Journal of Scientific Research and Reports

Volume 30, Issue 11, Page 223-230, 2024; Article no.JSRR.126074
ISSN: 2320-0227

Technology Intervention through Cluster Frontline Demonstration in Indian Mustard (*Brassica juncea*) in Arid Region of Western Rajasthan

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Author's contribution

The sole author designed, analysed, inteprted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/jsrr/2024/v30i112549

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/126074

Original Research Article

Received: 26/08/2024
Accepted: 28/10/2024
Published: 30/10/2024

ABSTRACT

During this study, cluster front-line demonstrations (CFLDs) were promoted to assess their contribution to yields, improve technology adoption, and enhance mustard growers' profitability during, 2019-20 and 2020-21, the on-farm demonstrations (n=108) were conducted, covering 140 ha area in Kolhu, Unthwalia, Dayakor, Palli-1, Gajja,Vijaynagar and Siyo ka baas (seven Villages) of Jodhpur district of Rajasthan and these were compared with existing farmer's practices of mustard cultivation. The improved production technologies consisting high yielding varieties (DRMRIJ-31 (Giriraj) and RH-0749, sowing methods, nutrient management, weed management and use of plant protection measures were included. The findings revealed that the package of improved production technologies recorded a mean yield of 18.4 q/ha which was 27.9 % higher

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Cite as: *Puniya, Manmohan. 2024. "Technology Intervention through Cluster Frontline Demonstration in Indian Mustard (Brassica Juncea) in Arid Region of Western Rajasthan". Journal of Scientific Research and Reports 30 (11):223-30. https://doi.org/10.9734/jsrr/2024/v30i112549.*

than the farmers' practices (14.4 q/ha). Comparatively average higher net returns (₹71533/ha) and with a B:C ratio of (4.93) were recorded with improved technologies as compared to farmers' practices (₹ 51210). Adoption of improved technologies significantly increased the yield as well as yield attributing traits of the mustard than the farmers' practices. So, there is a need to disseminate the improved technologies among the farmers with effective extension methods like training and demonstrations. The farmers should be encouraged to adopt the improved crop production technologies as discussed in this paper. So the higher productivity and economic returns from mustard cultivation could be realized. Overall, the study highlights the positive impact of implementing demonstrated agricultural technologies in mustard cultivation. These results indicate that the adoption of improved practices can lead to higher yields, better economic returns, and improved cost-benefit ratios compared to traditional practices.

Keywords: Cluster front line demonstration; mustard; productivity; profitability.

1. INTRODUCTION

Indian mustard is an important oilseed crop and determinant of oilseed-based agricultural economy of the country. However, productivity is low due to lack of awareness in farming community regarding improved package and practices of oilseed crops. Clusterfrontline demonstrations are important dissemination process for transfer of technology and to establish its production potentials on the farmers' fields. Mustard is grown either under the irrigated or rainfed conditions require the average external inputs, and contributes ~25% to the Indian oilseed supply (Limbalkar et al., 2021). It is widely used for flavour and nutritional properties, as it is an excellent source of essential fatty acids, protein, vitamins, and minerals etc. Rapeseed and mustard is grown on 6.69 million ha producing 10.11 million tonnes of output per hectare at an average productivity of 1511 kg/ha, While, in Rajasthan state the rapeseed and mustard is grown on 2.72 million ha producing 4.51 million tonnes of output per hectare at an average productivity of 1659 kg/ha, (GOI, 2020-21). India is one of the largest rapeseed-mustard growing country in the world, occupying the first position in area and second position in production after China (Thakur and Sohal, 2014). India is the largest producer of oilseeds in the world and accounts for about 14 per cent of the global oilseeds area, 7 per cent of the total vegetable oil production and 10 per cent of the total edible oil consumption. Indian mustard is an important oilseed crop of Indian subcontinent contributes more than 80 per cent of the total rapeseed-mustard production in India (Meena et al., 2014; Meena et al., 2015). The rapeseed-mustard production among *rabi* oilseed was 6.29 million tonnes from an area of 4.00 million hectares with a productivity of 1573 kg/ha in Rajasthan.In the Phalodi district, the mustard crop is grown in an area of 106526 ha with an annual production of over 102691million tons with a productivity of 964 kg/ha (Anonymous, 2023-24). This group of oilseed crops offers higher return with low cost of production and low water requirement, so it has greater potential to increase the availability of edible oil from the domestic production. Inspite the high quality of oil and also its wide adaptability for varied agro-climatic conditions, the area, production and yield of rapeseed-mustard have been fluctuating due to various biotic and abiotic stresses together with domestic price support programme. High yielding new varieties are also imperative to meet potential edible oil requirement of the country which is still increasing due to increase in population, increase in per capita consumption and slow increase in local production of oilseed crops (Shengwu et al., 2003). Thus, there is a need to disseminate the improved production technologies of mustard cultivation among the farmers to enhance the productivity and profitability. Accordingly, the present investigation was undertaken to bridge the extension gap.

2. MATERIALS AND METHODS

The cluster front-line demonstrations on mustard were conducted under irrigated condition in Jodhpur district of Rajasthan.In total 188 frontline demonstrations were conducted on farmers' field in villages of Kolhu, Unthwalia, Dayakor, Palli-1, Gajja, Vijaynagar and Siyo ka baas (seven Villages) of Jodhpur district of Rajasthan during 2019-20 and 2020-21. Each demonstration was conducted on an area of 0.4 and 0.8 ha, adjacent-to the demonstration plot was kept as farmers' practices. The package of improved technologies like line sowing, nutrient management, seed treatment and whole package were used in the demonstrations. The mustard variety DRMRIJ-31 (Giriraj) developed by the ICAR-DRMR, Bharatpur (Rajasthan) and RH-0749 developed by the CCSHAU, Hisar (Haryana) were included in demonstrations. In case of local check plots, existing practices being used by farmers were followed. In general, soils of the area under study were loamy fine to coarse and medium to low in fertility status. The spacing was 30 cm between rows and 10 cm between plants in the rows. The thinning and weeding were done invariably 20-25 days after sowing to ensure recommended plant spacing (10 cm) within a row (30 cm) because excess population adversely affects growth and yield of crop. Seed sowing was done in the mid to last week of October, with a seed rate of 3-4 kg/ha. Other management practices were applied as per the package of practices for *rabi* crops by Department of Agriculture, Arid Western Plains Zone (DOA, 2020). Data with respect to seed yield from FLD plots and from farmers' fields cultivated following local practices adopted by the farmers of the area were collected and evaluated. Different parameters as suggested by Yadav et al. (2004) was used for gap analysis, technology index and calculating the economics parameters of mustard.

Estimation of technology and extension gaps and technology index: The estimation of technology and extension gaps, technology index and other economic analysis was done using formula by Kadian et al., 1997: Samui et al. (2000).

Extension gap= Average demonstration plot yield – Farmers' average plot yield
Technology gap= Potential yield –Average demonstration plot yield
Technology index= Potential yield -–Average demonstration plot yield /Potential yield × 100
Additional cost (₹)= Demonstration cost (₹) – Farmers' practice cost (₹)
Effective gain= Additional returns (₹)–Additional cost (₹)
Additional returns= Demonstration returns (₹)– Farmers' practice returns (₹)
B: C ratio=Gross returns/ total costs
Incremental B: C ratio= Additional returns /Additionalcosts

3. RESULTS AND DISCUSSION

Improved technology v/s farmer's practices: Before the commencement of CFLDs at the farmers' field, the participatory rural appraisal was undertaken. Based on this, the gap between farmers' practices and improved technology of mustardcultivation in the Jodhpur district of Rajasthan was worked out (Table 1). Among varying technology interventions, no gap was observed under the farming situation, whereas a full gap was observed under soil treatment, seed treatment, spacing and variety. However, a partial gap was observed for the particulars *viz*.,: seed rate, time of sowing, fertilizer and weed management, and plant protection. These gaps noticed in the farmers' field are ascribed to the slow pace of extension machinery, coupled with unreached public extension systems or improved technologies, especially among small holder farmers and other vulnerable groups Das and Willey 1991: Badhala and Bareth 2013. Moreover, farmers used local mustard cultivars that produced low yields instead of newly released varieties with an improved package of recommended technologies. The improved package and practices are more important with technological intervention for productivity and profitability of oilseeds. Detailed package and practices with technological intervention for recommended practice has been presented in (Table 1). Sulphur is an important supplement for oilseed crops and it is recommended that farmer'sshould apply single super phosphate fertilizers to meet the requirement of both phosphorus and sulphur in mustard. It was also observed that farmer's use injudicious and non-recommended insecticides and most of the farmer's didn't use fungicides. Similar observations were reported by Singh et al., (2011).

Impact of CFLDs on seed yield: The (Table 2) indicated that an average maximum demonstration yield of 20.9 q/ha was recorded in vijaynagar village, followed by 20.7 q/ha in gajja village, 20.5 q/ha in siyo ka baas village, 17.7 q/ha in kolhu village, 17.5 q/ha unthwalia village and 17.3 q/ha in dayakor and palli-1villages which were found higher over local check 15.69, 16.65, 15.16, 13.52, 13.88, 13.82and 13.18 q/ha, respectively. We recorded 33.5% improvement in mustard yield compared to the farmers' practices at Vijaynagar followed by 32.6% (Gajjavillage), 35.3% (Siyo ka baas), 24.9% (Kolhu village), 21.8% (Unthwalia), 22.6% (Dayakor) and 24.7% (Palli-1) with an additional returns of Rs 25363, 24555, 25942, 17762, 17040, 16430 and 15168 /ha, respectively. The average yield of DRMRIJ-31 (Giriraj) ranged from 17.7 to 17.3 q/ha and as compared to 13.88 to 13.18 q/ha whereas, average yield of RH-0749 ranged from 20.9 to 20.5 q/ha and as compared to 15.7 to 15.16 q/ha of existing variety across villages, indicating their suitability due to the use of HYVs, better quality inputs and scientific backup by KVK specialists time to time. In farmers' practices, yields are low due to poor adoption of improed practices, depending on the cost, skill and knowledge of the improed practices. These findings conform to the results of a study carried out by Balai et al. 2012 in rapeseed and mustard crops and Sharma and Choudhary (2014) in wheat FLDs.

Gap analysis: The present findings are also in accordance with the findings of Sharma (2014) who found that the yield levels under farmers' practices were always lower than obtained under frontline demonstration. The results revealed that extension gap ranged from 3.48 to 5.34 q/ha in villages of Jodhpur district and average figure comes out to be 4.43 q/ha, which indicated that farmers should be aware for adoption of improved production technology in mustard. Here is a large gap between farmer yields and improved varieties as observed in cluster frontline demonstrations in farmer's fields. Farmer's practices are not as effective as frontline demonstrations Meshram et al., (2022), mustard productivity and production were increased by minimizing the extension gap by scientific intervention. Each village also had technology gaps ranging from 7.1 to 9.7 q/ha, with an average of 8.59 q/ha. Differences in crop management techniques, local weather patterns, and soil fertility status can all be factors contributing to the technological gap came to

Table 1. Details of technology intervention and farmer's practices under CFLDs on Mustard in Jodhpur district of Rajasthan

Technology Component	Improved technology	Farmer's practices	Gap
Farming situation	Irrigated	Irrigated	Nill
Variety	DRMRIJ-31, RH-725, RH-749	Local cultivar (Old variety)	Full
Seed rate (kg/ha)	3-4	5-6	Partial
Soil treatment	Trichoderma @ 2.5 kg/ha cultured with 100 kg FYM	No use	Full
Seed treatment	2.5 gm Mancozeb/kg seed and for white rust Metalexil 35 SD 6 gm/kg seed	No seed treatment	Full
Time of sowing	Mid to last week of October	Last week of October	Partial
Spacing	line sowing 30 cm (row to row) and 10 cm (plant to plant)	No proper spacing	Full
Fertilizer management	60:30-40:40 (NPS kg/ha)	Use of urea 45 kg/ha and DAP 50-60 kg/ha	Partial
Weed management	Pre- emergence application of Pendimethalin 30 EC @1.0 kg a.i./ha and Oxadiargyl @ 90gm/ha	Only use Pendimethalin	Partial
Plant protection	Painted bug and Aphid -Methyl Parathion @ 20 kg/ha White rust- Mancozeb 2 kg/ha	Products suggested by local pesticide dealers	Partial

Table 2. Yield gap analysis of cluster front line demonstrations on mustard crop 2019-2020 to 2020-21

Villages/Block	Variety	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
Kolhu	Giriraj	9.3	4.18	34.44
Unthwaliya	Giriraj	9.5	3.62	35.19
Dayakor	Giriraj	9.7	3.48	35.93
Palli -1	Giriraj	9.7	4.12	35.93
Gajja	RH-0749	7.3	5.05	26.07
Vijay nagar	RH-0749	7.1	5.21	25.36
Siyon ka baas	RH-0749	7.5	5.34	26.79
Avg.		8.59	4.43	31.32

similar conclusions by Kumar and Jakhar (2022). These gaps may be attributed to the variation in soil fertility status. Similarly, technology index was ranged from 25.36 to 35.93 per cent and average figure comes out to be 31.32 per cent. The program of large scale frontline demonstration could be popularized for other oilseed crops also in order to increase farmer's income and attain self-sufficiency in oilseeds production.

Economics: Different variables like a seed, fertilizers, bio-fertilizers, and pesticides were considered as cash input for the demonstrations as well as farmer's practice, and on average additional investment of ₹ 2360 per ha was made under demonstrations. The economics of improvedtechnology over farmer's practices were calculated depending upon the prevailing market prices of input and output for the particular year. It was observed that the cost of cultivation of mustardvaried from ₹17010 to ₹ 19310/ha with an average of ₹ 17996/ha under improved technologies. Whereas, the cost of cultivation of mustard varied from ₹16250 to ₹ 17100/ha with an average of ₹ 16651/ha under farmer's practices. Improved technology have shown higher net returns varying from ₹ 54264 to ₹ 91460/ha with an average of ₹ 71533/ha under improved technologies. Whereas, the net returns of mustardvaried from ₹ 39096 to ₹ 66097/ha with an average of ₹ 51210/ha (Table 4) recorded under farmers' practices. The average additional cost and net returns of ₹ 2360 and ₹ 20323/ha, respectively were recorded with the incremental cost-benefit-cost ratio of 8.61 (Fig. 1). On average, the benefit-cost ratio (BCR) under improved technologies and farmers' practices were 4.93 and 4.06, respectively. Higher additional returns and effective gains obtained through demonstrations may be attributed to improved technology, non-monetary factors, timely crop cultivation operations, and scientific monitoring. The higher benefit-cost ratio proved the economic viability of the technology interventions and motivated the farmers to the adoption of improved technologies. These findings corroborate with the findings reported by Meena and Singh (2016) and Kumawat et al. (2017).

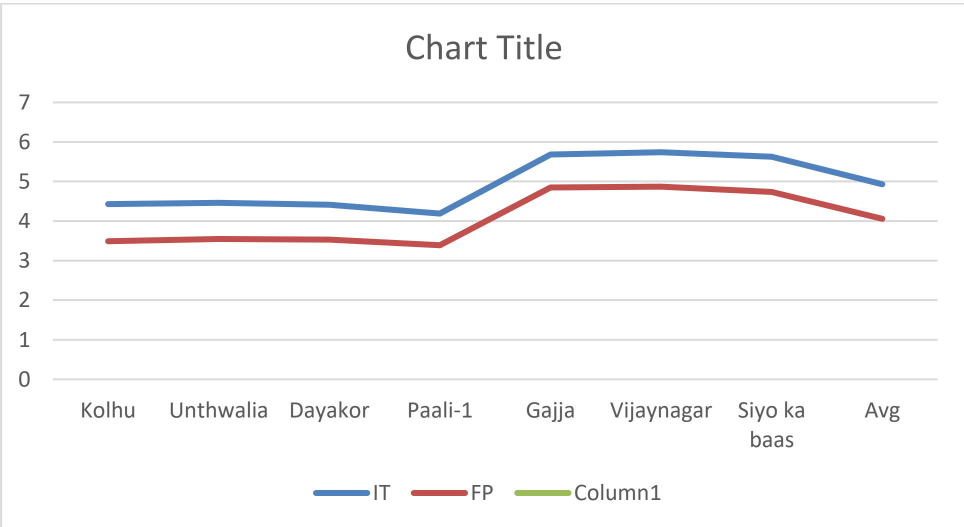

Fig. 1. ICBR of mustard demonstrationin Jodhpur districtof Rajasthan

Fig. 2. Performance of mustard variety RH-0749 under demonstration in Jodhpur district of Rajasthan

Table 3. Technical impact of mustard crop demonstrations during 2019-2020 to 2020-21 in different blocks

S.N	Crop	Villages/ Block	Variety	Area (ha.)	No. of CFLDs	Potential yield (q/ha)	Average yield under demo.(IT) (q/ha)	Avg. Yield under Farmer practices (q/ha)	Increase in yield (%)
1	Mustard	Kolhu	Giriraj	19.2	24	27.00	17.7	13.52	24.89
2	Mustard	Unthwaliya	Giriraj	10	25	27.00	17.5	13.88	21.81
3	Mustard	Dayakor	Giriraj	20.8	26	27.00	17.3	13.82	22.62
4	Mustard	Palli -1	Giriraj	20	25	27.00	17.3	13.18	24.7
5	Mustard	Gajja	RH-0749	20	25	28.00	20.7	15.65	32.6
6	Mustard	Vijay nagar	RH-0749	30	38	28.00	20.9	15.69	33.5
7	Mustard	Siyon ka baas	RH-0749	20	25	28.00	20.5	15.16	35.3
Total/Avg				140	188	27.43	18.84	14.41	27.92

Table 4. Economic analysis of CFLDs on mustard crop

Village/ Block	Average Cost of Cultivation (₹/ha)		Additional cost in demo. (₹/ha)	Average Gross Return (₹/ha)		Average Net Return (₹/ha)		Additional returns in demo. (₹/ha)	Benefit-Cost Ratio	
	IT/ CFLDs plot	FP/ Local check plot	-	IT/ CFLDs plot	FP/Local check plot	IT/ CFLDs plot	FP/Local check plot	-	IT/ CFLDs plot	FP/ Local check plot
Kolhu	17010	16250	760	75306	56784	58296	40534	17762	4.43	3.49
Unthwaliya	17010	16410	600	75936	58296	58926	41886	17040	4.46	3.55
Dayakor	17010	16430	580	75054	58044	58044	41614	16430	4.41	3.53
Palli -1	17010	16360	650	71274	55456	54264	39096	15168	4.19	3.39
Gajja	19310	17100	2210	109710	82945	90400	65845	24555	5.68	4.85
Vijay nagar	19310	17060	2250	110770	83157	91460	66097	25363	5.74	4.87
Siyon ka baas	19310	16950	2360	108650	80348	89340	63398	25942	5.63	4.74
Avg	17996	16651	1344	89529	67861	71533	51210	20323	4.934286	4.06

4. CONCLUSION

It is concluded that CFLDs were effective tools for increasing the productivity of mustard. The demonstrations conducted on mustardat the farmers' field revealed that the adoption of improved technologies significantly increased the yield as well as the net returns to the farmers. On average, gross return (₹ 89529), net returns (₹ 71533), ICBR (8.61), and benefit-cost ratio (4.93) were fetched under improved technologies over farmer's practices. So, there is a need to disseminate the improved technologies among the farmers with effective extension methods like training. Kisan ghosthies, field days, exposure visits, and demonstrations. This created greater curiosity and motivation among other farmers who do not adopt improved practices of mustardcultivation. These demonstrations also strengthened the relationship and trust between farmers and KVK scientists. It was also concluded that besides other practices of weed management, insectpest management, and water stress are to be given due attention for enhancing mustard production in the area. This will subsequently increase the income as well as the livelihood of the farming community of the district.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I 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.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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Peer-review history:
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