Journal of Experimental Agriculture International

Volume 46, Issue 12, Page 866-871, 2024; Article no.JEAI.128405
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Impact of Cluster Front Line Demonstration on Yield and Economics of *Kharif* Sesame in Semi-arid Regions of Gujarat

Traloki Singh [a], P.S. Renjith [b], S.P. Singh [c*], K.B. Anand [d], Brihma Nand [e], K. N. Rai [f] and T. N. Rai [a]

[a] ICAR-CSSRI, Krishi Vigyan Kendra, Hardoi-II, Sandila, Hardoi, Utter Pradesh-241203, India.
[b] ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Udhagamandalam, Tamil Nadu-643004, India.
[c] Krishi Vigyan Kendra Belipar, (NDU & AT, Ayodhya) Gorakhpur- Uttar Pradesh, 273011, India.
[d] Department of Agronomy, Udai Pratap Autonomous College, Varanasi, Uttar Pradesh, 221003, India.
[e] Department of Agronomy Janta College Bakewar Etwah- 206124 (UP), India.
[f] Department of Soil Science & Ag. Chemistry KNIPSS, Sultanpur- 228118, (Uttar Pradesh), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jeai/2024/v46i123195

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128405

Original Research Article

Received: 24/10/2024
Accepted: 28/12/2024
Published: 30/12/2024

ABSTRACT

A field experiment was conducted by ICAR-CAZRI, Krishi Vigyan Kendra, Kutch-II, at farmers' fields to assess the impact of Cluster Frontline Demonstrations (CFLDs) on yield gaps and the economic performance of *kharif* sesame during 2019-20 to 2021-22. The study involved 87 CFLDs on

**Corresponding author: E-mail: spskvkgkp73@gmail.com;*

Cite as: *Singh, Traloki, P.S. Renjith, S.P. Singh, K.B. Anand, Brihma Nand, K. N. Rai, and T. N. Rai. 2024. "Impact of Cluster Front Line Demonstration on Yield and Economics of Kharif Sesame in Semi-Arid Regions of Gujarat". Journal of Experimental Agriculture International 46 (12):866-71. https://doi.org/10.9734/jeai/2024/v46i123195.*

Integrated Crop Management (ICM) using the high-yielding, leaf spot-tolerant sesame variety GT-4, along with a full package of practices, covering 34.8 hectares across eight villages in the Bhuj, Nakhatrana, Anjar, and Rapar talukas of Kachchh district. This improved approach was compared with the farmer's local practices. Over three years, the improved practice (IP) achieved an average seed yield of 640.33 kg ha^{1}, a 17.23% increase over the farmer's practice yield of 545 kg ha^{-1}. The average extension gap, technology gap, and technology index were 99 kg ha^{-1}, 169 kg ha^{-1}, and 21.13%, respectively. Economic analysis showed a net return of ₹41,290 ha^{-1} and a benefit-cost (BC) ratio of 3.07 for the improved practice, compared to ₹32,231.67 ha^{-1} and a BC ratio of 2.66 for the farmer's practice. The adoption of the improved variety with recommended practices significantly boosted sesame productivity and reduced extension and technology gaps.

Keywords: Economics; extension gap; sesame; technology gap; technology index; yield.

1. INTRODUCTION

Sesame (*Sesamum indicum)*, also known as summer or rainy season sesame, is a warm-season oilseed crop grown during the monsoon season in India. It is an important crop for many farmers in the country, playing a crucial role in their livelihoods. *Kharif* sesame has been cultivated for centuries and holds rich cultural and historical significance in India. The cultivation of *kharif* sesame involves specific sowing practices, irrigation requirements, and pest management strategies to ensure optimal yields. The crop is typically sown after the onset of the monsoon rains and requires well-drained soils with good moisture retention capabilities. This warm-season crop is harvested in the autumn months. Sesame seeds contain 50% oil, 25% protein, and 15% carbohydrates and are widely used in baking, candy making, and other food industries. Sesame is the oldest oilseed crop in India and is referred to as the "queen of oilseed crops" due to its excellent oil quality. The oil is used in cooking, salad oils, and margarine and contains about 40% oleic acid and 40% linoleic acid. Sesame has the highest oil content (46-64%) among oilseeds and provides high dietary energy (6355 kcal ha^{-1}). Unlike other fats, its oil is highly stable and does not develop rancidity, preserving its flavor and vitamin content.

Sesame oil and foods fried in sesame oil have a long shelf life due to the presence of an antioxidant called sesamol. The oil is versatile and can be used in the manufacture of soaps, paints, perfumes, pharmaceuticals, and insecticides. Sesame seeds are a powerhouse of energy, rich in vitamins E, A, and B complex, as well as minerals such as calcium, phosphorus, iron, copper, magnesium, zinc, and potassium. They are an excellent substitute for mother's milk, particularly in cases of milk allergies, as a quarter cup of natural sesame seeds provides more calcium (351 mg) than a full cup of milk (291 mg) (Elleuch et al., 2017). Sesame seeds contain significant amounts of methionine, tryptophan, and other amino acids with numerous health benefits. The ancient Hindi proverbs "Til se dil" or "Til – dil" emphasize the importance of sesame for heart health (Chaturvedi et al., 2024).

Sesame seeds are small, oval, and come in various colors, including white, yellow, black, and red, depending on the variety. Improved varieties and scientific cultivation technologies have the potential to increase the productivity of sesame (Yadav et al., 2020]. In India, *kharif* sesame is primarily cultivated in states like Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Maharashtra, and West Bengal. India is a major producer of several oilseed crops, including groundnut, mustard, rapeseed, sesame seed, and castor.

In Gujarat, the major *kharif* sesame-growing regions are Saurashtra, North Gujarat, and parts of Central Gujarat. The area under *kharif* sesame cultivation was 140,080 hectares, with a production of 74,180 tonnes and a productivity of 530 kg ha^{-1}. Anonymous, 2019-20 (Anonymous, 2019). The main causes of low productivity in sesame include the use of local cultivars, low soil fertility, and imbalanced nutrition. The adoption of improved technology packages has been found to be financially attractive. Improved varieties and scientific cultivation techniques have the potential to increase sesame productivity. However, the adoption levels of several components of these improved technologies remain low, highlighting the need for better dissemination. Kiresur et al. (2001). The gap between the recommendations made by scientists and the actual practices used by farmers is frequently observed. Rohit et al., (2019). To address this, the Krishi Vigyan Kendra in Kachchh, Gujarat, conducted frontline demonstrations on 87 farmers' fields during the kharif seasons of 2019-20 to 2021-22. The objective was to showcase the production potential of new technologies in real farm situations compared to traditional farmer practices.

2. MATERIALS AND METHODS

The present study was conducted by ICAR-CAZRI, Krishi Vigyan Kendra, Kutch-II, across four Talukas—Anjar, Bhuj, Rapar, and Nakhatrana—in the Kutch district during the *kharif* seasons of 2019-20 and 2021-22. A total of 87 Frontline Demonstrations (FLDs) were carried out on farmers' fields in villages such as Laxmipar, Moti Virani, Pragpar, Tindlwa, Gudkiya, Kukma, Reldi, and Chapredi, covering 34.8 hectares under rainfed conditions. Eight villages were randomly selected for Cluster Frontline Demonstrations (CFLDs) in the adopted villages. The materials and methods used for the demonstrations are detailed in Table 1. Locally cultivated varieties were used as the control (local check).

Before conducting the CFLDs, primary data were collected using a survey method for the agricultural seasons of 2019 to 2021. The data gathered included information on improved crop production techniques, soil parameters, suitable high-yielding varieties, and insect pest infestations through field surveys and farmer training sessions. This data was used to assess the current status of sesame production and to implement necessary improvements. The improved sesame farming technology, which included a high-yielding variety of sesame (GT-4) and a comprehensive package of operations, was demonstrated across 34.8 hectares.

The materials and procedures used in the CFLDs and the farmers' practices are outlined in Table 1. The major constraints identified for lower yields included inappropriate production technologies such as the broadcast method of sowing, lack of fertilizer use, and untimely weed management. The soils in the research area were sandy to sandy loam, mostly saline-alkaline, with pH values ranging from 8.5 to 9.2 and electrical conductivity (EC) values ranging from 0.9 to 4.5 dSm^{-1}. The soils were also low in available nitrogen, phosphorus, essential

Table 1. Details of materials and procedures used in the experiments

S. No.	Operation	Demonstrated improved technology	Farmer's practice
1.	Variety	GT 4	GT 2 & GT-3
2.	Soil & Seed treatment	Bavstin @ 2g/kg and Trichoderma virde @ 10g/kg seed before one day sowing	Generally, not practiced
3.	Date of Sowing	Last week of June to second week of July	July to 1st week of August
4.	Method of sowing and spacing	Line sowing, 45 x 10 cm	Broadcasting
5.	Fertilizer N-P-K-S and Application time	5 tonnes FYM, N-50kg+25kg P^2O^5+40K^2O+S-15-20kg+ 250kg Gypsum/ha	5 tonnes N-80kg+P-50kg
6.	No. of Irrigation	6-8	10-12
7.	Weed management	Hand weeding at 25-30 days after sowing. Weed control by chemical Fluchloralin or Pendimathalin of 1.0 kg a.i. at pre-emergence stage	Hand weeding at 25-30 days after sowing, Fluchloralin of 1.0 kg a.i. at pre-emergence stage
8.	Plant protection	Seed treatment with Thiamethoxam 30 FS @ 7g/kg seed and Bavistin @2g/kg seed. With the appearance of capsule borer and whitefly, foliar spray with Chloropyriphos + Cypermethrin @ 1.5 ml/liter and thiamethoxam 7g/liter water at 15 days interval	Seed treatment not practiced Spraying with Dimethoate @ 0.05% or Profenophos 35ml/Pump

micronutrients, and organic carbon. Soil test results guided the need-based application of the three essential nutrients: nitrogen (N), phosphorus (P), and potassium (K). Yield data were collected through field observations.

Kharif sesame is typically sown after the first rains of the monsoon season, around June or July, and is harvested in September or October. The crop requires well-drained soil and thrives in hot and humid conditions. The crop was harvested and dried for threshing when the capsules turned pale yellow and a few had dried out. As shown in Table 1, farmers received important inputs such as seeds, fertilizers, and plant protection chemicals. Field days and farmer meetings were conducted to help other farmers learn about the benefits of the showcased varieties and technologies.

For the comparative study, data on various parameters such as seed yield and the percentage of insect-pest and disease incidence were collected separately from both improved practices (IP) and farmers' practices (FP). The data were then tabulated and analyzed using statistical tools like frequency and percentage. The extension gap, technology gap, and technology index were calculated using the formulas provided by Samui et al., (2000).

$$Per\ cent\ increase\ in\ yield\ = \frac{Yield\ gain\ in\ IP\ plot\ (kg/ha) - Yield\ gain\ in\ FP\ plot\ (kg/ha)\ x\ 100}{Yield\ gain\ in\ FP\ plot\ (kg/ha)}$$

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – Local check

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

A comparative analysis of the package and practices in the demonstration plot and local check is provided in Table 1.

3. RESULTS AND DISCUSSION

3.1 Analysis of Yield

The data in Table 2 showed that the average grain yield of *kharif* sesame was higher under improved practices (640.33 kg/ha) compared to the average seed yield of check plots (545 kg/ha) during 2019-20 to 2021-22. Furthermore, there was a 17.23% increase in yield with improved practices compared to farmers' practices (Table 2). Similar results were previously found by Rohit et al. (2019), Tetarwal et al., (2021), Singh et al., (2024).

This percentage increase in seed yield in demonstration plots was attributed to the recommended improved package and practices followed under the close supervision of KVK scientists. The use of a high-yielding recommended variety of sesame (GT 4), timely sowing, seed treatment, proper line sowing, balanced fertilizer use, and integrated weed and plant protection management under the cluster frontline demonstrations enhanced sesame yields compared to farmers' practices.

3.2 Analysis of Extension Gap and Technological Gap

The extension gap is a metric used to determine the yield difference between a demonstration plot and a plot already in use (farmers' practice). During the *kharif* season from 2019-20 to 2021-22, a gap of 77 kg/ha to 130 kg/ha was recorded (Table 2). In the demonstration plots, the average extension gap was 99 kg/ha. This gap should be minimized through various extension approaches, such as the adoption of improved varieties, farmer training, farmer goshtis, and better agro-techniques, to reverse the trend of a broad extension gap. These programs can help farmers adopt new and improved sesame production technologies, thereby reducing the extension gap. The findings of Rohit et al. (2019), Meena et al., (2019), support these conclusions.

The technological gap measures the difference between the demonstrated yield and the potential yield. It was significantly higher (222 kg/ha) in 2019-20, followed by 2020-21 (167 kg/ha), and 118 kg/ha in 2021-22. Over the three years of cluster frontline demonstrations, the average technology gap was 169 kg/ha, as shown in Table 2. This indicates that there is still a gap in technology adoption, preventing farmers from achieving the potential yield of improved practices. The technological gap may be attributed to differences in field conditions such as soil fertility, poor quality irrigation water, insect-pest infestations, and varying meteorological conditions during the crop season at different locations. Similar findings were observed by Singh et al., (2022) and Singh et al., (2024).

Table 2. Effect of cluster frontline demonstration on yield, percentage increase and technological gaps of *kharif* sesame at farmer's field

Years	No. of Farmers/ Demos	Area in ha	Potential yield (kg/ha)	Demo (kg/ha)	Local (kg/ha)	% Increase in yield	*Ext. gap (kg/ha	*Tech. gap kg/ha	*Tech. index %
2019-20	25	10	800	578	501	13.33	77	222	27.75
2020-21	35	14	800	633	503	25.84	130	167	20.88
2021-22	27	10.8	800	710	631	12.52	90	118	14.75
Average	87	34.8	800	640.33	545	17.23	99	169	21.13

*Note: *Extension gap, Technology Gap and Technology Index*

Table 3. Economics analysis of *kharif* Sesamum under cluster front line demonstrations at farmers field

Years	Gross Cost (Rs./ha)		Gross Return (Rs./ha)		Net Return (Rs./ha)		BCR	
	IP	FP	IP	FP	IP	FP	IP	FP
2019-20	15000	14500	54910	47595	39910	33095	3.66	3.28
2020-21	23500	22000	56970	45270	33470	26475	2.42	2.06
2021-22	23800	22820	74290	59945	50490	37125	3.12	2.63
Average	20766.7	19773.3	62056.7	50936.7	41290.0	32231.7	3.07	2.66

The technology index reflects the percentage ratio of the technological gap to the potential yield and demonstrates the viability of advanced technologies in farmers' fields. According to the results (Table 2), the technology index ranged from 14.75% to 27.75% for *kharif* sesame from 2019-20 to 2021-22. Over the three consecutive years of the CFLDs on the oilseed program, the average technology index for kharif sesame was observed to be 21.13%. Similar findings have been reported by Singh et al., (2024); Sagar et al., (2024) and Kiresur et al., (2001).

3.3 Analysis of Economics

The economic analysis of *kharif* sesame yield under frontline demonstrations is presented in Table 3. The economic viability of improved technology over the local check (farmers' practice) was calculated based on the prevailing prices of inputs and output costs, represented in terms of the benefit-cost ratio (B: C ratio). The cost of cultivation for sesame production varied from ₹ 15,000 to ₹ 23,800 per hectare, with an average of ₹ 20,766.67 per hectare, compared to ₹14,500 to ₹ 22,820 per hectare, with an average of ₹ 19,773.33 per hectare under control. The increased cost in the check plots was due to the farmers' use of 2-3 un-recommended pesticides for insect control. The data in Table 3 shows the cost of cultivation, gross return, net return, and benefit-cost ratio (BCR) of the sesame crop under improved practices in the cluster frontline demonstration and existing farmers' practices. The average cost of cultivation in improved practices was ₹ 20,766.67 per hectare, compared to ₹ 19,773.33 per hectare in farmers' practices. The higher average gross return was observed in demonstration plots (₹ 62,056.67 per hectare) compared to check plots (₹ 50,936.67 per hectare). The demonstration plots recorded considerably higher average net returns (₹ 41,290.00 per hectare) compared to farmers' practices (₹ 32,231.67 per hectare). The average B: C ratio of the demonstration plot (3.07) was higher than that of the farmers' practices (2.66). Similar findings have been reported by Yadav et al., (2020), Meena et al., (2023), Singh et al. (2024).

4. CONCLUSION

The research conducted through frontline demonstrations in Kutch, Gujarat, from 2019 to 2022, highlights the significant potential of adopting improved sesame cultivation practices over traditional methods. The use of high-yielding varieties, optimized fertilizer applications, and advanced pest management techniques under the guidance of KVK scientists led to notable increases in both grain yield and economic returns for farmers. The demonstrations revealed a 17.23% increase in yield with improved practices, a reduction in the extension gap, and better economic viability with a higher benefit-cost ratio compared to conventional farming methods. Despite these successes, challenges such as technological and extension gaps indicate that further efforts are needed to ensure widespread adoption of these improved practices. The findings underscore the importance of continued farmer education, effective technology transfer programs, and tailored interventions that consider local conditions to bridge these gaps. Overall, this study reaffirms the value of modern agricultural techniques in enhancing the productivity and profitability of kharif sesame, thereby contributing to the livelihood of farmers in India.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Anonymous. (2019). Directorate of Agriculture, Krishibhavan, Gujarat state Gandhinagar. 2019-20. http://dag.gujarat.gov.in

Chaturvedi, A., Tripathi, A. N., Mishra, N. K., & Pandey, V. K. (2024, February 27). The impact assessment of front line demonstrations on sesame: A case study in Tirap district of Arunachal Pradesh, India. *Arch. Curr. Res. Int.*, *24*(3), 52–57. Available from https://www.journalacri.com/index.php/ACRI/article/view/644

Elleuch, M., Besbes, S., Roiseux, O., Blecker, C., & Attia, H. (2017). Quality characteristics of sesame seeds and by-products. *Food Chemistry, 103*, 641–650.

Kiresur, V. R., Rumana Rao, S. V., & Hegde, D. M. (2001). Improved technologies on oilseeds production - An assessment of their economic potentials in India. *Agricultural Economics Research Review, 14*, 95–108.

Meena, M. S., Singh, S. K., Meena, H. N., & Bishnoi, R. (2023). Yield gaps and scaling up of sesame variety (RT-351) in potential areas of Rajasthan. *Indian Journal of Extension Education, 59*(2), 55–60.

Rohit, & Singh, J. (2019). Impact of front-line demonstrations on sesame (*Sesamum indicum* L.) in Agra district of U.P. *Journal of Pharmacognosy & Phytochemistry, 8*(6), 339–341.

Sagar, R. L., & Chandra, G. (2024). Front line demonstration on sesame in West Bengal. *Agricultural Extension Review, 10*, 7–10.

Samui, S. K., Roy, D. K., Mandal, A. K., & Saha, D. (2000). Evaluation of front line demonstration on groundnut. *Journal of Indian Society of Coastal Agricultural Research, 18*, 180–183.

Singh, T., & Tetarwal, A. S. (2022). Cluster frontline demonstrations (CFLDs): An effective approach to increase the productivity of mustard in the arid zone of Gujarat. *Annals of Agricultural Research, New Series, 43*(3), 21–59.

Singh, T., Tetarwal, A. S., & Dev, R. (2024). Assessment of cluster front line demonstration on yield and economics of summer sesame. *Indian Journal of Agronomy, 69*(2), 195–199.

Tetarwal, A. S., & Singh, T. (2021). Evaluation of cluster frontline demonstrations (CFLDs) on the productivity of *Kharif* groundnut in Kachchh district of Gujarat. *Annals of Agricultural Research, 42*(4), 451–457.

Yadav, N. K., Tiwari, D., Pandey, N. K., Ahmed, M., Sarita Devi, Dixit, A., & Chauhan, A. K. (2020). Impact of front line demonstration on sesamum crop in Lalitpur District of Bundelkhand Region. *Journal of Krishi Vigyan, 8*(2), 182–185.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/128405