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VARIETAL EVALUATION OF FODDER OAT THROUGH FRONT LINE DEMONSTRATIONS IN KACHCHH REGION OF GUJARAT

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SUMMARY

Oat is a crucial fodder crop that supports small and marginal farmers in the Kachchh region by providing more fodder in saline conditions and increasing income. It is a good source of protein, fiber, and minerals in their green forage, and produce high-quality silage, hay, and excellent grazing when grown with improved practices. To promote improved oat cultivation technology with high-yielding varieties JHO 822 and JHO 2010-1, KVK Bhuj conducted 30 Frontline Demonstrations (FLDs) across 12 hectares from Rabi 2020-21 to 2022-23 at different location of Kachchh Gujarat. The three years' data revealed that the average yield of JHO 2010-1 increased by 12.60%, from 254 q/ha (existing practice) to 286 q/ha (improved practice). The average technology gap, extension gap, and technology index for JHO 2010-1 were 20 q/ha, 32 q/ha, and 6.54%, respectively. For JHO 822, the yield increased by 10.82% in demo plots over conventional practice with an average technology gap, extension gap, and technology index of 59 q/ha, 40.67 q/ha, and 12.30%, respectively. Economically, the demonstrations showed an increased net return of Rs. 35,900/ha with a benefit-cost ratio (BCR) of 2.03 for JHO 2010-1, compared to Rs. 29,166.67 /ha and a BC ratio of 1.85 under local practices. For JHO 822, the net return increased to Rs. 68,066.67 /ha with a BC ratio of 2.89, compared to Rs. 59,466.67 /ha and a BC ratio of 2.73 for local practices. By conducting these FLDs, the yield potential of the oat crop and the income level of the farming community can be significantly improved.

Key words: Oat (*Avena sativa* L.), frontline demonstration (FLD), adoption, economics, technology gap, technology index

Oat (*Avena sativa* L.) is an annual herbaceous crop of the Poaceae family, well-known for its high green biomass productivity. Among cereals, oats produce the greenest fodder while requiring minimal irrigation (Ahmad *et al.,* 2013). In India, oat is a unique fodder crop grown during the rabi season due to their high dry matter content, 7-10% protein content, disease resistance, and suitability for silage production (Ahmad *et al.,* 2014). Oats are more palatable and softer than wheat and barley, making their green fodder highly preferred by all animals. Oat is a winter annual cereal crop cultivated in northern India (Paul *et al.,* 2022), and it can be utilized as green fodder, hay, or silage. It is also an energy-rich crop with excellent regeneration ability and high dry matter content (Kumar *et al.,* 2010). Livestock production is the cornerstone of Indian agriculture, accounting for 7% of the national GDP and providing employment and primary income for 70% of the rural population. India has the largest livestock population (~520 million) globally, representing approximately 15% of the world's cattle population (Neelar, 2011). To feed the current livestock population, 1594 MT of fodder is required annually, comprising 1025 MT of green fodder and 569 MT of dry fodder (Datta, 2013). The industry faces several challenges, including low productivity, high commercial feed costs, low green fodder production, limited dry fodder supply, and outdated technology. Only 4.9% of India's total cropped area is used for cultivated fodder (Kumar *et al.,* 1992).

According to the IGFRI Vision-2050 report, India has a net deficiency of 35.6% in green fodder, 11% in dry agricultural waste, and 44% in feed. To encourage farmers to produce forage crop seeds, especially oats, new varieties with higher seed yield potential should be introduced. The increased nutritional demand for optimal animal performance has pushed producers to select superior oat varieties and combine them with good management practices to produce high-quality fodder with higher yields (Kim *et al.,* 2006). Fodder crops are crucial for maintaining the vast animal population and meeting the growing demand for milk and meat from the increasing human population (Jitendra, 2017). The nutritional composition of fodder and feed directly impacts livestock health and productivity. The success of any dairy industry depends on the availability of nutrient-rich fodder (Surje *et al.,* 2015).

India's fodder production is unevenly distributed, influenced by cattle type, climate, socioeconomic environment, and crop patterns. Cattle and buffalo are often fed cultivated fodder, with some gathered grasses and top feeds used as supplements (Shashikala *et al.,* 2017). States like Punjab, Haryana, Uttar Pradesh, and parts of Madhya Pradesh, Orissa, Bihar, and West Bengal grow oats. The Kachchh district of Gujarat, with its coastal settings and approximately 360 kilometers of west shoreline along the Arabian Sea, offers opportunities for animal husbandry development through its large grasslands. Soil and water salinity, prevalent in the district, hampers fodder production; however, oats can be an option for green fodder under such conditions. Given this context, the current study evaluated the quality and productivity of different oat cultivars for use as fodder in Gujarat's coastal region.

MATERIALS AND METHODS

The experiment was conducted by ICAR-CAZRI, Krishi Vigyan Kendra, Bhuj, during the rabi seasons of 2020-21 and 2022-23 on farmers' fields in the Anjar and Bhuj talukas of Kachchh district. Thirty farmers were selected from each village, resulting in a total sample size of 300 farmers. The experiment lasted three years and took place in ten adopted villages of the Kachchh district in Gujarat's Arid & Semi-arid Zone.

The Kachchh region of Gujarat experiences a hot to semi-arid climate, with temperatures reaching 39-45°C during May and June and dropping to 1-8°C in December and January (Mangalassery *et al.,* 2017). During the rainy season, relative humidity can reach 85-90% in the coastal region and 65% elsewhere. The average annual rainfall is 326 millimeters (1988-2018). The total number of rainy days per year ranges between 12 and 20, with an average of 15 days (Dev *et al.*, 2020). According to soil testing reports from ICAR-CAZRI KVK and the state department, the soils of the Kachchh district are generally low in nitrogen, low to medium in phosphorus, and medium to high in potash. Similarly, iron and zinc levels are low throughout the area. The soils in the study area were primarily saline and alkaline, with pH, EC, OC, P2O5, Na, Ca, and Mg values ranging from 7.60 to 9.20, 0.15 to 1.58 dS/m, 0.06 to 0.5%, 11 kg/ha to 34 kg/ha, 114 to 226 kg/ha, 118 to 220 me/l, and 33 to 50 me/l, respectively, with sandy to sandy loam texture and low to medium micronutrient and organic carbon content. For the study, two blocks, Anjar and Bhuj junction, were selected as they are primary areas where farmers experience very low fodder yields due to the use of low-yielding oat varieties and saline soil with poor quality water. A total of 30 frontline demonstrations were held across a 12-hectare area in various villages. ICAR-CAZRI- KVK Bhuj introduced high-yielding oat varieties like JHO 822 and JHO 2010-1 in demonstration plots, comparing them to farmers' existing practices of green fodder production.

In this study, data on fodder oat production were collected from FLD plots as well as from local practices commonly used by farmers in this region on the same fields to investigate the differences between potential and demonstration yields, extension gap, and technology index. In demonstration plots, critical inputs such as quality seed and improved package of practices were demonstrated to farmers, while existing practices were treated as local checks. To compare the varietal performance, data on green fodder yield were gathered separately from both improved practices (IP) and farmers' practices (FP). The data were collected, tabulated, and analyzed using statistical tools like frequency and percentage. The extension gap, technology gap, and technology index were calculated using the formulae provided by Samui *et al.* (2000).

RESULTS AND DISCUSSION

Frontline Demonstration (FLD)

Frontline Demonstration is a new concept developed by ICAR to demonstrate newly released crop production technologies and their management practices in farmers' fields. The main objective of these demonstrations is to showcase the effectiveness of these new technologies.

Varietal Effect on Fodder Yield

ICAR-CAZRI Krishi Vigyan Kendra, Kachchh-Bhuj, conducted frontline demonstrations on fodder oat using high-yielding varieties (JHO 2010-1 and JHO 822) with improved practices, pest control, and enhanced knowledge and adoption of improved practices across ten villages in the Kachchh district. The results indicated (Table 1) that high-yielding varieties produced an average additional yield of 32 q/ha for JHO 2010-1 and 40.67 q/ha for JHO 822 compared to the local check (oat variety Kent). The maximum average yield from the improved varieties was 436.67 q/ha for JHO 822, followed by 314.67 q/ha for JHO 2010-1. In the local check, yields were 254 q/ha and 375.33 q/ha, respectively. A percentage increase in growth of 12.60% was observed for JHO 2010-1 and 10.82% for JHO 822. These findings align with the research of Singh and Tetarwal (2022), Neelar (2011), and Sheoran *et al.* (2017).

Gap Analysis

The data presented in table 1 showed that the technological gap, which measures the difference between demonstrated yield and potential yield, was highest (26 q/ha) in 2022-23, followed by 21 q/ha in 2020-21 and 13 q/ha in 2021-22, with an average of 20 q/ha for JHO 2010-1. For JHO 822, the gap was 70 q/ha in 2020-21, 50 q/ha in 2021-22, and 57 q/ha in 2022-23, with an average gap of 59 q/ha. These gaps suggest that potential yields of improved practices were not fully achieved due to varying field conditions such as soil fertility, poor irrigation water quality, pest infestations, and changing meteorological conditions. Similar observations were made by Singh and Tetarwal (2022) and Jitendra (2017).

The extension gap, which measures the yield difference between demonstration plots and existing farmers' practices, ranged from 28 q/ha to 35 q/ha for JHO 2010-1 and 37 q/ha to 45 q/ha for JHO 822. The average extension gap was 32 q/ha for JHO 2010-1 and 40.67 q/ha for JHO 822. To minimize this gap, various extension approaches such as the adoption of high-yielding varieties, training programs, and improved agro-technologies are needed. These initiatives could help farmers adopt new and improved production technologies, thereby reducing the extension gap. The findings of Tetarwal and Singh (2020) and Jitendra (2017) support these conclusions.

The technology index, which shows the percentage ratio of the technological gap to potential yield, demonstrates the viability of advanced technologies in farmers' fields. The highest technology index value was 14.37% for JHO 822, while the lowest was 10.53% in 2021-22, followed by 8.50% for JHO 2010-1 in 2022-23. During the three-year FLD program, the average technology index for the oat crop was 12.30% for JHO 822 and 6.54% for JHO 2010-1. Similar results were found by Tetarwal and Singh (2020) and Singh and Tetarwal (2022).

Economic Performance

The economic data from the frontline demonstrations (Table 2 and Fig. 2) showed the cost of cultivation, gross return, net return, and benefit-cost ratio (BCR) of the oat crop under improved practices and existing farmers' practices. The average cost of cultivation was higher for improved practices (Rs. 35,600/ha and Rs. 35,933.33/ha) for JHO 2010-1 and JHO 822, respectively, compared to local practices (Rs. 34,333.33/ha and Rs. 34,366.67/ha). The demonstration plots recorded significantly higher average gross returns (Rs. 71,500/ha and Rs. 104,000/ha) compared to farmers' practices (Rs.

TABLE 1

Yield of oat as influenced by improved technologies over local practice

Year	Variety	Demo plot Yield (q/ha)			Local (q/ha)	Add. yield over local (q/ha)	Increased in yield over local (%)	Ext. gap (q/ha)	Tech. gap (q/ha)	Tech. index (%)
		Max.	Min.	Mean						
2020-21	JHO 2010-1	315	290	285	250	35	14.00	35	21	6.86
	JHO 822	435	392	405	368	37	10.05	37	70	14.37
2021-22	JHO 2010-1	324	288	293	260	33	12.69	33	13	4.25
	JHO 822	447	412	425	380	45	11.84	45	50	10.53
2022-23	JHO2010-1	305	274	280	252	28	11.11	28	26	8.50
	JHO 822	428	383	418	378	40	10.58	40	57	12.00
Mean		375.7	339.8	351.0	314.7	36.33	11.71	36.33	39.50	9.42
S.D.		67.37	62.12	71.61	66.67	5.85	1.46	5.85	22.69	3.65
S. Em±		27.50	25.36	29.24	27.22	2.39	0.59	2.39	9.26	1.49
C.V. (%)		17.93	18.28	20.40	21.19	16.11	12.44	16.11	57.44	38.73

TABLE 2
Economics of fodder oat as affected by improved production technologies over local practice

Year	Variety	Total cost of cultivation (Rs.)		Gross returns (Rs./ha)		Net returns (Rs./ha)		B:C ratio		Addi. cost of cultiv-ation (Rs.)	Addi net returns (Rs.)
		IP	FP	IP	FP	IP	FP	IP	FP		
2020-21	JHO-2010-1	35200	33700	71250	62500	36050	28800	2.02	1.85	1500	7250
	JHO 822	35500	33900	101250	92000	65750	58100	2.85	2.71	1600	7650
2021-22	JHO-2010-1	35700	34500	73250	65000	37550	30500	2.05	1.88	1200	7050
	JHO 822	36000	34200	106250	95000	70250	60800	2.95	2.78	1800	9450
2022-23	JHO-2010-1	35900	34800	70000	63000	34100	28200	2.01	1.81	1100	5900
	JHO 822	36300	35000	104500	94500	68200	59500	2.88	2.70	1300	8700
Mean		35767	34350	87750	78667	51983	44317	2.46	2.29	1416.7	7667
S.D.		388.16	508.9	17903.2	16666.3	17709.8	16635.1	0.48	0.49	263.9	1258.8
S. Em±		158.46	207.8	7308.96	6804.0	7229.98	6791.3	0.19	0.20	107.8	513.9
C.V. (%)		1.09	1.48	20.40	21.19	34.07	37.54	19.4	21.2	18.6	16.4

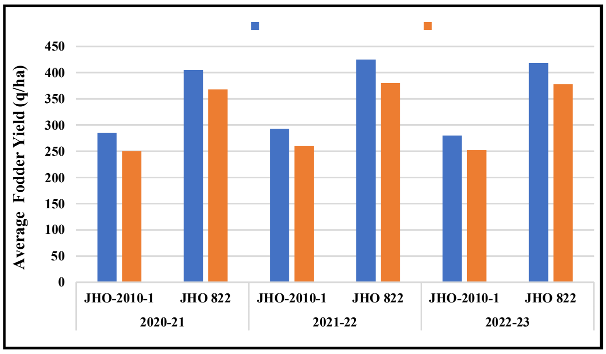

Fig. 1. Average fodder yield of improved variety compared with farmers' practice.

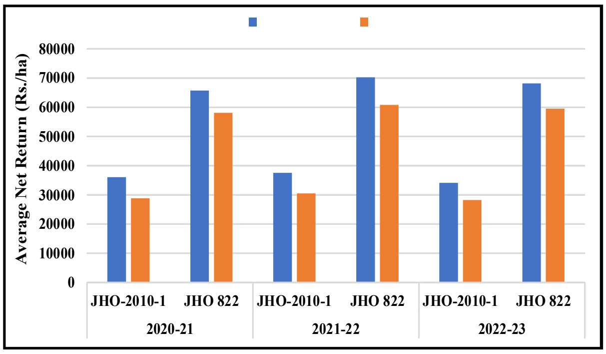

Fig. 2. Average net returns of improved variety compared with farmers' practice.

63,500/ha and Rs. 93,833.33/ha), with average BCRs of 2.03 and 2.89 for JHO 2010-1 and JHO 822, respectively, compared to 1.85 and 2.73 for farmers' practices. The additional cost of cultivation for improved practices was Rs. 1,266.7/ha for JHO 2010-1 and Rs. 1,566.7/ha for JHO 822, with an additional net return of Rs. 6,733.3/ha and Rs. 8,600/ha, respectively. These findings are consistent with those of Tetarwal and Singh (2020) and Singh *et al.,* (2019).

CONCLUSIONS

Frontline demonstrations on oats have proven to be an effective method to convince not only participating farmers but also neighbouring farmers of the benefits of improved practices. To close existing gaps, joint extension initiatives are needed to enhance the adoption of location- and crop-specific technologies among farmers. The economic feasibility of the demonstrations, indicated by a significant benefit-cost ratio, has persuaded farmers to implement these interventions. Successful implementation of frontline demonstrations and various extension activities, such as training, field days, and exposure visits, can facilitate the horizontal distribution of better technologies. Farmers have shown a strong interest in planting these high-yielding oat varieties in upcoming seasons.

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