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Research Paper

Assessment of cluster front line demonstration on yield and economics of summer sesame

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ABSTRACT

Sesame is one of the most important oilseed crops which play a major role in increasing the income of small and marginal farmers of the Kutch region of Gujarat. To promote the improved cultivation technology of sesame with high yielding variety 'GT4' and 'GJT5', 123 cluster front line demonstrations (CFLDs) were conducted in 63.2 ha area during summer, at ICAR-CAZRI, Krishi Vigyan Kendra, Kukma, Bhuj, Kachchh, Gujarat during summer 2017 to 2020. The four years data revealed that the average yield increased to 16.34% over the existing practice due to adoption of improved practice. The average technology gap, extension gap and technology index were 270.5 kg/ha, 121 kg/ha and 24.95%, respectively. Furthermore, the economics of the demonstrations and farmers practice showed an increased net return of ₹ 39,319/ha with benefit: cost ratio (BCR) of 2.47 in demonstrated plots over conventional plots where it was ₹ 30,700/ha and 2.19, respectively. By conducting front line demonstration of the proven technologies, yield potential of sesame crop could be enhanced to a greater extent with increase in the income level of the farming community.

Key words: Adoption, Extension gap, Impact, Sesame, Technology gap

Sesame (*Sesamum indicum* L.) is a tropical annual crop that has been cultivated for a long time, mainly for grain yields and high protein contents of its seeds (Sene *et al.,* 2018a). This is an herbaceous annual plant belonging to the Pedaliaceae family. Among the oilseed crops, sesame has been cultivated for centuries, particularly in Asia and Africa, for its high content of edible oil and protein.

Sesame can grow in low input soils and can thrives under higher temperatures, low water supply (up to 300 mm water) (Sene *et al.,* 2018a and Tunde-Akintunde *et al.,* 2012), thus it is a crop of present and future due to its aptitude to climatic resilience. It is cultivated for its protein-rich seed and its edible oil, protein content of sesame seeds is about 25% (Miraj and Kiani, 2016), which is a rich source of UFAs (Elleuch *et al.,* 2007) and have a high oil content between 55 and 59% of the seed (Miraj and Kiani, 2016; Sene *et al.,* 2018b). Its oil unlike other fats is highly stable and does not develop rancidity leading to loss of flavor and vitamin. India is the largest producer and exporter of sesame in the world (Puspha and Senthil 2003). It is also an important source of Vitamin E, calcium, potassium, phosphorus, iron, magnesium and zinc (Miraj and Kiani, 2016; Gharby *et al.,* 2017 and Deme *et al.,* 2017). Traditionally, Indians consume substantial quantity of edible oils mainly as a cooking medium.

Sesame is mainly cultivated in the states of Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh, Orissa, Maharashtra, Tamil Nadu, Andhra Pradesh, and West Bengal with an average low productivity (391 kg/ha) when compared with other countries. In Gujarat, this crop is cultivated in both seasons (*kharif* and summer) with an acreage of 2,086.31 ha area and 1,339 MT production with an average productivity of 642 kg/ha (Anonymous, 2021). The communities of farmers are growing sesame crop in both way as a rainfed and irrigated crop, using high yielding variety seeds.

A substantial amount of the world's sesame production is consumed as oil. Most commercial cultivars of sesame are intolerant of water-logging. Late onset of rainfall in the season prolongs growth and increases seed shattering and dehiscence losses. High wind velocity can also cause shattering at harvest. The major constraint responsible for lower yield is low productivity of local varieties, inappropriate production technologies, viz; broadcast method of sowing, poor soil fertility and imbalanced fertilization and untimely weed management (Khaleque and Begum, 1991).

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As the world population increases, demand for high-quality seed oils continues to grow. Adoptions of improved technology packages were also found to be financially attractive. An improved verities and scientific cultivation technologies are capable for increasing the productivity levels of Sesamum. Yet, adoption levels for several components (of the improved technology were low, emphasizing the need for better dissemination (Kiresur *et al*., 2001).

The gap between recommendations made by the scientists and actual use by farmers is frequently encountered (Rohit and Singh, 2019). Therefore, the Krishi Vigyan Kendra, Kachchh, Gujarat has conducted frontline demonstration on the 123 adopted farmer's field during summer 2017 to 2020 with the objectives of to show the production potential of the new technologies under real farm situation over the local farmers practices.

MATERIALS AND METHODS

The present investigation was carried out during summer 2017 to 2020 at ICAR-CAZRI, Krishi Vigyan Kendra, Kukma, Bhuj Gujarat in the adopted Villages of Anjar, Bhuj, Rapar and Nakhatrana talukas, as part of the National Food Security Mission on oilseeds. A total of fourteen villages were chosen at random for cluster front line demonstrations (CFLDs) in adopted villages under four talukas of Kachchh district. Materials and methods adopted for the frontline demonstrations are given in Table 1. A total of 123 cluster front line demonstrations were conducted in a 63.2 ha area at different locations as shown in Table 2. Locally cultivated varieties were used as local check. Before conducting CFLDs, we gathered fundamental data on crop production techniques, soil characteristics, acceptable high yielding varieties, and the occurrence of insect pests through field surveys and farmer meetings to determine the current condition in sesame production and, as a result, necessary improvements in cultivation practices were implemented. Improved sesame farming technology, including a high yielding variety of sesame (GJT-5) and a whole package of operations were demonstrated in various locations over 63.2 hectare acreage. The materials or procedures utilised in CFLDs and farmers' practice are listed in Table 2. The research area's soils were sandy to sandy loam, mostly saline-alkaline with pH and EC values ranging from 8.5 to 9.2 and 0.9 to 4.5 dS/m, respectively and in with low available nitrogen, phosphorus, essential micronutrients and organic carbon.

Every year, the sowing took place between second fortnight of February and the first fortnight of March under irrigated conditions, while the harvest took place between the last April and first fortnights of May. The crop was harvested and dried for threshing when the capsules became pale yellow and a few capsules dry out. As shown in

Table 1. Details of material and procedures used under improved practice and local check

S. No.	Operation	Demonstrated improved technology	Farmer's practice
1.	Variety	'GT 4' and 'GJT 5'	'GT 1', 'GT 2' and 'GT 3'
2.	Soil and Seed treatment	Bavstin @ 2 g/kg and Thiamethoxam @ 7 g/kg seed before one day sowing	Generally, not practiced
3.	Date of Sowing	2nd week of February	1st week of March
4.	Method of sowing and crop geometry	Line sowing, 45 × 15 cm	Broadcasting
5.	Fertilizer N:P:K:S and Application time	10 tonnes FYM, N: 25kg+25kg P_2O_5+S-20 kg+ 250 kg Gypsum/ha	5 tonnes N:100 kg + P:50 kg
6.	No. of flood Irrigation	6-8	10–12
7.	Weed management	Fluchloralin or Pendimathalin of 1.0kg a.i. at pre-emergence stage	Hand weeding at 25–30 days after sowing
8.	Plant protection	With the appearance of capsule borer and whitefly foliar spray of Chloropyriphos + cypermethrin @ 1.5 ml/liter and thiamethoxam 0.4 g/liter water at 15 days interval	Spraying with Dimethoate @ 0.05% or Profenophos 2 ml/liter water

Table 2. Year wise number and area of CFLDs covered in different villages

S. No.	Year	No. of Demonstrations (No.)	Area (ha)	Adopted villages for intervention
1.	2017	40	30	Sugariya, Bharapar, Kotda Chakar, Todiya, Khomdi, Kukma
2.	2018	25	10	Dhaneti, Modsar, Sugariya, Kotda Chakar, Ballbhpar, Tharawada
3.	2019	25	10	Laxmipar, Modasar, Rapar Khokhara
4.	2020	33	13.2	Laxmipar, Kukma, Nana Reha, Modsar, Rapar Khokhara
	Total	123	63.2	

Table 2, farmers got important inputs such as seed, fertiliser, and plant protection chemicals. Farmers who were chosen for CFLDs were instructed to use full package of practices. Farmers, on the other hand, were permitted to carry out their own practises in a farmer's practise or a local check. Field days and farmer meetings were conducted so that other farmers could learn about the benefits of the varieties and technologies on display. For comparison study, data on several parameters such as seed yield and percent insect pest and disease incidence were gathered separately from both improved practise (IP) and farmer's practise (FP). Furthermore, data were tabulated and analysed by using statistical tools like frequency and percentage. The extension gap, technology gap and technology index were worked out as per formulas given by the Samui *et al.* (2000) and Prasad *et al.* (2022).

Per cent increase in yield (kg/ha)

$$= \frac{\text{Yield gain in IP plot} - \text{Yield gain in FP plot}}{\text{Yield gain in FP plot}} \times 100$$

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – Local check

Technology index (%)

$$= \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

Impact on yield (% change)

$$= \frac{\text{Yield of demonstration plot} - \text{Yield of farmers practice}}{\text{Yield of farmers practice}} \times 100$$

Impact on yield (% change)

$$= \frac{\text{No. of adopters after FLD} - \text{No. of adopters before FLD}}{\text{No. of adopters before FLD}} \times 100$$

RESULTS AND DISCUSSION

Yield performance

The yield of sesame was higher in the demonstration field than in the local practise throughout summer 2017 to 2020, according to the data presented in Fig. 1 and 2. Following data analysis, it was shown that better technical intervention led in a 17.74% higher sesame seed production of 800 kg/ha compared to 679 kg/ha recorded with existing techniques (farmers practise) as shown in Fig.1. Previously, Naveen *et al.* (2017); Singh *et al.* (2019); Tetarwal and Singh (2021) and Chauhan *et al.* (2022) found similar results.

The percent increase in yield of demonstration plots over farmers' plots was 17.74 per cent. This seed yield increase of demonstration plots was due to the recommended package and practices followed under the supervision of KVK scientists. Use improved and recommended variety of sesame (GT 5 and GJT 7), optimum sowing time, proper seed treatment, line sowing, recommended dose of fertilizers, integrated weed and plant protection measures followed under CFLDs enhanced the yield of sesame compared to farmer's practices.

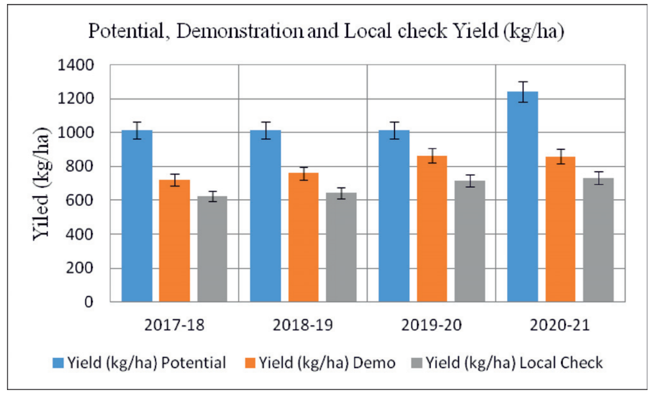

Fig. 1. Impact analysis of yield of sesame crop
Error bars represents the standard deviation (SD) of the mean. Different letters above the error bars indicate significant differences at the 0.05 level (ANOVA Duncan's multiple range test), n=3.

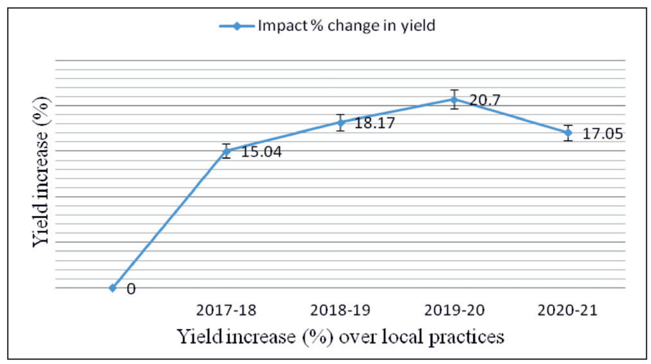

Fig. 2. Impact analysis in percentage change in yield
Error bars represents the standard deviation (SD) of the mean. Different letters above the error bars indicate significant differences at the 0.05 level (ANOVA Duncan's multiple range test), n=3.

Gap analysis

The technological gap measures the difference between the demonstrated yield and the potential yield, and it was higher (383 kg/ha) in 2020, followed by 2017 (295 kg/ha), 2018 (253 kg/ha) and 151 kg/ha in 2019. Under the four-year CFLD investigation, the average technology gap was 270.5 kg/ha as shown in Fig. 3. It is shown that there is still gap in technology demonstration as a result of which the potential yield of improved practices could not be achieved by the adopting farmers. The assessment of technological gap might be attributable to differences in field conditions like soil fertility, poor quality irrigation water, insect-pest assault, and variable meteorological conditions experienced throughout crop season at different places. Similar findings were observed by Singh and Tetarwal (2022), Amit *et al*. (2020) and Grover and Singh (2007). This extension gap is a metric used to determine the yield

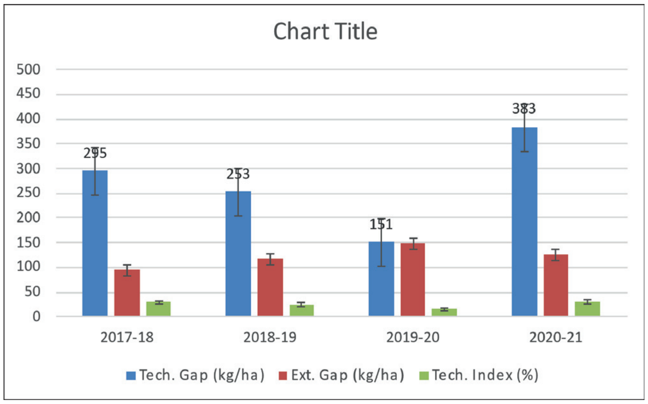

Fig. 3. Impact analysis of technological gap
Error bars represents the standard deviation (SD) of the mean. Different letters above the error bars indicate significant differences at the 0.05 level (ANOVA Duncan's multiple range test), n=3.

difference between a demonstration plot and a plot already in use (farmers practice). During the summer, 2017 to 2020, a gap of 94 kg/ha to 148 kg/ha was recorded (Fig. 3). In the improved practices plot, the average extension gap was observed 121 kg/ha, which has to be minimized via various extension approaches like adoption of high yielding varieties, training programmes, kisan gosthies, and better agro technologies to reverse this trend of broad extension gap. These programmes have the potential to assist farmers in adopting new and improved sesame production technologies, resulting in a reduction in the extension gap. The findings of Singh and Bajpai (1996), Sagar and Chandra (2004), Meena *et al.* (2018), Tetarwal and Singh (2020) and Prasad *et al.* (2022) supported the present investigations.

The technology index showed the percentage ratio of the technological gap to potential yield. It also demonstrates the viability of advanced technologies in farmers' fields. According to the results (Fig. 3), the highest technology index value of 30.86% was recorded in summer 2020, while the lowest technology index value of 14.89% was recorded in summer 2019. During four consecutive years of CFLDs on oilseed programme, the average technology index in castor crop was 24.95%. Tetarwal and Singh (2020) and Singh and Tetarwal (2022) found similar results.

Economics Performance

The data show in Table 3 shows the cost of cultivation, gross return, net return, and benefit: cost ratio (BCR) of sesame crop in improved practise under cluster front line demonstration and existing farmers' practise. The average cost of cultivation rose of summer sesame in enhanced practise (₹ 26,775/ha) compared to conventional methods (₹ 25,660/ha). The demonstration plot (₹ 66,094/ha) recorded considerably greater average gross returns than farmers' practises (₹ 56,360/ha). In comparison to farmer's practise (2.19), the average BC ratio of the demonstration plot (2.47) was greater. Naveen *et al.* (2017), Padmaiah

Table 3. Economics performance of castor crop under cluster front line demonstrations at farmer's field

Year	Economics of demonstration plot (₹/ha)				Economics of existing practices (₹/ha)				Increased income in %
	Gross cost	Gross returns	Net returns	Benefit: cost ratio (R/C)	Gross cost	Gross returns	Net returns	Benefit: cost ratio (R/C)	
2017–18	25,800	52,127	26,327	2.02	24,300	45,312	21,012	1.86	25.22
2018–19	27,500	53,925	26,425	1.96	26,250	46,875	20,625	1.79	28.12
2019–20	26,300	77,670	51,370	2.95	25,490	64,350	38,860	2.52	32.19
2020–21	27,500	80,652	53,152	2.93	26,600	68,902	42,302	2.59	25.65
Average	26,775	66,094	39,319	2.47	25,660	56,360	30,700	2.19	28.06
Standard Error	0	7577.93	7481.23	0.27	509.1	6008.09	5748.59	0.21	1.60

Table 4. Impact of frontline demonstrations on adoption of improved practices on yield summer sesame crop

S. No.	Improved practices	Number of Adopters (N=123)		Change in no. of adopters	Impact (% change)
		Before d emonstration	After demonstration		
1.	Field preparation & use of FYM	65 (52.85)	105 (85.36)	+40	+61.54
2.	High yielding variety (GT 3, GJT 5)	45 (36.58)	95 (77.24)	+50	+111.11
3.	Time of Sowing and spacing	75 (60.97)	110 (89.43)	+35	+46.67
4.	Fertilizer application NPKS & Gypsum	48 (39.04)	115 (93.50)	+67	+139.58
5.	Weed management	55 (44.72)	105 (85.37)	+50	+90.90
6.	IDM and IPM practices	45 (36.59)	95 (77.24)	+50	+111.11

et al. (2012), Sangwan *et al.* (2021) and Singh *et al.* (2019) have also found similar findings.

Impact on Adoption

As per the statistics in Table 4, the number of adoptions for field preparation and usage of FYM for sesame crop were 52.85% before field demonstrations, and jumped to 85.36% after frontline demonstrations in adopted villages. A similar trend was observed in the adoption of high-yielding varieties, as well as sowing time and spacing, with the percentage of adopters rising from 36.58 to 77.24 and 60.97 to 89.43%, respectively. The number of adopters for fertilizer application, weed control and IDM & IPM increased from 39.04 to 93.5%, 44.72 to 85.37%, 28 to 80% respectively, over the pre- and post-demonstration periods. The CFLD intervention practices had a significant positive impact on the adoption of improved practices. Similar findings were recorded by Singh and Tetarwal (2022), Meena *et al.* (2018).

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