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Impact Assessment of Cluster Frontline Demonstrations on Indian *Brassica napus* var. GSC-7 in Ludhiana District

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ABSTRACT

Gobhi Sarson is an important oilseed crop of the *Rabi* season contributing significantly to farmer's income and national edible oil production. However, low productivity due to the use of outdated varieties and suboptimal agronomic practices remains a major challenge for farmers in the region. The cluster frontline demonstrations on *Brassica napus* GSC-7 were carried out during *Rabi* 2023-24, covering an area of 20 ha in the Ludhiana district. The impact of frontline demonstrations on yield gaps and economics was studied through demo plots with improved practices and check plots with farmer practices. It was revealed that yield was significantly higher in demonstrated variety (GSC 7) *i.e.,* 21.20 q/ha with improved package of practices than check variety (Hyola-401) with farmer practices having yield of 19.57 q/ha. The average technology gap, extension gap and technology index were estimated to be 1.63, 1.05 and 4.95, respectively. Significantly better economic returns in terms of both net return (90556) and benefit cost ratio (4.56) were also observed in demo plots. Overall, farmers benefited from front-line demonstration on Gobhi sarson, as they get crop with better quality and higher yield following improved package of practices.

Key Words: *Brassica napus,* Extension gap, Frontline demonstrations, Impact.

INTRODUCTION

India is the world's fourth largest vegetable oil economy and the third largest producer of rapeseed-mustard after Canada and China, contributing to about 14 % of the world's total production (Renjini and Jha, 2023). Rapeseed-mustard (*Brassica* spp. L.), family Brassicaceae is a group of crops which includes four oleiferous brassicas *viz., Brassica juncea* (Indian mustard/ raya/laha), *B. rapa* (Indian rape/toria, yellow sarson, brown sarson), *B. napus* (Oilseed rape/gobhi sarson) and *B. carinata* (Ethiopian mustard/African sarson) and taramira/Rocket salad (*Eruca sativa*) (Chauhan *et al,* 2012). Rapeseed-mustard ranks just behind soybean among oilseed crops in the country in terms of both area and production. The cultivation of these crops across 28 states in India, under diverse agro-ecological situations, covers an area of 9.3 million hectares and produces 11.6 million tonnes, highlighting its significance in the country's vegetable oil sector (USDA, 2024). Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Haryana and West Bengal are the major producers that comprise about 90 percent of the total area under rapeseed-mustard (AICRP, 2011). In Punjab, Rapeseed-mustard is grown over an area of 45,000 hectares, yielding approximately 73,000 tonnes (Annoymous, 2024).

Among rapeseed-mustard, Gobhi sarson (*B. napus*) is emerging as an important oilseed crop, especially in irrigated areas of North India (Punjab, Himachal Pradesh, Haryana, Uttar Pradesh, and Uttarakhand) due to its better tolerance to low temperature and frost and higher oil content than the Indian mustard. Yield is one of the most important economic attributes, resulting from the interactions of various plant characteristics. Therefore, growers should choose high-yielding varieties with favourable agricultural traits to adapt to the constantly changing field conditions. Consequently, selecting the best variety is an essential strategy for improving agricultural productivity. High-yielding Canola cultivars of gobhi sarson (GSC-7) developed by the Punjab Agricultural University, Ludhiana, Punjab, have comparable yields with traditional non-canola cultivars. This canola cultivar not only yields well but also produces high-quality canola oil. Canola is a registered Canadian Canola Council trademark

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Table 1. Impact of CFLDs on the yield of *B. napus* in Ludhiana district of Punjab

Year	Number of demonstrations	Area (ha)	Average Yield* (q/ha)		% increase over FP	Statistical analysis
			Demo plots	Farmers practice		
2023-24	50	20	21.20±0.028	19.57±0.024	8.32	t=6.03; p<0.05

*Mean (± SE); Significant at p<0.05

Table 2. Yield gap analysis of *B. napus* in Ludhiana district of Punjab

Year	Potential yield (q/ha)	Average Yield* (q/ha) Demo plots	Yield gap minimized (q/ha)		Technology gap (q/ha)	Extension gap (q/ha)	Technology Index
			District	State			
2023-24	22.25	21.20	6.50	5.50	1.05	1.63	4.95

Table 3. Economic impact of CFLDs on *B. napus*

Year	Gross Return (Rs./ha)		Cost of cultivation (Rs./ha)		Net Return (Rs./ha)		B:C Ratio	
	Demon plots	F.P	Demon plots	F.P	Demon plots	F.P	Demon plots	F.P
2023-24	115996±168.78	95710±117.02	25440±9.81	24885±11.15	90556±170.06	70825±39.59	4.56	3.84
Statistical analysis	t=13.82; p<0.05		t=5.67; p<0.05		t=14.98; p<0.05			

*Mean (± SE); Significant at p<0.05
F.P means Farmers' practice.

describing the oil having less than 2% erucic acid, and the seed must contain less than 30 µmol of glucosinolates per gram of air-dried oil-free meal, making it suitable for human health as well as animal feed (Statistics Canada, 2009). Therefore, there is a great opportunity to increase the yield of oilseeds by introducing high-yielding gobhi sarson canola varieties at farmers' fields. So, Cluster Frontline Demonstrations on Indian *B. napus* var. GSC-7 was conducted to showcase the production potential of GSC-7, aiming for higher production, productivity and profitability for farmers.

MATERIALS AND METHODS

The Study on the performance of *B. napus* in Ludhiana district was conducted during *Rabi* 2023-24. Ludhiana district has a sub-tropical to semi-arid climate with hot and dry summers (April to June), hot and humid monsoons (July to September), mild (October to November), and cold winters (December to February). The average annual rainfall is 734 mm, 85% of which is received in the monsoon season. Mean minimum and maximum temperatures show considerable fluctuations during summer and winter. Krishi Vigyan Kendra, Ludhiana carried out the study using two varieties of oilseed rape (*B. napus*), GSC-7 as demo plot and Hyola PAC-401 as check plot. In this study, total of 50 farmers were selected from different villages of Ludhiana district under the cluster frontline demonstration of oilseeds (*B. napus*). Prior to conducting CFLDs, a list of farmers was compiled through field visits and interactions. Selected farmers received specific skill training on recommended cultivation practices. All the technological interventions were taken as per the recommended package and practices for integrated crop management of the mustard crop by Punjab Agricultural University, Ludhiana. KVKs provided critical inputs such as seed, soil ameliorants, pesticides, etc. under these FLDs. KVK scientists conducted regular field visits to monitor the demonstration plots. To promote the technology and help farmers to get benefit from it, various extension activities such as demonstrations, field days, hands-on training, and group discussions were also organized as needed. These efforts aimed to build capacity among the farmers.

Observations and statistical analysis

The data outputs like seed yield, gap analysis, input cost, net return, and benefit-cost ratio parameters were recorded from both demo plots as well as check plots (farmers' practices) and calculated (Table 1, 2). The data between demo plots and check plots were compared using t-test ($p \leq 0.05$) in Microsoft Excel. To find out gaps, different parameters were calculated as per formulas defined by (Samui *et al,* 2000):

RESULTS AND DISCUSSION

Grain yield

The data on grain yield from demonstration plots and check plots have been presented in Table 1. The results revealed a significant difference (t=6.03, $p<0.05$) between demonstration and check plot's yield. As the highest yield was recorded in demonstrated variety (GSC 7), *i.e.,* 21.20 q/ha, followed by the yield (19.57 q/ha) of the check variety (Hyola-401). The demonstrated variety (GSC-7) showed a positive response under frontline demonstrations on gobhi sarson with an 8.32 % increase in yield over the farmer's practice. A lesser yield in farmers' practices may be attributed to the delay in sowing time, non-scientific agronomic management practices. These results are consistent with the findings of Meena *et al* (2019) and Chaudhary *et al* (2018).

Technology gap

The technological gap is the discrepancy between the demonstration yield and the potential yield. Factors such as soil fertility, local weather patterns, and various crop management techniques contribute to the technological gap. The results showed that a technology gap of 1.05 was observed during the study. Similar findings have been reported earlier by Kumar and Jakhar (2022). By utilizing extension services that implement scientific interventions and crop-specific technologies to meet the needs of farmers, we can minimize this technology gap and enhance agricultural productivity.

Extension gap

The extension gap refers to the differences between the yield of the demonstrated plot and the farmer's practices. The mean extension gap was observed to be 1.63 q/ha. The existing gap can be minimized through various extension activities like field demonstrations, training, and awareness programmes, improved crop management practices, and updating of knowledge of the farmers. These findings were in agreement with Khoisnam *et al* (2024).

Technology index

The technology index shows how easily accessible technology is in the farmer's field. The lower the value of the technology index the greater the feasibility. The results showed a technology index of 4.95 (Table 1). This value might be due to improper management of agricultural practices, diseases, and insect attack.

Economics

The data outlined the economic analysis of the cluster frontline demonstration on *B. napus* var. GSC 7. The data suggested that economic returns in terms of gross return, net return (t=14.98; $p<0.05$), and benefit-cost ratio were significantly better in demonstration plots than check plots. The gross return from the demonstration plots was Rs. 115996 per hectare, while it was Rs. 95700/- for the farmer's practice. Additionally, the benefit-cost (B:C) ratio, which was 4.56, was also higher in the demonstration plots compared to the check plots (3.84). Similar findings of better economic returns from demonstration plots have been reported by earlier workers (Kalita *et al*, 2019; Verma *et al*, 2012). Similarly, Verma and Prasad (2024) reported a higher benefit-cost ratio in demonstrated plots.

CONCLUSION

It was concluded that farmers were benefited from front-line demonstration on *B. napus*, as they were inspired by the technology used in demonstration plots that yielded crops of better quality and higher yield. Furthermore, the reduced yield gaps from state and district average yields by cultivating the improved variety GSC-7 indicate that this variety, which has a higher yield potential along with scientific intervention, can enhance the productivity levels of oilseeds in the state. Also, the potential of improved variety along with improved crop management practices can be exploited through the CFLD programme to create awareness among farmers about GSC-7.

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