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Assessment of Yield Advantage of Pearl Millet Variety MPMH-17 under Rainfed and Irrigated Conditions over Farmers Practice in Arid Zone

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Abstract: Frontline demonstrations (FLD) were conducted in various villages of Jodhpur to showcase the substantial impact of improved crop production technologies on pearl millet yield during *kharif* 2022-23. The improved technologies, represented by the use of pearl millet hybrids (MPMH-17) along with the recommended dose of fertilizers (60 kg N + 30 kg P_2O_5 ha^{-1}), were assessed by comparing them to farmers' practices (Local landrace grown without fertilizers) both under rainfed (53) and irrigated (80) conditions. The mean grain yield with farmers' practice under rainfed conditions varied from 0.67 to 0.76 t ha^{-1} but of MPMH-17 varied from 1.03 to 1.18 t ha^{-1}. Corresponding values under irrigated conditions were 0.78 to 0.93 and 1.24 to 1.37 t ha^{-1} for farmers' practice and MPMH-17, respectively. Hybrid MPMH-17 exhibited the average extension grain and straw yields gap of 0.40 and 1.36 t ha^{-1} under rainfed and 0.44 and 1.58 tha^{-1} under irrigated conditions, respectively. Values of technology gap and technology index in grain yield of MPMH-17 were 1.73 t ha^{-1} and 61.02% in rainfed condition and 1.53 t ha^{-1} and 54.09% in irrigated condition and corresponding values for straw yield were 3.57 t ha^{-1} and 55.82% in rainfed condition and 3.05 t ha^{-1} and 47.71% in irrigated condition. Average additional returns were Rs. 20481 under irrigated and Rs 16643 under rainfed conditions.

Key words: Frontline demonstrations, pearl millet, yield, MPMH-17, Technology gap, Technology index.

In the arid and semi-arid regions of North India, pearl millet (*Pennisetum glaucum*) is a predominant nutrient-dense cereal crop of kharif season. 100 g of pearl millet provides 360 calories and contain 12 g protein, 5 g fat, 2 g minerals, 1 g fibre, 67 g carbohydrates, 42 mg calcium, 242 mg phosphorus, and 8 mg iron (Malik, 2015, Satyavathi *et al.*, 2017).Its grains are used not only for human consumption but also as animal feed (Yadav *et al.*, 2013) and in industry to produce ethanol. Its economic significance is noteworthy, particularly in arid and semi-arid tropical regions of Rajasthan, Gujarat, and Haryana.

The crop is resilient to changes in day length, moisture stress and temperature and can grow with <300 mm rainfall. Majority of pearl millet is cultivated in north-western India, an area that is well known for being extremely susceptible to

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Table 1. Comparison between improved practice (IP) and existing farmer practice (FP) under pearl millet FLDs

Items	Farmers' practices	Improved practice
Seed	Local variety	MPMH-17
Seed rate	Higher seed rate (6-8 kg ha^{-1})	Recommended (4 kg ha^{-1})
Seed treatment	---	Fungicides @ 2 g kg^{-1}, PSB + Azotobactor 500 g ha^{-1} each
Fertilizer	Lower doses 40 kg DAP	Recommended dose of fertilizers (60 kg N + 30 kg P_2O_5 ha^{-1})
Sowing	Broadcasting	Line sowing
Plant protection measures (Diseases/Insects)	---	Fenverlate 2% powder, Monocrotophos 36 WS, Quenlphos 25 EC, Dimethoate 30 EC, Mencozeb

drought stress of variable length, severity and intensity. In fact, pearl millet growing is an important part of the way of life of rural folk of the region. In India, pearl millet is grown on 7.65 mha with an average production of 10.8 mt and productivity of 1,311 kg ha^{-1} while in Rajasthan, pearl millet is grown on 4.38 mha, yielding 4.6 mt of grain (Directorate of Millets Development, 2021). Majority of pearl millet in Rajasthan is grown as a rainfed cereal crop, and the productivity of this crop varies from year to year depending on quality and patterns of rainfall distribution. Barmer, Jodhpur, Nagaur, Churu, Jalore, Sikar, Jaipur, Jhunjhunu, Alwar, Jaipur, and Bikaner are the main pearl millet-growing districts in the state.

In the face of climatic challenges, there is a crucial need to empower our workforce with employable skills and knowledge. This empowerment would enable them to significantly contribute to the economic growth and development of both their own families and of the country at large. In the pearl millet growing regions of Rajasthan, farmers face the dual challenge of low and variable productivity year after year (Jain 2018; Jat *et al.,* 2023). To address the issue of productivity, frontline demonstrations (FLD) were conducted on 133 farms (in 10 villages of which six were irrigated) during the kharif season of 2022-23. The focus was on cultivating high-quality grains of pearl millet var. MPMH-17, which are specifically suited for post-harvest processing. The villages selected were already chosen to be a part of strategic platform for developing entrepreneurial skills in community, particularly in the realm of secondary agriculture. The initiative, centred around increasing productivity of high-quality pearl millet grains, which through secondary processing holds the potential to create sustainable livelihoods with minimum additional input (Tewari *et al.,* 2018). The variety MPMH-17 was chosen for this study as it is a dual-purpose high yielding hybrid.

Materials and Methods

Present study was carried out in Jodhpur district of Rajasthan. Ten villages of Jodhpur (Rajasthan). In six of these villages namely, Padasala, Matoda, Nosaur, Nevra road, Raimalwara, Paldi-ranawata pearl millet was grown as irrigated crop and in the remaining four namely Sar, Rohicha kalla, Rohicha khurd and Daijer as rainfed. Front line demonstrations (FLD) were set up in the field of 133 farmers. The local check and improved variety production levels were compared in FLD on the same fields. Extension gap and technology index were also calculated from the data. Each demonstration was conducted in a 0.4 ha area, with an additional 0.4 ha area selected for the farmer's practice. A total of 133 demonstrations were carried out. The purpose of the front-line demonstrations (FLDs) was to illustrate the potential benefits of the improved set of practices as well as variety, in contrast to the methods currently practiced by farmers. The evaluation also aimed to determine the extension gap and technology index of the MPMH-17. The soils of the study area were coarse textured with low fertility status. The crop was sown during the second week of July 2022. All of the participating farmers were given training on scientific cultivation practices like improved cultivars, seed treatment, line sowing, time of sowing, depth of seed sowing, inter-culture operations, etc. The successful execution of the demonstration, along with the collection of farmers' opinions regarding the demonstration field, was facilitated through regular diagnostic visits conducted by scientists. Throughout the

harvest period, data on grain and stover yields were meticulously gathered. This involved the random selection of 1 m² areas from 3 to 4 locations within plots cultivating pearl millet MPMH-17, as well as those following traditional farming practices. Production and economics data for farmers practice and front-line demonstration were gathered and evaluated. As per as existing market prices, the input (cost of cultivation) and output costs (gross and net income) were computed. The whole package approach was demonstrated to farmers through FLD studies and included elements such as: variety, seed rate, treated seeds, fertilizers and plant protection measures (Table 1).

The technological viability gained as a result of FLD implementation in pearl millet was the operational definition of the technology index in the current study. The technology index, extension gap, and technology gap have been computed using the formulas used by Samuel *et al.* (2000).

Extension gap (kg ha^{-1}) = Demonstration yield - Local check yield

Technology gap (kg ha^{-1}) = Potential yield - Demonstration yield*

Technology Index = [(Potential yield – (Demonstration yield/ Potential yield)] × 100

**Potential grain yield of MPMH-17 is 2.8 t ha^{-1}*

**Potential straw yield of MPMH - is 6.4 t ha^{-1}*

(*Sources: http://krishi.icar.gov.in/jspui/handle/123456789/)

Results and Discussion

Quality production of pearl millet

MPMH-17 yielded higher grain and straw at all the locations as compared to the farmer's practice (Table 2 and 3). Local check under rainfed conditions produced between 0.61 to 0.85 t ha^{-1} grain yield and 1.23 to 1.87 t ha^{-1} straw yield in different villages under rainfed conditions but under irrigated conditions these values ranged from 0.70 to 1.01 t ha^{-1} for grain yield and 1.38 to 2.03 t ha^{-1} for straw yield. For MPMH FLDs grain yield values ranged from 0.94 to 1.27 t ha^{-1} under rainfed conditions and 1.14 to 1.44 under irrigated conditions. Comparable values for straw yield were 2.58 to 3.30 under rainfed and 2.83 to 3.15 t ha^{-1}. Comparison across the villages showed that farmers' practices, resulted in a mean grain yield was 0.85 t ha^{-1} with local check under irrigated conditions and 0.71 t ha^{-1} under rainfed conditions, FLD's improved practices resulted in a mean grain production of 1.3 t ha^{-1} under irrigated conditions and 1.1 t ha^{-1} under rainfed conditions. This increase amounted to 92.5% under rainfed conditions and 90.3% under irrigated conditions. Patel *et al.* (2013) and Jat *et al.* (2023) had also reported similar findings. These results unequivocally demonstrate that the improved variety's performance surpassed the local check under the same environmental conditions.

Yield gap analysis

The extension gap is a measure of the yield discrepancies between farmers' practices and the exhibited technology (improved variety). The extension gap of grain yield ranged from 0.44 t ha^{-1} in irrigated condition and 0.40 t ha^{-1} in rainfed condition and in straw yield comparable values were 1.36 and 1.58 t ha^{-1} (Table 2). The technology gap is the difference between the yield realised under enhanced technology demonstration and the potential yield. Numerous variables that affect agricultural productivity, like weather patterns and inadequate input application, could be the cause of this. The technology gap in grain yield with MPMH-17 was ranged from 1.53 t ha^{-1} in irrigated condition and 1.36 t ha^{-1} in rainfed condition. Technology gap in straw yield with MPMH-17 was 3.08 t ha^{-1} under irrigated condition and 1.73 t ha^{-1} in rainfed condition. The technology index shows how the choice is feasible on the farmer's field. The quality production of pearl millet (MPMH-17) has resulted in a technical feasibility that has been estimated using the Technology Index, which comes out to be 54.09% in irrigated condition and 61.02% in rainfed condition for grain yield and 47.71% in irrigated condition and 55.82% in rainfed condition for straw yield. As the value of the technology index decreases, the feasibility increases. Our results showing higher value of average technology index under rainfed conditions than irrigated support this view. Narolia *et al*. (2013) and Narolia *et al*. (2015) have also provided evidence in support of these conclusions.

Table 2 Comparable yield (t ha^{-1}) of pearl millet under improved practice (MPMH-17) vis-a vis farmer's practice (Local)

Name of village	No of Farmers	Local Check grain yield		SD±	MPMH-17 grain yield		SD±	Local Check straw yield		SD±	MPMH-17 straw yield		SD±
		Min.	Max.		Min.	Max.		Min.	Max.		Min.	Max.	
Irrigated													
Padasala	15	0.75	0.97	0.16	1.25	1.51	0.18	1.50	1.94	0.31	3.13	3.78	0.46
Nosar	17	0.64	0.99	0.25	1.18	1.46	0.20	1.11	1.71	0.43	2.22	3.22	0.71
Paldi-Ranavata	12	0.71	1.16	0.31	1.11	1.54	0.30	1.53	2.48	0.67	2.84	3.94	0.78
Raimalwada	12	0.68	0.94	0.18	1.14	1.33	0.13	1.42	1.96	0.38	3.01	3.51	0.35
Matoda	12	0.69	0.96	0.19	0.94	1.37	0.30	1.23	2.02	0.56	2.48	3.60	0.79
Nevra road	12	0.74	1.05	0.21	1.22	1.45	0.16	1.48	2.09	0.43	3.23	3.83	0.43
Mean	80	0.70	1.01	0.22	1.14	1.44	0.21	1.38	2.03	0.46	2.82	3.65	0.59
Rainfed													
Sar	17	0.59	0.85	0.18	0.83	1.24	0.29	1.30	2.02	0.51	2.93	3.55	0.43
Rohicha kalla	12	0.58	0.90	0.22	0.92	1.28	0.26	0.96	1.83	0.62	2.26	3.16	0.64
Rohicha khurd	12	0.59	0.82	0.16	0.96	1.27	0.22	1.23	1.75	0.37	2.40	3.14	0.52
Daijer	12	0.66	0.84	0.13	1.04	1.30	0.18	1.41	1.86	0.32	2.71	3.34	0.44
Mean	53	0.61	0.85	0.17	0.94	1.27	0.24	1.23	1.87	0.46	2.58	3.30	0.51

Economics of front-line demonstration

The highest gross returns were achieved with the improved hybrid MPMH-17 combined with fertilizers, surpassing local checks The economic analysis of pearl millet production revealed that frontline demonstration performed better than local checks in terms of gross and net returns (Table 3). Gross and net returns were maximum with improved variety MPMH-17 supplemented with improved production practices in comparison to local check in arid region (Fig. 1 and 2).

On an average 36657 Rs. ha^{-1} obtained as net return in irrigated condition same as well as 28797 Rs. ha^{-1} in rainfed condition by growing improved variety in comparison to local check in arid region and have shown that the economic feasibility of the proven technology is beneficial for local farmers to attain greater profits. Additional net returns also follow the same trend and indicate that the adoption of

Table 3. Production performance of pearl millet under improved practice (MPMH-17) vis-a vis farmer's practice (Local)

Village	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})		Extension gap (t ha^{-1})		Technology gap MPMH-17 (t ha^{-1})		Technology index (%) MPMH-17	
	Local	MPMH-17	Local	MPMH-17	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	Straw yield
Irrigated										
Padasala	0.88	1.35	1.77	3.38	0.47	1.61	1.48	3.02	52.26	47.23
Nosar	0.81	1.31	1.66	3.24	0.50	1.58	1.52	3.16	53.78	49.33
Paldi-Ranavata	0.93	1.37	1.99	3.50	0.44	1.51	1.46	2.90	51.70	45.33
Raimalwada	0.84	1.24	1.76	3.28	0.40	1.53	1.59	3.12	56.22	48.72
Matoda	0.78	1.19	1.65	3.13	0.41	1.48	1.64	3.27	57.95	51.09
Nevra road	0.88	1.34	1.76	3.55	0.46	1.79	1.49	2.85	52.65	44.53
Mean	0.85	1.30	1.76	3.35	0.44	1.58	1.53	3.05	54.09	47.71
SD±	0.05	0.07	0.12	0.16	0.04	0.11	0.07	0.16	2.48	2.49
Rainfed										
Sar	0.67	1.03	1.34	2.76	0.36	1.42	1.80	3.65	63.67	56.95
Rohicha kalla	0.71	1.10	1.45	2.71	0.39	1.26	1.74	3.70	61.31	57.73
Rohicha khurd	0.70	1.11	1.45	2.79	0.41	1.33	1.72	3.62	60.78	56.48
Daijer	0.76	1.18	1.62	3.07	0.42	1.44	1.65	3.34	58.34	52.11
Mean	0.71	1.10	1.47	2.83	0.40	1.36	1.73	3.57	61.02	55.82
SD±	0.04	0.06	0.12	0.16	0.03	0.08	0.06	0.16	2.19	2.53

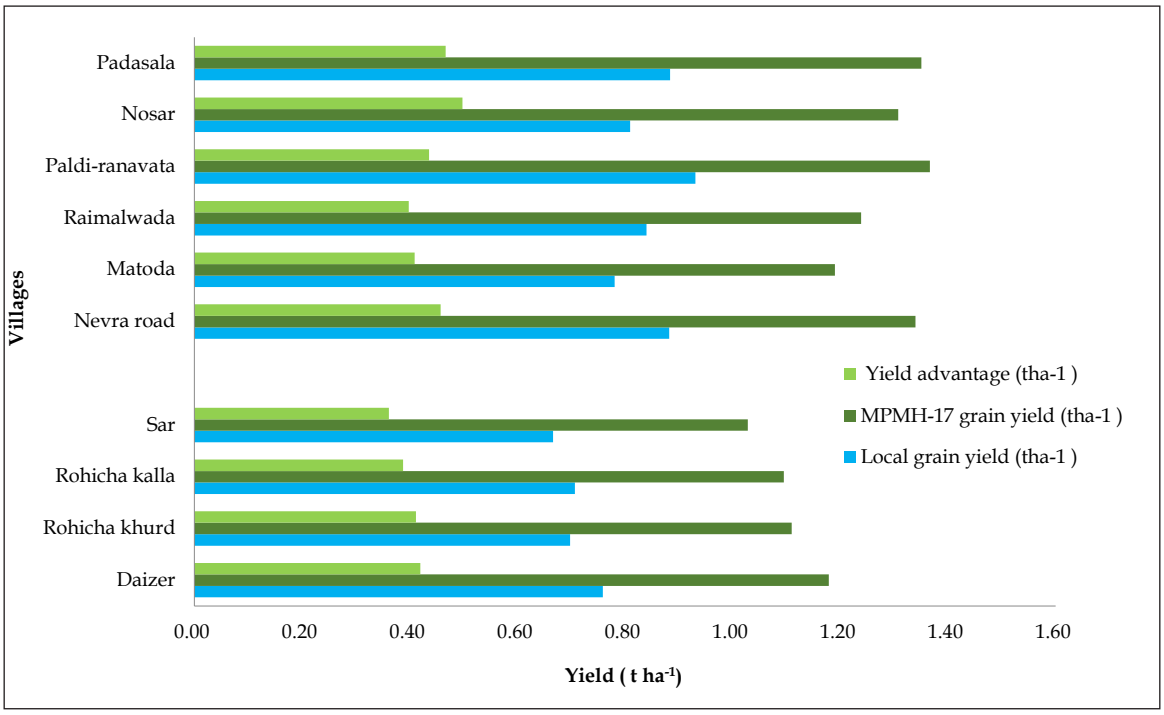

Fig. 1. Yield advantage of pearl millet under different villages of Jodhpur district.

improved technologies can increase the farm income in arid regions. It is observed that an additional net return 20481 Rs. ha^{-1} obtained with addition of cost Rs. 5119 Rs. ha^{-1} in irrigated condition and 16643 Rs. ha^{-1} obtained with addition of cost Rs. 5666 Rs. ha^{-1} in rainfed condition under FLD demonstration in Jodhpur district (Table 4 and Fig. 3). Improved technology, non-monetary factors, timely execution of crop cultivation, and scientific monitoring could contribute to the higher additional returns observed during

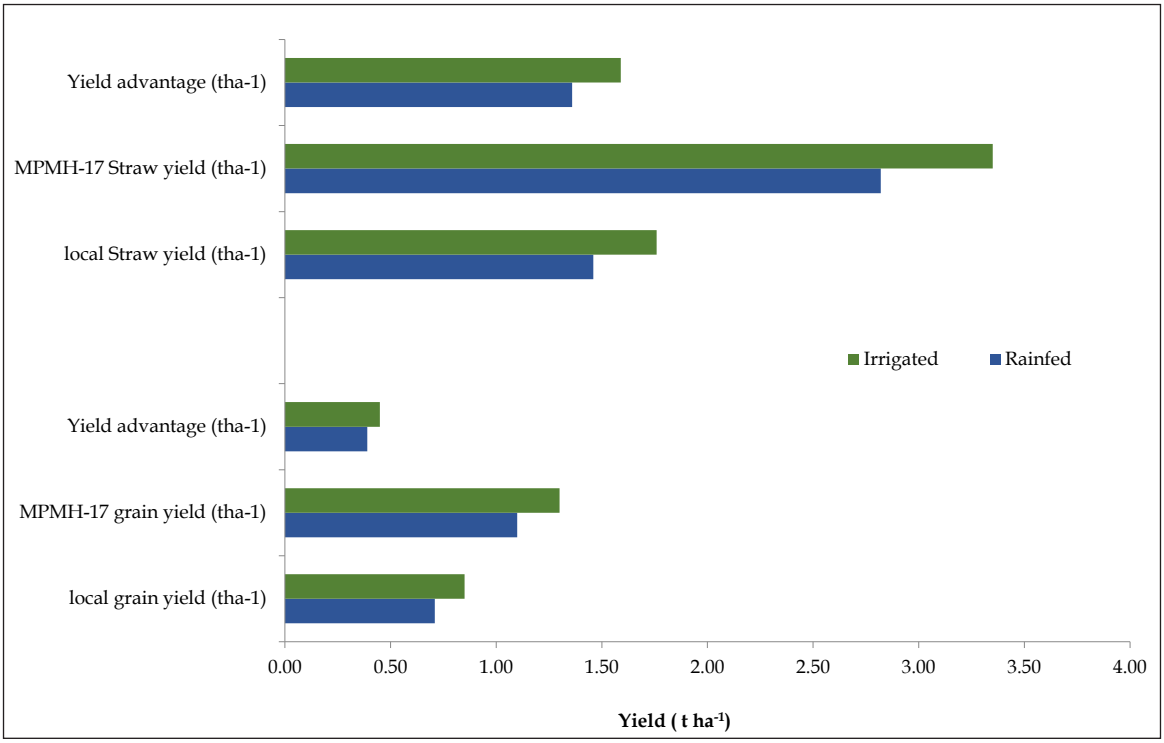

Fig 2. Comparable yield advantage of pearl millet under rainfed and irrigated area.

Table 4. Economics of pearl millet under improved practice (MPMH-17) and vis-a vis farmer's practice (Local).

Village	Cost of cultivation (Rs. ha^{-1})		Additional cost (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})		Net returns (Rs. ha^{-1})		Additional net return (Rs. ha^{-1})
	Local	MPMH-17		Local	MPMH-17	Local	MPMH-17	
				Irrigated				
Padasala	19722	25012	5291	37118	63485	17396	38473	21077
Nosar	19922	25378	5457	34408	61192	14486	35814	21328
Paldi-ranavata	22393	25302	2909	40395	65053	18001	39751	21750
Raimal wada	21379	24890	3511	36040	60074	14661	35184	20523
Matoda	18084	23907	5823	33654	57489	15570	33582	18012
Nevra road	20111	27833	7722	37051	64970	16940	37137	20197
Mean	20269	25387	5119	36444	62044	16176	36657	20481
SD±	1481	1309	1725	2389	3002	1478	2256	1331
				Rainfed				
Sar	17493	22416	4923	28066	50172	10573	27756	17183
Rohicha kalla	17707	23124	5417	30048	51137	12341	28012	15672
Rohicha khurd	18663	25629	6965	29882	52268	11219	26639	15421
Daizer	18448	23805	5357	32933	56584	14485	32779	18294
Mean	18078	23744	5666	30232	52540	12155	28797	16643
SD±	565	1379	894	2012	2829	1717	2721	1348

*MSP of pearl millet was 2200 (Rs/q); *The sale price of fodder was assumed to be Rs. 1000 (Rs/q)

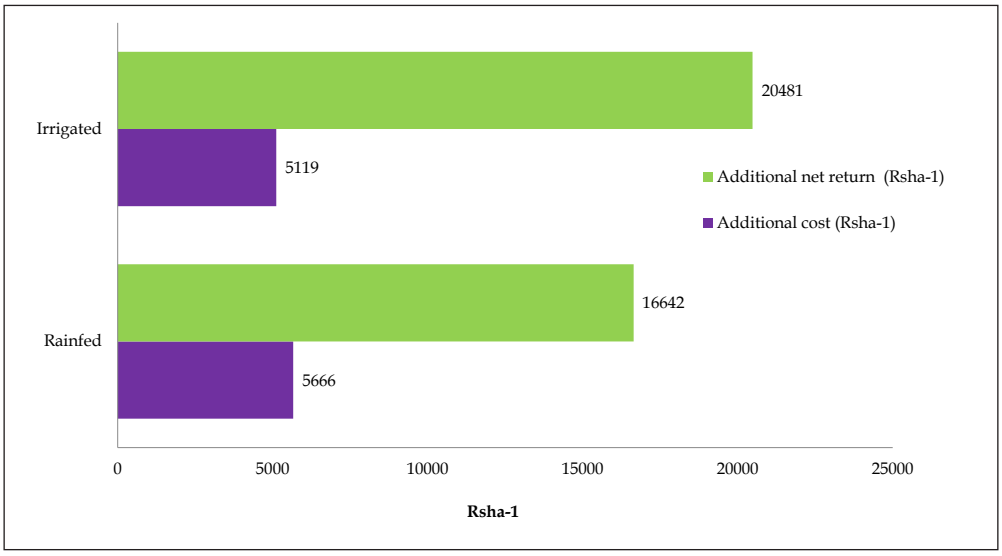

Fig. 3 Comparative returns of improved practice under rainfed and irrigated condition of Jodhpur.

demonstrations. These findings corroborate those of Kundu *et al.* (2019), Gautam and Singh (2020) and Lal *et al.* (2020). According to the results, farmers may find the improved pearl millet variety MPMH-17 beneficial and a viable choice in rain-fed environments.

Conclusion

The demonstrations clearly demonstrated that MPMH-17 can greatly enhance both grain and stover yield compared to local check and traditional farming methods employed by farmers, highlighting its potential to increase yield under the existing agro-climatic conditions. The increment in grain yield of cultivar over local check yield was 52.15% in irrigated condition and 55.85% in rainfed condition and in straw yield was 89% in irrigated condition and 92% in rainfed condition, respectively. The technical feasibility obtained due to implementation of quality production of pearl millet (MPMH-17) was estimated in terms of Technology Index which was calculated as 54.09% in irrigated condition and 61.02% in rainfed condition for

grain yield and 47.71% in irrigated condition and 55.82% in rainfed condition for straw yield.

References

Directorate of Millets Development 2021. Available online at: http://millets.dacfw.nic.in

Gautam, Y. and Singh, O.P. 2020. Analysis of costs and resource productivity in pearl millet production under solar irrigation system in Jaipur, Rajasthan. *Journal of Pharmacognosy and Phytochemistry* 9(6): 470-472.

Jain, L.K. 2018. Technology and Extension Gaps in Pearl millet Productivity in Barmer District, Rajasthan. *Indian Journal of Dryland Agricultural Research and Development* 33(2): 39-42.

Jat, N.K., Ola, C.M., Vijay Avinashilingam, N.A., Meghwal, P.R., Parmender and Hajong, D. 2023. Impact of front line demonstrations on productivity and economics of rainfed pearl millet [Pennisetum glaucum] in western Rajasthan. *Annals of Arid Zone* 62(2): 169-173.

Kundu, K.K., Kumar, D. and Sumit. 2019. Production and Marketing Patterns of Pearl Millet in India with Special Reference to Haryana. *International Journal of Current Microbiology and Applied Sciences* 8(8): 2152-2160.

Lal, S., Kumar, S. and Singh, V. 2020. An Economic Analysis of Production of Pearl Millet (*Pennisetum glaucum*) in Sikar District of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences* 9(12): 1635-1639.

Malik, S. 2015. Pearl Millet-Nutritional Value and Medicinal Uses. *International Journal of Advance Research and Innovative Ideas in Education* 1(3):414-418.

Narolia, R.S., Meena, H. and Singh, P. 2015. Impact of water management practices on productivity of soybean + maize intercropping system in Chambal command. *Annals of Agricultural Research*. New Series 36(4): 364-369.

Narolia, R.S., Singh, P., Mathur, I.N. and Panwar, L.L. 2013. Impact of improved water management technology on productivity and sustainability of soybean grown in Chambal command of S.E.Rajasthan. *Soybean Research* 11(1): 36-42.

Patel, M.M., Jhajharia, A.K., Khadda, B.S. and Patil, L.M. 2013. Frontline demonstration: An effective communication approach for dissemination of sustainable cotton production technology. *Indian Journal of Extension Education* 21: 60-62.

Samuel, S.K., Misha, S. Roy, D.K., Mandal, A.K. and Saha, D. 2000. Evaluation of frontline demonstration on groundnut. *Journal of Indian society Coastal Agricultural Research* 10: 180-183.

Satyavathi, T., Praveen Shelly C., Mazumdar, S., Chugh, L.K. and Kawatra, A. 2017. Enhancing demand of pearl millet as super grain - Current status and way forward. ICAR All India Coordinated Research Project on Pearl millet, Jodhpur. 20 p.

Tewari, P., Singhal, S., Kalash P. and Jain, D. 2018. Entrepreneurship development through food processing. *Indian Farming* 68(9): 56-59.

Yadav, O.P., Rajpurohit, B.S., Beniwal, B.R., Khairwal, I.S., Bishnoi, H.R., Rathore, M.S. 2013. MPMH 17– A new medium maturing dual-purpose pearl millet hybrid. *Indian Farming* 63(9): 8-10.

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