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Evaluation of productivity and profitability of mustard cluster frontline demonstrations in semi arid region of Rajasthan

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Abstract
To accelerate the production performance and profitability of improved mustard production technologies, the Cluster Front Line Demonstrations (CFLDs) on mustard crop were conducted during *rabi* 2023-24 to 2024-25 in Laxmangarh & Fatehpur Panchayat Samiti of Sikar district of Rajasthan. It was found that the average yield of mustard crop under CFLDs was 19.89qtha^{-1} during *both year* resulting in increase of 19.35% yield as compare to farmer's practice (16.73qtha^{-1}). Two years average data indicated that CFLD practice, showed net income of Rs. 85233 ha^{-1} with B:C ratio of 3.77 more than to farmers practice i.e. Rs. 71379 ha^{-1} with B:C ratio of 3.77. It means the Net profit difference of Rs. 13854 was gain more against additional cost of Rs.2295 from one hectare area of CFLD mustard field as compare to farmer's practice with incremental B:C ratio of 6.35. The horizontal expansion of area periodically from 380 to 500 ha (31.58%) in 2023-24 and 520 to 740 ha (42.31%) area spread in the year 2024-25. Thus, the complete package of practices and participatory approach in planning and conducting the demonstration definitely help in the transfer of new technology to the farmers.

Keywords: Mustard, CFLDs, Productivity and Profitability

Introduction
Mustard is an important oilseed crops widely grown in India. In Rajasthan state, the mustard crop is mostly cultivated in Alwar, Bharatpur, Jaipur, Dholpur, Sawaimadhopur, Sriganganagar, Jhunjhunu & Sikar districts. Bharatpur, eastern district of Rajasthan is the largest mustard growing division covering about 48 per cent of the total production of state. Rajasthan is the largest mustard-producing state in India, contributing approximately 45-49% of the country's total production (Mustard crop Survey Report 2023-24). Recently, National Mission on Oilseeds and Oil Palm (NMOOP) was introduced with a vision to boost production of vegetable oils sourced from oilseeds and various other initiatives have been adopted to increase oilseed production including, mustard in India to meet domestic demand. The total oilseed production of India is 34.8 million tones. Mustard seeds (Brassica Napus) also known as Rape, Oilseed rape, Rapeseeds and Canola are very widely cultivated throughout the world. Mustard seed is the third leading source of vegetable oil in the world after Soya bean oil and palm oil. Notably world's second leading sources of protein meal after soybean meal. Mustard seed oil content varies from 33% to 46% and average oil recovery is around 32% to 38%. After oil extraction, the remaining part of the seed is used to produce rapeseed/mustard meal, an important source of cattle and poultry feed. It is basically a winter crop and it requires a temperate climate to prosper.

Mustard is a condiment made from the seeds of a mustard plant (white/yellow mustard, Sinapis alba; brown/Indian mustard, Brassica juncea or black mustard, B. nigra). Mustards (Brassica spp.) are herbaceous annual plants in the family Brassicaceae grown for their seeds which are used as a spice. Mustard plants are thin herbaceous herbs with yellow flowers. The leaves of the plant are toothed, lobed, and occasionally have the larger terminal lobes. Plants can reach 16 cm (6.3 in) in length. The yellow flowers grow in spike like clusters of 2–12 flowers and individual flowers are 8 mm (0.3 in) in diameter. The seeds are red to brown in color and produced from each flower. Mustard can grow 1.2-2 m (4–6.6 ft) in height and as an annual plant, survives only one growing season. Mustard are also being referred to as mustard, brown mustard, red mustard, yellow mustard or wedlock and is believed to have

originated in the temperate regions of Europe. Origin of Mustard appeared in Spain with the arrival of the Roman legions & then to India with arrival of Vasco de Gama.

National Food Security Mission on Oilseeds (NFSM) was launched in 2007-08 to increase the production of rice, wheat and pulses. Coarse cereals were also included in the Mission from 2014-15 under NFSM. To accelerate the production of oilseeds recently, National Food Security Mission on Oilseeds (NFSM) was introduced with a vision to boost production of vegetable oils sourced from oilseeds and various other initiatives have been adopted to increase oilseed production including, mustard in India to meet domestic demand. In recent years, mustard consumption has been increasing, leading to increased demand in global as well as domestic markets. NFSM continued during 12th Five Year Plan with the target of additional production of 25 mt of food grains. Beyond the 12th Plan, the mission is being continued with new additional target of 13 million tonnes of food grains from 2017-18 to 2019-20.

These demonstrations have been conducted under the close supervision of scientists of the National Agricultural Research Stations, Krishi Vigyan Kendra, State Agricultural Universities and their Regional Research Stations in a block of two to four hectares of land. The KVK plays an important role in transfer of newly released crop production and protection technologies up to the farmers imparting through trainings at KVK, at farmer's field and conducting CFLDs at farmer's field.

The major mustard growing states in India are Rajasthan, followed by Uttar Pradesh (UP), Haryana, Madhya Pradesh, Gujarat and West Bengal. In Rajasthan, Alwar takes the lead as the major producing district followed by Sri Ganganagar, Bharatpur, Tonk, Sawai Madhopur, Baran and Hanumangarh. As a result of the various efforts taken up by the Central as well as state government, estimated production of mustard in Rajasthan is likely to increases.

The area, production and productivity under rapeseed-mustard in Rajasthan are 36.6 lakh ha, 44.1 lakh tones and 1,205 kg/ha, respectively. The major constraints in higher production are salt affected soil and poor quality irrigation water, moisture deficiency at seeding time, prevalence of higher temperature at sowing time and continuous adoption of fallow-mustard sequence in large area leading to *Orobanche* and *Sclerotinia* rot problem. The technological interventions suggested.

Therefore, it is recommended that the extension agencies engaged in transfer and application of agricultural technologies on farmer's field should give priority to organize frontline demonstrations (FLDs) on cluster basis for harnessing the productivity potential of oilseed crops in the country. The FLD is an important method of transfer of latest package of practices in totality to farmers and main objective of this programme is to demonstrate newly released crop production, protection and management practices at the farmer's field under real farming situation under different agro climatic regions. Through it, farmers learn the latest technology that may lead to higher production. Realizing the importance of FLDs in transfer of latest technologies through KVKs, it was thought that it is appropriate to study the "Evaluation of Production Performance and profitability of mustard demonstrations" has been undertaken.

Materials and Methods

Cluster Frontline Demonstrations (CFLDs) were conducted in the district Sikar of Rajasthan during Rabi seasons of year 2023-24 to 2024-25 in 70.0 ha area on 175 farmer fields under National Mission on Oilseeds & Oil Palm. Farmer's for the CFLDs were selected based on group meeting taking in to consideration mainly the easy accessibility and effective applicability of demonstration technologies. Farmers were selected from adopted villages of operational area of KVK, Sikar for the study where CFLDs on mustard crop were conducted by KVK during *rabi* seasons from 2023-24 to 2024-25. The performance of total 175 beneficiary respondents of 10 villages in an area of 70 ha where CFLDs were conducted in an area of 0.4 ha of each farmer was included in the study. The climate in the district is semi-arid. Soils of the study area sandy and sandy loam in the texture with low nitrogen, law to medium phosphorus, high in available potassium and widely deficient in zinc. A material for the present study has been identified with respect to CFLDs and farmer's practices were given in Table 1. In case of local check plots; existing practices being used by farmers were followed. Technological interventions under demonstration were decided based on technological gap analysis (Table-1).

Table 1: Assessment of technology gap between existing and recommended practices of Mustard cultivation in Sikar district

Technological point/Practice	Existing Farmer's practice	Recommended improved practice	% Gap
Variety	Local, Bio-902, Laxmi, Pioneer (45S35, 45S46)	Giriraj (DRMR IJ-31), NRCDr-2, RH-725	60
Seed rate	5-6 kgha^{-1}	4.0 kgha^{-1}	25
Seed treatment	No or rarely proper seed treatment. Only 30% farmers	Seed treatment with Apron SD 35 @ 6gm/kg seed and Imidacloprid 17.8 SL	70
Fertilizer Dose	N:P: K@ 30:30:00 kgha^{-1} (Mostly Through DAP & Urea)	N:P: K@ 60:40:00 kgha^{-1} (Through SSP & Urea)	50
Micro Nutrient	No or rarely apply of micro-nutrient. Only 30% farmers apply	Soil application of Zinc sulphate @ 25 kgha^{-1} or Gypsum 250 kgha^{-1}	70
Weed mgt	Only manual weeding	30 DAS by Hoeing and Application of weedicide just after sowing by Pendimethalin @30%EC @3.0 liter ha^{-1}	50
P.P. Measures			
Disease mgt (White rust)	Only 20% farmers apply fungicide in standing crop	Seed treatment with Apron SD 35 @ 6gm/ kg seed. Spray of Mancozeb @1.0 kg/ha	80
Insect mgt (Aphid)	Only 40% farmers apply insecticide if required	Quinalphos 1.5% dust @ 25 kgha^{-1} Imidacloprid 17.8% S L @250 ml/ha	60

The data were collected through personal interview schedule consisting of set of questions, which were asked to the CFLD farmers by the investigator in face-to-face situation to give their response about each improved production technology of mustard. To study the production performance & profitability of mustard crop the yield data of CFLDs were collected from each farmer and average out in each year at all locations during study. The collected information was grouped and tabular analysis was done for calculating the yield data by using the following formula:

$$\% \text{ increased in yield} = \frac{D - L}{L} \times 100$$

Where,
D = Demonstration yield, L= Local check yield (Existing practice)
Technology Gap = Potential Yield – Demonstration Yield
Extension Gap = Demonstration Yield – Control Plot Yield
Technology Index (%)= (Technology gap/Potential Yield) x 100
Cost Benefit ratio (C:B ratio) = Gross returns/ Gross cost of cultivation

Result and discussion

Comparison of demonstration package & farmer's practices in mustard crop

The Table 1 shows that under CFLDs full package of practices were applied. In which recommended improved varieties were demonstrated. For sufficient plant population 4 kg treated seed ha^{-1} with Apron SD 35 were given for line sowing. Recommended dose of fertilizers and Gypsum were applied before sowing in soil. Pendamethilin was applied for weed control after sowing. For timely plant protection measures Quinalphos dust was also given. Whereas, under farmer's practice they generally use local varieties, high seed rate without seed treatment. Recommended dose of fertilizers, gypsum and proper plant protection measures were not applied by majority of farmers in the study area.

B. Production performance of improved practices and local farmer's practices

The yield performance results of mustard crop obtained during last two years (2023-24 to 2024-25) are presented in Table 2 taken from annual reports of KVK, Fatehpur-Sikar.
The result revealed that the highest mean seed yield in the CFLD field and farmer's practice was 21.37 qtha-^{1} and 18.21qtha-^{1}, respectively during 2024-2025. The per cent yield increase over farmers practice i.e. 20.72 and 17.35 per cent in each respective year show greater impact of improved practices of CFLDs due to supply of critical inputs & close supervision of KVK's scientists during all two *rabi* season. These results created greater awareness and motivated the other farmers to adopt the new production technologies on their farm. Similarly, Balai, C.M. *et. al.* (2012) also reported that increase in productivity and income gain under FLD's over traditional practices of soybean cultivation supports the present results.
The extension gap ranging between 3.16 qtha^{-1} during the study period emphasized the need to educate the farmers through various means for adoption of improved to reverse the trend. The trend of technology gap (ranging between 8.63 to 11.96 qt ha^{-1}) reflects the farmer's cooperation in carrying out such demonstrations with encouraging results in subsequent years. The technology gap observed might be attributing to the dissimilarity in soil fertility status and weather conditions, non-availability of irrigation water and insect-pest attack in crop.
Similar findings were also recorded by Mitra *et al.* (2010) [14] and Katare *et al.* (2011) [7]. The technology index showed the feasibility of the evolved technology at the farmer's fields.
The 'Local' varieties of mustard were replaced by improved variety RH-725 with horizontal expansion of area periodically from 380 to 500 ha in 2023-24 and 520 to 740 ha area in the year 2024-25 with increase 31.58%, 42.31% respective years in the nearby 10 villages area show good impact of CFLD on horizontal spread of varieties.

Table 2: Impact analysis of FLDs on yield performance and extension gap of mustard demonstration during *rabi* 2023-24 to 2024-25

Year	Demons Variety	No. of Demo.	Potential yield (qha^{-1})	District Avg Yield (qha^{-1})	Yield (qha^{-1})		Impact (% Increase)	Tech. gap (qha^{-1})	Ext. gap (qha^{-1})	Horizontal spread of new variety in nearby 10 villages Area in (ha)		
					Demo.	FP				Before	After	% increase
Rabi-2023-24	RH-725	75	30	14.10	18.41	15.25	20.72	11.59	3.16	380	500	31.58
Rabi-2024-25	RH-725	100	30	14.52	21.37	18.21	17.35	8.63	3.16	520	740	42.31
Average		175		14.31	19.89	16.73	19.035	10.11	3.16	450	620	36.95

C. The profitability of Mustard crop during conducting the CFLD

Economic indicators i.e. gross cost of cultivation, gross income, net income and benefit cost ratio of CFLDs are presented in Table 3. The gross cost of cultivation for mustard cultivation under demonstrated practice ranged from Rs. 28925 to 32323 ha^{-1} with a mean value of Rs. 30624 ha^{-1} as compare to farmer's practice where it ranged from Rs. 27375 to 29282 ha^{-1} with an average of Rs.28328.5 ha^{-1}. The data showed that demonstrated technologies increased net returns as compare to farmer's practice during all the years of demonstration. Two years average data indicated that CFLD practice, showed net income of Rs. 85233.5 ha^{-1} with B:C ratio of 3.77 more than to farmers practice i.e. Rs. 71379.5 ha^{-1} with B:C ratio of 3.51. It means the Net profit difference of Rs. 13854 was gain more against additional cost of Rs.2295 from one-hectare area of CFLD mustard field as compare to farmer's practice with incremental B:C ratio of 6.35 which might be attributed to yield enhancement under demonstration with least additional cost. Higher cost benefit ratio and additional profit clearly indicate that demonstrated techniques were found cost effective and feasible for yield enhancement of mustard on farmer fields. Farmers were also found greatly convinced with the mustard varieties RH-725 and other technological interventions due to higher economic returns with least additional investment and management practices. The variation in cost benefit ratio during 2023-24 & 2024-25 might be due to variation in yield performance and input output cost in that particular year. The similar findings were also observed by Patel *et al*. (2009) [16] in groundnut and

Phukon *et.al*. (2021) [18], in oilseed crop yield under oilseed demonstrations confirms these results.

Table 3: The profitability of Mustard CFLD fields during 2023-24 to 2024-25:

Year	Gross cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio		A cost due to IT (Rs./ha)	A returns due to IT (Rs./ha)	IB CR
	IT	FP	IT	FP	IT	FP	IT	FP			
2023-24	28925	27375	102337	89393	73412	62018	3.54	3.26	1550	11394	7.35
2024-25	32323	29282	129378	110023	97055	80741	4.00	3.76	3041	16314	5.36
Mean	30624	28328.5	115857.5	99708	85233.5	71379.5	3.77	3.51	2295.5	13854	6.35

Conclusion

By conducting CFLDs of proven technologies, yield potential of mustard can be increased to a great extent. The highest yield in the CFLD field and farmer's field was 18.41qt ha-[1] and 21.18.21qt ha-[1], respectively. The results of Cluster Front Line Demonstrations indicated that the mustard productivity could be increased 17.35 to 20.72 percent on the farmers fields by the application of improved techniques of on farmers fields with least additional investment. Newly demonstrated techniques also found cost effective, profitable and acceptable among farming community. It has been observed that potential yield can be achieved by imparting scientific knowledge, demonstrating the need-based inputs and their proper application. The concept of Frontline demonstration may be applied to all farmer categories including progressive farmers for speedy and wider dissemination of the recommended practices to other members of the farming community. Technological and extension gaps in mustard productivity can be bridged by popularizing improved package of practices with emphasis on variety seed, seed treatment, inclusion of zinc and Sulphur in fertilizers, weed management practices and proper-pest management techniques. Thus, complete package of practices and participatory approach in planning and conducting the Front Line Demonstration definitely help in the transfer of newly technology to the farmers.

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