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Enhanced Mustard Productivity and Profitability through Frontline Demonstrations in South-Eastern Rajasthan, India

B.S. Meena[1]*, D.S. Meena[1], K.C. Meena[2] and C.B. Meena[1]

[1]Agricultural Research Station, Ummedganj, Agriculture University, Kota-324001 (Rajasthan), India
[2]KVK, Sawai Madhopur, India

**Corresponding author*

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A B S T R A C T

Frontline demonstrations of mustard were conducted from 2011-12 to 2017-18 in humid South-Eastern Plain Zone-V of Rajasthan to enhance mustard productivity at the farmers' field in adopted villages of Kota and Baran district during *rabi* 2011-12 and 2017-18.. The selection of farmers was done on the basis of Participator Rural Appraisal (PRA) action plan. The results of seven years front line demonstrations indicated that improved varieties i.e. Bio 902, DMH 1, NRCDR 2, Giriraj and NRCHB 101 of mustard with full package under demonstration had significant impact on seed yield compared to local varieties used by farmers. Further, mean results of the study revealed that additional yield (352.18 kg), yield increase (22.21%), gross monetary return (₹ 66,293) and additional net monetary return (₹ 8619), additional return (₹ 11778) and IBCR (3.73) from one hectare were obtained over farmer practices by adoption of improved production technology. The improved package of practices i.e. row spacing, fertilizer, irrigation, weed management and plant protection measures including improved varieties NRCHB 101 and Giriraj were followed in demonstrations. Farmers were motivated by results of improved practices applied in the FLDs trials and they would adopt these technologies in the coming years for betterment of farming. It may be concluded that improved production technology of mustard has found more productive, economic viable and also feasible to local conditions as compared to existing farmer practices

Introduction

Oilseeds play a pivotal role in Indian economy, accounting for 5% of the gross national product and 10% of the value of agricultural products. Amongst the oilseed, rapeseed-mustard (*Brassica spp*.) ranks second in area next only to soybean in India as well as in the world. It is a major *rabi* oilseed crop of the country cultivated 6.8 million ha area with a production of 8.2 million tones and its average productivity is 1176 kg/ha (FAO, 2015). It is the most important *rabi* season oil seed crop of Rajasthan and grown in 2.21 mha with a production of 2.91 mt and with average productivity of 1316 kg/ha, thus it has major share in area (46%) and production (49%) of rapeseed mustard in India (Anonymous 2009-

10), which is nutritionally very rich and its oil content varies from 37-49 % but production of this crop need to be enhanced to meet the national short fall. To meet the vegetable oil requirement of the country at optimum level, we have to increase our production from present level of 20 million tones to about 50 million tones by 2020 (Hedge, 2005).

Improved agricultural technologies are the product of modern science which leads to ultimate sustainable production. Mustard (*Brassica Juncea*) is established as major *rabi* crop in central part of India. Survey of technology adoption levels of package of practices in Hadoti region (Kota, Bundi, Jhalawar and Baran districts of Rajasthan) indicated that there was either lack of adoption or partial adoption of improved practices resulting in lower productivity levels as compared to their potentially yield levels recorded in the yield maximization trials conducted on the farmer's field on one acre demonstration plots. Least use of improved varieties, higher seed rate, lack of seed treatment with chemical and bio-agents (*Azotobactor*), inadequate and imbalanced fertilizer use, lack of use of plant protection measures against pest and diseases, poor efficiency in harvest during unfavorable weather conditions, were some of the critical production factors contributed to the poor and stable yield.

To convince the mustard growers on effectiveness of technology and to motivate them for adoption, lying out of demonstration is one of the proven methods. In view this frontline demonstration financed by Department of Agricultural and Co-operation (DAC), through Directorate of rapeseed-mustard Research, Bharatpur, ICAR, Govt. of India were conducted by Agricultural Research Station, Ummedganj farm, Kota (Agriculture University, Kota) in the south eastern humid zone V, (Hadoti region) of Rajasthan to demonstrate the potentials of improved practices (IP) versus farmer's practices (FP) under real farm conditions. Though, a suitable variety with improved technologies for a specific agro-ecological region is important for enhancing productivity of mustard. Therefore, improved production technologies with full package were demonstrated at farmer's field to augment the mustard productivity. This study may be helpful to the mustard grower in doubling farmer income under changing scenario and congenial environment condition.

Materials and Methods

The study was conducted in humid South-Eastern Plain Zone-V of Rajasthan to enhance mustard productivity under front line demonstrations at the farmers' field in adopted villages of Kota and Baran district during *rabi* 2011-12 and 2017-18. All the participating farmers were given one day training prior to demonstration on improved production technology of mustard. A total of 180 frontline demonstrations were conducted to evaluate the impact of research emanated production technology on mustard productivity over seven years during *rabi* 2011- to 2017-18. The improved package of practices i.e. row spacing, fertilizer (recommended dose of fertilizer: 80 kg N, 40 kg P_2O_5 and 40 kg S/ha, seed inoculated with bio-fertilizers *Azotobactor* and PSB culture), irrigation, weed management (fluchlorolin @ 1.0 l/ha) and plant protection measures (Quinalphos 1.5% dust 7-10 days after germination followed by one spray of diamethoate 30 EC, 875 ml/ha, seed treatment with emidaclopride 48 FS 6 g/kg seed for sucking pest and apron 35 SD 6 g/kg seed for white rust including improved varieties NRCHB 101 and Giriraj, Bio-902, DMH 1 and NRCDR 2 were followed in demonstrations. The performance of mustard grows with improved technologies were compared with the farmer's practice

which included 6 kg own seed/ha without seed treatment, 100 kg N + 50 kg P_2O_5/ha. Production and economics data of front line demonstrations and farmer practices were collected and analyzed. The selection of cultivators was done on the basis of Participator Rural Appraisal (PRA) action plan and care has been taken to layout the demonstrations on road side facilitate the demonstration of technology. Each frontline demonstration was laid out on 0.5 ha area, adjacent 0.5 ha was considered as control for comparison (farmer's practice). Majority of demonstrations were sown in the first fortnight of October. The soil of the demonstrations fields were clay loam, alkaline in reaction ranges (pH 7.75 to 8.1), medium in organic carbon (0.52 to 0.55 %), nitrogen (290.0 to 325 kg/ha) and phosphorus (22.4 to 36.5 kg/ha) and high in potassium (312.0 to 340 kg/ha). The nitrogen and phosphorus were given through di-ammonium phosphate and remaining quantity of nitrogen was given through urea applied as basal as well as top dressing at 40-45 DAS. The potassium was applied through murate of potash on soil test basis.

Results and Discussion

The results of seven years (2011-12 to 2017-18) front line demonstrations indicated that improved varieties i.e. Giriraj and NRCHB 101 of mustard with full package under demonstration had excellent impact on seed yield compared to local varieties used by farmers (Table 1). Among mustard varieties, variety Giriraj gave the highest (2550 kg/ha) yield in the year 2017-18. The next best variety was NRCHB 101 (2430 kg/ha) in the year 2016-17, which is suitable for timely and late sown irrigated condition, followed by Bio-902 (1945 and 1970 kg/ha) in the year 2011-12 and 2012-13, DMH 1 (1777 kg/ha),NRCDR 2 (1594 kg/ha) in the year 2013-14, DMH 1 (1750 kg/ha) in the year 2014-15, Giriraj (2213 kg/ha), NRCHB 101 (2108 kg/ha) in the year 2015-16,Giriraj (2156 kg/ha), NRCHB 101 (2085 kg/ha) in the year 2016-17 and Giriraj (2216 kg/ha), NRCHB 101(2004 kg/ha) in the year 2017-18, thus recorded 17.88, 18.67, 23.37, 21.69, 16.67, 29.46, 28.84 and 23.36 percent, respectively higher seed yield under recommended package of practices over local varieties with farmer's practice. From these results it is evident that the performances of improved varieties were found better than the local checks under local conditions. It could partly be accounted for the interaction between low temperature and nature of mustard varieties. The minimum yield of 1450 kg/ha (Improved Practices) and 1310 kg/ha (farmer's practice) was recorded in case of variety NRCDR 2 and NRCHB 101 due temperature fluctuation, this showed that high temperature in the season must have caused forced maturity (heat injury) in the season must have suppressed the performance of the variety. Data further revealed that the highest mean seed yield (1983.45 kg/ha) recorded under improved practices than farmer practice (1631.30 kg/ha) and yield increase over farmer practice was to the tune of 22.21 %.

There has been year to year variation in average yield of mustard which varied from 1594 to 2216 kg/ha in case of improved practices and 1310 to 1778 kg/ha in farmer's practices. This reveals that the adoption of improved production technology of mustard cultivation is capable to enhance the productivity by 22.21 percent over farmers practice. Meena and Meena (2015) reported that the research emanated production technologies are capable of increasing production of mustard by 20-32 percent through frontline demonstration on farmer's field, similarly Dhaka *et.al*.(2010) observed 26.7 percent increase in yield over local check in case of maize (Table 2).

Table.1 Yield of mustard in improved and farmers practices through frontline demonstration under real farm situation in Hadoti region of Rajasthan

Year	Variety used in IP	No of FLDs	Seed yield (kg/ha)				YIOFP (%)	AYOFP (kg/ha)
			IP			FP		
			Maximum	Minimum	Mean	Mean		
2011-12	Bio 902	20	2350	1950	1945	1650	17.88	295
2012-13	Bio 902	20	2410	2000	1970	1660	18.67	310
2013-14	DMH 1	10	1825	1735	1777	1441	23.37	336
	NRCDR 2	10	1620	1565	1594	1310	21.69	284
2014-15	DMH 1	20	1810	1750	1750	1500	16.67	250
2015-16	Giriraj	7	2475	1675	2213	1719	29.46	494
	NRCHB 101	13	2270	1450	2108	1727	28.84	381
2016-17	Giriraj	20	2500	1500	2156	1745	23.36	411
	NRCHB 101	20	2430	1750	2085	1730	20.61	355
2017-18	Giriraj	32	2550	1840	2216	1778	24.77	438
	NRCHB 101	8	2250	1750	2004	1684	19.01	320
Mean		180	2226.36	1724.09	1983.45	1631.27	22.21	352.18

YIOFP: Yield increase over farmer's practice; AYOFP: Additional yield over farmer's practice; IP: Improved practices; FP: Farmers' Practices;

Table.2 Economics of improved practices under frond line demonstration at farmer's field (Mean data of 7 years)

Year	Cost of cultivation (Rs./ha)		GMR (Rs./ha)		ANMR (Rs./ha)	B:C Ratio		Additional cost (Rs./ha)	Additional returns (Rs./ha)	IBCR
	IP	FP	IP	FP		IP	FP			
2011-12	18882	16023	58350	49500	5991	2.09	2.08	2859	8850	3.10
2012-13	22630	20512	65010	54450	8442	1.87	1.65	2118	10560	4.99
2013-14	24137	20908	50565	41257	6079	1.09	0.93	3229	9308	2.88
2014-15	24200	20915	56000	48000	4715	2.31	2.29	3285	8000	2.44
2015-16	26494	22554	68306	54856	9510	1.58	1.43	3940	13450	3.41
2016-17	26960	23418	80074	64196	10336	1.90	1.74	3542	13878	3.92
2017-18	26567	23427	85748	69346	13268	2.23	1.96	3140	16408	5.23
Mean	24267	21108	66,293	54,515	8619	1.87	1.73	3159	11774	3.73

CoC: Cost of cultivation; GMR: Gross monetary return; ANMR: Additional Net Monetary Return; IBCR: Incremental benefit cost ratio; B:C: Benefit : Cost

Table.3 Comparative economics of mustard improved practices and farmer practices (Mean data of 7 years)

Particulars	Farmer's practices	Improved Practices	Actual increase over farmer's practices	Increase over farmer's practice (%)
Average yield (kg/ha)	1631.27	1983.45	352.18	**22.21**
Gross return (₹/ha)	54515	66293	11778	**21.61**
Cost of cultivation (₹/ha)	21108	24267	3159	**14.97**
B:C ratio	**1.73**	**1.87**	**0.14**	**8.09**

Similar yield enhancement in different crops in frontline demonstration has amply been documented by Mishra *et.al.* (2009) and Bhawani Shankar and Meena (2015). Variations in yield were observed due to fluctuations and uneven distribution of rainfall in the year. From these results it is evident that the performances of improved varieties were found better than the local checks under real farm situations. Farmers were motivated by results of improved practices applied in the FLDs trials and they would adopt these technologies in the coming years for betterment of farming. The higher yield of mustard could be attributed due to adoption of high yielding improved varieties, line sowing with 30 cm row spacing, weed management and plant protection measures. These results are also supported by Baldev Ram *et al.,* (2013), Tetarwal *et al.,* (2013) and Meena *et al.,* (2015).

The economics of improved production practice under front line demonstrations were estimated on the basis of prevailing market rates recorded higher gross monetary return (₹85748 /ha) and additional return (₹ 16408 /ha) with IBCR (5.23) compared to farmer practice in the year 2017-18 and minimum in the year 2016-17 (₹ 64269 /ha, ₹14134 /ha and 3.99), respectively. The results suggest that improvement in productivity and economic viability of mustard were obtained by adoption of improved practice under specific agro-ecological situation. Similar result was also reported by Tetarwal *et al.,* (2013). Thus on the basis of average of seven years (Table 3) revealed that additional yield (352.18 kg), yield increase (22.21%), gross monetary return (Rs 66,293) and additional net monetary return (₹ 8619), additional return (₹ 11778) and IBCR (3.73) from one hectare were obtained over farmer practices by adoption of improved production technology. The B: C ratio of improved technologies 1.87 was higher over farmer's practice 1.73. Similarly economics enhancement in different crops in frontline demonstration has also been documented by Dhaka *et al.,* (2015) and Meena *et al.,* (2016).

It may be concluded that improved production technology of mustard has found more productive, economic viable and also feasible to local conditions as compared to existing farmer practices.

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