tropical and subtropical regions of the world. It occupies a prominent position among oilseed crops due to its high oil content, superior nutritional quality, and wide industrial applicability. Sesame seeds contain about 45–52 per cent oil, rich in unsaturated fatty acids and natural antioxidants such as sesamol and sesamin, which impart exceptional oxidative stability to sesame oil and make it highly valued for edible, pharmaceutical, cosmetic, and export purposes (Bedigian 2011; Pathak *et al*. 2019) [1, 9]. India is one of the largest producers of sesame globally, contributing significantly to the total area under cultivation; however, the national average productivity remains considerably lower than the global average (FAO 2022).

In India, sesame is predominantly cultivated under rainfed conditions during the kharif season,

particularly in semi-arid regions. In Rajasthan, major sesame-growing districts include Tonk, Bundi, Kota, Sawai Madhopur, and adjoining areas, where the crop plays an important role in sustaining farm livelihoods under low-input systems. Despite its adaptability to drought-prone environments, sesame productivity in the region is constrained by several biophysical and socio-economic factors. These include erratic and uneven rainfall distribution, low soil fertility, use of local or obsolete varieties, broadcasting method of sowing, imbalanced and inadequate fertilizer application, poor weed management, and limited adoption of plant protection measures (Kumar *et al*. 2020; Meena and Dudi 2018) [4, 6]. In addition, farmers often neglect critical practices such as seed and soil treatment, resulting in poor crop establishment, higher pest incidence, and substantial yield losses.

Bridging the yield gap between research station yields and farmers' field yields remains a major challenge in sesame cultivation. In this context, Front Line Demonstrations (FLDs) have emerged as an effective extension intervention for accelerating the transfer of improved agricultural technologies. FLDs are conducted by Krishi Vigyan Kendras (KVKs) under the guidance of the Indian Council of Agricultural Research (ICAR) to demonstrate the production potential of newly released varieties and improved management practices directly on farmers' fields under real agro-ecological conditions. By providing hands-on experience, technical backstopping, and continuous interaction between scientists and farmers, FLDs play a crucial role in enhancing farmers' knowledge, confidence, and adoption of recommended practices, thereby reducing the yield gap and improving farm profitability (Samui *et al*. 2000; Tiwari *et al*. 2014) [10, 12].

While several studies have documented the positive impact of FLDs on cereals, pulses, and other oilseed crops, systematic and long-term evaluations of FLDs in sesame under the semi-arid conditions of Rajasthan are limited. Moreover, information on the combined effects of FLDs on productivity, technology gap, extension gap, economic returns, and water-use efficiency in sesame remains scarce. Therefore, the present investigation was undertaken to assess the impact of Front-Line Demonstrations on sesame cultivation in Tonk district of Rajasthan over multiple years, with the objective of quantifying yield improvement, identifying technological and extension gaps, evaluating economic viability, and analysing resource-use efficiency under rainfed conditions.

Materials and Methods

Study Area

The study was conducted in Tonk district of Rajasthan, characterized by a semi-arid climate with hot summers and mild winters. The average annual rainfall ranges between 400 and 600 mm, most of which is received during the southwest monsoon (July-September). The soils are predominantly sandy loam to loam, low in organic carbon and available nitrogen, medium in phosphorus, and variable in potassium status.

Front Line Demonstrations

Front Line Demonstrations on sesame were conducted by Krishi Vigyan Kendra, Tonk during five consecutive kharif seasons from 2020 to 2024. A total of 85 demonstrations were laid out covering 90 ha area involving 190 farmers across 10 villages.

Technological Interventions

Table 1: Demonstration package and farmer's practice under FLDs in Sesame in Tonk district of Rajasthan, India

Technology Component	Demonstration plot	Farmer's practice
Variety	RT-351, RT-372	RT-46
Seed rate	5kg/ha	6 kg/ha
Sowing Method	Line sowing	Broadcasting
Spacing	30x15 cm	Not proper
Seed treatment	Carbendazim 50 WP @2.5 gm/Kg of seed, Imidacloprid 600 FS @ 4 ml/Kg and NPK consortia @ 10 ml/Kg of seed	No seed treatment
Soil treatment	NPK consortia @ 1 litre/ha with 80-100 kg FYM	No soil treatment
Fertilizer dose	Soil test based fertilizers @ (N-60:P-30) Kg/ha+ Zinc Sulphate @ 15 kg/ha as basal dose	N:30, P:23
Weed management	Pendamethalin 30 EC @1.5 litre/ha as pre-emergence	Manual weeding
Plant Protection	Profenophos @ 1 litre/ha	Improper plant protection
Technical guidance	Time to time	-

Table 2: Sowing and harvesting dates, seasonal water use and rainfall distribution of sesame under FLDs in Tonk district of Rajasthan

Variety	Year	Date of sowing	Date of harvesting	Seasonal water use (mm)	Rainfall distribution
RT-351	2020	15–16 July 2020	04-06 Oct 2020	436.5	July (136.38) + Aug (236.5) + Sept (62.0) + Oct (1.62)
RT-351	2021	12–15 July 2021	02-05 Oct 2021	661.75	July (197.33) + Aug (328.43) + Sept (108.33) + Oct (27.66)
RT-351	2022	04–05 July 2022	27-28 Sept 2022	705.56	July (313.89) + Aug (320.34) + Sept (71.33)
RT-351	2023	25–27 June 2023	27-29 Sept 2023	450.30	June (140.3) + July (190.0) + Aug (39.0) + Sept (80.0)
RT-372	2024	28–30 June 2024	29-30 Sept 2024	1431.00	July (395.1) + Aug (530.0) + Sept (505.9)

Data Collection and Analysis

Yield data were recorded from demonstration plots and farmers' practice plots. Technology gap, extension gap, and technology index were calculated using standard formulas. Economic analysis was carried out based on prevailing market prices. Seasonal water use was computed from rainfall data corresponding to crop duration.

Results and Discussion

Impact of Front-Line Demonstrations on Yield Performance, Technology Gap and Technology Index of Sesame under Front Line Demonstrations

The data presented in Table 3 clearly indicate the positive impact of Front-Line Demonstrations (FLDs) on sesame productivity in Tonk district of Rajasthan over five consecutive kharif seasons (2020–2024). The yield of sesame under

demonstration plots ranged from 4.40 to 6.60 q ha^{-1}, whereas farmers' practice recorded lower yields varying between 3.00 and 5.20 q ha^{-1}. The highest demonstration yield (6.60 q ha^{-1}) was obtained during kharif 2020 with variety RT-351, while the lowest demonstration yield (4.40 q ha^{-1}) was recorded during kharif 2024 with variety RT-372.

The percentage increase in yield over farmers' practice ranged from 21.78 to 46.60 per cent, demonstrating the effectiveness of improved production technologies under farmers' field conditions. Maximum yield enhancement (46.60%) was observed during kharif 2024, followed by kharif 2022 (38.24%), indicating greater yield advantage of improved technologies during adverse climatic conditions. The yield improvement can be attributed to the adoption of high-yielding varieties, line sowing, balanced fertilization, seed and soil treatment, and improved weed and pest management practices under FLDs. Similar yield advantages of sesame under FLDs have been reported by Samui *et al*. (2000) [10], Tiwari *et al*. (2014) [12] and Yadav *et al*. (2017) [13].

The technology gap, representing the difference between potential yield and demonstration yield, varied from 1.05 to 3.60 q ha^{-1}. The lowest technology gap during kharif 2021 suggests favourable rainfall and better realization of yield potential, whereas higher gaps during kharif 2022 and 2024 indicate the influence of erratic rainfall and moisture stress under rainfed conditions. These findings highlight that environmental factors play a crucial role in limiting the expression of genetic potential in sesame, as also reported by Meena and Dudi (2018) [6] and Kumar *et al*. (2021) [5].

The extension gap, which reflects the yield difference between demonstration plots and farmers' practice, ranged from 1.10 to 1.40 q ha^{-1}. The presence of a consistent extension gap across years signifies considerable scope for enhancing sesame productivity through effective dissemination and adoption of improved technologies. Reduction of this gap through intensive extension efforts can substantially improve farm-level productivity, as emphasized by Singh *et al*. (2016) [11].

The technology index varied from 17.50 to 45.00 per cent, indicating the feasibility of demonstrated technologies under farmers' field conditions. Lower technology index values during initial years signify better adaptability of improved practices, whereas higher values in later years reflect climatic variability affecting crop performance. Overall, the declining trend in technology index with improved management highlights the potential of FLDs in promoting adoptable and location-specific technologies.

Table 3: Technology gap, extension gap and technology index of sesame under Front Line Demonstrations in Tonk district of Rajasthan

Variety	Year	Area (ha)	No. of farmers	No. of villages	Potential yield (q ha^{-1})	Demonstration yield (q ha^{-1})	Farmers' yield (q ha^{-1})	Yield increase over FP (%)	Technology gap (q ha^{-1})	Extension gap (q ha^{-1})	Technology index (%)
RT-351	2020	10	25	1	8.0	6.60	5.20	26.92	1.40	1.40	17.50
RT-351	2021	20	45	2	8.0	6.15	5.05	21.78	1.05	1.10	23.10
RT-351	2022	10	20	1	8.0	4.70	3.40	38.24	3.30	1.30	41.20
RT-351	2023	20	40	2	8.0	5.20	4.00	30.00	2.80	1.20	35.00
RT-372	2024	30	60	4	8.0	4.40	3.00	46.60	3.60	1.40	45.00

4.2 Impact of Front Line Demonstrations on Economic Performance of Sesame under Front Line Demonstrations

Economic analysis of sesame cultivation under FLDs and farmers' practice is presented in Table 4. The cost of cultivation under demonstration plots was marginally higher than farmers' practice due to additional inputs such as quality seed, balanced fertilizers, herbicides, and plant protection measures. However, the higher investment under FLDs resulted in substantially greater economic returns.

The net returns under demonstration plots ranged from Rs 21,101 to Rs 29,668 ha^{-1}, whereas farmers' practice recorded lower net returns ranging from Rs 10,601 to Rs 22,260 ha^{-1}. The highest net return (Rs 29,668 ha^{-1}) was achieved during kharif 2021, primarily due to higher yield and favourable market prices. Additional returns under FLDs varied from Rs 7,408 to Rs 10,674 ha^{-1}, clearly indicating the economic advantage of improved sesame production technologies.

The benefit–cost (B:C) ratio under demonstration plots ranged from 2.09 to 2.94, compared to 1.62 to 2.52 under farmers' practice. Higher B:C ratios under FLDs confirm the profitability and economic viability of improved technologies even under rainfed conditions. These results are in agreement with earlier studies by Yadav *et al*. (2018) [14], Meena *et al*. (2020) and Kumar *et al*. (2022), who reported higher profitability of sesame under improved management practices.

Overall, the economic findings clearly demonstrate that Front Line Demonstrations not only enhanced sesame yield but also significantly improved farm income, making sesame cultivation more attractive and sustainable for farmers in semi-arid regions of Rajasthan.

Table 4: Economic analysis of sesame under Front Line Demonstrations and farmers' practice in Tonk district of Rajasthan

Variety	Season / Year	Cost of cultivation (Rs ha^{-1}) DP	Cost of cultivation (Rs ha^{-1}) FP	Gross returns (Rs ha^{-1}) DP	Gross returns (Rs ha^{-1}) FP	Net returns (Rs ha^{-1}) DP	Net returns (Rs ha^{-1}) FP	Additional cost (Rs ha^{-1})	Additional returns (Rs ha^{-1})	B:C ratio (DP)	B:C ratio (FP)
RT-351	2020	15,700	14,200	45,243	35,646	29,543	21,446	1,500	8,097	2.88	2.51
RT-351	2021	15,270	14,640	44,938	36,900	29,668	22,260	630	7,408	2.94	2.52
RT-351	2022	15,700	14,500	36,801	26,622	21,101	12,122	1,200	8,979	2.34	1.84
RT-351	2023	17,800	16,300	44,902	34,540	27,102	18,240	1,500	8,862	2.52	2.12
RT-372	2024	19,500	17,200	40,775	27,801	21,275	10,601	2,300	10,674	2.09	1.62

Conclusion

The study conclusively demonstrates that Front Line Demonstrations significantly enhanced sesame productivity, profitability, and water-use efficiency in Tonk district of Rajasthan. Adoption of improved varieties, scientific crop management practices, and timely technical guidance resulted in 22–47 per cent higher yield over farmers' practice. Reduction in extension gap highlights the critical role of KVKs in technology

dissemination. Scaling up of FLDs and strengthening farmer training programs are essential for achieving sustainable sesame production in semi-arid regions.

References

1. Bedigian D. *Sesame: the genus Sesamum*. Boca Raton: CRC Press; 2011.
2. Food and Agriculture Organization of the United Nations. FAOSTAT statistical database. Rome: FAO; 2022.
3. Kumar S, Meena RS, Singh R. Economic viability of improved sesame production technologies under rainfed conditions. J Oilseeds Res. 2022;39(1):45–51.
4. Kumar S, Singh R, Meena BS. Constraints and prospects of sesame cultivation in semi-arid regions of India. J Oilseeds Res. 2020;37(2):101–107.
5. Kumar S, Singh R, Meena BS. Technological gaps and performance of sesame cultivation under rainfed ecosystems. Indian J Agric Sci. 2021;91(4):567–572.
6. Meena ML, Dudi A. Productivity constraints of sesame under rainfed conditions. Indian J Agric Sci. 2018;88(4):567–572.
7. Meena ML, Dudi A. Productivity constraints and technological gaps in sesame under rainfed conditions. Indian J Agric Sci. 2018;88(4):567–572.
8. Meena RP, Singh VK, Kumar A. Profitability and adoption behaviour of improved oilseed production technologies under front-line demonstrations. Indian J Ext Educ. 2020;56(3):72–76.
9. Pathak N, Rai AK, Kumari R, Bhat KV. Value addition and nutritional quality of sesame (*Sesamum indicum* L.). J Food Sci Nutr. 2019;58:173–185.
10. Samui SK, Maitra S, Roy DK, Mandal AK, Saha D. Evaluation of front-line demonstrations on oilseed crops. J Indian Soc Coast Agric Res. 2000;18:180–183.
11. Singh D, Patel AK, Baghel MS, Singh A. Impact of front-line demonstrations on productivity enhancement of oilseed crops. Agric Ext Rev. 2016;28(4):17–21.
12. Tiwari RB, Singh V, Parihar P. Role of front-line demonstrations in transfer of agricultural technologies. Indian J Ext Educ. 2014;50(1–2):93–97.
13. Yadav DB, Kamboj BK, Garg RB. Increasing productivity and profitability of sesame (*Sesamum indicum* L.) through front-line demonstrations. Agric Ext Rev. 2017;29(2):12–16.
14. Yadav DB, Kamboj BK, Meena RS. Economic evaluation of front-line demonstrations in oilseed crops. Indian J Ext Educ. 2018;54(3):72–76.