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Productivity Enhancement in Pearl Millet through Frontline Demonstrations under Saline Condition in Western Rajasthan

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Abstract

Cluster Front Line (CFLDs) demonstrations are a unique approach which provides a direct interface between researchers and farmers when scientists participate directly in the planning, execution and monitoring of demonstrations of the technologies developed by them and get direct feedback from the farmers' field about the crops. The cluster frontline demonstrations (45 in number) on pearl millet were conducted by Krishi Vigyan Kendra, Athiyasan, Nagaur-I during 2020 to 2021 in Kharif season in village Roon and Gaju in Mundwa block in a saline area of 20 ha by the active participation of farmers with the objective to demonstrate the improved technologies meant for proving production potential of pearl millet (Variety MPMH-17). The improved technologies consisting use of improved variety, soil treatment by *Trichoderma viride,* seed treatment with Carbendazim, mechanized sowing and use of integrated nutrients. The yield was found 1669 kg ha^{-1} in demonstration plot as compared to local check (1325 kg ha^{-1}) which revealed 26% higher yield by use of improved technology.

Key words: Pearl millet, Improved technology, *Trichoderma viride,* Mechanized sowing, Variety MPMH-17

Introduction

Pearl millet (*Pennisetum glaucum*) is sixth most important grain crop of the world and an important cereal crop of western Rajasthan. Climate change, water scarcity, widespread malnutrition and obesity make it imperative to speed up pearl millet productivity. The pearl millet can tolerate drought hence is highly adopted in western Rajasthan. The total pearl millet production in India is 10.30 million Mg (Anonymous, 2020-21). In Rajasthan state, it was cultivated in an area of 4.24 million ha with production of 3.75 million Mg and productivity 886 kg ha^{-1} during the year 2017-18 (Anonymous, 2017-18). Even in case of harsh temperature changes, it is highly resilient, nutritious crop, which can be grown under marginal conditions and produces higher economic returns than other cereals. Furthermore, it has higher grain yield under ceiling temperatures and is an underutilized crop with enormous nutritional potential (Krishnan and Meera, 2018). As a C_4 plant, pearl millet, along with other C_4 plants like maize and sorghum, can account for 30% of worldwide terrestrial carbon fixation (Choudhary *et al*., 2020). It is also a rich source of vitamins such as B_1, B_2, B_3 and minerals such as, phosphorous, potassium, iron, zinc, magnesium, copper, and manganese (Weckwerth *et al*., 2020). Pearl millet is profoundly nutritious as well as easy to digest. The cereal is used in various preparations like porridge, *chapati (roti), halwa, churama*, savory dishes, snacks, biscuits, cake and many kinds of sweets. It is gluten free and its food products are boon for persons with celiac disease. It's both green and dry plants, chopped and mixed with other fodders are palatable feed for animals. The concept of frontline demonstrations in India is put under National Food Security Mission. The main objective of frontline demonstrations is to demonstrate newly released crop-production technologies and their management practices on the farmers' fields under different farming situations. These demonstrations are carried out under the supervision of scientists of Krishi Vigyan Kendra. The newly and innovative technology having higher production potential under the specific cropping system can be

popularized through these programs. The present study has been undertaken to evaluate the difference between demonstrated technologies vis-a-vis practices followed by the local farmers cultivating pearl millet crops.

Materials and Methods

MPMH 17, is a pearl millet hybrid variety developed by the All India Coordinated Research Project on Pearl Millet (AICRP on Pearl Millet), Agricultural Research Station, Mandor, Jodhpur (Rajasthan) that has demonstrated wide adaptability even in the difficult climatic conditions of Western Rajasthan. (Moola Ram *et al.*, 2018). The variety produces comparatively higher grain and stover yields (Anonymous, 2017). To assess the economic feasibility of technology transfer for crop management and better productivity of pearl millet, the frontline demonstrations were conducted at 45 farmers' fields of village Roon and Gaju (Block-Mundwa), of Nagaur district in Rajasthan during Kharif season of 2020 and 2021 in rainfed condition in sandy loam saline soil with low-medium fertility status under pearl millet–cumin/fallow cropping system. Each demonstration was conducted on an area of 0.4 ha to 0.5 ha and the same area adjacent to the demonstration plot was kept as farmer's practices. The package of improved production technologies included improved variety MPMH-17, fertilizer 40:20 kg ha^{-1} N:P, 12.5 kg ha^{-1}Zinc Sulphate (33%), 12.5 kg ha^{-1}Sulphure (80% WDG) and 2.5 kg ha^{-1}N: P: K ratio as per schedule. Soil treatment by *Trichoderma viride* @ 2.5 kg ha^{-1} (mixed with 100 kg FYM). Seeds were treated with Carbendazim @ 2.0 g kg^{-1} seed and inoculated with NPK consortia @ 5 ml kg^{-1} seed. Seed sowing was done in first fortnight of July every year with a seed rate of 4 kg ha^{-1} in line sowing with row to row spacing of 45 cm and 15 cm between plants. Optimum plant population was maintained in the demonstrations. Recommended dose of fertilizer was applied through DAP as basal application. Use insecticide of Imidacloprid @ 150 ml a.i.ha^{-1} for Sucking insects. The crop was harvested during first fortnight of October. The benefit cost ratio was calculated based on gross return. The yield data were collected from both the demonstration and farmers' practice and their technology gap, extension gap and technology index were worked out (Samui *et al.*, 2000) as given below:

Percent increased yield = (Demonstration yield- farmer's yield)/farmer's yield × 100

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield- Farmer's yield

Technology Index = Technology gap /potential yield × 100

Results and Discussion

The key differences were observed between demonstration package and farmers' practices about recommended varieties, soil and seed treatment, sowing method, time of sowing and fertilizer dose. Table 1 shows that under the

Table 1. Details of gap analysis in Pearl millet

S.N.	Technology	Recommended practice	Farmer's practice	Gap
1.	Variety	MPMH-17	HHB-67/ Local seed	50%
2.	Seed rate	4 kg ha^{-1}	5-6 kg ha^{-1}	40%
3.	Soil treatment	Soil treatment by *Trichoderma viride* @ 2.5 kg ha^{-1} (mixed with 100 kg FYM)	15% application	85%
4.	Seed Treatment	Carbendazim @ 2.0 g kg^{-1} seed	20% application	80%
5.	Fertilizers (kg ha^{-1})			
	N	40	10-20 kg ha^{-1}	80-90%
	P	20	10-15 kg ha^{-1}	85-90%
	$ZnSO_4$	25	35% application	65%
	Bio-fertilizer	PSB & Azotobacter(@ 200 g per 10 kg seed)	5% application	95%
6.	Weed management	Use of Atrazine @ 0.5 kg a.i ha^{-1} pre-mergence followed by hand weeding at 30 DAS	20% applicationHand weeding	80%
7.	Plant protection			
	Sucking insects	Imidacloprid @ 150 ml ha^{-1}	15% application	85%

demonstrated plot only recommended varieties and bio-agents were used which were given to farmer by the KVK and the farmer itself under the direction of KVK scientists timely performed all the other package and practices. Under farmers' practice, they sow seed of pearl millet varieties HHB-67 or Local seed at higher seed rate without seed treatment. As a result, the farmers selected under FLD program on Pearl millet were provided seed of Pearl millet variety MPMH-17. It is also observed that under farmer practice, sowing of pearl millet is done earlier to escape from water shortage for irrigation, thus leading to reduction in yield. Regarding the method of fertilization under demonstration, all fertilizers were drilled at the time of sowing, whereas under farmers' practice, broadcast method of fertilization was used.

Grain yield

Results revealed that an average yield 1614 and 1724 kg ha^{-1} were found in demonstration plot of variety MPMH-17 as compared to 1293 and 1356 kg ha^{-1} in local check plot during Kharif-2020 and Kharif-2021, respectively in the Roon and Gaju village. The improvement in yield might be due to soil and seed treatment, use of bio-fertilizers, timely sowing, application of recommended dose of fertilizers and integrated pest management practices.

Extension gap, technology gap and technology index

The technology gap 1186 and 1076 kg ha^{-1}, extension gap 321 and 368 kg ha^{-1} and technology index 42.36 and 38.43% was recorded in demonstration plot (Table 2) during Kharif-2020 and Kharif-2021 respectively. The technology index showed the practicability of evolved technology at the farmers' fields.

Economics

The net return of demonstration plot was ¹ 25640 and ¹ 28130 per ha and for control plot ¹ 17986 and ¹ 19448 per ha during Kharif-2020 and Kharif-2021, respectively. Benefit-cost ratio for demonstration was 2.58 and 2.53 and control was 2.19 and 2.14 during Kharif-2020 and Kharif-

Table 2. Yield performance, technology gap, extension gap and technology index of pearl millet under Farmers' practice and cluster front line demonstration

FLD conducted year	Crop	Variety	No. of demons-trations	Area (ha)	Yield (kg ha^{-1})			% increased yield over farmers practices	Technology gap (kg ha^{-1})	Extension gap (kg ha^{-1})	Technology index (%)
					Potential of variety	Demonstrated plot	Local Checkplot				
Kharif-2020	Pearl millet	MPMH-17	20	10	28	1614	1293	24.83	1186	321	42.36
Kharif-2021	Pearl millet	MPMH-17	25	10	28	1724	1356	27.14	1076	368	38.43
Total/Average			45	20	28	1669	1325	25.98	1131	345	40.39

Table 3. Economics of pearl millet under cluster front line demonstrations

Conducted year	Cost of cultivation ($₹ ha^{-1}$)		Gross returns ($₹ ha^{-1}$)		Net returns ($₹ ha^{-1}$)		Additional net return over local check ($₹ ha^{-1}$)	BC Ratio	
	Demonstrated plot	Local Check plot	Demonstrated plot	Local Check plot	Demonstrated plot	Local Check plot		Demonstrated plot	Local Check plot
Kharif-2020	16265	15125	41905	33111	25640	17986	7655	2.58	2.19
Kharif-2021	18375	17115	46505	36563	28130	19448	8683	2.53	2.14
Average	17320	16120	44205	34837	26885	18717	8168	2.56	2.17

2021, respectively (Table 3). The results indicated that the frontline demonstrations have good impact over the farming community of Nagaur district as they were motivated by the new agricultural technologies applied in the FLD plots (Table 1). Findings of the study are in line with the findings of Patil *et al*. (2015) in green gram and in black gram by Sahare *et al*. (2018). It is concluded that the FLD program is an effective tool for increasing the production and productivity of pearl millet and changing the knowledge, attitude and skill of farmers. The per cent increment in yield of pearl millet to the extent of 24.83 to 27.14 over the farmers practice created greater awareness and motivated the other farmers to adopt the improved package of practices for pearl millet. These demonstrations also built the bond and confidence between farmers and scientists. The partner farmers of FLDs also play an important role as source of information and quality seeds for wider dissemination of the high yielding varieties of pearl millet for other nearby farmers.

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