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Impact assessment of cluster frontline demonstration on yield gap of Gobhi Sarson (*Brassica napus* L.) in sub-mountainous area of Punjab, India

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Abstract
The present study was conducted by Krishi Vgyan Kendra, Pathankot of Punjab Agricultural University, Ludhiana across three blocks *viz*, Pathankot, Sujanpur and Gharota. During the entire course of study, 75 farmers were selected for conducting frontline demonstration on 30 hectare area for the year 2021-22 and 2022-23. The results of the study revealed highest average yield (15.7 qha^{-1}) was obtained in demonstration plots as compared to check plots of farmers practice (10.1). There was 55.2 percent increase in yield in demonstration plots as compared to farmer plots. A perusal of the data reveals that average technology gap and extension gap was 6.4 qha^{-1} and 5.6 qha^{-1}. However the average technology index for district pathankot was 29.1 percent. The data reported that the overall net returns (Rs 83,300) and benefit cost ratio (6.5) was also higher in demonstration plots as compared to check plots.

Keywords: Rapeseed-mustard, Frontline demonstrations, extension gap, technology index

Introduction
Rapeseed-mustard (*Brassica spp.*) is one of the major group of oilseed crops of the world. India is the third largest rapeseed/mustard seed producer in the world after China and Canada, with 12 percent of the world's total production NRIS (2004) [15]. India occupies an important place in global oilseed scenario with 12-15 percent of area, 6-7 percent of vegetable oil production and 9-10 percent of the total edible oil consumption and 13.6 percent of vegetable oil imports Kumar (2017) [9]. In India, rapeseed and mustard is an important source of edible oil followed by ground nut Panday *et al.* (1999) [16]. However, rapeseed-mustard occupies the second place after groundnut in edible oilseed crops of India contributing about 27.8 percent in India's oilseed economy with 32 percent of the total oilseed production in the country Thakur and Sohal (2014) [20]. Due to its high yield potential and oil content Indian mustard is preferred. Indian mustard has numerous uses as a spice or condiment in preparation, seasoning and stuffing of several foods and pickles in India. The crop diversification is being very popular now a days as the adverse impacts of rice-wheat system are being realized not only by the scientists but also by the farmers. In the state, rapeseed and mustard were grown on 43.9 thousand hectares with a production of 69.3 thousand tonnes during 2021- 22. Moreover, the demand for cultivation of Gobhi sarson is increasing day by day in the state due its 40.5 percent oil content. Gobhi sarson crop has good adaptability to the agro-climatic conditions of Punjab. It's a less water requiring crop as compared to cereals. Although the oilseed cultivation is a traditional practice in the country as more emphasis is given in growing cereal crops due to increased production of major cereal crops like rice and wheat.
The programme of Cluster Front Line Demonstration was commenced by Ministry of Agriculture and Farmer's welfare, GOI New Delhi under National Mission on Oilseeds and Oil Palm (NMOOP). To lay out the CFLD, Division of Agricultural Extension, Indian Council Agricultural Research (ICAR), New Delhi was given the responsibility on important oilseed crops such as sesamum, mustard, linseed to organize demonstrations through Krishi Vigyan Kendras throughout the country. Indian Council of Agricultural Research, New Delhi initiated National level CFLD on oilseeds with main objective to demonstrate production potential of new varieties and the related scientific production technologies Deka *et al*. (2021) [4]. The programme also aimed at increasing the productivity of oilseeds throughout the country. Front Line Demonstration (FLD) is one such important technology transfer tool which aims to evaluate and demonstrate improved production techniques on farmer's field itself.

The KVKs aim to promote the rapid transfer of latest technologies, through trainings and demonstrations, among farmers. It ensures gap filling between innovative and indigenous technologies. Hence, the present study was undertaken by KVK, Pathankot in the variety “GSC-7” with an objective of increasing the production in the area by identifying the technology gap among farmers and by introducing modern cultivation technologies for boosting the crop cultivation.

Materials and Methods

The present study was conducted by Krishi Vigyan Kendra, Pathankot of Punjab Agricultural University, Ludhiana across three blocks of the district *viz*, Pathankot, Sujanpur and Gharota. During the entire course of study, 75 farmers were selected for conducting frontline demonstration on 30 hectare area. For conducting the front line demonstrations, the farmers were identified/selected through proper survey of the area as suggested by Choudhary (1999) [3]. Regular visits to the demonstrated fields was conducted by KVK scientist and the farmers were guided as and when required. The selected farmers were guided about improved package and practices for the oilseed crop cultivation through off-campus training programmes. Field days, Kisan Goshti and awareness camps were also organized at the demonstration sites to provide the opportunities to other farmers to witness the benefits of demonstrated technologies. The crop raised by farmers using local variety and following their own traditional practices was taken as local standard check. For frontline demonstration plots an integrated crop management approach was demonstrated to farmers. In this approach, all the practices were strictly followed according to recommended package of practices developed by Punjab Agricultural University, Ludhiana. A comparative analysis of the package and practices in demonstration plot and local check is given in the table 1. The soils of the farmers’ fields were sandy loam to loamy sand in texture, neutral to slightly alkaline in reaction with medium soil organic carbon, medium to high in phosphorus and low in potassium. Each demonstration was conducted on an area of 0.4 ha and adjacent plot (0.1-0.2 ha) to the demonstration plot was kept for assigning farmers’ practices. The crop was sown during second fortnight of October. The practices adopted for front line demonstrations and farmers’ practice are given in Table 1. Yield data were collected from control (Farmer’s practice) and demonstration plots and net returns and benefit: Cost ratio were computed and analyzed. The extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al*. (2000) [8].

Extension gap (q/ha) = Demonstration yield (q ha^{-1}) - Farmer‘s yield (q ha^{-1})

Technology gap (q/ha) = Potential yield (q ha^{-1}) - Demonstration yield (q ha^{-1})

$$\text{Increase in yield (\%)} = \frac{(\text{Demonstration yield} - \text{Farmers yield})}{\text{Farmers yield}} \times 100$$

$$\text{Technology index} = \frac{\text{Potential yield-Demonstration yield}}{\text{Potential yield}} \times 100$$

Results and Discussion

Seed yield: The data given in table 2 depict the yield comparison between demonstration and farmers practices. A comparative study between the demonstrated technologies and local check revealed higher seed yield in demonstrated technology. During the first year of study maximum yield was observed in demonstration plot (15.2 q ha^{-1}) against the farmer plots (10 qha^{-1}). In line with these results, the demonstration plot witnessed a yield increase of 52 percent over farmer plot. Similar trend was observed in the second year, where maximum yield was under demonstration plot (16.3 q ha^{-1}) against the farmer plot (10.3 q ha^{-1}) and 58.2 percent yield increase in demonstration plot was observed over farmers plot. Overall, the average yield of Gobhi sarson increased by 55.1 percent under demonstrated technologies (15.7 qha^{-1}) as compared to check (10.1q ha^{-1}). Highest yield in demonstration plots may be attributed to the adoption of improved cultivation technologies like method of sowing, effective weed control, Fertilizer application according to recommended package of practices. Lower yield in farmers practice may also be attributed to use of local/un-recommended variety, delayed sowing, use of excess seed, untimely application of fertilizers, irrigation, higher weed infestation and lack of plant protection measures. The results corroborate with the findings of Imoloame *et al*. (2007) [6] who reported the superiority of row planting over broadcasting to control weeds, which resulted in considerable yield increase. Similar results were confirmed by Ghintala *et al*. (2018) [5]; Mitra and Samajdar (2010) [13]; Verma *et al.* (2012) [24]; Tomer *et al.* (2003) [22] and Tiwari *et al.* (2003) [21] in frontline demonstrations in the improved mustard varieties.

The variations in yield could be attributed to technology and extension gap. The technology gap is the difference between potential yield and yield under demonstration plot. It gives the gap in demonstration yield over potential yield. A perusal of the data reveals that technology gap in demonstrated plot over potential was 7.0 q ha^{-1} and 5.9 q ha^{-1} during the year 2021-22 and 2022-23 and the average technology gap of 6.4 qha^{-1} was observed (Table 2). The technological gap may be attributed to the heterogeneity of the soil fertility status and weather conditions (Mukherjee, 2003) [14]. The variation in technology gap during first and second year may be attributed to the difference in response of a particular variety to soil fertility status, weather condition, water quality and management practices of the farmers. Therefore, it might appear in the demonstration plot despite under strict supervision of scientists. To bridge this gap, region specific recommendations are required which can aid in overcoming it to some extent. Extension yield gaps are the indicators of lack of awareness about improved and recommended farm technologies by the farmers Kadian *et al.*(1997) [8]; Vedna *et al.* (2007) [23]. In the present study, the extension gap ranged from 5.2 q ha^{-1} (2021-22) to 6 q ha^{-1} (2022-23). Overall the extension gap of 5.6 q ha^{-1} was found in demonstration plot over farmer plot (table 2). The existence of such extension gaps denotes the poor adoption of demonstrated technologies (*viz.* improved variety and cultivation practices) by the farmers. This reveals the necessity of educating farmers about improved cultivation technologies. Awareness through training programmes, field days, exposure visits and mass media can play a crucial role in bridging this gap. Similar findings were also revealed by Rao and Ramana (2017) [17], Kumar *et al*. (2019) [10] and Matharu and Tanwar (2018) [11].

The technology index shows the feasibility of the evolved technology at the farmer’s fields and the lower the value of technology index more is the feasibility of the technology (Jeengar *et al*, 2006) [7]. The technology index varied between 31.6 percent to 26.7 percent durng the first year and second year of study and the average technology index was determined as 29.1 percent (table 2) such variations in technology index may be attributed to variation in soil fertility status, erratic climate, weed infestation and pest – disease attack during period of study. Similar results were also recorded by Anuj *et al*. (2014) [1] in different oilseeds crops.

Economic performance

The economic analysis of CFLDs is presented in Table 3. It is necessary to determine the economics of cultivation in any experiment in order to ensure its economic feasibility. A perusal of the data of the economic analysis reveals that the plot demonstrating improved cultivation technologies revealed higher average gross return Rs 98,300 ha^{-1} as well as net return Rs 83,300 ha $^{-1}$ in comparison to the farmer's practice which, recorded an average gross return of Rs 60,900 and average net return of Rs45,650 (table 3). Similar findings of higher net returns from demonstration plots were also reported by Singh *et al.* (2014) [19], Yadav *et al.* (2016) [25], Meena and Dudi (2018) [12]. The benefit cost ratio ranged from 6.5 to 6.59 (2021-22) and 4.0 to 3.9 (2022-23) under demonstration plot and farmer's practice, respectively. Overall, the highest B:C ratio was worked out under demonstration plot i.e. 6.5. The higher monetary benefits under demonstration plots over farmers' practice may prove the worth of improved technological interventions. These results were in line as reported by Balai *et al.* (2012) [2].

Table 1: Comparison between demonstration package and existing farmers' practices in Gobhi sarson

Parameter	Demonstration package	Farmers practice
Farming situation	Irrigated, rainfed	Irrigated, Rainfed
Varieties	GSC-7	Local
Time of sowing	10-30 October	Last week of November
Seed rate (kg ha^{-1})	3.75 kg ha^{-1}	2.5 kg ha^{-1}
Fertilizer application	As per recommendations of PAU or on soil test based (Urea@ 225 kg ha^{-1} in two splits along with drilling of SSP @ 187.5 kg ha^{-1} at the time of sowing	Urea (60-75 kg ha^{-1}), No use of SSP
Plant protection	Need-based use of recommended pesticides	Blanket sprays of chemicals for insect pest management

Table 2: Seed yield and gap analysis of front line demonstrations on Gobhi sarson

Period of cultivation	Potential Yield (q ha^{-1})	Yield (q ha^{-1})		Yield increase (%)	Technology gap (qha^{-1})	Extension gap (qha^{-1})	Technology index (%)
		DP	FP				
2021-22	22.25	15.2	10	52	7.0	5.2	31.6
2022-23	22.25	16.3	10.3	58.2	5.9	6	26.7
Mean	22.25	15.7	10.1	55.1	6.4	5.6	29.1

Table 3: Economic performances of front line demonstrations on Gobhi sarson

Period of cultivation	Average cost of cultivation (Rs ha^{-1})		Average gross return (Rs ha $^{-1}$)		Average Net return (Rs ha^{-1})		B: C Ratio	
	DP	FP	DP	FP	DP	FP	DP	FP
2021-22	15000	15000	98,800	60,000	83800	45000	6.5	4
2022-23	15000	15500	97,800	61800	82800	46300	6.59	3.9
Mean	15000	15250	98,300	60,900	83,300	45650	6.5	3.9

*DP: Demonstration plot
*FP: Farmers plot

Conclusions

To conclude, it can be said that cluster frontline demonstrations (CFLDs) played an important role in disseminating the recommended cultivation practices for realizing higher productivity and returns over the farmer's practice in all the study years. Further, it helped the scientists to minimize the extension and technology gap to make the Gobhi sarson cultivation more remunerative. The CFLD beneficiary farmers also inspires other farmers for faster adoption of improved cultivation practices.

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