Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8005

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2020) *8*(2), 108-113

Research Article

Enhancement of Mustard (*Brassica juncea*) Productivity and Profitability through Front Line Demonstrations in Kota district of Rajasthan

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Received: 27.02.2020 | Revised: 30.03.2020 | Accepted: 6.04.2020

ABSTRACT

Mustard is a major rabi oilseed crop in Kota district of Rajasthan. To demonstrate production potential of improved agro-techniques of mustard crop, cluster front-line demonstrations were conducted during rabi 2016-17 to 2018-19 on selected farmer fields of the Kota district. Technological interventions demonstrated based on technological gap analysis consisted of varieties NRC HB-101 & Giriraj, Seed treatment with metalaxyl @ 6.0 g kg^{-1} seed and imidacloprid48 FS @ 6 ml kg^{-1} seed, soil treatment with Trichoderma viride @ 2.5 kg ha^{-1}, sowing of crop in row of 30 cm apart, optimum seed rate @ 4 to 5 kg ha^{-1}, *recommended doses of fertilizers (NP @80:40 kg ha^{-1}, sulphur @ 25 kg ha^{-1} and zinc sulphate@ 25 kg ha^{-1}) and need based plant protection measures. A perusal of three years data revealed that application of improved technologies resulted in substantially higher mustard seed yield with mean seed yield of 2099 kg ha^{-1} which represents 24.61 per cent yield enhancement over local check (1685 kg ha^{-1}). Demonstrated techniques fetched average net returns of Rs 54467 ha^{-1} with B:C ratio of 3.08, higher in comparison to local practice (Rs 41192 ha^{-1}, B:C ratio 2.75). An average additional return of Rs.13275 ha^{-1} was obtained due to demonstrated technologies with incremental B:C ratio of 5.07. Yield gap analysis showed extension gap in the range of 376 to 437 kg ha^{-1}, emphasizes the need for transferring the feasible improved technologies among farmers to bridge the wide extension gap. Technology gap values observed to be in the range of 344 to 784 kg ha^{-1} and technology index in the present study varied between 13.76 to 28.51 per cent and averaged 21.04 per cent.*

Key words: *Mustard, Frontline demonstration, Yield gap, Technology index*

INTRODUCTION

Oilseed crops, accounting about 19 per cent of global area with around 2.7 per cent of global production, hold the second most important determinant of Indian agricultural economy only next to cereals. India occupies a significant position in the world as forth leading oilseeds producing countries lacking behind only to USA, China and Brazil (Reddy & Emmanuel, 2017).

Cite this article: Sharma, K.M., Goyal, M.C., Singh, M., & Sharma, A.K. (2020), Enhancement of Mustard (*Brassica juncea*) Productivity and Profitability through Front Line Demonstrations in Kota district of Rajasthan, *Ind. J. Pure App. Biosci. 8*(2), 108-113. doi: http://dx.doi.org/10.18782/2582-2845.8005

Domestic consumption of edible oils has increased substantially in India, over the years, with increasing population. The Government decided to achieve self-sufficiency in edible oilseeds production by various technological interventions to overcome stagnant oilseed production through promoting latest production technologies in oilseed production.

Mustard crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Rajasthan is the major Indian mustard (*Brassica juncea* L.) producing state in India. Also, it is a major *rabi* oilseed crop of the district Kota covering about 20 per cent acreage of total *rabi* sown area. Mustard is cultivated in area of around 40 thousand ha in the district with the average productivity varying in between 1677 to 1932 kg ha^{-1} during 2016-17 to 2018-19 (GOR, 2018 and Anonymous, 2019). Major factors responsible for low productivity of mustard in the district includes use of old variety seeds, improper nutrient management, improper crop geometry by use of high seed rate and inadequate plant protection measures against biotic and abiotic stresses. There exists ample scope to enhance the productivity of mustard up to at least 2000 kg ha^{-1} by the adoption of new varieties and improved agro-techniques.

Organization of front-line demonstrations (FLD's) is most effective tool for transfer of new profitable & sustainable technologies among the farmers and making them acceptable. Therefore, frontline demonstrations were conducted during *rabi* seasons of the year 2016-17 to 2018-19 on selected farmer's fields of the operational area of Krishi Vigyan Kendra, Kota with the objective of exhibiting the performance of newly released high yielding variety Giriraj (DRMR IJ-31) & NRC HB-101 along with recommended cost-effective agro-techniques which could be adapted by the farmers for yield enhancement.

MATERIALS AND METHODS

Cluster Frontline demonstrations (CFLD's) were conducted in the district Kota of Rajasthan state during *rabi* seasons of year 2016-17 to 2018-19 in 90.0 ha area on 215 farmer fields under National Mission on Oilseed & Oil Palm and National Food Security Mission. Farmer's for the CFLD's were selected based on group meeting taking in to consideration mainly the easy accessibility and effective applicability of demonstration technologies. Farmer were selected from 13 different villages of operational area of Krishi Vigyan Kendra, Kota namely Rajpura, Gandifali,Galana, Nangalheri, Aanwa, Kalyakhedi, Gokulpura, Bhandahera, Umarda, Tankarwada, Madhopur, Laxmipura and Suhana. Kota District falls under Agro-climatic Zone-V "Humid South-eastern plain zone" of Rajasthan. The climate in the district is semi-arid and moderate. Soils of the study area clay loam in texture with low nitrogen, low to medium phosphorus, high in available potassium and widely deficient in zinc.

The area under each FLD's were kept 0.4 ha with farmers practice as control plots. Technological interventions under demonstration were decided based on technological gap analysis (Table-1). Based on gap analysis, technological interventions demonstrated consisted of use of improved varieties NRC HB-101 and Giriraj (DRMRIJ-31), optimum seed rate @ 4 to 5 kg ha^{-1} and sowing in 30 cm row spacing, seed treatment with metalaxyl @ 6.0 g kg^{-1} seed and imidacloprid 48 FS @6 ml kg^{-1} seed, recommended doses of NP fertilizers @ 80-40 kg ha^{-1}, use of zinc sulphate @ 25 kg ha^{-1}, bentonite sulphur @ 25 kg ha^{-1} and need based plant protection measures for painted bug and aphid. Farmers were also suggested for efficient use of fertilizers by drilling in furrows, need based weed management & thinning at 15-20 DAS and irrigation at critical stages.

Table 1: Technological gap analysis for mustard

Technological point	Existing Farmer's practice	Recommended improved practice
Variety	Local, variety Bio-902, private company seeds	Variety Giriraj (DRMR IJ-31), NRC HB-101
Seed rate	Seed rate 7-8 kg ha^{-1}	Seed rate 4-5 kg ha^{-1}
Seed treatment	No or rare proper seed treatment	Seed treatment with metalaxyl and imidacloprid 48 FS
Soil treatment	No soil treatment	Soil treatment with *Trichoderma viride* @ 2.5 kg/ha
Row spacing	Sowing crops in 22.5 cm rows. No practice of thinning	Sowing crops in 30 cm rows & thinning as per need at 15-20 DAS
Fertilizer use	Improper use of DAP, High dose of Urea. No use of Zn & S	NP @80:40 kg ha^{-1}. Soil application of Zn So_4@ 25 kg and sulphur @ 20-40 kg ha^{-1}
Weed mgt.	No practice of hand weeding	Hand weeding at 15-20 DAS or application of pendimethalin @1.0 kg ai ha^{-1} at pre-emergence
Pest management	Improper use of insecticides	Spray of dimethoate 30 EC @ 1.0 Litre $ha^{-1}$for aphid management

Selected farmers were provided trainings on advanced production technology for effective application of improved technologies of mustard. Critical inputs were also provided to the farmers and other inputs were suggested as per need. Crop was timely sown i.e. during first to last week of October and sown in 30 cm rows apart. Farmers applied 1 to 2 irrigations at critical growth stages of the crop. All steps like site and farmer selection, layout of demonstration, farmer's participation etc. were followed as suggested by Choudhary (1999). Monitoring of FLD sites were done by periodical visits and needful suggestion were given to the farmers. Field days were also organized at crop maturity to demonstrate the results of FLD among other farmers of the local area for horizontal spread of technologies. The crop was harvested during first fortnight of March. Data related to yield and cost particulars were collected separately for FLD plots and farmers practice. The average prices of inputs and outputs commodities prevailed during each year of demonstrations were taken for calculating cost of cultivation, net return and benefit cost ratio. The technology gap, extension gap and technology index were calculated as suggested by Samui et al. (2000).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmers yield

Technology index (%) = (Technology gap/ Potential yield) × 100

Cost Benefit ratio (C:B ratio) = Gross returns/Gross cost of cultivation

RESULTS AND DISCUSSION

The results of the cluster frontline demonstrations conducted at farmers' field clearly reveal that yield of mustard was recorded substantially higher under demonstration plots in comparison to the local checks (farmer's practice) during all the three years (2016-17 to 2018-19). The yield of mustard during three years ranged from 1966 to 2176 kg ha^{-1} under demonstrated improved technologies as against 1590 to 1739 kg ha^{-1} under farmers practices (local check). As evident from table.2, demonstrated technologies recorded mean yield of 2099 kg ha^{-1} which represents 24.61 cent yield enhancement over local check (1685 kg ha^{-1}). The higher productivity of mustard under demonstration in comparison to farmer's local practice could be ascribed mainly to the use of high yielding varieties NRC HB-101 & Giriraj and inclusion of sulphur and zinc in fertilizers application along with recommended doses of NP fertilizers and improved agronomic practices. The variety NRCHB 101 demonstrated during 2016-17 showed better

branching, vigorous growth and comparatively more number of pods per plant. Similarly, variety Giriraj performed well on farmer fields with better branching, high number of pods and greater number of seeds per pod. Both these varieties were observed to be less infected with white rust disease than other varieties under farmer's practice. Seed treatment with metalaxyl and imidacloprid were found effective against white rust disease and commonly occurred painted bug attack, respectively.

Table 2: Impact of Front Line Demonstrations on yield performance of mustard

Season & Year	Variety	No. of FLD	Area of FLD (ha)	Yield (kg/ha)		% increase in yield over FP	District average yield (kg/ha)
				IT	FP		
Rabi 2016-17	NRCHB-101	40	20.0	2156	1725	24.99	1677
Rabi 2017-18	Giriraj	100	40.0	1966	1590	23.64	1665
Rabi 2018-19	Giriraj	75	30.0	2176	1739	25.13	1932
Mean				**2099**	**1685**	**24.61**	**1758**

IT- Improved techniques FP- Farmer's local practice

Similar trends with regards to yield enhancement were also reported by Mitra et al. (2010) and Sharma et al. (2015). A perusal of data (Table-3) further shows that values for extension gap ranged from 376 to 437 kg ha^{-1} with a mean value of 415 kg ha^{-1} during the period of demonstration which emphasizes the need for transferring the feasible improved technologies among farmers to bridge the extension yield gap. Technology gap which imply researchable issues for realization of potential yield ranged from 344 to 784 kg ha^{-1}, with a mean of 567 kg ha^{-1} during three years of demonstration. Katare et al. (2011) reported that technology index shows the feasibility of evolved technology at the farmer's field and lower the value of technology index more is the feasibility of the technology. Technology index in the present study varied between 13.76 to 28.51 per cent and averaged 21.28 per cent. Variation in technology index during three seasons might be attributed to dissimilarity in the weather and soil condition.

Table 3: Yield gap and technology index of Front Line Demonstrations (FLD) of Mustard

Season & Year	Potential Yield (kg/ha)	Extension Gap (kg/ha)	Technology Gap (kg/ha)	Technology Index (%)
Rabi 2016-17	2500	431	344	13.76
Rabi 2017-18	2750	376	784	28.51
Rabi 2018-19	2750	437	574	20.87
Mean	**2670**	415	567	21.28

IT- Improved techniques FP- Farmer's local practice

Economic indicators i.e. gross cost of cultivation, gross returns, net returns and B:C ratio of cluster front line demonstrations are presented in Table 4. The gross cost of cultivation for mustard cultivation under demonstrated practice ranged from Rs. 24354 to 29760 ha^{-1} with a mean value of Rs. 26179 ha^{-1} against local check where it ranged from Rs.21017 to 27308 ha^{-1} with an average of Rs. 23562 ha^{-1}. The data clearly revealed that demonstrated technologies provided substantially higher net returns than local check i.e. farmers practice during all the years of demonstration. Three years pooled data

revealed that CFLD practice, fetched net returns of Rs. 54467 ha^{-1} with B:C ratio of 3.08, higher in comparison to local practice (Rs 41192 ha^{-1}, B:C ratio 2.75). An average additional return of Rs.13275 ha^{-1} was obtained under demonstrated improved technologies with incremental B:C ratio of 5.07 which might be attributed to yield enhancement under demonstration with least additional cost. Higher cost benefit ratio and additional returns clearly shows that demonstrated techniques were found cost effective & feasible for yield enhancement of mustard on farmer fields. Farmers were also found greatly convinced with the mustard varieties NRCHB-101 & Giriraj and other technological interventions due to higher economic returns with least additional investment and management practices. The variation in cost benefit ratio during different years might be due to variation in yield performance and input output cost in that particular year.

Table 4: Impact of Front Line Demonstration on economic indicators of Mustard

Season & Year	Gross cost of cultivation (Rs./ha)		Gross Return (Rs./ha)		Net Returns (Rs./ha)		B:C ratio		Δ cost due to IT (Rs./ha)	Δ Returns due to IT (Rs./ha)	IB CR
	IT	FP	IT	FP	IT	FP	IT	FP			
Rabi 2016-17	24422	22360	76382	61513	52960	39153	3.26	2.75	2062	13807	6.70
Rabi 2017-18	24354	21017	84,606	68,143	60,251	47,126	3.47	3.24	3337	13125	3.93
Rabi 2018-19	29760	27308	80948	64604	51188	37297	2.72	2.37	2452	13891	5.67
Mean	**26179**	**23562**	**80645**	**64753**	**54467**	**41192**	**3.08**	**2.75**	**2617**	**13275**	**5.07**

IT- Improved techniques FP- Farmer's local practice

CONCLUSION

The results of frontline demonstrations presented clearly indicates that the mustard productivity could be enhanced to the magnitude of 21 to 33 per cent on farmers fields by the application of improved techniques on farmer 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 improved variety seed, seed treatment, inclusion of zinc and sulphur in fertilizers, weed management practices and proper insect-pest management techniques.

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