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Performance of mustard (*Brassica juncea* L.) crop grown under cluster front line demonstration over farmer practices in different villages of Kurukshetra

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Abstract
Cluster Front line demonstrations of Mustard were conducted from 2019 to 2022 by Krishi Vigyan Kendra, Kurukshetra, CCSHAU to compare the yield gap, net return and cost benefit ratio between demonstrated field conducted at farmers' field and farmer practices under irrigated semi arid condition. Mustard yield, net return and cost benefit ratio was recorded higher in demonstrated field over traditional farmer practices during the period of experimentation. The average yield of four years of experimentation in mustard was recorded 17.5 and 14.8 q/ha in demonstrated field and farmers practices respectively. The average Technology gap 10.2, extension gap 2.7 and technology index percent 36.8 was recorded. The yield and net return gap between demonstrated field and farmer practices was due to the farmer was followed the latest scientific technology as mentioned in package of practices published by CCSHAU, Hisar from any stage of crop grown like seed treatment to final maturity period.

Keywords: Mustard, cluster front line demonstration, traditional farmer practices, economic and yield

Introduction
India is one of the largest mustard and rapeseed growing countries in the world and occupying the first position in terms of area and second position in Production after China Thakur and Sohal., (2014) [15].
In Haryana, Kurukshetra district has covers 3.46 percent area. The district annual rainfall is 582mm which is distributed unevenly over the area. About 81 percent of annual rainfall is contributed by southwest monsoon and 19 percent received due to western disturbances and thunder storms. Soil condition of the area is clay loam to loam which is covered by tropical arid brown soils which are deep and imperfectly drained with moderate to strongly alkaline in reaction. The district ground water level in different blocks is depleting at an almiring rate i.e., 0.5 to 2.0 meter per year. Out of 433 villages of Kurukshetra, 422 villages are categorized as severely groundwater stressed. In this situation, crop diversification is only method to overcome such situation and select those crops which required less water for growththan required by paddy and wheat crops. The dependence of rice-wheat system has adversely effects the soil health and ground water resources. Presently, only 70-80 percent of farmers had land below 2 hectares these farmers must be diversified with high remunerative crops such as Mustard etc. Statistic of the state agriculture department reported that the cultivation area under mustard has increased for the last three years. It has increased to around 7.8, 6.1 and 5.62 lakh hectares during 2021-22, 2020-21 and 2019-20 respectively.
Keeping in view the reckless depleting of ground water of the district, Mustard had promoted for demonstration purpose at farmer field. This variety was developed during 2013 for the regions of Punjab, Haryana, Delhi and some part of Rajasthan states. This is a timely sown variety in irrigated condition and it produces seed yield 10.0 to 11.5 q/ha, its maturity period is 145-148 days after sowing. The siliquae of this variety is long and bold andthe edible oil content of the seeds is around 39.0-40.0 percent.

Materials and Methods
Cluster front line demonstrations with Mustard var. RH-749 from 2019 to 2021 and PM-25 in 2022 was conducted by Krishi Vigyan Kendra Kurukshetra (Haryana) which covers an area 195.5 ha in different villages of Kurukshetra.

Improved Mustard variety was sown in demonstrated plots of farmer's field as per the information mentioned in package of practices published by CCS Haryana Agricultural University, Hisar. Soil conditions of all the villages under demonstration were clay loam to loam in texture with low to medium in organic carbon content and other essential plant nutrients which is necessary for plant growth and development like Nitrogen**,** Phosphorous and Potassium. Mustard seeds were sown at 30 cm row-row and 10-15 cm plant-plant spacing in the demonstrated farmers' fields after seed treatment with Rhizobium culture and all the cultural and management practices like maintain proper density of crop in the field by timely thinning operation, irrigation is applied at critical stages, timely weed management operation with weedicides application, use proper doses of essential fertilizers at right time and timely application pesticides to control insect-pest and diseases during infestation. The gap of yield and economic between both the practices i.e., demonstrated field and farmers practices are given in Table 1. The output data were collected from demonstrated field as well as traditional farmers practices for analysis all the parameters under studied. The technology gap, extension gap, technology index and cost benefit ratio (B:C) were analyzed as calculated by Katare *et al*., (2011) [3] and Samui *et al*., (2000) [9].

Table 1: Comparison of demonstrated field practices and farmers field practices

Components	Demonstrated field practices	Farmers field practices
Variety	RH-0749 and PM-25	Local or non-recommended variety
Seed rate	1.25 kg/acres	Less or more seed rate
Time of sowing	25 September to 10 October	Delay in sowing
Seed treatment	Seed treatment with Azotabacter culture	No seed treatment
Row to row spacing	Row- Row: 30 cm and Plant-Plant: 10-15 cm	Not maintained plant population in their field
Fertilizer doses	Urea:35 kg, SSP: 50 kg, Zinc sulphate: 10 kg/Acre	Apply imbalance doses of fertilizers
Water management	At the time of flowering and siliquae formation	Water stress during critical period
Plant protection	**Insects control** 1. Hairy caterpillar: Quinalphos 25 EC @ 500 ml in 250 liters of water 2. Painted bug: Malathion 50 EC @ 200 ml in 200 liters of water 3. Mustard aphid and leaf minor: Methyldemeton 25EC @ 250 ml in 250 liters of water **Disease control** 1. Alternaria blight and white rust: Mancozeb @ 600ml in 250-300 liters of water, repeat 3-4 times after 15 days interval. 2. Stem rot: Seed treatment with 2 g Carbendazim/kg of seeds and spray with 0.1% carbendazim after 45-50 and 65-70 days interval	Applied more pesticides without proper doses

Technology Gap = Potential Yield (q/ha) – Demonstration Yield (q/ha)

Extension Gap = Demonstration Yield (q/ha) – Farmers Practices Yield (q/ha)

$$\text{Technology Index} = \frac{\text{Potential Yield (q/ha)} - \text{Demonstration Yield(q/ha)}}{\text{Potential Yield (q/ha)}}$$

$$\text{B: C} = \frac{\text{Gross Return (₹/ha)}}{\text{Cost of Cultivation (₹/ha)}}$$

Results and Discussion

Cluster front line demonstration of Mustard was conducted in farmers field by adopted all the latest scientific technologies as mentioned in package of practices like use of improved variety of mustard, treatment of seed with rhizobium culture before sowing, proper weed management to control of weeds in the field and applied recommended doses of essential fertilizers which was helpful for the growth and development of crop, judiciously applied pesticides for the control of insect pest and diseases which infested the crop.After the application of all the essential cultural and management practices, the yield of mustard was recorded higher in all the demonstrated farmers field and the average of four years Mustard yield was recorded 17.5 q/ha in demonstrated farmers field whereas 14.8 q/ha yield was recorded in traditional farmers practices. Chaudhary *et al*., (2018) [2] revealed that after two years of study of mustard crop, the yield was obtained in demonstrated plots were 21.50 q/ha as compared to 16.65q/ha in traditional farmer practices fields. Sharma *et al.,* (2020) [10] also reported that the yield of mustard was recorded higher in demonstrated farmers field than traditional farmer practices field by the adopted the improved technology. Meena *et al*., (2018) [4] reported that the use of improved variety in demonstrated field with the application of full package of practices of growing mustard crop had significant impact on seed yield than local varieties grown by the farmers in traditional farming system. Use of improved variety, line sowing, maintain proper plant population in the field, use of recommended doses of fertilizers, timely weed management and control of insect-pest increased the yield of mustard from 44.31 to 50.08 percent under demonstrated field than farmer practices reported by Rachhoya *et al*., (2018) [7].

The average of four years studied, technology gap was found 10.2, extension gap 2.7 and technology index 36.8 percent was recorded. The average mustard yield was increased 18.1 percent in demonstrated farmer's field over traditional farmer's practices. Singh *et al.,* (2023) [11] reported that the average yield in mustard crop in demonstrated field was recorded higher than farmers practice was due to the farmers had applied the scientific technology as mentioned in package of practices. The extension gap indicating the need to aware the farmer community through organizes various extension activities for adopting the latest and improved technology. It was notice that there is lot of possibility to apply improved technologies at farmer's field which are mentioned in Package

of Practices. The technology feasibility will be increased if the technology index was found lower reported by Singh *et al.,* (2023) [11] in case of mustard crop. The technology and extension gap had suggested that the further improvement in the extension activities to reduce the gap for better adoption of improved technology reported by Prasad *et al*., (2022) [6].Technology gap, extension gap and technology index gap between demonstrated farmers field than traditional farmers practice may be due to the farmers has not adopted the latest technology of growing chickpea as mentioned in package of practices from seed treatment to final maturity of crop reported by Singh *et al*., (2023) [13]. Similar observation also reported by Singh *et al.,* (2021) [12] in summer moong crop.

Table 2: Comparison of yield (q/ha), Technolgy Gap, Extension Gap and Technology Index of Mustard between Front line demonstration practices and Farmers practices

Year	Variety	No. of Farmers	Area (ha)	Yield (q/ha)			% increase Over farmers practices	Technology Gap	Extension Gap	Technology Index (%)
				PY	DY	FP				
2019	RH749	140	60	28.75	17.6	15.4	14.3	11.2	2.2	38.8
2020	RH749	140	60	28.75	18.6	15.2	22.4	10.2	3.4	35.3
2021	RH749	88	35.5	28.75	18.9	15.5	21.9	09.9	3.4	34.3
2022	PM25	100	40	24.05	14.7	12.9	13.9	09.4	1.8	38.9
Total/average		468	195.5	27.6	17.5	14.8	18.1	10.2	2.7	36.8

PY: Potential Yield, DY: Demonstrated Yield, FP: Farmer Practices

Table.3. showed the economics of demonstration and traditional farmer practices i.e., gross cost, gross return and net return and B:C was calculated higher in demonstrated farmers field as compared with traditional farmer practices during the periods under studied. The mean gross cost, gross return and net return was calculated 27167.5, 85555, 58387.5 in demonstrated field and 28600, 72105.3 and 43505.3 in traditional farming practices. The gross cost, gross return and net return was calculated higher in demonstrated field than traditional farmers' practices in case of chickpea reported by Singh *et al*., (2023) [13]. The higher net return may be due to the adopting of latest technology and proper management practices of growing mustard crop as mentioned in package of practices in demonstrated farmers field than traditional farmers practices. In short duration paddy crop, the net return in demonstrated farmer's field was higher over traditional farmers' practices reported by Singh *et al.*, (2021) [14] . Similar observation was also recorded by Rajpoot (2020) [8] that the net returnobtained higher due to higher crop yields in demonstrated field by adopting latest technology of growing crop and less cost of cultivationthan farmer practices. Mishra *et al.,* (2018) [5] and Bezbaruah and Deka (2020) [1] also reported similar observation in case of Greengram crop by adopting scientific technology of growing crop in farmers field. The mean B:C ratio was recorded 3.14 and 2.52 in cluster front line demonstration and traditional farmers practices respectively in four years of studied from 2019 to 2022. Better B:C ratio under demonstrated field indicated that the farmers using the latest scientific technology for cultivation of Mustard as described in package of practices gave better net return than farmer practices. The cost benefit ratio (B:C) was obtained higher in demonstrated field than farmers practice reported by Singh *et al.*, (2023) [13] in case of chickpea. Chaudhary *et al.*, (2018) [2] also reported that the benefit cost ratio in mustard crop was recorded better in demonstration fields than control (farmer's practices) field during the year of experimentation. Singh *et al.,* (2023) [11] concluded that the farmers obtained higher net return and cost benefit (B:C) ratio by adopting the latest technology of growing mustard crop in their field as described in package of practices like treatment of seeds, timely sowing, line sowing, maintain proper plant population in the field, use of improved variety, timely weed control, application of proper doses of fertilizers and pesticides.

Table 3: Comparison of Economic between demonstration and farmer practices of mustard

Year	Varity	Economic of demonstration (Rs/ha)				Economic of farmer practices (Rs/ha)			
		Gross cost	Gross return	Net return	BCR	Gross Cost	Gross return	Net return	B:C
2019	RH7-49	26960	70920	43960	2.63	28350	60676	32326	2.14
2020	RH7-49	26960	69752	42792	2.58	28350	57094	28744	2.01
2021	RH7-49	27850	106880	79030	3.84	29500	87575	58075	2.97
2022	PM-25	26900	94668	67768	3.52	28200	83076	54876	2.95
Mean		27167.5	85555	58387.5	3.14	28600	72105.3	43505.3	2.52

Conclusion

It may be concluded that the yield and net return of mustard crop in demonstrated farmer's field was recorded higher due to the application of latest technology as mentioned in package of practices from seed treatment to final maturity period. The B:C ratio also recorded higher in demonstrated field than traditional farmers practices. This gap may be overcome by organizing various programmes at right time like training, awareness programme, field visit, kisan mela to aware the farmers for adopting the latest technology and management practicesas mentioned in Package of Practices developed by CCS Haryana Agricultural University.

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