RESEARCH ARTICLE

PRODUCTIVITY AND PROFITABILITY OF MUSTARD (*BRASSICA JUNCEA* L.) IN PEARL MILLET-MUSTARD CROPPING SYSTEM AS INFLUENCED BY FRONT LINE DEMONSTRATIONS INTRANSITIONAL PLAIN OF INLAND DRAINAGE ZONE OF RAJASTHAN

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Received-30.06.2021, Revised-14.07.2021, Accepted-26.07.2021

Abstract: Front line demonstration is an appropriate means for demonstration as well as transfer of improved agricultural innovations to the farming community. Under centrally sponsored schemes on oilseed production technology under NFSM schemes, KVK Athiyasan, Nagaur-I conducted 425demonstrations on mustard covering 180 ha areaduring *Rabi*, 2015-16to 2019-20. The critical inputs were identified in existing production technology through discussion with farmers and on the basis of soil sampling. Lack of plant protection measures were the predominant identified causes of low productivity of oilseed crop in district Nagaur. In the same sequence the other parameters like technological impact, economical impact and extension gap were analyzed for impact assessment of frontline demonstration (FLDs) on mustard crop. The results of five consecutive years study revealed that the demonstration plots produced on an average 1954 kg/ha mustard grain yield, which was 22.51% higher compared to prevailing farmers practice (1597 kg/ha). The average increase in gross return, net return and cost of cultivation was in the tune of 22.36, 31.08 and 6.43 per cent, respectively. Further, data indicated that the average additional cost of cultivation (Rs. 1435/ha) under integrated crop management demonstrations and has fetched additional net returns of Rs. 12659 per hectare with incremental benefit: cost ratio of 0.41. The average technology gap, extension gap & technological index were found 636kg/ha, 356kg/ha and 24.44percent, respectively. The results clearly indicate the positive effect of FLDs over the existing practices.

Keywords: Economics, Extension gap, Frontline demonstration, Mustard, Satisfaction, Technology gap, Technology index

INTRODUCTION

Frontline Demonstration (FLD) is the concept of field demonstration evolved by the Indian Council of Agricultural Research with the inception of the Technology Mission on Oilseed Crops during mid-eighties. The field demonstrations conducted under the close supervision of scientists of the National Agriculture Research System is called front-line demonstrations because the technologies are demonstrated for the first time by the scientists themselves before being fed into the main extension system of the State Department of Agriculture (Sharma *et al.*, 2011). Frontline demonstration (FLD) is one of the most powerful tools of extension because farmers, in general, are driven by the perception that '*Seeing is believing'*. The main objective of Front-Line Demonstrations is to demonstrate newly released crop production and protection technologies and its management practices in the farmers' field under different agro-climatic regions and farming situations. While demonstrating the technologies in the farmers' field, the scientists are required to study the factors contributing higher crop production and thereby generate production data and feedback information.

Mustard (*Brassica juncea* L.) is an important oilseed crop in India. Rapeseed- mustard is the major source of income especially even to the small and marginal farmers in rainfed areas because of its low water requirement (80-240mm) so it fits well in the rainfed cropping system.

Indian mustard *Brassica juncea* is predominantly cultivated in Rajasthan, U.P. Haryana, M.P. and Gujarat (Shekhawat*et. al.* 2012). The area, production and productivity of rapeseed mustard in the Rajasthan state was 2.7 million ha, 4.3 million tonnes and 1586 kg/ha, respectively (Anonymous, 2019).

Mustard seed contains 35-40% oil and 16-22% protein content and high level of amino acids. The oil of mustard possesses a sizable amount of erucic acid (38-57%). Protein content in rapeseed and mustard normally range between 24-30% on the basis of whole seed basis and between 35-40% on the meal basis. But the presence of toxic glucosinolates in the mustard cake renders it unsuitable as a source of human protein and is at present as manure and as cattle feed. The leaves of young plants are used in

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human diet as a green vegetable. The oilseed Brassica usually contains 4.7-13% linolenic acid and 27% oleic acid and high nutritive value required for human health.

The improved technology packages were also found to be financially attractive. Yet, adoption level of several components of improve technology were low, emphasizing the need for better dissemination.Keeping the above points in view the FLDs on mustard using new crop production technology was started with the objectives of showing the productive potentials of the new production technology under real farm situation over the locally cultivated mustard crop and to know the varietal replacement of oilseed crops and its horizontal spread due to FLDs.

MATERIALS AND METHODS

The present study was carried out by the Krishi Vigyan Kendra, Athiyasan (Nagaur) under Agriculture University, Jodhpur during *rabi*seasons from 2015-16 to 2019-20 (05 years) at the farmers' fields of different villages of Nagaur of Rajasthan.Nagaur district falls under agro climatic zone II-A called as transitional plans of inland drainage and situated between 260.25" to 270.40" North latitude and 730.18" to 750.15" East longitude. The average rainfall of the zone is 360 mm. In general, soils of the area under study were sandy to sandy loam in texture with average pH 7.8, organic carbon 0.31, low in nitrogen and medium in phosphorus and potash.

In total 425 front line demonstrations in 180 ha area in different villages were conducted. All the technological intervention was taken as per prescribed package and practices for mustard crop as well as farmers' practices are given in Table-1. In case of farmers practice plots, existing practices being used by farmers were followed.

Assessment of gap in adoption of recommended technology was done before laying out FLD's through personal discussion with selected farmers. The training was organized for selection of farmer's and skilled development about detailed technological intervention with improved package and practice for successful mustard cultivation. Scientists visited regularly demonstrated fields and farmer's field also. The feedback information from the farmers was also recorded for further improvement in research and extension programmes. The extension activities i.e. training, scientist's visits and field days were organized at the cluster frontline demonstration sites. The basic information were recorded from the farmer's field and analyzed to comparative performance of demonstrated plot and local check. Data on yield parameters from demonstrated plots and farmer's practices were collected by random crop cutting method.

The technology gap, extension gap and technology index were calculated using the following formulae given by (Samui*et al*., 2000).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - yield under existing practice

Technology index = {(Potential yield - Demonstration yield)/Potential yield} x 100

The satisfaction level of participating as well as neighboring farmers' for the performance of improved variety demonstrated was also assessed. In all, 425 participating farmers' were selected to measure satisfaction level of farmers' for the performance of improved variety demonstrated. The selected respondents were interviewed personally with the help of a pre-tested and well structured interview schedule. Client Satisfaction Index was calculated as below.

Client satisfaction index = (Individual score obtained/ Maximum score possible) x 100

The data collected were tabulated and statistically analyzed to interpret the results. The economic-parameters (gross return, net return and C: B ratio) were worked out on the basis of prevailing market prices of inputs and Minimum Support Prices of outputs.

Table 1. Details of package and practices for mustard cultivation

S. No.	Technological intervention	Recommended Practice (FLD's)	Farmer's practice
1.	Variety	Laxmi, PM-27, 26, Giriraj (DRMRIJ-31)	Bio-902, Pusa bold, Pioneer 45S42
2.	Seed rate	3.5-4.0 kg/ha	4-5 kg/ha
3.	Seed treatment	Metalaxyl 35 SD @ 6.0 g/kg+ Imidacloprid 70 WS 5 g/kg seed and *Azotobacter+PSB* culture	Carbendazim@ 2g/kg seed
4.	Soil treatment	*Trichoderma* spp. @ 2.5 kg/ha (mixed with 100 kg FYM)	No soil treatment
5.	Spacing	30x10 cm	No definite spacing
6.	Time of Sowing	Second fortnight of October	Oct.-Nov.

7.	Nutrient management	Balanced use of fertilizers (60 kg N + 30 kg P_2O_5 + 25 kg $ZnSO_4$/ha)	Imbalance use of fertilizers (70 kg N + 20 kg P_2O_5)
8.	Weed management	Use of oxadiargyl @ 90 g *a.i.* or pendimethalin 0.75 kg*a.i*/ha at 1-2 DAS + one hand weeding at 20-25 DAS	One hand weeding at 20-30 DAS
9.	Plant protection measures	Aphid management-Dimethoate 30 E.C. @ 875 ml/ha or Thiomethoxam 25 WG @ 100 g/ha or Imidacloprid 17.8% @ 150ml/ha. White rust management-Metalaxyl 8% +Mancozeb 64% @ 1.0kg/ha.	Aphid- Dimethoate 30% E.C. @ 875 ml/ha White rust- Mancozeb @ 2 g/liter of water

RESULTS AND DISCUSSION

Effect on Yield performance:

The performance of mustard crop owing to the adoption of improved technologies was assessed over a period of five years and is presented in Table2. Results of 425 front line demonstrations indicated that the cultivation practices comprised under FLDs*viz.*, use of improved varieties, seed and soil treatments, optimum seed rate, balanced application of fertilizers, line sowing, timely management weeds, insects and disease, produced on an average 1954 kg/ha mustard grain yield, which was 22.51% higher compared to prevailing farmers practice (1597 kg/ha).The seed yield of demonstration plots was higher as compared to farmers practice due to high yielding variety and other integrated crop management practices. Similar yield enhancement in different crops in front line demonstration has been documented by Balai*et al.,* (2012) and Choudhary *et al.,* (2018),Kirar (2018)and Jat, *et al.* (2021). The results clearly indicated the positive effect of FLDs over the existing practices toward enhancing the yield of mustard in the study area due to use of high yielding variety, timely sowing, INM, IWM, plant protection etc.

Table 2. Yield performance of mustard under FLDs at farmers' field

Year	Yield (q/ha)		Yield increase over FP (%)	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)
	Demonstration	Farmers practice				
2015-16	1851	1435	28.99	599	416	24.45
2016-17	2017	1750	15.26	433	267	17.67
2017-18	1799	1548	16.21	651	251	26.57
2018-19	1982	1579	25.52	818	403	29.21
2019-20	2120	1675	26.57	680	445	24.29
Average	**1954**	**1597**	**22.51**	**636**	**356**	**24.44**

Effect on Extension gap, Technology gap andTechnology index:

The extension gaps ranged from 251 to 445 kg/ha with average value of 356 kg/ha during the period of demonstration emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology.

The technology gap observed may be attributed to the dissimilarity in soil fertility status and weather conditions. The average value for technology gap (Table-2) was 636 kg/ha which reflected the farmer's cooperation in carrying out such demonstrations with encouraging results in subsequent years.

The technology index (Table-2) showed the feasibility of the evolved technology at the farmer's fields and the lower is the value of technology index, more the feasibility of the technology demonstrated as such lower value of index 24.44 percent exhibited the feasibility of technology demonstrated. The results of the present study are in consonance with the finding of Kirar (2018), Singh *et al.,* (2019) and Jat, *et al.* (2021).

Effect on Economic performance:

The economics of the dataregarding cost of cultivation, gross return, net return, additional cost, additional return and benefit: cost ratio were analyzed and presented in Table- 3 and 4.

Effect on Cost of cultivation, Gross and Net return

The economics (Cost of cultivation, gross & net return) of mustard under front line demonstrations were estimated and the results have been presented in Table 3. The front line demonstrations recorded higher average gross returns (Rs.77130/ha) and net

return (Rs. 63036/ha) with slightly higher cost of cultivation (Rs. 23737/ha) compared to farmers practice. The average increase in gross return, net return and cost of cultivation was in the tune of22.36, 31.08 and 6.43 per cent, respectively. The findings of the present study are in line with the findings of Choudhary *et al*., (2018),Kirar (2018) and Jat, *et al*. (2021).

Table 3. Economic performance of mustard under FLDs at farmers' field

Year	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)	
	Demonstration	Farmers practice	Demonstration	Farmers practice	Demonstration	Farmers practice
2015-16	20350	19300	62009	48073	41659	28773
2016-17	19575	18305	74629	64750	55054	46445
2017-18	20500	19100	71960	61920	51460	42820
2018-19	29335	27655	83244	66318	53909	38663
2019-20	28925	27150	93810	74119	64885	46969
Average	**23737**	**22302**	**77130**	**63036**	**53393**	**40734**

Sell price of mustard was Rs. 3350, 3700, 4000, 4200 and 4425 per quintal in 2015-16, 2016-17, 2017-18, 2018-19 and 2019-20, respectively.

Effect on Additional Cost of Cultivation, Return and B: C Ratio

Further, data (Table 4) shows that the average additional cost of cultivation (Rs.1435/ha) under integrated crop management demonstrations and has yielded additional net returns of Rs. 12659 per hectare with incremental benefit: cost ratio of 0.41. The results suggest that higher profitability and economic viability of mustard demonstrations under local agro-ecological situation. This might be due to higher production under FLDs as compared to the prevailing farmers practice in all the years. . The results are in close conformity with the results of Jat, *et al*. (2021).

Table 4. Additional economic performance of mustard under FLDs at farmers' field

Year	Additional Cost of Cultivation (Rs./ha) in Demonstration	Additional Return (Rs./ha) in Demonstration	C : B Ratio	
			Demonstration	Farmers practice
2015-16	1050	12886	3.05	2.49
2016-17	1270	8609	3.81	3.54
2017-18	1400	8640	3.51	3.24
2018-19	1680	15246	2.84	2.40
2019-20	1775	17916	3.24	2.73
Average	**1435**	**12659**	**3.29**	**2.88**

Farmer's satisfaction:

The extent of satisfaction level of respondent farmers over performance of demonstrated technology was measured by Client Satisfaction Index (CSI) and results presented in Table 5. It is observed that majority of the respondent farmers expressed high (51.29%) to the medium (26.11%) level of satisfaction regarding the performance of FLDs, whereas, very few (22.59%) of respondents expressed lower level of satisfaction. The higher to medium level of satisfaction with respect to performance of demonstrated technology indicate stronger conviction, physical and mental involvement of in the frontline demonstrations which in turn would lead to higher adoption. The results are in close conformity with the results of Dhaka*et al*. (2010)and Jat, *et al*. (2021).

Table 5. Extent of farmers satisfaction over performance of FLDs (n=425)

Satisfaction level	**Number**	**Per cent**
High	218	51.29
Medium	111	26.11
Low	96	22.59

CONCLUSION

From the findings of present study, it can be concluded that use of latest technologies of mustard cultivation can reduce the technology gap to a considerable extent resulting in to increased productivity of mustard in the district. It requires collaborative extension efforts to enhance adoption level of location and crop specific technologies among of the farmers for bridging these gaps. Therefore, extension agencies in the district need provide proper technical support to the farmers through various education and extension methods for better mustard production in the district.

ACKNOWLEDGEMENT

Authors are thankful to ICAR, New Delhi for providing financial assistance and Agricultural Technology Application Research Institute (ATARI), Zone-II, Jodhpur for proper guidance and support for conducting front line demonstrations on mustard crop.

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