



Cluster Frontline Demonstration: A Innovative Extension Approach to Enhance Mustard Production in Semi-arid Condition of Jaipur District of Rajasthan, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A extension approach known as Cluster frontline demonstration (CFLD) was demonstrated on rapeseed mustard crop in 110 ha area of six villages namely Sevapura, Shrirampura, Tankarda, Adagela, Mendwas and Sirsiya of Jaipur district during *Rabi* 2020-21 and 2021-22, respectively by Krishi Vigyan Kendra (KVK), Jaipur-I. Integrated crop management comprised of high yielding variety, seed treatment technology, weed and nutrient management and plant health management was also performed at selected farmers' fields. These efforts resulted highest mean yield 23.84 q/ha in experimental plot and lowest mean yield 19.06 q/ha in control plot (farmers practices). In term of economics, net return Rs.91,536/ha was gained from experimental plot as compared to control plot

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(Rs.70,450/ha). Likewise, from experimental plot maximum (4.83) average benefit cost ratio was obtained compare to control plot (4.34). Technology interventions and extension approaches were responsible for 25.15 % increase in mustard yield. During the experimentation, 3.66 q/ha mean technology gap, 4.78 q/ha extension gap and 13.31 % technology index were observed.

Keywords: Mustard; extension approach; high yielding variety; CFLD; technology intervention.

1. INTRODUCTION

In many parts of the world, oilseeds play a major role in agricultural economy. India is 5th largest oilseed producer after the United States, Brazil, Argentina, China (Shenoi, 2003). The Indian agricultural economy depends primarily on oilseed crops, which are the second-largest category of agricultural products after cereals due to their high fat content. Rapeseed mustard is the third-largest group of oilseed crops in the world, after palm and soybean oil. The main edible oilseed crop in India is mustard, which produces almost one-third of all oil. The oil content of Indian mustard seeds varies from 30% to 48%. Among rapeseed-mustard, Indian mustard (*Brassica juncea* L.) is one of the most important *Rabi* oilseed crops, in term of area and production under the nine oilseeds crops grown in India, rapeseed-mustard accounts for 30.3% of the acreage and 33.2% of the production, with the production of 13.2 million tons during 2023-24, rapeseed-mustard became the first largest oilseed crop in India (Anon, 2025). Rajasthan, Haryana, Punjab, West Bengal, Madhya Pradesh, Uttar Pradesh, Gujarat, Bihar and Assam are rapeseed mustard cultivating state of India. Rapeseed-mustard cultivation in Rajasthan is about in 2.37 million ha area with the production of 4.08 million tonnes, having a productivity of 1720 kg ha⁻¹ (Khan et al., 2020). Indian mustard's is principally grown for edible oil and additionally leaves, seeds, and stem are consumed. Young plant leaves are used as green vegetables, in salads, or blended with other salad greens. Seed waste is used in livestock feed and fertilizers (Khan et al., 2022). Protein content in Indian mustard seed is nearly about 28-36% with ample amount of nutritive value and additionally it contains 38-57% erucic acid, 5-13% linoleic acid, and approximately 27 %oleic acid. Additionally, they are excellent carriers of antioxidant vitamins A, D, E, and K. Indian mustard oil is indispensable culinary part of north Indian kitchen (Dekhane et al., 2024). Cool temperatures and sufficient soil moisture during the growing season is prerequisite for mustard cultivation and dry condition at the time of harvesting (Banerjee et al., 2010). The

majority of our country is covered in rainfed dryland conditions, where crops are widely grown and suffer from a lack of soil moisture during critical growth stages, resulting in poor growth and yield. The yield varies by state due to differences in rainfall and soil types. Mustard play crucial role in edible oil economy of country as well as an additional source of income and livelihood of poor and small farmers. Negligence in adoption of technology intervention and package of practice among mustard growers leads to low productivity. This constraint is key factor for low productivity and under exploitation of production potentials of improved varieties of ICAR institutes and state agricultural universities.

The main goal of frontline demonstration (FLD) is to provide farmers with the technical knowledge that they may easily increase their current crop production by using the recommended package and methods. It was also determined that the upgraded technology bundles were commercially appealing. However, a improved technology's components had poor acceptance rates, highlighting the necessity of greater dissemination (Kiresur et al., 2001). Due to the widespread belief that "seeing is believing," FLD is one of the most effective extension strategies. FLDs primary goal is to showcase recently developed crop production and plant health technologies along with their management techniques in farmers' fields across various agroclimatic zones and farming conditions. Considering the necessity of CFLDs, the KVK Jaipur-1 has performed CFLDs on mustard with the goal of identifying yield gaps between farmer practice and FLD in the KVK's area of operation.

2. MATERIALS AND METHODS

The study under investigation of CFLDs on Mustard was conducted by KVK Jaipur-1 during *Rabi* 2020-21 and 2021-22 at villages namely Sevapura, Shrirampura, Tankarda, Adagela, Mendwas and Sirsiya of Jaipur Rajasthan. Before conducting demonstration, a baseline survey was conducted to find out constraints of mustard production in that particular locality and existing farmer practices.

Table 1. Technological gap analysis for mustard

Sr. No.	Name of Technology	Farmers' already Practicing	Recommended technology
1	Name of Variety	Local seed/ Bio-902	Giriraj, RH-725 & RH-749
2	Seed rate kg per hectare	5-6	4.0
3	Seed treatment technology	Majority of farmers not follow	Treatment with Metalaxyl 35% SD @ 6 gm/seed
4	Use of Bio - fertilizers	No use	Seed priming of PSB culture @ 5 ml/kg seed
5	Nutrient management	NPS - 40:20:00 kg/ha	NPS - 60:40:40 kg/ha
6.	Weed management	Practicing One Hand Weeding	Application of Pendamethaline @ 750 gm a.i./ha as a pre-emergence followed by One hand weeding 30-35 DAS
7	Plant protection tactics (Aphid management)	Dusting of Methyl Parathion @15 kg/ha for Aphid	Application of Imidacloprid 17.8 SL @ 0.4 ml/ lit

Selected villages come under agro-climatic zone-III A where temperature during mustard cultivation varies from -2 °C to 30 °C. The demonstration was conducted in an area of 80 ha with 200 demonstrations in *Rabi* 2020-21 in villages namely Sevapura, Shrirampura, Mendwas and Sirsiya of Phagi block under rainfed condition however, 30 ha with 75 demonstrations in *Rabi* 2021-22 in villages Tankarda, Adagela of Govindgarh block under irrigated condition against local variety in two years and each demonstration size was 0.4 ha. With the active participation of farmers, 275 demonstrations covering 110 hectares were carried out during *Rabi* 2020–21 and 2021–22 to showcase improved mustard technologies in selected villages, ensure production potential of crop, and increase the district's area sown to the crop. Comparison of technological intervention demonstrated and farmers practices is presented in Table 1. The soils in selected villages were sandy loam to loamy sand in texture and mustard crop was grown in conserved moisture of soil under rainfed condition. Only few farmers provide lifesaving flood irrigation, whenever available from community pond. A training on mustard cultivation was provided to selected farmers for adoption of the package of practices recommended for agro-climatic zone III A of Rajasthan. Essential critical inputs were also supplied to farmers for achieving production potential of mustard. (Table 1).

Gap assessment in technology adoption was carried out by group discussion with selected farmers before starting CFLDs programme.

Starting from seed sowing to harvesting KVK researchers regularly monitored CFLDs fields and control field (farmer's field). Feedbacks were gathered from beneficiary farmers for further improvement of programme. Additionally, KVK researchers organized field days at pod maturation stage of crops. Samui et al., (2000) formulae were employed to estimate extension gap, The technology gap and technology index.

3. RESULTS AND DISCUSSION

The findings of the CFLDs (Table No. 2) executed at farmers' fields clearly revealed that mustard production was higher in demonstration sites than in farmer's practice during both years (2020-21 to 2021-22). The mustard production over two years varied from 23.38 to 24.30 q/ha in demonstration sites against 18.41 to 19.71 q/ha in farmer practices (Control plot). The demonstrated technology produced a mean yield of 23.84 q/ha, indicating a 25.15 percent increase over farmers' practices (19.06 q/ha).

Similar results were also observed by Shukla et. al., (2022), Chaudhary et. al., (2018), Verma et al., (2012), Tiwari & Saxena (2001). The results clearly indicated the higher productivity of mustard under cluster frontline demonstration in comparison to farmer's practice due to the use of high yielding variety, timely sowing, balance doses of fertilizers and inclusion of sulphur in fertilizers application along with recommended doses of nitrogen & phosphorus (NP) fertilizers, improved agronomic practices and need based plant protection measures.

Table 2. Comparative performance of mustard variety giriraj along with technology intervention under CFLDs

Demo. Year	Area of Demo (ha.)	No. of Demo.	Varieties Demonstrated	Yield (q/ha)			% increase over farmers practices	Extension gap (q/ ha)	Technology gap (q/ ha)	Technology index (%)
				Potential	Demo.	FP				
2020-21	80	200	Giriraj (DRMRIJ-31)	27.5	24.30	19.71	23.29	4.59	3.20	11.64
2021-22	30	75	Giriraj (DRMRIJ-31)	27.5	23.38	18.41	27.00	4.97	4.12	14.98
Total	110	275	-	-	-	-	-	-	-	-
Average	-	-	-	27.5	23.84	19.06	25.15	4.78	3.66	13.31

Table 3. Economics of demonstrated technology and farmer practice

Year	Cost of Cultivation (Rs/ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio	
	Demo.	FP	Demo.	FP	Demo.	FP	Demo.	FP
2020-21	22493	19373	112995	91652	90502	72279	5.02	4.73
2021-22	25500	23350	118069	91971	92569	68621	4.63	3.94
Average	23997	21362	115532	91812	91536	70450	4.83	4.34

Demo. – Demonstration, FP- Farmer Practice

So, demonstration technologies had excellent impact on seed yield of mustard as compared to local varieties used by farmers.

3.1 Extension Gap

According to the study (Table 2), there was an extension gap of 4.59 to 4.97 q/ha between CFLDs and farmers' practice, with an average extension gap of 4.78 q/ha throughout two years of demonstration. The largest extension gap was determined to be 4.97 q/ha during rabi 2021-22, while the lowest extension gap was found to be 4.59 q/ha during rabi 2020-21. This alarming trend of a wider extension gap may be due to the adoption of improved scientific technologies in demonstrations, which resulted in higher produces than traditional and old farmers' practices. Increased use of the latest production technologies, as well as a greater emphasis on the use of high yielding new varieties, will eventually lead to farmers discontinuing the old technology and adopting the new one. Parallel results were also documented by Shukla et. al., (2022), Hiremath & Nagaraju (2010).

3.2 Technology Gap

During rabi 2020-21 and 2021-22, the technology gap was assessed to be 3.20 and 4.12 q/ha, respectively, and the average technology gap over two years was 3.66 q/ha. The variation in technology gap between years may be due to varietal performance coupled with various types of technological interventions and suitability of demonstrated technologies during the two years in different locations of demonstration sites. The found technology disparity could be attributed to differences in soil fertility gradient, timing of sowing, and meteorological conditions. Mitra and Samajdar (2010) and Chaudhary et al. (2018) were also reported similar results.

3.3 Technology Index

In Rabi 2020–21 and 2021–22, the technology index ranged between 11.64 and 14.98 percent,

according to this analysis. Over the course of two years of demonstration, the average technology index was 13.31 percent. A lower technology index value indicates that the technology is more feasible. The technology index also showed how well-suited the demonstrated technologies were for the farmer's fields. Jeengar et al., (2016), Mitra & Samajdar (2010), and Shukla et al., (2022) reported comparable findings.

3.4 Economics

Table 3 presents the findings of an estimation of the economics of mustard under CFLDs. The findings unequivocally demonstrated that, in comparison to farmer practices, the CFLDs higher average gross returns (Rs. 112995/ha and Rs. 118069/ha) and net returns (Rs. 90502/ha and Rs. 92569/ha) during Rabi 2020–21 and 2021–22, respectively, with higher cost: benefit ratios (5.02 and 4.63). When comparing CFLDs to farmer practice, the mean two-year gross returns were Rs. 115532/ha, the net return was Rs. 91536, and the B:C ratio was 4.83.

Over the years, there was variation in the economic returns as a function of seed production and MSP retail price. Increased seed yield and Minimum Support Prices, which were set by the Indian government, resulted in the highest returns. The utilization of efficient, proven technology, non-monetary elements, timely crop cultivation operations, and periodic scientific field monitoring of farmers' fields are the only reasons for the higher additional returns and effective gain achieved under CFLDs. The outcomes support the conclusions of frontline demonstrations on pulse and oilseed crops conducted by Yadav et al. (2004), Shukla et al. (2022), Yadav & Khan (2024), and Verma et al. (2012), Hooda, V., & Jangra (2024).

4. CONCLUSION

The adoption of technological interventions of CFLDs coupled with the high yielding variety

Giriraj performed marvellous as compare to farmer practices in all the demonstrations, because the two-year results of the CFLDs on mustard crop showed that the yield increased by up to 25.15 percent more than farmer practices. The technologies that were demonstrated were found to be effective in increasing the yield, and the CFLDs was the most innovative extension and successful approach to transfer of technology for increasing the production potential of mustard. Therefore, it is necessary to employ various extension methodologies viz. farmers training, diagnostic/field visit and field days for dissemination of high yielding varieties along with area specific production technologies for farmers benefits.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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