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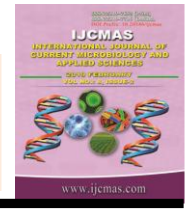

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Impact of Technological Interventions on Productivity of Mustard in Kymore Plateau and Satpura Hills Zone of Madhya Pradesh

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A B S T R A C T

India is the fourth largest oilseed producer in the world. Among the edible oilseed crops cultivated in India, mustard occupying the second position after groundnut sharing 27.5 per cent in Indian economy. It is also one of the important oilseed crops of Madhya Pradesh and is commonly grown in Sidhi district which falls in Kymore Plateau and Satpura Hills zone of the state. Krishi Vigyan Kendra, Sidhi conducted 64 technological frontline demonstrations to know the yield gap between improved package of practices (IP) and farmers practices (FP) under limited irrigation conditions. The study revealed that the mustard yield in improved practice ranged from 8.75 to 13.23 q/ha whereas in farmers practice it was in range of 6.70 to 10.09 q/ha. The technology demonstration on mustard registered highest yield (13.23 q/ha) which recorded in 2014-15 in which was 31.11 per cent higher over the farmer's practice (10.09 q/ha). Extension gap and technology gap ranged between 1.87 to 3.60 and 2.95 to 11.43 q/ha respectively. The technology index ranged from 19.66 per cent to 57.15 per cent. The technology gap and index reflected farmer's collaboration in carrying out the technology demonstrations with encouraging results in preceding years. The benefit cost ratio was estimated to be 2.15 to 3.64 under demonstration, while it ranged from 1.91 to 2.85 under farmer's practice. The results indicated that these technology frontline demonstrations produced good impact on the farming community of the district as they were motivated by the technological interventions applied for considerably better production of mustard.

Introduction

Oilseed constitutes the second largest agricultural commodity in India after cereals accounting for nearly 5 per cent of gross national product and 10 per cent of the value of all agricultural products. Despite the fact that India is one of the leading oilseed producing countries in the world, it is not able to meet the edible oil requirement for its own vast population. Among the oilseeds, mustard is an important oilseed crop of India standing next to groundnut in terms of both area and production. India is one of the largest producer of rapeseed – mustard in the world and contribute 19.29 per cent and 11.18 percent of total area and production respectively (USDA, 2012) but the average National productivity remains 1184 kg/ha which is far below the world average 1950 kg/ha. Its area of the country is 5.76 million hectare with producing around 6.822 million tonnes (Anonymous, 2016). In Madhya Pradesh, rapeseed and mustard grown in an area of 0.617 million hectare with total production of 0.70 million tones and the average productivity of 1134 kg/ha (Anonymous, 2016). The area under mustard is 6.8 thousand hectares in the Sidhi district of Madhya Pradesh. However, average productivity of the district is 677 kg /ha which is very low in comparison to that of the state which is 1134 kg/ha. The low yield of mustard in the Sidhi district are attributed to the non availability of improved cultivars, inadequate dose of fertilizers, non application of secondary plant nutrients, untimely management of diseases and pests etc. Among the various agronomic practices date of sowing, plant spacing, seed treatment, application of biofertilizers and crop management practices play an important role in determining the yield of mustard. Keeping in the view the above, technology frontline demonstrations was conducted by the centre to enhance the production of mustard. The aim of technology frontline demonstrations in general was to raise the production through technology transfer and influence the farmers as well as the extension functionaries. In the above concern the present study was thus designed with the objective to explore the production potential of mustard through the technological interventions under the actual farm situations in the district.

Materials and Methods

The present study was carried out by the Krishi Vigyan Kendra, Sidhi during *rabi*, 2009-10 to 2014-15 (six consecutive years) in the farmer field of the randomly selected villages of Sidhi district under Kymore Plateau and Satpura Hills agro climatic zone of Madhya Pradesh. During the study, an area of 26.8 hectare was covered and the individual plot size was kept 0.4 ha under technology frontline demonstrations in participatory mode at 64 farmers of five villages (Hadbado, Mamder, Jhalwar, Chorgarhi and Karwahi) of Sidhi district. Before conducting these demonstrations, farmers were selected through group meeting and specific training was imparted to the selected farmers regarding different aspects of cultivation was followed as suggested by Venkattakumar *et al.,* (2010). In general, the study soils of the experimental site were loam to sandy loam in texture, neutral in reaction (pH 7.0 to 7.9), low to medium in organic carbon (0.45 to 0.69%) and available nitrogen (249 to 312 kg/ha), medium in available phosphorus (12.9 to 21.31 kg/ha) and high in Potassium (282.5 to 315.21 kg/ha). The package of improved technologies included improved variety of mustard i.e. JM 3 sown in 2009, PusaTarak in 2010-11, 2012-13 and 2014-15 and Pusa Agrani in 2011-12 and 2013-14. Seeds treated with metalaxyl @ 6g kg^{-1} seed for prevention of seed borne diseases (Chattopadhyay *et al.,* 2003) and inoculated with PSB @ 20 g kg^{-1} for increasing availability of phosphorus to the crop roots. Sowing was done between 15th October to 30thOctober in every year keeping seed rate of 5 kg/ha at 30x15 cm plant geometry. The recommended dose of NPKS fertilizers were supplied @ 60:40:20:40 kg/ha through DAP, urea, muriate of potash and sulphur dust in each demonstrations. Full dose of fertilizers were applied as basal except N which was supplemented in two splits. Weed control was done by use of pre-emergence herbicide pendimethalin @ 0.3 kg a.i. ha^{-1} and once hand weeding at 35 DAS for effective control of weed. To protect the yield losses in the crop from aphid, spray of NSKE @ 5 per cent at 10-15 aphid/plant stage was done when it were observed. The harvesting was done during first fortnight of March every year. The farmer's practice included use of degenerated seeds of local varieties @ 4-5 kg ha^{-1} and fertilizer doses were 18 kg N and 46 kg P ha^{-1}. Entire dose of N and P were broadcasted along with seed under mixed cropping of wheat/gram/lentil at time of sowing. Sowing was done by the farmers during second to third week of November every year. No protection measures were taken by the farmers for management of aphid. The seasonal rainfall data (during crop period) was varied from 88.8 to 117.0 mm. Comparison between technology demonstration package and existing practice of mustard is given in table 1.

The visit of farmers and extension functionaries was organized at the demonstration plots of improved technological interventions to disseminate the massage at large scale. The demonstration farmers were facilitated by regular visit of KVK scientists in performing field operations like sowing, fertilizer application, pest management, weed management, harvesting etc. during the course of training and visits. The output data was collected from both FLD plot as well as farmers practice plot and finally the extension gap, technology gap, technology index along with cost benefit ratio were worked (Samui *et al.,* 2000) as given below:

Extension Gap (kg/ha) = (Yield in improved practices – Yield in farmers practice)

Technology Gap (kg/ha) = (Potential yield – Yield in improved practice)

Technology index (%) = (Technology Gap/Potential yield) x 100

Results and Discussion

Yield

The result of 64 front line demonstrations conducted during 2009-10 to 2014-15 in 26.8 ha area on farmer field of four villages of Sidhi district under Kymore Plateau and Satpura Hills Agro climatic zone of Madhya Pradesh. The productivity of mustard in Sidhi district of Madhya Pradesh under improved production technology ranged between 857 to 1323 kg ha^{-1} with mean seed yield of 1069 kg ha^{-1} (Table 3). The productivity of mustard in technology demonstrations ranged from 819 to 972, 807 to 953, 897 to 1091, 907 to 1310, 1176 to 1488 and 1207 to 1523 kg ha^{-1} with an average seed yield of 910, 857, 924, 1195, 1205 and 1323 kg ha^{-1} during 2009-10, 2010-11, 2011-12, 2012-13, 2013-14 and 2014-15 respectively over the farmer practice seed yield ranged between 695 to 1009 kg ha^{-1} with an average of 820.16 kg ha^{-1}. The additional yield under technological interventions over the farmer's practices ranged from 187 to 360 kg ha^{-1} with an average of 248.84 kg ha^{-1}. An increase of 31.5 %, 31.2%, 27.44 %, 43.11%, 28.19%, and 31.11% in productivity of mustard under improved technology demonstrations was noted in 2009-10, 2011-12, 2012-13, 2013-14 and 2014-15 respectively over farmers practice. The increased seed yield with improved production practice was mainly because of increased total dry matter, number of siliquae per plant and harvest index (Table 2). The similar results of yield enhancement in mustard front line demonstrations has been documented by Meena *et al.,* (2012) in Rajasthan. The results are also in confirmatory with the findings of Katare *et al.,* (2011), Dutta (2014) and Ram and Anand (2014).

Yield attributing characters

The data on yield attributing characters of mustard for six years presented in table 3 revealed that number of siliqua per plant under improved technology demonstrations were 149, 159, 159, 179, 156.2 and 158.33 in comparison to farmers practice (local check) which was 112, 117, 128, 121, 112 and 114.7 during 2009-10, 2010-11, 2011-12, 2012-13, 2013-14 and 2014-15 respectively. The increase percentage in number of siliquae per plant under improved production technology was 33.03, 35.89, 24.21, 47.93, 39.46 and 38.03 per cent over the local check (farmers practice).

The average number of siliqua per plant was 160.08 under technology demonstrations and 117.45 under farmers practice, thus there was 36.42 percent more siliqua per plant under technology demonstrations as compared to farmers practice. Meena *et al.,* (2012) and Dutta (2014) were reported that 22.22 to 31.48 percent number siliqua per plant increased in improved production technology in mustard front line demonstrations over farmers practice.

Aphid population

The data on aphid infestation after spray of NSKE @ 5% during the study period is presented in table 3 clearly indicated that during 2009-10, 2010-11, 2011-12, 2012-13, 2013-14 and 2014-15 the per cent aphid infestation under technology demonstrations were 8.5, 6.75, 11, 9.5, 8.25 and 7.0 per cent with an average of 8.5 percent over farmers practice which was 36.75, 76.23, 63.57, 56.3, 51.5 and 59.5 per cent respectively with an average of 57.33 percent aphid infestation.

The percent reduction in aphid infestation under technology demonstrations during the study years was found to be 74.82, 91.14, 82.69, 83.12, 83.98 and 88.23 per cent with an average of 83.99 from 2009-10 to 2014-15. These findings are in conformity with those of Singh and Lal (2009) and Chanchal and Lal (2009) who found that NSKE @ 5% is effective in reducing the mustard aphid population.

Economic return

The Economic viability of improved technology over farmers practice was calculated depending on prevailing price of inputs and outputs (Table 4). It was found that the additional cost of production of mustard under technology demonstrations varied from Rs.1250.0 to 1520.90 ha^{-1} with an average of Rs.1352.73 ha^{-1} over farmer practice which varied from Rs.7092 to 11577.25 ha^{-1} with an average of Rs. 9002.62 ha^{-1}. The additional cost incurred in technology demonstrations over farmers practice was mainly due to more cost involved in fertilizer, improved quality seed, seed treatment and IPM measures, However the improved technology resulted in higher net return which ranged from Rs.8695 to 23589.30 ha^{-1} with an average of Rs. 15909.70 ha^{-1} as compared to farmers practice which recorded Rs. 6506 to 17202.7 ha^{-1} with an average of Rs. 10886 ha^{-1}. The improved technology demonstrations also gave higher benefit cost ratio 2.52, 2.15, 2.5, 3.64, 2.18 and 2.78 as compared to FP BC ratio 1.91, 1.96, 2.29, 2.85, 2.00 and 2.55 under farmers practice in the corresponding years from 2009-10 to 2014-15. The additional income could substantially benefit the mustard growers of the region and improved their livelihood too. These results are in conformity with findings of Meena *et al.*, (2012), Dutta (2014) and Sarma *et al.*, (2014) in front line demonstration of rape seed and mustard.

Technology gap

The technology gap varied between 395 – 893 kg ha^{-1} (Table 4) at all the locations which proved that encouraging results were obtained in technology demonstrations on account of farmers' cooperation. The variation observed in technology gap may be attributed to the dissimilarity in soil-fertility status and weather condition at different locations. Technology gap was noted to be highest in the year 2010-11 (893 kg ha^{-1}). The similar results of technology gap in rapeseed and mustard crop in front line demonstrations have been recorded by Ram and Anand (2014), Meena *et al.,* (2012), Dutta (2014) and Sarma (2014) who opined that lower the value of technology index, more is the feasibility of the technology demonstrated.

Extension gap

The highest extension gap of 360 kg ha^{-1} and lowest 187 kg ha^{-1} was observed in year 2012-13 and 2010-11 respectively (Table 4). This emphasized the need to educate the farmers through various means for the adoption of improved production technologies of mustard to reverse the trend of wide extension gap. More and more use of latest production technologies with high yielding variety will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinue the old variety/technology and to adopt new technology. These findings are in corroboration with the findings of Meena *et al.*, (2012) and Sarma *et al.*, (2014).

Technology index

The technology index showed the feasibility of the evolved technology for the evaluation at farmers' field and the lower the value of technology index more is the feasibility of the technology (Jeengar *et al.,* 2006). It was found to be ranging between 24.40 to 51.05 per cent and revealed that the lower value of technology index is also feasible rather than the higher value of technology index. The lower value of the technology index of the year of 2014-15 was due to severe attack of aphid. This indicates the yield gap exists between the technology generated at research station and farmers fields. In comparative profitability of mustard the additional benefit cost ratio was obtained in the year 2014-15 (1: 4.2) due to the adoption of recommended mustard production technology (Table 5).

Table.1 Details of technology demonstration package and farmers practice in mustard

Particulars	Demonstration Package	Farmers Practice
Variety	JM-3, Pusa Tarak and Pusa Agrani	Degenerated seeds of varuna cultivar
Seed rate	5 kg/ ha	4-5 kg/ha
System of Sowing	Sole crop	Mixed with wheat/ gram/lentil
Seed treatment	Metalaxyl @ 6 g/ kg seed + PSB @ 5 g/kg seed	Nil
Sowing time	IInd fortnight of October	IInd – IIIrd week of November
Sowing Methods	Line Sowing at 30X 15 cm spacing	Broadcasting
Farming Situation	Irrigated (Two irrigation)	Rainfed
NPKS	@ 60:40:20:40 kg/ha	18:46:0:0 kg/ha
Insect pest management	Spray of NSKE @ 5% at ETL (30 % plant affected by aphid)	Spray of Dimethoate @ 1 ml/litre

Table.2 Effect of improved production technology on yield of mustard under frontline demonstrations

Year	Variety	No. of demo.	Area (ha)	Demo yield (kg/ ha)			Yield of Local Check (kg/ ha)	per cent increase over local check
				Highest	Lowest	Average		
2009-10	JM-3	05	2.0	972	819	910	695	31.5
2010-11	Pusa Tarak	12	5.0	953	807	857	670	31.20
2011-12	Pusa Agrani	11	4.8	1091	897	924	725	27.44
2012-13	Pusa Tarak	12	5.0	1310	907	1195	835	43.11
2013-14	Pusa Agrani	12	5.0	1488	1176	1205	987	28.19
2014-15	Pusa Tarak	12	5.0	1523	1207	1323	1009	31.11
Total/ Average		**64**	**26.8**	**1222.83**	**968.83**	**1069**	**820.16**	**32.09**

Table.3 Effect of improved production technology on aphid infestation and yield attributing character of mustard

Year	Aphid infestation (%)		% decrease in aphid infestation over farmers practice	Incidence of Alternaria blight (%)		% decrease in incidence of Alterneria blight over farmers practice	Yield attributing Characters (No. of Siliquae / Plant)		% age Increase over farmers practice
	Improved Practice	Farmers Practice		Improved Practice	Farmers Practice		Improved Practice	Farmers Practice	
2009-10	8.5	36.75	74.82	9.6	34.2	71.90	149	112	33.03
2010-11	6.75	76.23	91.14	8.9	36.12	75.35	159	117	35.89
2011-12	11.0	63.57	82.69	10.75	31.5	65.87	159	128	24.21
2012-13	9.5	56.3	83.12	11.25	39.6	71.59	179	121	47.93
2013-14	8.25	51.5	83.98	10.5	38.12	72.45	156.2	112.0	39.46
2014-15	7.0	59.5	88.23	11.5	39.5	70.88	158.33	114.7	38.03
Average	**8.5**	**57.33**	**83.99**	**10.41**	**36.50**	**71.34**	**160.08**	**117.45**	**36.42**

Table.4 Economic impact of improved production technology of mustard under front line demonstrations

Year	Economics of Mustard Production (Rs./ha)								
	Cost of Cultivation(Rs./ ha)		Net returns (Rs./ ha)		B:C ratio		Additional Cost (q/ha.)	Additional return (Rs./ ha)	Additional Benefit cost-ratio
	Improved Practices	Farmers Practices	Improved Practices	Farmers Practices	Improved Practices	Farmers Practices			
2009-10	7922.0	6692	13840.0	6506.0	2.52	1.91	1250.0	7334.0	5.86
2010-11	8005.0	6775	8695.0	6065.0	2.15	1.96	1230.0	2630.0	2.13
2011-12	7487.5	6315.0	11292.5	8185.0	2.57	2.29	1272.5	3107.5	2.44
2012-13	8389.0	7016.0	21686.5	15559.0	3.64	2.85	1373.0	6127.5	4.46
2013-14	12770.0	11300	16355.0	11800	2.18	2.00	1470.0	4555.0	3.08
2014-15	12589.1	11077.2	23589.3	17202.7	2.78	2.55	1520.9	6387.3	4.20
Average	**9527.10**	**8195.86**	**15909.71**	**10886.0**	**2.64**	**2.26**	**1352.73**	**5023.58**	**3.71**

Table.5 Technology gap, extension gap and technology index in mustard frontline demonstrations

Year	Potential Yield (kg/ha)	Yield (kg/ ha)		Technology gap (kg/ha)	Extension gap (kg/ ha)	Technology Index (%)
		Improved Practices	Farmers Practices			
2009-10	1600	910	695	690.0	215	43.12
2010-11	1750	857	670	893.0	187	51.05
2011-12	1600	924	725	676.0	199	42.25
2012-13	1750	1195	835	555.0	360	31.71
2013-14	1600	1205	987	395.0	218	24.68
2014-15	1750	1323	1009	427	314	24.40
Average	**1675**	**1069.0**	**820.16**	**606.0**	**248.83**	**36.20**

The Improved production technology of varieties (JM-3/Pusa Tarak/Pusa Agrani) of mustard performed better (average yield 1069 kg ha^{-1}) over the control i.e. farmers' practice (average yield 820.16 kg ha^{-1}) at all the locations under technology demonstrations. From the above findings, conclusion can be drawn that use of improved technology with suitable variety can reduce the yield gap up to a considerable extent leading to increased productivity of mustard crop in the district. Moreover, extension agencies in the district need to provide proper technical guidance and support to the farmers through different educational and extension methods to reduce the extension gap for better mustard production in the district. KVK has also played a major role in serving as a linkage mechanism.

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