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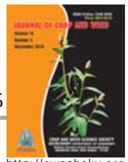

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Quantification of yield gap in *kharif* mash through frontline demonstration in sub-mountainous area of Punjab, India

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ABSTRACT

The present investigation was carried out by Krishi Vigyan Kendra, Pathankot during the year 2018-19 and 2019-20 in three clusters of three blocks of the district. 75 front line demonstrations were conducted on kharif mash variety Mash-114. The results of the study revealed a higher average grain yield (887kg ha^{-1}) in the demonstration plots compared to check plots of farmers practice (725 kg ha^{-1}). There was 18.25 per cent increase in yield of demonstration plots from farmer's practice. However, the highest grain yield was obtained in demonstration plots as compared to farmers plot in all the blocks of the district. But among the three blocks higher grain yield was observed in block Pathankot and lowest in the Dhar kalan block. The higher grain yield in this block was due to the good status of soil as well as timely sowing of the crop. Technology gap and extension gap was 112 kg ha^{-1} and 162 kg ha^{-1} respectively. The technology index for Pathankot district in the kharif mash crop was 11.25 percent. Overall, net returns (Rs. 41945) and benefit: cost ratio (3.07) was also higher in demonstration plots as compared to check plots.

Keywords: Front line demonstration, grain yield, *kharif* mash and technology gap

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. Presently, pulses cover 29.99 M ha area with a production of 25.23 Mt. Ingenious efforts in research and development, have prompted a paradigm shift in pulse production over the years. The contribution of pulses to the food grain production basket has increased from 5.63 per cent (during 2000-01) to 8.85 per cent (during 2017-18) (Annual Report 2017-18). India grows a wide variety of pulse crops across different states. Among these, chickpea (gram), pigeon pea (tur), mash bean (urd) and mung bean are the major ones. 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, the legume it also possess immense therapeutic potential. Zia-ul-Haq *et al.* (2014) illustrated the prevalence of emollient, astringent, thermogenic, diuretic, aphrodisiac and laxative properties in mash. Besides its dietary and therapeutic properties, cultivation of mash bean also contributes in the improvement of ecology. Being legume crop, the crop aids in improving soil properties (*viz.* physical structure) and fertility levels through biological nitrogen fixation. On an average, the crop can fix atmospheric nitrogen upto 30-70 kg ha^{-1} per season (Ali *et al.*, 2005).

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. 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. The major mash growing districts of the state are Amritsar, Gurdaspur, Pathankot, Hoshiarpur and Rupnagar. Mash bean is an important *kharif* pulse crop of district Pathankot, but its production per unit area is low. Studies in the past also report a declining trend in its area and production. Apart from the unavailability of improved varieties and modern technologies; greater preference for growing cereal crops *viz.* wheat and rice among farmers are accountable to it. However, pushing pulses cultivation can be remunerative to the farmers as well as state. Pulse cultivation can be beneficial to meet the growing challenges of monoculture and nutritional security, which probably is the need of hour. Keeping this in view, introduction of high yielding varieties and improved production techniques is crucial. Krishi Vigyan Kendra's (KVKs) play a pivotal role in this regard.

The KVKs aim to promote the rapid transfer of modern technologies, through trainings and demonstrations, among farmers. 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

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technologies. Hence, the present study was undertaken by KVK Pathankot in the variety “Mash 114” 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.

The present study was conducted by Krishi Vgyan Kendra, Pathankot of Punjab Agricultural University, Ludhiana across three blocks of the district *viz.* Narot Jaimal Singh, Pathankot and Dhar Kalan during *kharif* 2018 and 2019. District Pathankot belongs to sub mountainous undulating zone which is located at an elevation of 332 meters above mean sea level. During the entire course of study, a total of 75 farmers were selected for conducting Cluster front line demonstrations of *Kharif* mash on 30 hectare area. For the selection of farmers, a comprehensive list of mash growers was prepared avoiding any repetition. The selected farmers were guided about improved package and practices for the pulse crop cultivation through off-campus training programmes. The crop raised by farmers following theirown traditional practices was taken as local standard check. Whereas,for front line demonstration plots an integrated cropmanagement approach was demonstrated to farmers. In thisapproach, all the practices demonstrated to farmers startingfrom soil testing, bio-fertilizer application, weed management, disease and insect pest management *etc*. were strictly followed according to recommended package ofpractices 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 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 N, P and K were analyzed. Soil test results were helpful in need based application of all the three essential nutrients of N, P and K. The pH of soils ranging from 6.7 to 7.8 with electrical conductivity ranges from 0.74 to 0.91 dSm^{-1}. The organic carbon, available phosphorus and available potassium ranges from 0.49-0.72 %, 17.2-24.4 and 275.6-339.4 kg ha^{-1}, respectively. The temperatures generally remains between 35 °C to 45 °C during summer and 7 °C -15 °C (max) to 0 °C to 8 °C(min) in winters. The data on yield and economics was collected, basedon crop cut and personal interviews. Further, the benefit cost ratio was worked out as the ratio of average gross returns corresponding to the average cost of cultivation. The parameters *viz* technology gap, extension gap and technology index were also determined for better understanding of the results. Following formulas were used for calculating these variables as reported by (Samui *et al*., 2000).

i. Technology Gap= Potential yield - Demonstration plot average yield

ii. Extension Gap= Demonstration plot average yield - Farmer’s plot average yield

iii. Technology Index= (P-D) / P X 100

Where,

P= Potential yield of the crop

D= Average demonstration plot yield of the crop

The results pertaining to the yield parameters are mentioned in the table 2. A comparative study between the demonstrated technologies and local check revealed invariably higher yields in the former. During the first year of study, maximum yield was recorded under demonstration plot (875 kg ha^{-1}) as against the local check (750 kg ha^{-1}). In line with these results, the demonstration plot witnessed a yield increase of 14.28 per cent over check. The same trend was followed in the second year,where maximum yield was under demonstration plot (900 kg ha^{-1}) which was 22.22 per cent higher than the local check (700 kg ha^{-1}). Overall, the average yield of mash crop increased by 18.25 per cent under demonstrated technologies (887 kg ha^{-1}) as compared to check (725 kg ha^{-1}). The adoption of improved cultivation technologies like sowing method, weed control, fertilizer application according to recommended package of practices resulted increased yield in demonstration plot as compared to check. A study by 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).

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. In the present study, an average technology gap of 112 kg ha^{-1} was observed (Table 2). Such technology yield gap was also reported by (Kumar *et al*., 2019 and Rao and Ramana, 2017). This gap is mainly attributed to the disparities in soil properties (*viz*. nutrient and fertility levels, salinity, alkalinity *etc*.) and climatic vagaries (Rao and Ramana, 2017). 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. The extension gap, on the other hand, signifies the gap between demonstration plot yield and yield obtained under farmers practice (local check). In the present study, extension yield gap ranged from 125 kg ha^{-1} to 200 kg

Table 1: Details of the package practices in cluster front line demonstrations

Crop	Technology Component	Demonstration plot	Local Check
Kharif Mash	Variety	Mash 114	Local mash variety
	Seed rate	8 kg	5 kg
	Sowing time	15-25 July	25 July –15 August
	Seed Inoculation	Inoculate the seed with Rhizobium (LUR-6) culture at the time of sowing	No inoculation
	Sowing method	Sowing was done at row spacing of 30 cm with seed drill at 4-6 cm depth	Broadcast
	Fertilizer	11 kg urea & 60 Kg single super phosphate	15 Kg Urea
	Technical guidance	Time to Time through trainings and field visits	Nil

Table 2: Grain yield and gap analysis of front line demonstrations on *kharif* mash cv. Mash - 114

Period of cultivation	Potential yield (kg ha^{-1})	Yield (kg ha^{-1})		Yield increase (%)	Technology gap (kg ha^{-1})	Extension gap (kg ha^{-1})	Technology index (%)
		DP	FP				
Kharif 2018	100	875	750	14.28	125	125	12.50
Kharif 2019	100	900	700	22.22	100	200	10.00
Mean	100	887	725	18.25	112	162	11.25

Table 3: Cost of cultivation and benefit cost ratio as affected by technologies

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
Kharif 2018	19,960	22,460	61,250	52,500	41,290	30,040	2.06	1.33
Kharif 2019	20,400	22,000	63,000	56,000	42,600	34,000	3.08	2.54
Mean	20,180	22,230	62,125	54,250	41,945	32,020	3.07	2.44

Note: DP – demonstrated plot, FP – farmer's practice

ha^{-1}. Overall, an average extension gap of 162 kg ha^{-1} was found in demonstration plot over farmer's plot. 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).

The feasibility of improved cultivation technologies in the farmer's field is assessed by technology Index. According to Jeengar *et al*. (2006) lower the value of technology Index, higher is the feasibility of evolved technologies in farmer's field. The technology index varied from 12.5 to 10 per cent, in the present study (Table 2). Overall, the average technology index was determined as 11.25 per cent thus, signifying feasibility of the demonstrated practices (*viz* improved variety and cultivation practices) in the farmer's field. These results were corroborated with the findings of (Ashiwal *et al.*, 2008).

It is necessary to determine the economics of cultivation in any experiment in-order to ensure its economicfeasibility. Owing to this, the cost of cultivation and net returns were also worked out in this study (Table 3). The results revealed lower average cost of cultivation under demonstration plot (Rs 20,180 per ha) as compared to farmer's practice (Rs 22,230 per ha). The demonstration plot recorded lower cost of cultivation during the first (Rs 19,960 per ha) as well as second year (Rs 20,400 per ha) of study. Further, throughout the entire course of study, higher returns were obtained under demonstration plot as against the farmer's practice. The plot demonstrating improved cultivation technologies revealed higher average gross return

(Rs. 62,125 per ha) as well as net return (Rs. 41,945 per ha) in comparison to the farmer's practice which, recorded an average gross return of Rs 54, 250 per ha and average net return of Rs. 32,020 per ha. The benefit cost ratio ranged from 2.06 to 3.08 and 1.33 to 2.54 under demonstration plot and farmer's practice, respectively. Overall, the highest B:C ratio was worked out under demonstration plot i.e. 3.07. 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 demonstrations due to the application of recommended cultivation practices.

This study reveals that the higher yield of demonstration plot from check plots is attributed to the use of all the farming practices like improved variety, sowing method, fertilizer application, plant protection measures according to the recommended package of practices. Among the other factors that contributed to lower yield of check plots following farmer'sown practices include delay in sowing of *Kharif* mash coincides monsoon that led to excessive vegetative growth of the crop which reduces number of flowers, pods and delay sowing also led to the susceptibility of *kharif* mash to diseases and pod borer problems due to unfavorable environmental conditions. Lack of knowledge about proper farming practices like herbicide application, irrigation, use of fertilizers also decreased the yield as well as net returns which reduces the benefit cost ratio in check plots. During this study it was also concluded that the various farmer interactions, field days and higher yield results obtained from front line demonstrations triggered other farmers to adopt recommended farming practices and new technologies.

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