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Evaluation of yield performance of Indian mustard (*Brassica juncea*) through front line demonstration

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Abstract
Front line demonstration of Indian mustard (var. Pusha Tarak) was carried out at farmers' field of Mandla district (MP) during *Rabi* seasons 2014-15 and 2015-16 to study the yield gaps between improved package of practices (IP) and farmers' practices (FP). The findings of result revealed that the yield of Indian mustard in IP was ranged from 1637 kg/ha to 1668 kg/ha whereas in FP it was ranged from 843 kg/ha to 932 kg/ha. The average yield of Indian mustard under IP was recorded higher (1653 kg/ha) as compared to FP (888 kg/ha) which was grown traditionally by the farmers. The per cent increased in yield with IP was recorded in the range of 78.97 to 94.19 over the FP. The extension gap (794 to 736 kg/ha) and technological gap (163kg/ha to 132kg/ha) were declined due to adoption of improved package of practices by the farmers. The average net return of IP was found significantly higher than that of FP. The C:B ratio was 4.85 to 4.90 under IP, while it was 2.85 to 2.95 under the FP.

Keywords: mustard, *Brassica juncea*, yield performance, extension gap, technology gap, net return

Introduction
India mustard [*Brassica juncea* (L.) Czernj] alone contributes about one third of the total oilseed (nine oil seeds) crops grown in the country. This crop provides high quality of edible oil and is widely adaptable to various agro-climatic conditions. Indian mustard is cultivated in rainfed and irrigated condition during *Rabi* season. The growers of this crop achieve higher market price and add to the uplift rural economy. The leading states of mustard in India are Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, West Bengal, Gujarat, Bihar and Assam where it is cultivated in 5.76 million ha area with the production of 6.82 million tones and productivity of 1169 kg/ha. In Madhya Pradesh this crop occupy 747.90 thousand ha area with the production of 975.79 thousand tones and productivity of 1305 kg/ha (Anonymous, 2018) [1]. The production and productivity of India mustard in India have been declined since last few years due to various biotic and abiotic constraints. The productivity of Indian mustard in Madhya Pradesh having less as compared to other states and this was mainly due to very old conventional practices, improper crop geometry, imbalance use of manures and fertilizers and climatic variability which are the major limiting factors for fetching out potential yield. In the context, to enhance the production and productivity of agricultural crops in thrust areas, the Krishi Vigyan Kendra conducted various front line demonstrations (FLDs) in the farmers' field to disseminate the new technological interventions among the farmers. It is a unique approach to provide direct interface between the agricultural extension scientists and farmers. The scientists are directly involved in planning, execution and monitoring of the demonstrations for the improved technologies developed by them and having close contact to get feedback from the active beneficiary farmers about the crop production. Many farmers are become deprived to get benefit from the new improved agricultural technologies due to lack of knowledge and reliance. Looking to the above facts, present investigation on front line demonstration was conducted on farmers' field with a view to demonstrate the performance of improved variety of Indian mustard with all recommended package of practices towards the enhancement of mustard production in adopted villages.

Materials and Methods
A total number of 125 front line demonstrations (0.4 ha each) on improved variety of Indian mustard (Pusha Tarak) were conducted subsequently for two years during *Rabi* seasons 2014-15 and 2015-16 at farmers' field of three villages (*viz*; Kindri, Pondimal and Mohgaon Chak) of Mandla district (Northern Hill of Chhattisgarh Zone), Madhya Pradesh, India. The material of improved package of practices (IP) and farmers' practices (FP) was taken in consideration

in the present study has been mentioned in Table 1. The improved technology included seed treatment with fungicide (Thirum + Bavistin 2:1 @ 2.5 g/kg seed, balanced dose of fertilizers including micronutrient (sulphur @30 kg/ha) on the basis of soil testing reports. A half dose of nitrogen and full dose of phosphorus, potash and sulphur were applied as basal application. The remaining dose of nitrogen was split in two parts which first and second parts was given after first and second irrigation as top dressing. The seed rate was 5 kg/ha sown in line with maintaining the spacing of 30 x10 cm between rows and plants, respectively in demonstrated plots. Further, proper irrigation was given at 30-35, 45-50 and 65-70 days after sowing (DAS) whereas, one hand weeding was also done at 25-30 DAS. In plant protection measures, one spray of Imidacloprid 17.8 SL @125ml/ha was done against the aphids and painted bugs at ETL level. The performance of the crop was valuated with the existing local farmers' practices at the same location, which included use of local seed (7-9 kg/ha) without seed treatment with fungicides, broadcast seeding and one irrigation were applied without application of fertilizers, weeding and plant protection measures. The crops were sown in the second week of October to first week of November and harvested manually at maturity stage i.e. last week of February to first week of March. After that, the seed yield data from demonstrations and existing farmers' practices were collected through personal contact at farmers' field. Finally, the production and profitability parameters *viz*; technology gap between the potential yield and demonstrated yield, extension gap between demonstrated yield and farmers yield, technology index were analyzed following the formulas as described by Samui *et al.* (2000) [2] and sum-up with the concrete results.

Extension gap = Demonstrated yield – Yield under existing practice

Technology gap = Potential yield – Demonstrated yield

Percent increase yield = [Demonstration yield – Farmers yield/ Farmers yield] x 100

Technology index = [Technology gap/ Potential yield] x 100
Benefit cost ratio = Gross return/ Gross cost

Results and Discussion

Results of 125 FLDs conducted during 2014-15 and 2015-16 in 50 ha total area on farmers' fields of three villages of Mandla district indicated that the improved practices comprised under FLD *viz*; use of improved variety - Pusha Tarak, line sowing, balanced application of fertilizers and control of mustard aphid through insecticide at ETL was superior over the farmers' practices. The data of Table 2 revealed that the yield of Indian mustard fluctuated successively over the years in demonstrated plots, produced on an average 86.58% more yield of mustard as compared to local practices (888 kg/ha). The maximum yield was recorded (1668 kg/ha) during 2015-16 and minimum yield (1637 kg/ha) in the year 2014-15. The average yield of two year's study period was recorded 1653 kg/ha over local practices (888 kg/ha). The yield increase in per cent was ranging 78.97% to 94.19% during both years. The results clearly indicated the positive effects of FLDs over the existing farmers' practices toward the enhancing Indian mustard production in the adopted villages.

Average benefit-cost ratio was recorded higher under demonstrated plots against farmers' practices in both the years of study. These results were also supported by Singh *et al.* (2008) [3] who found that the improved technologies of mustard crop have significant effect in higher productivity of mustard. The findings revealed that a gap exists between the actual yield of farmers' practices and recommended practices. Apparently, the extension gap was exhibited as an increasing trend. The maximum and minimum extension gap (794 and 736 kg/ha, respectively) was recorded during 2014-15 and 2015-16, respectively. The present investigation emphasizes the need to impart motivational trainings and demonstrations for the marginal and medium farmers through various ways for adoption of improved agricultural production technologies to get the benefit and uplift their socio-economic status. Other hand, the trend of technological gap ranged between 163-132kg/ha indicates the active farmers' participation and adoption pattern in respect of improved agricultural demonstrations. Although, the technology gap observed might be attributing to the dissimilarity in soil fertility status and abiotic factors. The present findings are in accordance with the findings of Mukharjee (2003) [4] who have also suggested that wisely identification of thrust area and use of farming situation, specific technological interventions may have greater implications in enhancing productivity. Similar findings and suggestions were also given by Mitra *et al.* (2010) [5], Katare *et al.* (2011) [6] and Verma *et al.* (2012) [7]. The technology index was expressed 0.91% and 0.73% during the year 2014-15 and 2015-16, respectively. The average technology gap was 148kg/ha. The technology index expressed the feasibility of the improved technology at the farmers' fields. It is revealed that the lower value of technology index the more is the feasibility of technology. The benefit cost ratio of FLDs was higher in respect to farmers' practices.

The factors of economic indicators *viz*; cost of cultivation, gross return, net return and benefit cost ratio of FLDs and existing farmers' practices is presented in Table 3 depicted that the recommended improved practices was significantly higher than that of farmers' practices. The average cost of cultivation from recommended package of practices was found to be Rs. 18652/ha as compared to farmers' practices i.e. Rs.16806/ha. Although, the cost of cultivation of FLDs was higher than that of farmers' practices but the average net return (Rs. 81697/ha) was significantly maximum due to following the recommended package of practices. On an average Rs. 49675/ha was obtained as additional income following the recommended package of practices over the farmers' practices. The average benefit: cost ratio 4.88 was found under IP whereas, 2.90 in FP. Similar results were also reported by Asiwal *et al.* (2008) [8], Meena *et al.* (2012) [9], Deshmukh *et al.* (2013) [10], Tiwari *et al.* (2017) [11] and Rachhoya *et al.* (2018) [12] as they also advocated that the active participation by the farmers (as beneficiary) towards the adoption of new improved package of practices (proven technologies) certainly helpful to uplift the socio-economic status of farmers community. The present findings revealed that the yield performance and economic returns of improved variety of Indian mustard with recommended package of practices was found to be higher than farmers' practices.

Table 1: Comparison between front line demonstration (FLD) and farmers' practices of Indian mustard

S. No.	Practices	Demonstration practices	Farmers' practices	Technological gap
1	Land preparation	Two ploughing	Two ploughing	No gap
2	Variety	Push Tarak	Local seed	Full gap (100%)
3	Seed rate	5 kg ha^{-1}	7-9 kg ha^{-1}	Higher seed rate
4	Seed treatment	Thirum+Bavistin 2:1 @ 2.5 g kg^{-1} seed	No seed treatment	Full gap (100%)
5	Sowing method & spacing	Line sowing (45 cm x 15 cm)	No line sowing (Broadcasting)	Full gap (100%)
6	Manures & Fertilizers	60:40:30:30 NPKS $kgha^{-1}$	No use of fertilizer	Full gap (100%)
7	Weed management	One hand weeding at 30-35 DAS	No weeding	Full gap (100%)
8	Pests management	Need based plant protection management	No plant protection management	Full gap (100%)
9	Irrigation management	Three irrigation at pre flowering, siliqua formation and siliqua filling stage	One irrigation	Partial gap

Table 2: Productivity, extension gap, technology gap and technology index of mustard as grown under FLDs and existing package of practices

Year	Area (ha)	No. of FLDs	Variety	Average yield (kg ha^{-1})			Increase yield over FP (%)	Extension gap (kg ha^{-1})	Technology gap (kg ha^{-1})	Technology index (%)
				Potential	IP	FP				
2014-15	20	50	Pusha Tarak	1800	1637	843	94.19	794	163	0.91
2015-16	30	75	Pusha Tarak	1800	1668	932	78.97	736	132	0.73
Total	50	125	-	-	3305	1775	173.16	1530	295	1.64
Mean	25	-	-	-	1653	888	86.58	765	148	0.82
FLDs: Front line demonstrations, IP: Improved package of practices, FP: Farmers' practices										

Table 3: Economic comparison between improved package of practices and farmers' practices under Indian mustard front line demonstration

Year	Average cost of cultivation (Rs. ha^{-1})		Average gross return (Rs. ha^{-1})		Average net return (Rs. ha^{-1})		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP
2014-15	18381	16251	90035	46365	71654	30144	4.90	2.85
2015-16	18922	17360	91740	51260	91740	33900	4.85	2.95
Total	37303	33611	181775	97625	163394	64044	9.75	5.80
Average	18652	16806	90888	48813	81697	32022	4.88	2.90
IP: Improved package of practices, FP: Farmers' practices								

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