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Impact of cluster front line demonstration in enhancing productivity and profitability of summer mash in sub-mountainous region of Punjab, India

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ABSTRACT

The main objectives of FLD's on pulses is to demonstrate and popularize the improved package of practices on farmers' fields for effective transfer of generated technology and fill the gap between recommended technology and traditional farming practices. To boost the production and productivity of pulses in district pathankot, the present investigation was carried out by Krishi Vigyan Kendra, Pathankot during the summer year 2023 in district Pathankot. Twenty five cluster line frontline demonstration were conducted on summer mash variety mash 1137 in an area of 10 ha during summer 2023 for demonstrating improved cultivation technologies to the farmers. The results of the study revealed that yield of summer mash under demonstrated plots was 9.5 q ha^{-1} where as the yield under farmers practice was 7.5 q ha^{-1}. A considerable increase of 26.6 percent in the yield of summer mash was observed in demonstrated plots over farmers practice plots during summer 2023. In addition to increase in yield, the findings of the study revealed that technology gap, extension gap and technology index was found to be 1.75 q ha^{-1}, 2.0 q ha^{-1} and 15.5 percent, respectively. It was further observed that the technology demonstrated fetched more gross returns (Rs.71,250 ha^{-1}) and net return (Rs.50,250 ha^{-1}) as compared to farmers practice. However the benefit cost ratio (B:C) was also higher under demonstrated practice (3.3), as compared to farmers practice (2.6).

Keywords: B:C ratio, Summer mash, Technology gap, Technology index, Yield

Pulses, "the poor man's protein", are inferred as important food grains after cereal crops. India ranks first in the production and consumption of pulses, worldwide. After cereals, pulses occupy important place in Indian diet as they are rich in protein and essential nutrients (Sunil *et al.*, 2023). Pulses are 20 to 25 percent protein by weight which is double the protein content of wheat and three times that of rice. Mash bean, botanically known as Vigna mungo, is widely consumed in the form of whole or split grains and are generally referred to as 'dal'. According to (Pal, 1939), mash has highest nutritive value after bengal gram. It is a rich source of protein and is considered as a healthy food due to high nitrogen solubility and less fat content (Savage, 1991). Besides being the source of protein, they maintain soil fertility by improving soil properties (viz. physical structure) through biological nitrogen fixation and the crop can fix atmospheric nitrogen upto 30-70 kg ha^{-1} per season (Ali *et al.*, 2005), thus play a vital role in sustainable agriculture (Kannaiyan, 1999).

The major mash bean producers of the country are Madhya Pradesh, Rajasthan, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Maharashtra, Jharkhand, Gujarat, Karnataka and West Bengal (Kaul *et al.,* 2020). In Punjab, the total area under pulses is merely 0.36 per cent of the total gross cropped area, of which, mash bean has a meagre share of 0.03 per cent with 2.5 thousand ha area under cultivation (Kaul *et al.,* 2020). The major mash growing districts of the state are Amritsar, Gurdaspur, Pathankot, Hoshiarpur and Rupnagar.

Mash bean is an important kharif and summer crop of district Pathankot but its production per unit area is low. Earlier studies on mash bean crop reported a declining trend in its area and production. One of the main reason for this declining trend was unavailability of improved variety and improved cultivation practices, greater preference for growing cereal crops *viz.* wheat and rice among farmers and the system of growing cereal after cereal are accountable to it due to which monoculture prevailed in Punjab and this pattern is still dominating in. The system of growing cereal after cereal resulting in adverse effects the soil health. Thus, there is a need to alter this cropping system with some short duration crops.However pulse cultivation is considered as viable option for diversification of Punjab agriculture (Mahajan, 2017). Summer mash is a short duration crop which can be mainly can be grown in the central and sub-mountainous tracts during summer in Punjab. Summer mash has low input requirement and has the ability to fix nitrogen which enables the crop to meet its own nitrogen requirement and also benefits to the succeeding crops and also improves soil fertility.

The concept of frontline demonstration is a form of adaptive research under the initiative of Ministry of Agriculture & Farmers Welfare Government of India, New Delhi, which is conducted under close supervision of agricultural scientists. 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. It ensures gap filling between innovative and indigenous technologies (Kaul *et al.*, 2020). Keeping in view the importance of pulses in sustainable farming systems, the present study was conducted by Krishi Vigyan Kendra, Pathankot in summer mash crop 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

Details of study area

To achieve these objectives, cluster front line demonstrations were conducted in Punjab province that is situated in the north-west of India. The latitudinal and longitudinal extends of the Punjab are from 29°32′31.563″ to 32°34′39.658″ N and 73°53′13.453″ to 76°56′40.597″ E (Raj Kumar *et al.,* 2008). For this purpose, district Pathankot of Punjab region that geographically, occupies an area of 27,123 ha lies between 32°23′31″ to 32°23′52″ North Latitudes and 75°39′55″ to 75°56′12″ East Longitudes was selected. The present study was conducted by Krishi Vigyan Kendra, Pathankot of Punjab Agricultural University, Ludhiana during summer 2023. District Pathankot belongs to sub mountainous undulating zone which is located at an elevation of 332 meters above mean sea level. During the period of study, a total of 25 farmers were selected for conducting cluster frontline demonstration in an area of 10 ha. All steps like site and farmer selection, layout of demonstration, farmers' participation etc. were followed as suggested by Choudhary (1999). Farmers for the FLD's were selected based on group meetings taking in to consideration mainly the prevailing problem and adaptive attitude of the farmers'. Selected farmers were trained through off-campus training programmes to follow the package and practices for summer mash cultivation as recommended by the Punjab Agricultural University, Ludhiana. Critical inputs decided based on technological gap analysis were provided and other inputs were suggested as per need. Every demonstration site was paired with an adjacent control plot of equal size managed under farmers' traditional practices. In the frontline demonstration plots all the crop management practices were demonstrated to the farmers starting from adopting improved high yielding variety, proper seed rate, line sowing, seed treatment, fertilizer management, plant protection measures and disease management were according to recommended package of practices for summer mash cultivation as recommended by the Punjab Agricultural University, Ludhiana (Table 1). A comparative analysis of the package and practices in demonstration plot and local check is given in the Table 1. The soils of the area are mostly sandy loam in texture. To know the status of soil health, soils samples from each demonstration were collected and various parameters of soil like pH, EC, OC (%), available P and K were analyzed. Soil test results were helpful in need based application of the essential nutrients N and P. The pH of soils ranges from 6.9 to 7.6 with electrical conductivity ranges from 0.62 to 0.80 dSm^{-1}. The organic carbon, available phosphorus and available potassium ranges from 0.42-0.57%, 15.2-21.4 and 270.6-330 kg ha^{-1}, respectively. The temperatures generally remains

Table 1. Difference between technological interventions and farmers' practices under cluster frontline demonstration in summer mash

Crop	Technology component	Demonstration plot	Farmers plot
Variety	Variety	Mash 1137	Local mash variety
Seed rate	Seed rate	50 kg ha^{-1}	37.5 kg ha^{-1}
Sowing time	Sowing time	15th March to 1st week of April	Last week of February to first week of March
Seed Inoculation	Seed Inoculation	*Rhizobium* culture(LUR 6)	No inoculation
Sowing method	Sowing method	Sowing was done at row spacing of 22.5 cm with seed drill at 4-6 cm depth	Broadcast
Fertilizer guidance	Fertilizer	27.5 kg of urea per hectare and 150 kg SSP per hectare	No Fertilizer application
Plant protection measures	Need based spray of insecticides and fungicides	Need based spray of insecticides and fungicides	Over dose/ un recommended brands of insecticides and fungicides
Technical guidance	Technical guidance	Time to Time through trainings and field visits	Nil

between 35°C to 45 °C during summer and 7 °C -15 °C (max) to 0 °C to 8 °C(min) in winters. Data related to yield and cost particulars were collected separately for CFLD and farmer's practice. The average prices of inputs and outputs commodities prevailed during the year of demonstrations were taken for calculating cost of cultivation, net return and benefit cost ratio. The technology gap, extension gap and technology index were calculated as suggested by Samui *et al.* (2000).

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – Farmers' yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

The results pertaining to the yield parameters are presented in Table 2. Results of the study reveals that the higher yield in demonstrated plots (9.5 q ha^{-1}) over farmers practice (7.5 q ha^{-1}) (Table 2). A considerable increase of 26.6 percent in grain yield of summer mash was observed in demonstrated plots over farmers practice. The adoption of improved and recommended variety of summer mash, optimum sowing time, proper seed treatment, line sowing, judicious use of fertilizers, integrated weed, plant protection measures and technical guidance followed under CFLDs increased the yield of summer mash compared to farmers practice. Matharu and Tanwar (2018) also registered higher yields in demonstration plot as against the farmer's practice. Similar results were also recorded by (Mishra *et al.*, 2018 and Dwivedi *et al.*, 2018). Similar yield enhancement in different crops in front line demonstration has been documented by Poonia and Pithia (2011) and Raj *et al.*, (2013). Sharma *et al.*, (2012) and Choudhary (2009) has also reported yield enhancement by the use of recommended agro-technologies in FLDs'. The higher yield of summer mash under improved technologies due to the latest high yielding varieties, balanced use of fertilizers and plant protection measures was also observed by Charak *et al.*, (2021). Similar results have been reported earlier by Jeengar *et al.,* (2006), Dhaka *et al.,* (2010), Balai *et al.,* (2013).

Technology gap

The variations in yield could be attributed to technology and extension gap. The technology gap is the difference between potential yield and yield

Table 2. Yield performance and gap analysis of summer mash under cluster front line demonstration

Year	Potential Yield (qha^{-1})	Yield (q ha^{-1})		% increase	Technology gap (qha^{-1})	Extension gap (qha^{-1})	Technology index (%)
		Demonstration plot (DP)	Farmers plot (FP)				
2023	11.25	9.5	7.5	26.6	1.75	2.0	15.5

Table 3. Economic analysis of summer mash under cluster frontline demonstration

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
2023	21000	21000	71250	56250	50,250	35,250	3.3	2.6

*DP: Demonstration Plot; FP: Farmers Plot

under demonstration plot. It gives the gap in demonstration yield over potential yield (Kaul *et al.,* 2020). In the present study technology gap of 1.75 qha^{-1} was observed (Table 2). It indicates that still there is gap in technology demonstration as a result of which the potential yield of the improved practices could not be realized by the participating farmers (Sharma and Singh, 2024).The technology gap observed may be attributed to the dissimilarity in soil fertility status and weather conditions (Mandavkar *et al*., 2012). Therefore this gap 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 gap

The extension gap, on the other hand, signifies the gap between demonstration plot yield and yield obtained under farmers practice (local check) (Kaul *et al.,* 2020). Extension yield gaps indicate lack of awareness about improved farm technologies among farmers (Kadian *et al*., 1997, Vedna *et al*., 2007, Choudhary *et al*., 2009). In the present study, the extension gap of 2.0 qha^{-1} was observed (Table 2). The prevalence of such gap denotes the poor adoption of demonstrated technologies (*viz.* improved variety and cultivation practices) by the farmers. Lack of awareness is mainly responsible for it. 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), Kumar *et al*., (2019) and Matharu and Tanwar, (2018).

Technology index

The technology index shows the feasibility of the evolved technology at the farmer's fields and lower the value of technology index more is the feasibility of the technology (Jeengar *et al*., 2006). Higher technology index reflected the insufficient extension services for transfer of technology. The lower value of technology index shows the efficacy of good performance of technological interventions (Singh *et al.,* 2019). The data presented in Table 2 reveals that the technology index of 15.5 percent was observed during period of study signifying feasibility of the demonstrated practices (*viz* improved variety and cultivation practices) in the farmer's field.

Economics

The economics of summer mash under cluster frontline demonstration were estimated and the results are presented in Table 3.The inputs and outputs prices of commodities prevailed during the study of the demonstration were taken for calculating net return and benefit cost ratio. A perusal of the data presented in Table 3 reveals that the higher returns were obtained under demonstration plot as against the farmer's practice. The plot demonstrating improved cultivation technologies revealed higher average gross return of Rs.71250 as well as net return Rs.50,250 per ha in comparison to the farmer's practice which recorded an average gross return of Rs.56,250 and net return 35,250 per ha (Table 3). However the benefit cost ratio of cluster frontline demonstration presented in table 3 showed higher benefit cost ratio under demonstrated plots (3.3) over farmers practice (2.6). Similar results were also reported by Kumar *et al*., (2019) who stated that such variations in the economical returns can be ascribed to the superior performance of improved variety and new cultivation techniques in demonstration plot. Dwivedi *et al*., (2018) also revealed higher monetary returns under demons-trations due to the application of recommended cultivation practices.

CONCLUSION

From this study it can be concluded that CFLD programme is an effective tool for enhancing the productivity and production of summer mash and changing the attitude, skill and knowledge of the farmers. Grain yield of summer mash can be increased by adopting recommended package and practices. Higher yield of summer mash in demonstrated plots is attributed to the use all improved cultivation practices like improved variety, sowing method, fertilizer application, plant protection measures according to the recommended package of practices. The findings of the study showed that the potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality need based inputs and proper application of inputs. Horizontal spread of improved technologies may be achieved by the successful implementation of frontline demonstration and various extensions activities like training programme, field day, exposure visit organized in CFLDs programmes in the farmer's fields. The productivity gain under CFLD's over farmer's practice created awareness and motivated the farmers of adjoining villages to adopt appropriate production technology of summer mash in the district.

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