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Research Article

Popularization of Pearlmillet Production Technology through Front Line Demonstrations in the Transitional Plain Zone of Luni Basin of Rajasthan

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Abstract

Front line demonstrations on pearlmillet were carried out by College of Agriculture Sumerpur, Pali (Rajasthan) to study the yield gaps between improved packages of practices (IP) verses farmer's practice (FP) during *Kharif* seasons 2019-20 to 2021-22 at Rohit block of Pali district of Rajasthan. The improved technologies consisted use of high yielding hybrids, application of micro nutrients, integrated weed, pest and disease management. Yield attributes of improved practice (IP) and farmers' practice (FP) were recorded, and percent yield increase, technology gap, extension gap, technology index, and FLD economics were examined. The results revealed that the highest seed yield was obtained in demonstrated plot with an average of 1481 kg ha^{-1} as compared to 1119 kg ha^{-1} and recorded an increase in the tune of 32.4 per cent. Higher net return (₹ 18642 ha^{-1}) in the demonstration plots compared to farmers' practice plot (₹ 13719 ha^{-1}) was also net worth with an extension and technology gaps of 362 kg ha^{-1} and 1319 kg ha^{-1}, respectively on mean basis. The demonstrations also recorded an additional return of ₹ 4922 ha^{-1} with additional investments of ₹ 2062 ha^{-1}. It was attributed to scientific management and monitoring of demonstrations and use of low cost monitory inputs. The MSP of pearl millet during different years influenced the economic returns resulted into an incremental benefit: cost ratio of 2.6 under demonstrations on an average basis besides fluctuating rates of various inputs. By conducting front line demonstration of proven technologies, yield potential of pearl millet crop could be enhanced to a great extent with increase in the income level of the farming community.

Key words: Demonstration, Economics, Gap analysis, Pearlmillet Production Technology, Productivity, Profitability

1. Introduction

Pearl millet [(*Pennisetum glaucum* (L) R. Emend Stuntz] is low value nutritious coarse grain millet grown as rainfed and is staple food for majority of peoples in dry tracts of country. It is drought and heat tolerant among rest of cereals and millets and has the higher water use efficiency under moisture stress conditions. It is the only major crop that has high levels of tolerance to both acidic and saline soils (Kumar *et al.* 2010). The adaptive and nutritional features combined with yield potential make pearl millet an important nutra-cereal crop. Its importance as dry fodder and green forage, the Rajasthan state is leading in area as well as in production of pearl millet in country. In Rajasthan it was grown on 4.4 m ha with average productivity of 818 kg ha^{-1} while in Pali district it was grown on 0.86 m ha with average productivity of 434 kg ha^{-1} (Anonymous 2021) (Table 1).

Table 1: Area, Production and Productivity of pearl millet (Kharif 2019 to Kharif 2021)

Parameters/Year		2019	2020	2021
India	Area (000'ha)	8776.7	7297.4	7810.7
	Production (000't)	10276.0	8742.0	9250.1
	Productivity (kg ha^{-1})	1171	1198	1184
Rajasthan	Area (000'ha)	5019.9	3988.9	4434.6
	Production (000't)	4593.2	3876.7	3627.5
	Productivity (kg ha^{-1})	915	972	818
Pali district	Area (000'ha)	878.7	702.1	863.2
	Production (000't)	576.9	295.7	374.4
	Productivity (kg ha^{-1})	656	421	434

The productivity level of crop in the Pali district is low because farmers are not following recommended package of practices. Therefore, on the principle of 'seeing by believing' it is very essential to demonstrate the latest technologies at farmers' field for adoption. Farmers' poor or partial acceptance of an enhanced package of practices appears to be a gap between the scientist's proposed technology and its altered form at the farmer's level. A wide gap exists in pearl millet production with the use of available techniques and its actual application by the farmers and reflected through poor yields at farmer's fields. There is a tremendous opportunity for increasing the productivity of crop by adopting the region specific improved technologies generated by state agricultural universities and research stations but due to poor transfer and adoption of technology, the productivity is still low. To demonstrate the newly released crop production technologies and its management practices among the farmers' under different farming situations in different agro climatic regions with scientific cultivation and to motivate for adoption, front line demonstrations were laid out at farmer's field during *Kharif* 2019-20, 2020-21 and 2021-22. Further, economics of FLD's and generate production data and provide effective feedback information for research and extension system for strengthening.

2. Material and Methods

A study of 60 frontline demonstrations on pearl millet was conducted on farmer's field from *kharif* 2019-20 to 2021-22 in Rohit block of Pali district under transitional plain zone of Luni river basin of Rajasthan to evaluate the economic feasibility of technology transfer and adoption under Front Line Demonstration programme. The crop was sown with the onset of monsoon and harvested as per maturity. During crop growing period various extension activity like pre-seasonal trainings, kishan goshti, field days, farmer's trainings, literature distirbution, SMS, diagnostic visits etc were undertaken to benefit the farmers'. The soils of the study area are sandy to sandy loam and medium in fertility status. Before conducting FLDs, a list of farmers was prepared from group meeting and specific skill training on different aspects of cultivation etc. to fulfill the gap existing between crop productivity (Table 1). The whole package approach demonstrated to farmers through FLD trials included component such as variety, seed rate, seed treatment, weed management, fertilizers and plant protection measures (Table 2).

Table 2: Set of practices followed at the farmers' field under pearl millet FLDs

Items	Farmer's practices	Recommended practices
Seed/ Variety	Local seed (aged old)	Improved & recommended hybrids MPMH 17 & HHB 299
Seed rate	Higher (6-8kg ha^{-1})	Recommended (4 kg ha^{-1})
Seed treatment	----	Fungicides @ 2gm/kg, PSB+*Azotobactor* 500gm ha^{-1} each
Fertilizer		
-N	30 Kg	60 kg ha^{-1}
-P_2O_5	20 kg	30 kg ha^{-1}
Sowing	Broadcasting	Line sowing
Plant Protection	-------	Fenvalerate 20% EC, Dimethoate 30 EC, Mencozeb 75 WP
Micro nutrients		Zinc sulphate @25 kg/ha

The farmers practice higher seed rate without or less recommended nutrients and plant protection measures. Under strict supervision of multidisciplinary scientists of institute, regular monitoring was conducted from sowing to harvesting. The FLDs were used to look at the differences in potential yield and demonstration yield, as well as the extension gap and technology index. In this impact study, yield data was obtained from FLD plots along with local farming practices widely used by farmers in this region, for comparative analysis. Data on crop yield was collected by per sq. meter observation randomly from 3 to 4 places per demonstration and local plot. The grain yield of demonstration crop was recorded & converted in standard unit. Different parameters as suggested by Yadav *et al.* (2004) and Verma *et al.* (2014) were used for calculating gap analysis, costs and returns. The analytical tool used for assessing the performance of the FLD on pearl millet is as follows:

- Technology gap (kg/ha): Potential yield – Demonstration yield
- Extension gap (kg/ha): Demonstration yield –Farmers yield
- Technology index (%): (Technology gap/ Potential yield) X 100
- Additional return (Rs/ha) = Demonstration return - Farmers' practice return
- B:C ratio = Net return / Cost of cultivation
- Incremental B:C ratio = Additional return / Additional cost

3. Results and Discussions

Grain yield

Data pooled over the three years of 60 demonstrations revealed that the use of high yielding variety, micro nutrients, weed management and control of insect & disease at economic threshold level gave average of 32.4 % more yield of pearl millet (1481 kg ha^{-1}) as compared to farmer practices (1119 kg ha^{-1}) over three years. The increase in the seed yield of demonstration over the farmer's practices ranged from 34.0 to 37.2 per cent in different years. Joshi *et al.* (2004) have also observed that improved package of practices along with water management have shown positive effect on yield potentials of different crops. Similar findings have also been supported by Narolia *et al.,* 2015 and Jain 2018. Overall, the yield of demonstration plots exceeds that of farmer's plots in all FLD.

Gap analysis

Extension gap is a parameter to know the yield differences between the demonstrated technology and farmers' practice whereas technology gap is the difference between potential yield and yield obtained under improved technology. Technology gap is of greater significance than other parameters as it indicates the constraints in implementation and drawbacks in our package of practices, these could be environmental or varietal. An extension gap ranging from 284-482 kg ha^{-1} was found between FLD demonstration and farmers practices during the different years and on average basis it was observed 362 kg ha^{-1} (Table 3). The extension gap was lowest (150 kg ha^{-1}) in *Kharif* 2020 and was highest (482 kg ha^{-1}) in *Kharif* 2021. Such gap might be attributed to adoption of improved technology in demonstrations which resulted in higher grain yield than that in the farmer's practices. Wide technology gap were observed during these years and this was lowest (1023 kg ha^{-1}) during *Kharif* 2021 and highest was 1557 kg ha^{-1} during *Kharif* 2019. On average basis the technology gap of all the 60 demonstrations was found to be 1319 kg ha^{-1} (Table 3). The difference in technology gap during different years could be due to differential feasibility of recommended technologies during different years. Similarly, the technology index for all the demonstrations during different years were in accordance with technology gap. Higher technology index emphasized the need to educate (insufficient extension services in transfer of technology) the farmer's through various means for the adoption of improved / recommended production technology to decrease the gaps.

Economic analysis

To assess their profit above existing technology, it is essential to comprehend the economic viability of any technique exhibited on farmers' fields. Grain yield, cost of production and minimum support price of grain determine the economic returns and those vary from year to year with the variation in cost of inputs and labour charges. Different variables like seed, micro nutrient, herbicides and plant protection chemicals were considered as cash inputs for the FLD demonstrations as well as for farmers practice. It is observed an average net return of ₹ 18642

Table 3: Performance of pearlmillet in crop technology demonstrations. (Kharif 2019 to Kharif 2021)

Year	No. of demonstration	Area (ha)	Improved package of practices (IP)		Farmers practices (FP)		% increase over FP	Potential yield (kg ha^{-1})	Technology index (%)	Technology gap (kg ha^{-1})	Extension gap (kg ha^{-1})
			Variety	Yield (kg ha^{-1})	Variety	Yield (kg ha^{-1})					
2019	20	10	MPMH 17	1243	Local	959	34.0	2600	55.6	1557	284
2020	20	10	MPMH 17	1350	Local	1200	34.0	2600	51.8	1450	150
2021	20	10	MPMH 17	1777	Local	1295	37.2	2600	36.5	1023	482
Total/ Average	60	30		1481		1119	32.4	2600	47.1	1319	362

Note: The number of demonstrations and total area allotted under demonstrations and farmers practice are equal in study period

Table 4: Economic analysis of front line demonstrations of pearlmillet on farmers field (Kharif 2019 to Kharif 2021)

Year	Cost of Cultivation (₹ ha^{-1})		MSP of pearl millet (₹)	Gross return (₹ ha^{-1})		Net return (₹ ha^{-1})		B:C ratio		Additional in demonstration	
	IP	FP		IP	FP	IP	FP	IP	FP	Return (₹ ha^{-1})	B:C
2019	13366	12120	2000	27090	20970	13724	8850	1.03	0.73	4874	3.91
2020	14226	13060	2150	31425	28100	17199	15040	1.21	1.15	2159	1.85
2021	18306	14530	2250	43308	31798	25002	17268	1.37	1.18	7734	2.05
Average	15299	13237	-	33941	29956	18642	13719	1.20	1.02	4922	2.60

ha^{-1} was received under FLD's as against of ₹ 13719 ha^{-1} in local practice and recorded a B:C ratio of 1.20 as against of 1.02. The higher returns under demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The average additional gain of ₹ 4922 ha^{-1} and B:C ratio of 2.60 (Table 3) with an extra expenditure of ₹ 2062 ha^{-1}, which is very less and affordable to small and marginal farmers. The results are in conformity with the findings of Lathwal, O.P. (2010), Dayanand *et al.* (2012), Meena, *et al.* (2012) and Jain (2018). The B:C of 1.20 is sufficiently high to motivate the farmers under aberrant and rainfed conditions to adopt the technology. Therefore, FLD program was effective in changing attitude, skill and knowledge of farmers towards improved / recommended practices of pearl millet cultivation. This also led to improvement in the relationship between farmers and scientists and built confidence between them. The FLD beneficiary farmers change in attitude might be attributed to their direct contact with the scientist at all important and critical stages of the crop cultivation along with participation in different extension activities and may also act as source of information dissemination among other members of farming community. Extension functionaries may be invited in the program to follow the same procedure in their future demonstration programme to achieve success.

Reactions and Constraints

The improved and treated seed of hybrids have reported good seed germination, profuse tillering along with early maturity. The variety was also suited to arid environment. In-spite of best efforts and feedback from respondents, there was some constraints for higher adoption and was listed below:

- Smut and green ear disease tolerance varieties should be developed.
- High cost of hybrid seeds and timely unavailability of newly released seeds.
- Lack of proper post-harvest management and value addition
- Lack of centralized facilities for cleaning, grading, processing, packing and storage in the state is prior requirement.

Extension Strategies

- More number of training programmes should be arranged and frequent field visit by the concerned extension experts to enhance the level of adoption of dry land crop production technology practices by the farmer.
- Seed village concept should be adopted to overcome the problem of availability of seeds.
- Cooperative marketing for popularization for better market value of products.
- Procurement of farm produce on minimum support prices as the farm harvest prices fluctuates year to year depending of production.
- Timely procurement will also help in timely repayment of loans.

Conclusion

The yield enhancement under frontline demonstrations can be valuable in improving farmers' attitudes, knowledge, and competence. The use of bio-fertilizers and micronutrients can contribute to high-quality production at low cost and environmental safety. It can be concluded that FLDs conducted under the close supervision of scientists are an important extension tool for demonstrating newly released crop production and protection technologies at farmer's field in various agro-climatic regions and farming situations, resulting in increased output and income. Farmers can attain a higher additional return with a lower additional input cost by using this technology.

Author contributions

Conceptualization of research (LKJ, HPP & SDR); Designing of the experiments (LKJ, HPP & SDR); Contribution of experimental materials (LKJ, HPP & SDR); Execution of field/lab experiments and data collection (LKJ, HPP & SDR); Analysis of data and interpretation (LKJ, HPP & SDR); Preparation of the manuscript (LKJ, HPP & SDR).

Conflict of interest: No

Declaration

The authors declare no conflict of interest.

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