



Dissemination of salt tolerant mustard varieties through frontline demonstrations approach for sustainable mustard production in Pali district of Rajasthan

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Abstract

Front line demonstrations (FLDs) on mustard were laid down at 565 farmers' fields to demonstrate production potential and economic benefits of improved production technologies comprising salinity tolerance varieties namely CS 52, CS 54, CS 56 and CS 58 in Pali district of arid zone of Rajasthan state during *Rabi* seasons from 2012-13 to 2017-18 in irrigated farming situation. The findings of the study revealed that the improved production technologies recorded an additional yield ranging from 3.6 to 7.9 q/ha with a mean of 5.5 q/ha. The per cent increase yield under improved production technologies ranged from 35.8 to 68.7 (CS 52), 34.3 to 57.9 (CS 54), 37.6 to 65.9 (CS 56) and 61.5 to 67.5 (CS 58) in respective years. The average extension gap, technology gap and technology index were 5.5q/ha, 6.5q/ha and 28.3 per cent, respectively in different salt tolerance varieties of mustard. The improved production technologies gave higher benefit cost ratio ranging from 2.4 to 3.6 with a mean of 2.6 as compared to local checks (1.9) being grown by farmers under locality. The results revealed that the maximum number of the respondents had medium level of knowledge and extent of adoption regarding recommended mustard production technology. The study reported lack of suitable salinity tolerance HYV as major constraints by beneficiaries at rank first followed by low technical knowledge. Thus the productivity of mustard per unit area could be increased by adopting feasible scientific and sustainable management practices with a suitable salinity tolerance variety.

Key words: Adoption, constraints, impact, FLD, salinity affected soils, technology, mustard

Introduction

India is the third largest rapeseed-mustard producer in the world after China and Canada with 12 % of world's total production (2017-18). This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Rapeseed-mustard is the major source of income especially even to the marginal and small farmers in rainfed areas. Since, these crops are cultivated mainly in the rain-fed and resource scarce regions of the country, their contribution to livelihood security of the small and marginal farmers in these regions is also very important. By increasing the domestic production substantial import substitution can be achieved. Cultivated in 26 states in the northern and eastern plains of the country, about 6.8 mha is occupied under these crops (2017-18). Nearly 30.7% area under rapeseed mustard is under rainfed farming. Rapeseed Mustard Scenario in India Indian mustard (*Brassica juncea*) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat which contribute 81.5% area and 87.5% production (2017-18). During 2017-18, more than 84 % of the total

rapeseed-mustard acreage and production in the country is accounted for by these states, out of which more than 47.0% contributed by Rajasthan state alone. India holds a premier position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production, respectively. This group of oilseed crops is gaining wide acceptance among the farmers because of adaptability for both irrigated as well as rainfed areas and suitability for sole as well as mixed cropping. Mustard is one of the important oilseed crop grown in *Rabi* season grown in all over the Rajasthan. Area, production and productivity of mustard crop during 2017-18 in Pali district was 59261ha, 47950 tons and 809 kg per ha, respectively (GOR 2017-18).

Soil and water salinity and lack of irrigation are the principal constraints affecting crop planning in narrow arid zone of western Rajasthan. The physical, soil characteristics of the well developed soils are good and do not constitute any restriction for food crop production. If efforts are made to evolve and introduce a scientific crop planning in the saline affected areas, it should be possible to increase mustard productivity sustainability. Higher salinity delayed and reduced germination percentage (Ramden *et al.*, 2012). Salinity decreased germination per cent, root length, callus size, coleoptiles

length and seedling growth (Islam *et al.*, 2001, Meena *et al.*, 2018, Lallu and Dixit, 2005; Ghannadha *et al.*, 2005 and Bera *et al.*, 2006). Plant height, stem diameter, dry weight decreased with increasing levels of salinity. For increasing mustard productivity in salt affected area, it is necessary to make more intensive efforts for evolving suitable salt tolerant varieties of mustard like CS 52, CS 54, CS 56 and CS 58 which was tolerant saline (EC 5-7 ds m⁻¹) as well as alkaline soil (pH 8.7-9.3).

Frontline demonstration is the new concept of field demonstration evolved by the Indian Council of Agriculture Research (ICAR) with main objective to demonstrate newly released crop production and protection technologies and its management practices in the farmers' field under different agro-climatic regions of the country under different farming situations. While demonstrating the technologies in the farmers' field the scientists are required to study the factors contributing higher crop production, field constraints of production and thereby generate production data and feedback information. Taking into account the above considerations FLDs were carried out in a systematic manner on farmer's field to show the worth of a new variety and convincing farmers to adopt improved production management practices of mustard for enhancing productivity of mustard. The low productivity of this crop is due to poor adoption of improved technologies of mustard by the farmers. Hence, the Krishi Vigyan Kendra, Pali has organized frontline demonstrations (FLD's) with improved salt tolerant variety along with recommended package of practices. The main purpose of these demonstrations was to enhance the productivity levels of mustard which in turn will increase the income levels of farmers and to transfer the latest production technologies to farmers in the district. Pali district is located between 24.45 to 26.75 degree N latitude and 72.48 to 74.20 degree E longitude at an altitude ranging between 212 m to about 220 m above mean sea level with a total geographical area of 12,387 square kilometers. In Pali district mustard traditionally grown as a *Rabi* crop. The regions are biotic, abiotic, and socio-economic constraints causing low productivity in pulses in this region. In addition, lack of improved varieties is reported as most serious constraints among all biophysical constraints in pulses production. While demonstrating the technologies in the farmer's fields, the scientists are required to study the factors contributing higher crop production, field constraints of production and thereby generate production data and feedback information. Taking into account the above considerations, frontline demonstrations (FLDs) were

carried out in a systematic manner on farmer's field to show the worth of a new variety and convincing farmers to adopt improved production management practices of mustard for enhancing productivity.

Materials and Methods

The study was conducted in farmers' fields to demonstrate production potential and economic benefits of improved technologies in Pali district arid zone of Rajasthan state during *Rabi* seasons from 2012-13 to 2017-18 in irrigated farming situation. To popularize the improved mustard production practices, constraints in mustard production were identified through participatory approach. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in mustard production. Farmers were also asked to rank the constraints they perceive as limiting production factor for mustard cultivation in order of preference. Based on top rank farmers problems identified, front line demonstrations were planned and conducted at the farmer's fields. In all, 565 full package frontline demonstrations were conducted to convince them about potentialities of salinity tolerant varieties of mustard *viz.*, CS 52, CS 54, CS 56 and CS 58 during *Rabi* seasons from 2012 to 2018 under irrigated farming condition, in light to medium soils with low to medium fertility status under mustard-mungbean cropping systems. Each demonstration was conducted in an area of 0.4 ha and adjacent to the farmer's fields in which the crop was cultivated with farmer's practice/ local variety. The package of practices included were improved varieties, seed treatment, maintenance of optimum plant stand, recommended fertilizers dose, plant protection measures especially termite management. The spacing followed was at 35 m x 15 cm sown between second week of September during the five years with the seed rate of 4 kg/ha. All the participating farmers were trained on all aspects of mustard production management. To study the impact of front line demonstrations, out of 464 participating farmers, a total of 160 farmers were selected as respondent through proportionate sampling. Production and economic data for FLDs and local practices were collected and analyzed. The Extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al.* (2000).

Extension gap (qha-1) = Demonstration yield (qha-1) – Yield of local check (qha-1)

Technology gap (qha-1) = Potential yield (qha-1) – Demonstration yield (qha-1).

Technology index (%) = [(Potential yield – Demonstration yield) / Potential yield] x 100

Knowledge level of the farmers about improved production practices of mustard before frontline demonstration implementation and after implementation was measured and compared by applying paired t-test at 5% level of significance. Further, the satisfaction level of respondent farmers about extension services provided was also measured based on various dimensions like training of participating farmers, timeliness of services, supply of inputs, solving field problems and advisory services rendered, fairness of scientists, performance of variety demonstrated and overall impact of FLDs. The selected respondents were interviewed personally with the help of a pre-tested and well structured interview schedule. Client Satisfaction Index was calculated as developed by Kumaran and Vijayaragavan (2005). The individual obtained scores were calculated by the formula as:

$$\text{Client Satisfaction Index} = \frac{\text{Totale individual obtained score}}{\text{Maximum score possible}}$$

The data thus collected were tabulated and statistically analyzed to interpret the FLDs results.

Table 1: Comparison between knowledge levels of the respondents farmers about improved farming practices of mustard (N=160).

Before FLD implementation	Mean score		Calculated "t" value
	After FLD implementation	Mean difference	
33.7	72.6	38.9	9.78*

*Significant at 5 % probability level

educational efforts made by the scientists. The findings confirm with the finding of Kumari *et al.* (2017) and Mahale *et al.* (2016).

Farmer's satisfaction

The extent of satisfaction level of respondent farmers over extension services and performance of demonstrated variety was measured by Client Satisfaction Index (CSI) and results presented in Table 2. It is observed that majority of the respondent farmers expressed medium (68.8%) to the high (20.6%) level of satisfaction for extension services and performance of technology under demonstrations whereas, very few 10.6 per cent of respondents expressed lower level of satisfaction. The results are in close conformity with the results of Rathore *et al.* (2016) on cluster bean crops, Meena and Singh (2016) on moth crops and Dhaka *et al.* (2016) on black gram crop. The medium to higher level of satisfaction with respect to services rendered, linkage with farmer's and technologies demonstrated *etc.* indicate stronger

Results and Discussion

Increase in knowledge

Knowledge level of respondent farmers on various aspects of improved mustard production technologies before conducting the frontline demonstration and after implementation was measured and compared by applying paired t-test. It could be seen from the Table 1 that farmers mean knowledge score had increased by 38.9 after implementation of frontline demonstrations. The increase in mean knowledge score of farmers was observed significantly higher. As the computed value of 't-test' (9.78) was statistically significant at 5% probability level. The results are at par with Meena and Singh (2016) on cotton crops, Singh *et al.* (2016) on *toria* crop, Meena and Dudi (2014) on mustard crop, Dhaka *et al.* (2016) on blackgram crop, Man and Sharma (2017) on wheat crop and Rathod *et al.* (2016). It means there was significant increase in knowledge level of the farmers due to frontline demonstration. This shows positive impact of frontline demonstration on knowledge of the farmers that have resulted in higher adoption of improved farm practices. The results so arrived might be due to the concentrated

conviction, physical and mental involvement in the frontline demonstration which in turn would lead to higher adoption. This shows that the relevance of frontline demonstrations. It indicates that mustard grown with low yield are identified by low knowledge, unfavorable attitude towards high yielding varieties, low risk bearers with negative perception of mustard production technology. In other words it may also be due to then socio-economic status, lower holdings and unavailability of inputs and credit facilities and to some extent supply and marketing problems. This is a point of concern for research and extension functionaries to

Table 2: Extent of farmers satisfaction of extension services rendered (N=160).

Satisfaction level	Number	Percent
Low	17	10.6
Medium	110	68.8
High	33	20.6

disseminate improved mustard production technologies for raising the productivity of mustard at all the levels.

Constraints in mustard production

Farmer's mustard production problems were documented in this study. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in mustard production. The ranking given by the different farmers are given in Table 3. A perusal of table indicates that lack of suitable salinity tolerance high yielding variety (HYV) (87.5%) was given the top most rank followed by low technical knowledge (79.4%), aphids' infestation (75.3%), vagaries of weather (73.8%). Based

on the ranks given by the respondent farmers for the different constraints revealed that lack of suitable salinity tolerance HYV, low technical knowledge, aphid infestation are the major constraints to mustard production and followed by wild animals (51.7%), respectively. Other constraints such low or cutworm infestation, rust disease infestation, weed infestation, low soil fertility, erratic weather condition (frost, fog and rain) and marketing were found to reduce mustard production. Among all the constraints, post harvest management got least constraints (20.8%). Other studies Sharma and Thomas (2013), Sharma *et al.* (2014) and Singh *et al.* (2016) have reported similar problems in mustard and toria production.

Table 3: Ranking given by farmers for different constraints of mustard crop (N=160).

Constraints	Percentage	Ranks
Lack of suitable salt tolerance mustard variety	87.5	I
White rust diseases	27.3	VII
Cutworm infestation	46.8	VI
Low soil fertility	23.9	X
Low technical knowledge	79.4	II
Wild animals (Blue bulls and wild pigs)	51.7	V
Vagaries of weather (mid season high temperature)	73.8	IV
Weed infestation	25.6	VIII
Aphid infestation	75.3	III
Water lodging	30.2	IX
Marketing	24.3	XI
Post harvest management	20.8	XII

Performance of FLD

A comparison of productivity levels between demonstrated varieties and local checks is shown in Table 4. During the period under study, it was observed that the productivity of mustard in Pali district under improved production technologies ranged between 14.1 to 19.6 q/ha with a mean yield of 16.3 q/ha. The productivity under improved technologies varied from 14.7 to 17.3, 14.1 to 16.7, 15.0 to 17.9 and 18.9 to 19.6q/ha for the varieties CS 52, CS 54, CS 56 and CS 58, respectively as against the yield range between 9.4 to 11.7 with a mean of 10.7 q/ha under farmers local practices and varieties during study period. The additional yield of different varieties under improved production technologies over local practices ranged from 3.6 to 7.9 q/ha with a mean of 5.5 q/ha in comparison to local practice and varieties. The per cent increase yield under improved production technologies ranged from 35.8 to 44.8 (CS 52), 34.3 to 57.9 (CS 54), 37.6 to 65.9 (CS 56) and 61.5 to 67.5 (CS 58) in respective years. This increased grain yield with improved production technologies was mainly because of high potential yielding varieties.

The variation in the productivity was also caused unusual delay in sowing in some of the farmer's fields. In fields where delayed sowing was done because of prolonged dry hot spell in the month of September and unavailable of irrigation, the crop growth was restricted. The late sowing crop was subjected to relatively less time span available for plant growth and development. Similar yield enhancement in different crops in front line demonstration has amply been documented by Dhaka *et al.* (2016), Kumar *et al.* (2010), Dayanan *et al.* (2012), Mahale *et al.* (2016), Iqbal *et al.* (2017), Tolessa *et al.* (2017) and Hussain *et al.* (2018). From these results it is evident that performance of improved salinity tolerant varieties was found better than the local check under local conditions. Farmers were motivated by results of agro technologies applied in the FLDs trials and it is expected that they would adopt these technologies in the coming years also. Yield of the frontline demonstration trials and potential yield of the different varieties of crop was compared to estimate the yield gaps which were further categorized into technology index. The technology gap shows the gap in the demonstration yield over potential yield and it was 6.5 q/ha. The observed technology gap may be

Table 4 Yield of mustard as influenced by improved production technologies and drought tolerance varieties over local practices in farmer's fields (2012-2018).

Year	Variety	Area (ha)	No. of Demo	Yield (q/ha)		Add. Yield over local check (q/ha)	% increase over local check	EG (q/ha)	TG (q/ha)	TI (%)
				IP	FP					
2012	CS 52	10	25	15.9	10.2	5.7	35.8	5.7	4.6	22.4
	CS 54	14	35	16.7	11.3	5.4	47.7	5.4	5.8	25.8
2013	CS 52	10	25	17.3	10.7	6.6	62.3	6.6	3.2	15.6
	CS 56	16	40	15.3	10.6	4.7	44.3	4.7	9.2	37.6
2014	CS 52	14	35	16.2	09.6	6.6	68.7	6.6	4.3	21.0
	CS 54	16	40	15.4	10.9	4.5	41.3	4.5	7.1	31.6
	CS 56	12	30	17.2	10.5	6.7	63.8	6.7	7.3	29.8
2015	CS 56	10	25	17.9	11.7	6.2	52.9	6.2	6.6	26.9
	CS 52	12	30	14.7	10.6	4.1	38.7	4.1	5.8	28.3
2016	CS 52	14	35	16.2	11.2	5.0	44.6	5.0	4.3	20.9
	CS 54	10	25	14.8	10.5	4.3	40.9	4.3	7.7	34.2
	CS 56	12	30	15.6	09.4	6.2	65.9	6.2	8.9	36.3
2017	CS 52	16	40	16.8	11.6	5.2	44.8	5.2	3.7	18.0
	CS 54	10	25	14.1	10.5	3.6	34.3	3.6	8.4	37.3
	CS 56	10	25	15.0	10.9	4.1	37.6	4.1	9.5	38.8
	CS 58	14	35	19.6	11.7	7.9	67.5	7.9	6.2	24.0
2018	CS 54	10	25	15.0	09.5	5.5	57.9	5.5	7.5	33.3
	CS 58	16	40	18.9	11.7	7.2	61.5	7.2	6.9	26.7
	Mean	12.5	31.4	16.3	10.7	5.5	50.6	5.5	6.5	28.3

Table 5 Cost of cultivation (Rs. ha⁻¹) net return and benefit cost ratio of mustard as affected by improved production technologies over local practices.

Year	Variety	Total cost of cultivation		Gross return (Rs ha ⁻¹)		Net return (Rs ha ⁻¹)		B:C ratio		Add. Cost of cultivation	Add. Net returns (Rs.ha ⁻¹)
		IP	FP	IP	FP	IP	FP	IP	FP		
2012	CS 52	17500	16500	45315	29070	27815	12570	2.6	1.7	1000	15245
	CS 54	18500	17600	47595	32305	29095	14705	2.5	1.8	900	14390
2013	CS 52	19500	18700	52765	32635	33265	13935	2.7	1.7	800	19330
	CS 56	17500	16300	46665	32330	29165	16030	2.6	1.8	1200	13135
2014	CS 52	17800	16500	50220	29760	32420	13260	2.8	1.8	1300	19160
	CS 54	19400	18700	47740	33790	28340	15090	2.4	1.8	700	13250
	CS 56	18500	17400	53320	32550	34820	15150	2.9	1.6	1100	19670
2015	CS 56	19600	18600	59965	39195	40365	20595	3.0	2.1	1000	19770
	CS 52	20500	19800	49245	35510	28745	15710	2.4	1.7	700	13035
2016	CS 52	19800	18400	57510	39760	37710	21360	2.9	2.1	1400	16350
	CS 54	20400	19300	52540	37275	32140	17975	2.6	1.9	1100	14165
	CS 56	21200	20600	55380	38695	34180	18095	2.6	1.8	600	16085
2017	CS 52	18600	17600	60480	41760	41880	23860	3.2	2.3	1000	18020
	CS 54	19700	18400	50760	37800	31060	19400	2.5	2.0	1300	11660
	CS 56	20500	19500	54000	39240	33500	19740	2.6	2.0	700	13760
	CS 58	21300	20700	70560	42120	49260	21420	3.3	2.0	600	27840
2018	CS 54	20900	19800	63000	39900	42100	20100	3.0	1.9	1100	22000
	CS 58	21500	20900	79380	49140	57880	28240	3.6	2.3	600	29640
Mean	19594	18628	55358	36824	35763	18180	2.6	1.9	950	17584	

attributed to dissimilarities in soil fertility, salinity and erratic rainfall and other vagaries of weather conditions in the area. Hence, to narrow down the gap between the yields of different varieties, location specific recommendation appears to be necessary. Technology index shows the feasibility of the variety at the farmer's field. The lower the value of technology index more is the feasibility. Table 4 revealed that the technology index value was 28.3. The findings of the present study are in line with the findings of Sawardekar *et al.* (2003), Dhaka *et al.* (2016), Kumari *et al.* (2017), Mahadik and Talathi (2016), Singh and Kumar (2017) and Kumar 2017.

The economic feasibility of improved technologies over traditional farmer's practices was calculated depending on the prevailing prices of inputs and output costs (Table 5). It was found that cost of production of mustard under improved technologies varied from Rs. 17500 to Rs. 20500 ha⁻¹ in case of CS 52, Rs. 18500 to Rs. 20900 ha⁻¹ for CS 54, Rs. 17500 to Rs. 21200 ha⁻¹ for CS 56 and Rs. 21300 to 21500 ha⁻¹ in case of CS 58 with an average of Rs. 19594 ha⁻¹ of improved technologies and with an average of Rs. 18628 ha⁻¹ in local practice. The additional cost incurred in the improved technologies was mainly due to more costs involved in the cost of improved seed only. Front line demonstrations recorded higher mean gross returns (Rs. 55358 ha⁻¹) and mean net return (Rs. 35763 ha⁻¹) with higher benefit ratio (2.6) under improved technologies of different improved varieties of mustard as compared to local checks. These results are in line with the findings of Yadav *et al.* (2016), Meena *et al.* (2016), Morwal *et al.* (2018), Meena and Dudi (2012), Dhaliwal *et al.* (2018), Dhaka *et al.* (2016) and Pathak (2018). Further, additional cost of Rs. 950 ha⁻¹ in demonstration has yielded additional net returns of Rs. 17584 ha⁻¹ with incremental benefit cost ratio 3.1 suggesting its higher profitability and economic viability of the demonstration. Similar results were also reported by Meena and Singh (2017), Dhaka *et al.* (2016), Rathore *et al.* (2016), Meena and Singh (2017) and Morwal *et al.* (2018) in wheat crops. The results from the present study clearly brought out the potential of improved production technologies in enhancing mustard production and economic gains in irrigated farming situations conditions of this region of Rajasthan. Hence, mustard production technologies have broad scope for increasing the area and productivity at each and every level.

Conclusion

It may be concluded that the introduction of salt tolerant mustard varieties on saline affected soil with proper agronomic practices are followed then mustard yield increased by 34.3 to 68.7 per cent. Full adoption of salinity

tolerant mustard production technology was reported by 68.8 per cent and partially adopted by 10.6 per cent. The major constraints perceived by farmers were salt affected soils followed by lack of suitable salt tolerance variety. If these constraints are managed somehow then farmers can harvest more yield with the same level of input which would definitely improve their socio-economic status through frontline demonstration at real farming situation in Pali district. On the basis of the result obtained in present study that the yield gap between conventional practices and improved production technologies was perceptibly higher, there is urgent need to make stronger extension services for educating the cultivators in the implementation of improved production technology. However, the yield level under FLD was better than the local varieties and performance of these varieties could be further improved by adopting recommended production technologies. Hence, it can be observed that increased yield was due to adoption of high yielding varieties and conducting front line demonstration of proven technologies. Yield potentials of crop can be increased to greater extent. This will subsequently increase the income as well as the livelihood of the farming community. From the above research findings it can be also concluded that the maximum number of the respondents had medium level of knowledge and extent of adoption regarding recommended mustard production technology. The study reported lack of suitable salt tolerance HYV as major constraint by the beneficiaries and is ranked first followed by low technical knowledge.

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