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Probing yield inefficiencies in *Gobhi sarson* via frontline demonstrations in heavy soils of South-Eastern part of Punjab

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Abstract

Rapeseed-mustard is a key oilseed crop in India, contributing significantly to the national economy and edible oil supply. However, conventional rapeseed varieties contain high erucic acid and glucosinolate content, negatively impacting human health and animal feed quality. To address these concerns, canola-quality rapeseed-mustard varieties with low erucic acid (<2%) and glucosinolates (<30 µmol/g of deoiled meal) have been developed. This study evaluates the impact of Frontline Demonstrations (FLDs) on the yield and economic benefits of GSC-7 (Gobhi Sarson) in south eastern Punjab from 2017–2024. The research was conducted across five blocks of Fatehgarh Sahib, Punjab, covering 250 farmers over five years. A comparative analysis between FLD-recommended and farmers' conventional practices was performed. The results revealed that GSC-7 under FLD consistently outperformed farmers' practices, with yield improvements averaging 26.05%. The technology gap declined from 17.25 q/ha (2017–2018) to 15.30 q/ha (2023–2024), indicating improved efficiency in achieving potential yields. The extension gap narrowed from 6.75 q/ha to 2.50 q/ha, reflecting the increased adoption of recommended practices of Punjab Agricultural University, Ludhiana. Economic analysis showed that FLD plots achieved higher gross returns, averaging Rs. 1,00,697/ha, compared to Rs. 73,305/ha under farmers' practices. The B:C ratio for FLD was 3.22, significantly higher than the 2.15 recorded for traditional farmer practices, indicating superior economic viability. The study highlights the positive impact of FLD interventions in reducing yield gaps and increasing farmer profitability. Strengthening technology dissemination and farmer trainingis essential to enhance productivity in Punjab's mustard-growing regions.

Keywords*: *Canola-quality, economic analysis, frontline demonstrations, rapeseed-mustard, yield performance

Introduction

Rapeseed-mustard is a crucial oilseed crop in India, playing a vital role in meeting the country's edible oil demands. Among conventional rapeseed varieties, the presence of erucic acid and glucosinolates is considered undesirable due to their negative implications for human health and animal feed quality (Chahal *et al*., 2020). High erucic acid levels are associated with potential health risks, while glucosinolates in oil cake reduce its nutritional value for livestock. To address these concerns, the development of canola-quality rapeseed-mustard varietiescharacterized by very low erucic acid (<2%) and glucosinolate content (<30 µmol/g of deoiled meal)has become a major focus in India's crop improvement programs (Elewa *et al*., 2014).

Canola oil is recognized for its nutritional superiority, with a well-balanced composition of saturated fatty acids (7%), high levels of monounsaturated oleic acid (~61%), and moderate levels of polyunsaturated linoleic (21%) and linolenic (11%) acids, making it a desirable edible oil option (Molazem *et al*., 2013). Unlike conventional rapeseed, canola is a quality standard rather than a distinct biological classification. Punjab Agricultural University, Ludhiana, has recently developed canola-quality cultivars of oilseed rape (*Brassica napus*) that exhibit comparable yields to traditional rapeseed-mustard varieties and possess resistance to white rust (Kaur *et al*., 2018). The overall nutritional and functional properties of rapeseed oil depend on its fatty acid profile, with an ideal proportion of essential fatty acids enhancing its dietary value. However, the historically high erucic acid content (40-57%) in Indian mustard oil limits its acceptability for human consumption (Ackman *et al*., 1977; Agnihotri *et al*., 2007; Singh *et al*., 2014 and Wanasundara, 2011).India ranks among the top oilseed-producing countries, with oilseeds covering 14% of the total gross cropped areaand contributing nearly 10% of the total agricultural product value (Anonymous, 2005). Mustard, in particular, holds a significant share of 30.64% of total oilseed production, with a cultivation area spanning 6.79 million hectares. Despite its prominence, there exists a substantial yield gap between potential productivity and actual farm-level yields, particularly in Punjab, where productivity has fluctuated between low yield values. This gap highlights the necessity for effective technology transfer mechanisms to ensure the adoption of improved agronomic practices (Prasad *et al*., 1987).

To bridge this productivity gap, Frontline Demonstrations (FLDs) serve as an essential tool for transferring advanced farming technologies to mustard growers through Krishi Vigyan Kendre. FLDs provide a direct on-field comparison between conventional and improved farming practices, helping farmers understand the economic and agronomic benefits of adopting high-yielding canola-quality varieties. These demonstrations not only validate research findings under real-world farming conditions but also facilitate the scaling up of sustainable production technologies. In the Southeastern region of Punjab, optimizing rapeseed-mustard productivity is particularly critical for meeting growing domestic oil demand while maintaining agro-ecological sustainability.This study aims to evaluate the impact of Frontline Demonstrations on rapeseed-mustard productivity, assessing how the adoption of canola-quality varieties and advanced agronomic practices can enhance yield performance, resource efficiency, and overall farm profitability. By analyzing field-level implementation and farmer adoption rates, this research will provide actionable insights into improving mustard cultivation in Punjab and other major rapeseed-growing regions of India.

Material and Methods

The study was carried out in the operational area of Krishi Vigyan Kendre, Fatehgarh Sahib (30.6435° N latitude, 76.3970° E longitude) located in the southeastern part of Punjab. Front-line demonstrations (FLDs) were conducted across five blocks (Sirhind, Bassi Pathana, Amloh, Khamano, and Khera) in Fatehgarh Sahib over five cropping years (2017-2024) to evaluate the impact of improved agricultural technologies (GSC-7) on Gobhi Sarson yield. All Five blocks were selected, and five villages were randomly chosen within each block. From each village, a sample of ten farmers was selected, culminating in a total of 250 farmers. The study covered 20 hectares on average per year. Each demonstration's soil was collected and analyzed for pH, EC, OC (%), available nitrogen, phosphorus and potassium. Among all demonstrations, the soil texture was sandy loam. However, the soil was medium in organic carbon, available nitrogen and phosphorus were medium and potassium was high concerning pH and electrical conductivity was normal. Material for the present study concerning FLDs and farmers' practices has been given in Table 1.

Table 1: Comparison between demonstration package and existing farmers' practice under GSC-7 FLDs

Practice	PAU practices	Farmer practices
Farming situation	Irrigated	Irrigated
Variety	GSC-7	Hyola
Time of sowing	10-30 October	1-20 November
Method of sowing	Line sowing	Broadcasting
Seed rate	3.75 kg/ha	2.5 kg/ha
Fertilizer practices	100 kg N/ha + 30 kg P/ha	125 kg N/ha + 50 kg P/ha
Plant protection	Actara @ 100g/ha	Rogor @ 1250ml/ha
Weed management	Two hoeing's	Nil

The crop was harvested at its optimal physiological maturity to ensure accurate yield assessment. Yield data were meticulously recorded to evaluate the impact of the demonstrated interventions. The technology gap (Gap-I) was quantified as the difference between the potential yield and the yield obtained under Front Line Demonstrations (FLD), whereas the extension gap (Gap-II) was determined as the difference between FLD yield and farmers' yield, as per the methodology outlined by Saumi *et al*. (2000). Gross returns were computed based on the prevailing market prices and the yield realized by farmers across all demonstration years. The total input cost was derived by aggregating the expenditures incurred on various farm inputs for each experimental plot. The benefit-cost ratio (B:C ratio) was subsequently determined by dividing the gross returns by the total cost of cultivation, following the approach of Sandhu and Dhaliwal (2019). Additionally, economic efficiency indicators were analyzed to assess the profitability and viability of the demonstrated technologies. Correlation between attributes analyzed with the help of R studio (Statistical Software) heat map-based program.

Result and Discussion

Yield performance

The yield performance of the demonstrated technology of GSC-7 (Gobhi Sarson) and the farmer's practice was assessed over multiple years (2017-2024), and the results are summarized in Table 2.The crop's potential yield remained constant at 37.05 q/ha across all years (Oilseed section, Plant breeding & Genetics department recorded data). However, the FLD yield (GSC-7) exhibited variation, ranging from 19.80 q/ha (2017–2018) to 21.75 q/ha (2023–2024), with a mean yield of 20.67 q/ha. The farmer's practice

Table 2: Yield gap analysis in Gobhi Sarson in Fatehgarh Sahib

Year	Area (acre)	No. of Farmer	Potential yield (q/ha)	FLD yield (q/ha)	Farmer practice (q/ha)	% Increase over FP	Technology gap	Extension gap	Technology index (%)
2017-2018	20	50	37.05	19.80	13.05	51.72	17.25	6.75	46.56
2018-2019	20	50	37.05	20.35	15.60	30.45	16.70	4.75	45.07
2021-2022	20	50	37.05	20.21	16.60	21.75	16.84	3.61	45.45
2022-2023	20	50	37.05	21.25	18.75	13.33	15.80	2.50	42.65
2023-2024	20	50	37.05	21.75	19.25	12.99	15.30	2.50	41.30
Mean	20	50	37.05	20.67	16.65	26.05	16.38	4.02	44.21

recorded consistently lower yields, ranging from 13.05 q/ha (2017-2018) to 19.25 q/ha (2023-2024), with an average yield of 16.65 q/ha over the study period at Fathegarh Sahib.The highest percentage increase in FLD yield (GSC-7) over the Farmer practice was observed in 2017-2018 (51.72%), while the lowest was in 2023-2024 (12.99%). The mean percentage increase over the farmer practice was 26.05%, indicating the effectiveness of the improved practices demonstrated under FLDs in enhancing crop productivity.These findings suggest that the adoption of improved agronomic practices through FLD can significantly enhance productivity, though the magnitude of improvement varies across years due to factors such as climatic conditions, soil fertility, management and extension practices (Katare *et al*., 2011 and Ajrawat *et al*., 2023).

Yield gap and technology index

The data on the technology gap, extension gap, and technology index of Fatehgarh sahib related to the Gobhi Sarson (GSC-7) crop is presented in Table 2.The technology gap, which represents the difference between potential yield and FLD yield, varied from 15.30 q/ha in 2023–2024 to 17.25 q/ha in 2017-2018, with an average of 16.38 q/ha. A declining trend in the technology gap over the years indicates an improvement in achieving the potential yield of Gobhi Sarson (GSC-7) through demonstrated practices.The extension gap, reflecting the difference between FLD yield and farmers' practice, ranged from 6.75 q/ha in 2017-2018 to 2.50 q/ha in 2022-2023 and 2023-2024, with an overall mean of 4.02 q/ha. The reduction in the extension gap over time suggests that farmers are gradually adopting improved cultivation practices of oilseeds, thereby reducing the yield disparity of Gobhi Sarson's crop.The technology index, which assesses the effectiveness of the demonstrated technology in farmers' fields, showed a decreasing trend over the years. It was highest at 46.56% in 2017-2018 and lowest at 41.30% in 2023-2024, with an average of 44.21%. The decline in the technology index over time indicates an increasing adoption of improved technologies, resulting in better yield realization. Mukherjee (2003) also suggested that the identification and strategic utilization of specific farming situations could significantly influence system productivity. These findings are consistent with the observations reported by Mitra *et al.* (2010) and Katare *et al.* (2011).These results demonstrate the positive impact of FLD interventions in enhancing crop productivity by reducing both the technology and extension gaps. However, continued efforts in farmer education and technology dissemination are necessary to further bridge these gaps and enhance yield potential in farmers' fields.

Economic analysis

The economic analysis of Frontline Demonstration (FLD) on GSC-7 revealed a notable improvement in profitability compared to the farmers' practice (FP) [Table 3]. The cost of cultivation under FLD ranged from Rs. 23,108/ha in 2018-2019 to Rs.32,799/ha in 2023-2024, with an average of Rs.28,957/ha. In comparison, the cost of cultivation under farmer practice (FP) varied from Rs. 19,730/ha in

Table 3: Returns over variable costs and B:C ratio of Gobhi Sarson in Fatehgarh Sahib

Year	Cost of cultivation (Rs./ha)		Gross returns (Rs./ha)		B:C Ratio (Rs.)	
	FLD	FP	FLD	FP	FLD	FP
2017-2018	23134	19730	69883	43525	3.02	2.20
2018-2019	23108	20730	71100	54525	3.07	2.63
2021-2022	33123	31730	131600	84525	3.97	2.66
2022-2023	32619	32580	117289	86975	2.59	1.66
2023-2024	32799	37580	113614	96975	3.46	1.58
Mean	28957	28470	100697	73305	3.22	2.15

2017-2018 to Rs. 37,580/ha in 2023-2024, with a mean of Rs. 28,470/ha. The slightly higher cost of cultivation in FLD plots can be attributed to the use of quality inputs, improved agronomic practices, and better crop management strategies.The gross returns from FLD plots were consistently higher than those from farmer practice. The highest gross return of Rs. 1,31,600/ha was recorded in 2021-2022, while the lowest was Rs. 69,883/ha in 2017-2018, resulting in an average of Rs. 1,00,697/ha. In contrast, gross returns from FP ranged from Rs. 43,525/ha (2017-2018) to Rs. 96,975/ha (2023-2024), with an overall mean of Rs. 73,305/ha. The increase in gross returns under FLD was due to higher yields achieved through improved cultivation practices.The B:C ratio, an indicator of profitability, was notably higher in FLD plots compared to FP. The highest B:C ratio of 3.97 was recorded in 2021-2022, while the lowest was 2.59 in 2022-2023, with an average of 3.22. Under FP, the B:C ratio ranged between 2.20 (2017-2018) and 1.58 (2023-2024), with a mean of 2.15. The consistently higher B:C ratio in FLD suggests that the adoption of improved production practices resulted in better economic returns and greater profitability. These findings are in alignment with the results of Singh *et al.* (2008), who reported that the adoption of improved mustard cultivation technologies significantly enhanced crop productivity.

Correlation

The correlation analysis revealed a strong negative relationship between FLD yield and both the technology gap (-1.00) and the technology index (-1.00), indicating that higher FLD yields significantly reduce these constraints (Fig. 1). A strong positive correlation was observed between a % increase over Farmer practice and extension gap (0.99), suggesting that enhanced extension efforts contribute to yield improvements. Additionally, FLD yield and Farmer practice yield exhibited a high positive correlation (0.93), demonstrating that advancements in

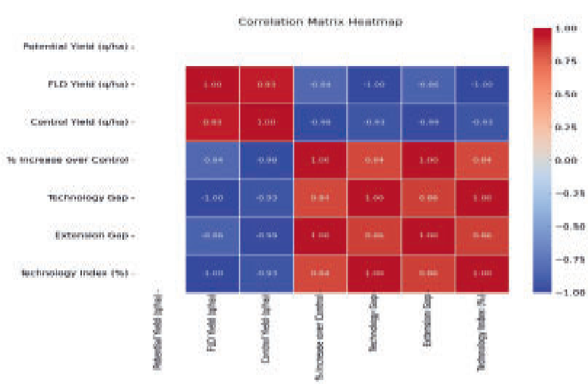

Fig. 1: Correlation between yield and extension-based attributes

demonstration plots positively influence conventional farming practices.

Conclusion

The results from the study demonstrate that Frontline Demonstrations (FLD) on GSC-7 significantly outperformed traditional farming practices. The FLD yield showed an average increase of 26.05% over the farmers' practice, indicating a substantial gain in productivity. Additionally, gross returns under FLD were consistently higher, with a notable average increase of 37.85% compared to the farmers' practice. The B:C ratio also reflected this improvement, with an average of 3.22 for FLD, compared to 2.15 for FP, resulting in a 49.3% higher B:C ratio under FLD.The reduction in the extension gap and technology gap indicates growing acceptance and adoption of improved practices over time. However, there remains scope for further improvement in technology dissemination, farmer training, and access to quality inputs. Expanding these improved practices among farmers can lead to better productivity, increased income, and long-term sustainability in agriculture.

References

Ackman RG, Eaton CA, Sipos JC, Loew FM, Hancock D. 1977. Comparison of fatty acids from high levels of erucic acid of RSO and partially hydrogenated fish oil in non-human primate species in a short-term exploratory study. *Bibl Nutr Dieta* **25**: 170 -185.

Agnihotri A, Prem D, Gupta K. 2007. The chronicles of oil and meal quality improvement in oilseed rape. In: Gupta SK (ed) *Advances in Botanical Research: Oilseed Rape Breeding.* New York, USA, Elsevier Publication, pp 49 - 97.

Ajrawat B, Parmar AM, Jamwal M. 2013. Impact of frontline demonstration of oilseed crops in improved technology transfer.*J Oilseed Brassica,* **4**: 96 - 97.

Anonymous. 2005. Government of MP, *Compendium of Agricultural Statistics.*MP Agricultural Marketing Board, pp 114.

Chahal HS, Singh A, Malhi GS. 2020. Role of sulphur nutrition in oilseed crop production - A review. *J Oilseed Brassica,***11**: 95 -102.

Elewa TA, Mekki B, Bakry BA, El-Kramany MF. 2014. Evaluation of some introduced Canola (*Brassica napus* L.) varieties under different nitrogen fertilizer levels in newly reclaimed sandy soil. *Middle-East J Sci Res,* **21**: 746 -755.

Katare S, Pandey SK, Mustafa M. 2011. Yield gap analysis of rapeseed-mustard through frontline demonstrations. *Agric Update,* **6**: 5-7.

Kaur L, Sardana V, Sharma P. 2018. Effect of sowing dates and nitrogen application on growth and productivity of canola oilseed rape (*Brassica napus*). *J Oilseed Brassica,* **9**: 114 -121.

Mitra B, Samajdar T. 2010. Yield gap analysis of rapeseed-mustard through frontline demonstration. *Agric Ext Rev,* **22**: 16 -17.

Mukharjee N. 2003. *Participatory Learning and Action.* New Delhi, India, Concept Publishing Company, pp 63 - 65.

Prasad C, Chaudhary BN, Nayar BB. 1987. *First Line Transfer of Technology Project.*New Delhi, India, ICAR, pp 87.

Sandhu BS, Dhaliwal NS. 2019. Impact of frontline demonstration on rapeseed productivity in the south-western part of Punjab. *J Oilseeds Res,* **36**: 102 -104.

Singh BK, Bala M, Rai PK. 2014. Fatty acid composition and seed meal characteristics of *Brassica* and allied genera.*Natl Acad Sci Lett,* **37**: 219 -226.

Singh G, Sirohi A, Malik YP. 2008. Impact of improved technology on the productivity of Indian mustard. *J Oilseeds Res,* **25**: 125.

Wanasundara JPD. 2011. Proteins of *Brassicaceae* oilseeds and their potential as a plant protein source. *Crit Rev Food Sci Nutr,* **51**: 635 - 677.