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IMPACT OF FRONTLINE DEMONSTRATIONS ON YIELD AND ECONOMICS OF FENNEL (*Foeniculum vulgare* MILL.) IN BANASKANTHA DISTRICT OF GUJARAT, INDIA

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ABSTRACT

Front Line Demonstrations (FLDs) play a vital role in accelerating the adoption of improved crop production technologies under farmers' field conditions. The present investigation was conducted by Krishi Vigyan Kendra, Banaskantha-II, Gujarat, during the *rabi* seasons of 2022-23 to 2024-25 to evaluate the performance of improved fennel production technology and its influence on crop productivity and profitability. A total of 45 FLDs were organized on the fields of 45 farmers covering an area of 18 ha at Dhima, Forna, Rampura, Kotda villages using the improved fennel variety Gujarat Fennel 12 along with the recommended package of practices. The demonstrated technology was compared with the prevailing farmers' practices. The improved production technology recorded the superior crop growth and seed yield over farmers' practice. In case of growth attributes, maximum plant height (152.08 cm), branches per plant (13.07) and number of umbels per plant (16.21) in improved practice (IP) than the farmers' practice (FP), which recorded 145.25 cm plant height, 9.96 branches per plant and 13.65 umbels per plant, respectively. The average demonstration yield of 22.23 kg/ha was higher than the farmers' yield of 19.12 kg/ha, indicating the significant production potential of the demonstrated technology under field conditions. Improved crop management also resulted in better economic returns with a higher benefit-cost ratio than the existing farmers' practice. The study highlights that Front Line Demonstrations are an effective extension approach for narrowing the productivity gap, improving farm profitability and promoting the adoption of scientific fennel cultivation practices in North Gujarat.

Key words : Fennel, Improved practices, Farmer practices and Demonstration.

Introduction

Fennel (*Foeniculum vulgare* Mill.) is commonly known as 'saunf' belongs to the family Apiaceae. It is an important open-pollinated spice of temperate and subtropical regions (Kumar *et al.*, 2022) originated in the southern Mediterranean region (Badgujar *et al.*, 2014) and has become an integral component of Indian agriculture, cuisine and traditional medicine. India recognized as the world's leading producer and consumer of spices and long been recognized globally as the "Land of Spices, Ainapur *et al.* (2025) with fennel ranking among the most important seed spices. In India total spice cultivation covered 46.87 lakh hectares with the production of 119.96 lakh metric tons, whereas fennel cultivated

around 2.77% of the total spice area and contribute about 2.03% of the total spice production in India. Gujarat state is leading in total area and production of spices with share of 77.0 and 86.2 per cent in area and production receptively, followed by the Rajasthan (Anonymous, 2025a). In Gujarat state, fennel mainly grown in the districts, (Surendranagar, Banaskantha, Mehsana, Aravali, Sabarkantha, Gandhinagar, Patan and Kutch) over 63,776 hectares' area with the production of 1.31 metric tons. The Banaskantha district contributes 4,111 hectares and a production of 8,222 metric tons around 6.45% of total fennel area of the state (Anonymous, 2025b). The crop is widely valued for its aromatic seeds (Badgujar *et al.*, 2014), which are used in culinary preparations as well as

in pharmaceutical and nutraceutical products (Zeeshan *et al.*, 2023). Fennel seeds are rich in essential nutrients, minerals and vitamins (Lekhwar *et al.*, 2026). District Banaskantha has suitable agro-climatic conditions having great potential and favourable conditions for fennel cultivation even though the area is still less. Despite this, the productivity levels observed at farmers' fields often remain below the potential yield achieved under recommended scientific practices. This gap highlights the need for effective dissemination and adoption of improved production technologies. Front Line Demonstrations (FLDs) have been recognized as an effective approach to bridge this gap between research and practice. These demonstrations are conducted under real farming conditions to showcase the performance of improved crop varieties and recommended agronomic practices. By providing farmers with access to quality inputs, scientific guidance and hands-on experience, FLDs help in enhancing productivity and profitability. They also serve as a platform for identifying constraints faced by farmers and gathering feedback for further refinement of technologies. Considering the importance of fennel cultivation in the region and the existing yield gaps, the present study was undertaken in Banaskantha district of Gujarat. The objective was to evaluate the impact of Front-Line Demonstrations on yield, economics and technology adoption. The study also aims to analyse yield gap, extension gap and technology index between demonstrated practices and farmers' traditional methods, thereby assessing the effectiveness of FLDs in improving fennel production and farmers' income.

Materials and Methods

The present investigation was carried out by the Krishi Vigyan Kendra, Banaskantha-II SDAU, Gujarat during the rabi seasons from 2022-23 to 2024-25. The study was implemented at farmers' fields covering different (Dhima, Forna, Rampura, Kotda,) villages under KVK jurisdiction area in total, 45 frontline demonstrations (FLDs) were conducted over an area of 18 hectares. The area is characterized by semi-arid climate with low and erratic rainfall and soil having moderate fertility level with low water holding capacity. The demonstrations were conducted using the high-yielding fennel variety GF-12, developed by the Seed Spices Research Station, Sardarkrushinagar Dantiwada Agricultural University (SDAU), Gujarat. The variety is recommended for cultivation in North Gujarat because of its high yield potential and adaptability under irrigated conditions. The improved production technology included the use of certified seed, timely sowing, line sowing at the recommended spacing, balanced nutrient management,

timely irrigation, integrated weed management and need-based plant protection measures according to the package of practices recommended for North Gujarat. Farmers' practice consisted of the locally followed cultivation methods, which generally involved the use of farm-saved seed, non-uniform crop geometry, imbalanced fertilizer application and conventional crop management. Each demonstration plot established adjacent to a plot managed under the farmer's existing cultivation practice, enabling a direct comparison under identical field conditions. Sowing was carried out in rows during the fourth week of October, maintaining a spacing of 45 × 15 cm. The Seeds were treated with carbendazim @ 2.5g/kg seed followed by *Trichoderma viride* at @ 10 g per kg of seed prior to sowing. A recommended fertilizer dose of 90 kg nitrogen and 30 kg phosphorus (P₂O₅) along with 10 ton Fermented Organic Manure (FYM), per hectare was applied. The entire phosphorus and half of the nitrogen was applied as a basal dose, while the remaining nitrogen was top-dressed in two equal splits at 30 and 60 days after sowing (DAS). Weed management included the application of pendimethalin at 1.0 kg/ha as a pre-emergence herbicide, followed by one hand weeding at 30 Days after sowing. No major incidence of diseases was observed during the crop period. However, for the sucking pest *i.e.* aphid, thrip neem oil followed by dimethoate 30 EC @ 10 ml per 10 lit of water was used as a preventive measure. The observations on plant height at harvest (cm), number of primary branches per plant and number of umbels per plant were recorded from randomly selected representative plants in each demonstration. Seed yield was recorded from the net harvested area of both demonstration and farmers' practice plots and expressed as kg/ha.

Assessment of technology

The FLDs were evaluated to assess yield performance, extension gap and technology index by comparing demonstration plots with farmers' traditional practices. The technology gap indicates the difference between the potential yield of the variety and the yield obtained under farmers' field conditions. The extension gap reflects the yield advantage achieved through improved production technology over the existing farmers' practice. The technology index expresses the feasibility and field applicability of the demonstrated technology, where lower values indicate greater adaptability under farmers' conditions. The assessment indicator was calculated as per the following formula.

Technology gap = Potential yield – Demonstration yield

Table 1 : Comparison of improved production technology and farmers' practices adopted in Front Line Demonstrations.

Particular	Farmers' practice	Improved technology demonstrated
Variety	Local seed/GF11	Gujarat Fennel 12 (Improved variety from SDAU, Dantiwada)
Sowing time	October to November	Last week of October to first week of November
Seed treatment	None	Carbendazim @ 2.5g/kg seed followed by <i>Trichoderma viride</i> at @ 10 g per kg of seed/ Azotobacter 4.0 gm/kg and PSB (PBA-4) 4.0 g/kg seed
Method of sowing and spacing	Conventional sowing, non-uniform spacing	Line sowing at 45 × 15 cm (Row x Plant)
Nutrient management	FYM- 2-3 @ ton/ha Imbalanced fertilizer application	FYM @ 10-12 ton/ha Recommended dose 45 kg N and 30 kg P/ha as basal dose and remaining 45 kg N/ha apply in two equal splits at 30 and 60 DAS
Weed management	Irregular weeding	Pendimethalin 30 EC @ 1.0 L/ ha immediate day after sowing. Hand weeding at 25 and 40 days after sowing followed by inter culture operation
Irrigation	As per farmers' convenience	Fist at sowing time, 8 and 33 DAS and remaining seven irrigations at 12 - 15 days interval
Plant protection	Broadly used chemicals fungicide mancozeb	- Carbendazim + Mancozeb @ 0.2 % (1.35 kg/ha) or chlorothalonil 75 WP @ 0.15 % (20 g/10 lit. water) for three times at an interval of 10 days for Ramularia blight - Two foliar sprays of thiamethoxam 25 WG @ 0.0084 % (3.5 g in 10 lit. water) or acetamiprid 20 SP @ 0.004 % (2 g in 10 lit. water) for seed wasp

Extension gap = Demonstration yield – Farmers practice yield

Additional return = Demonstration return – Farmers practice return

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

Results and Discussion

Growth attributes

The observations recorded over three consecutive years revealed that the crop exhibited satisfactory growth under the recommended package of practices, as reflected in plant height, number of primary branches and number of umbels per plant (Table 2). Plant height at harvest was consistently greater under improved practices (IP) in all three years, ranging from 148.65 to 154.34 cm compared with 137.54 to 149.73 cm under farmers practices (FP). On a average basis, plants under IP attained a mean height of 152.08 cm, which was 6.83 cm (4.70%) higher than FP (145.25 cm). The number of branches per plant under IP ranged from 11.34 to 15.44 compared with 8.62 to 11.21 under FP. The average mean recorded 13.07 branches per plant under IP against 9.96 under FP. The greatest improvement was recorded during 2022-23, where IP produced 12.43 branches per plant compared with only 8.62 under FP, indicating a substantial enhancement in canopy development. The number of umbels per plant remained consistently higher under IP

throughout the study period, varying from 14.32 to 17.88, whereas FP recorded only 12.66 to 14.43 umbels per plant. On average, IP produced 16.21 umbels per plant compared with 13.65 under FP. Among the individual years, the highest value (17.88 umbels per plant) was observed during 2024-25 under IP, while FP recorded only 14.43. Since umbels constitute the primary reproductive units responsible for seed formation in fennel, their increased number directly reflects greater reproductive efficiency and yield potential. The results of improved practice (IP) are consistent with previous findings that integrated and scientific crop management enhances vegetative growth and reproductive development in fennel. These improvements indicate that balanced nutrient management coupled with timely agronomic interventions promoted greater biomass

Table 2 : Growth attributes of fennel under Front Line Demonstrations.

Year	Plant height at harvest (cm)		Branches per plant		Umbels per plant	
	IP	FP	IP	FP	IP	FP
2022-23	154.34	149.73	12.43	8.62	16.44	13.88
2023-24	148.65	137.54	11.34	10.05	14.32	12.66
2024-25	153.24	148.50	15.44	11.21	17.88	14.43
Mean	152.08	145.25	13.07	9.96	16.21	13.65

*IP=Improved Practice; FP= Farmers Practice

accumulation and assimilate partitioning towards reproductive structures. Similar responses were reported by Kalasare *et al.* (2016), who demonstrated that integrated nutrient management significantly increased plant height, branching, umbels per plant and seed yield of fennel under Gujarat conditions. Similarly, Kumar *et al.* (2022) reported that the combined application of recommended fertiliser doses with *Azotobacter* and phosphate-solubilising bacteria improved plant growth, branching, yield attributes and seed yield by enhancing nutrient availability and uptake efficiency. Similar improvements in fennel growth and productivity under improved production technologies have been reported by Singh and Choudhary (2025), who highlighted that integrated technological interventions substantially improve crop vigour and yield potential of fennel in Rajasthan.

Yield performance

The improved practice (IP) outperformed the farmers' practice (FP) in seed yield across all three years (Table 3). The mean seed yield under IP was 22.23 q/ha, compared with 19.12 q/ha under FP, resulting in an average yield obtained 16.41% over FP. The yield improvement increased progressively from 9.17% in 2022-23 to 24.71% in 2024-25, indicating the consistent effectiveness of the recommended production technology under varying seasonal conditions. Despite a potential yield of 25.00q/ha, the yield gap between potential and realised yield under IP remained relatively small (2.78q/ha), suggesting that adoption of improved practices enabled farmers to exploit a greater proportion of the crop's yield potential. The higher productivity achieved under IP can be attributed to the combined effect of improved crop establishment, balanced nutrient management, timely plant protection measures and better agronomic management, which collectively enhanced crop growth and yield attributes. Similar findings were reported by Kumar *et al.* (2022), who observed significant increases in fennel seed yield following integrated nutrient management involving the recommended fertiliser dose combined with *Azotobacter* and phosphate-solubilising bacteria, owing to improved nutrient availability and enhanced yield components. Further, the yield advantage observed under the improved practice is consistent with the findings of Ramnival *et al.* (2022), who reported a 22.08% increase in fennel seed yield under frontline demonstrations compared with farmers' practice, highlighting the effectiveness of improved production technologies under farmers' field conditions.

Technology gap

Table 3 : Effect of Front Line Demonstrations on seed yield of fennel.

Year	Potential yield (Q/ha)	Yield (Q/ha)		% increase over check (FP)
		IP*	FP	
2022-23	25.00	21.67	19.85	9.17
2023-24	25.00	21.80	18.90	15.34
2024-25	25.00	23.20	18.60	24.71
Mean	25.00	22.23	19.12	16.41

*IP=Improved Practice; FP= Farmers Practice

The technology gap, defined as the difference between potential yield and demonstration yield. The data shown in (Table 4) indicated that technology gap declined from 3.33 q/ha in 2022-23 to 1.80 q/ha in 2024-25, with an average mean of 2.78 q/ha. The progressive reduction in technology gap indicates improved realization of the crop's yield potential under frontline demonstrations and reflects the effectiveness of the recommended production technology under farmers' field conditions. However, the remaining gap suggests that environmental variability and location-specific management constraints still limited complete exploitation of the potential yield. Comparable reductions in technology gap under fennel frontline demonstrations have been reported by Ramniwas *et al.* (2022) in arid Gujarat and Singh and Choudhary (2025), who attributed lower technology gaps to improved adoption of scientific crop management practices. However, the another FLD studies by Meena and Dudi (2012), highlighting that technology gaps primarily arise from agro-climatic variability and partial adoption of recommended practices. Similarly, Kaid *et al.* (2012) reported that the overall technological gap in fennel cultivation was 36.80%, indicating that partial adoption of recommended technologies remains a major constraint to achieving the crop's production potential in banaskantha district.

Extension gap

The data presented in the (Table 4) showed the extension gap increased from 1.82 q/ha in 2022-23 to 4.60 q/ha in 2024-25, with a mean of 3.11 q/ha. This increasing trend demonstrates the substantial yield advantage of improved practices over the existing farmers' practice and indicates considerable scope for enhancing productivity through wider dissemination of recommended technologies. In contrast, the yield under farmers' traditional practices remained comparatively stable because many farmers continued to follow their existing cultivation methods and did not fully adopt the recommended technologies. Consequently, the difference between demonstration yield and farmers' yield widened,

Table 4 : Technology gap, extension gap and technology index under Front Line Demonstrations on fennel.

Year	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
2022-23	3.33	1.82	13.32
2023-24	3.20	2.90	12.80
2024-25	1.80	4.60	7.21
Mean	2.78	3.11	11.11

demonstrations (10.0%), indicating good field applicability of improved production technologies. Similar interpretations have been reported by Meena and Dudi (2012) and Singh *et al.* (2022), who concluded that lower technology indices reflect better compatibility of recommended technologies with local production systems and higher prospects for large-scale adoption. Further, Rajpoot *et al.* (2021), who reported a technology index of 6.90% in fennel frontline demonstrations under drip

Table 5 : Economic analysis of Front Line Demonstrations on fennel.

Year	Total cost of cultivation of (₹/ha)		Gross returns (₹/ha)		Net returns (₹/ha)		Additional return (₹)	B:C Ratio	
	IP*	FP	IP	FP	IP	FP		IP	FP
2022-23	38900	37800	282880	258310	243980	220510	23470.00	7.27	6.83
2023-24	39800	39900	249800	216556	210000	176656	33344.00	6.28	5.43
2024-25	41500	40800	271864	204600	230364	163800	66564.47	6.55	5.01
Mean	40066	39500	268181	226488	228114	186988	41126.00	6.70	5.76

*IP=Improved Practice; FP= Farmers Practice

leading to an increase in the extension gap. The higher extension gap therefore indicates the substantial potential for increasing fennel productivity through wider dissemination and adoption of the recommended production technologies. A higher extension gap reflects the need to strengthen extension efforts, farmer training and timely technical support to accelerate adoption of improved production practices. Similar findings were reported by Ramniwas *et al.* (2022) in fennel, who observed an average extension gap of 3.90 q/ha, indicating significant opportunities for improving farm productivity through technology transfer. Comparable conclusions have also been drawn by Tatarwal and Ramniwas (2022) in coriander and Singh *et al.* (2022) in wheat, emphasizing that effective extension interventions substantially reduce the productivity gap between demonstration and farmers' fields.

Technology index

The results presented in the (Table 4) The technology index decreased from 13.32% in 2022-23 to 7.21% in 2024-25, with an overall average of 11.11%. A lower technology index indicates greater feasibility and adaptability of the demonstrated technology under farmers' field conditions. The declining trend over the study period suggests that the recommended package of practices became increasingly effective and acceptable to farmers, thereby improving technology performance under real farming situations. The average technology index observed in the present study is comparable with that reported by Ramniwas *et al.* (2022) for fennel

irrigation and fertigation.

Economic analysis

Economic viability is one of the major factors influencing farmers' decisions to adopt improved agricultural technologies. Therefore, the economic performance of the demonstrated technology was evaluated by comparing the cost of cultivation, gross return, net return and benefit-cost ratio with the prevailing farmers' practice (Table 5). The economic analysis demonstrated that the improved practice (IP) was consistently more profitable than the farmers' practice (FP) throughout the study period (Table 5). Although the average cost of cultivation under IP (₹ 40,066 per ha) was marginally higher than FP (₹ 39,500 per ha) the additional investment resulted in substantially greater economic returns. The mean gross return under IP was ₹ 268,181 per ha, compared with ₹ 226,488 per ha under FP, while the corresponding net returns were ₹ 228,114 per ha and ₹ 186,988 per ha, respectively. Consequently, adoption of the improved production technology generated an average additional return of ₹ 41,126 per ha, with the highest additional return (₹ 66,564 per ha) recorded during 2024-25. Similarly, the mean benefit Cost (B:C) ratio increased from 5.76 under FP to 6.70 under IP, indicating that every additional investment made under the recommended technology produced proportionately higher economic gains. The higher profitability under IP can be attributed to increased seed yield and improved resource-use efficiency achieved through the adoption of the recommended package of practices. Similar,

economic advantages of frontline demonstrations in fennel have been reported by Rajpoot *et al.* (2021), who observed higher net returns and benefit ratio under improved production technologies involving drip irrigation and fertigation. Likewise, Ramniwas *et al.* (2022) reported that frontline demonstrations on fennel generated an average additional return of ₹ 22,562 ha⁻¹ over farmers' practice, confirming the economic viability of improved production technologies. The current results are in line with Meena and Dudi (2012), Singh *et al.* (2024), Hooda *et al.* (2024), Gaur *et al.* (2024) and Singh and Choudhary (2025).

Conclusion

The findings of the three years frontline demonstration at farmers' fields clearly demonstrate that the improved fennel production technology, including the high-yielding variety Gujarat fennel 12 and the recommended package of practices, performed consistently better than the prevailing farmers' practice under the agro-climatic conditions of Banaskantha, North Gujarat. The demonstrated technology improved plant growth, seed yield and profitability while reducing the technology gap and enhancing resource-use efficiency. The higher net returns and benefit ratio confirmed the economic viability of adopting the recommended production practices. Further, the systematic extension interventions such as farmer trainings, field demonstrations and technical advisories, are needed accelerate technology adoption and enhancing the productivity and profitability of fennel cultivation under farmers' field conditions.

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References

- Ainapur, S.D., Prasad M.B.N., Prabhakar I. and Meghana H.R. (2025). Flavors of legacy: The evolution and prominence of India's spice industry. *Int. J. Res. Agron.*, **8(7)**, 1866-1872. <https://doi.org/10.33545/2618060X.2025.v8.i7w.3902>
- Anonymous (2025a). Major spice state wise area production 2024-25. Spices board of India. [web.pdf](http://www.indianspices.com/sites/default/files/Major%20spice%20state%20wise%20area%20production%202024-25%20web.pdf)
- Anonymous (2025b). Horticulture cultivation: Area and production of horticultural crops, 2024-25. Department of Horticulture, Government of Gujarat. Department of Horticulture, Government of Gujarat.
- Badgujar, S.B., Patel V.V. and Bandivdekar A.H. (2014). *Foeniculum vulgare* Mill: A review of its botany, phytochemistry, pharmacology, contemporary application and toxicology. *BioMed Res. Int.*, 842674. <https://doi.org/10.1155/2014/842674>
- Gaur, V.S., Bisen U.K., Bisen N.K. and Solanki R.S. (2024). Impact of Front-Line Demonstration on Yield and Economics of Hybrid Rice Varieties (JRH-5 and JRH-19). *Asian Res. J. Agricult.*, **17(1)**, 73-78. DOI: 10.9734/ARJA/2024/v17i1416.
- Hooda, V. Kumar S. and Singh S.K. (2024). Estimation of gap and economic analysis of cluster frontline demonstrations on mustard crop. *Int. J. Agricult. Ext. Soc. Develop.*, **7(6S)**, 188-191. DOI: 10.33545/26180723.2024.v7.i6Sc.741.
- Kaid, S.V., Prajapati M.R., Prajapati R.R. and Sen A. (2012). Technological gap in kharif fennel cultivation by fennel growers of Banaskantha district of Gujarat. *Gujarat J. Ext. Educ.*, **23**, 117-119.
- Kalasare, R.S., Patel M.V., Patel H.K., Kadu S.P., Patel A.P. and Umale A.A. (2016). Role of Integrated Nutrient Management on Growth Attributes, Yield Attributes and Seed Yield of Rabi Fennel (*Foeniculum vulgare* Mill.) in Middle Gujarat condition. *J Pure Appl Microbiol.*, **10(4)**, 3057-3062. doi: 10.22207/JPAM.10.4.78
- Kumar, R. and Pal V. (2024). Productivity of fennel (*Foeniculum vulgare* Mill) genotypes in response to varying sowing time and row spacing under Punjab conditions. *Plant Sci. Today*, **2(11)**, sp3: 36-42. <https://doi.org/10.14719/pst.4720>
- Kumar, V., Singh P., Malik T.P., Kumar V., Richa, Sharma N. and Kumar A. (2022). Effect of integrated nutrient management on growth and yield of fennel (*Foeniculum vulgare*). *Indian J. Agricult. Sci.*, **92(1)**, 131-135.
- Lekhwar, C., Meghwal M. and Giuffre A.M. (2026). Bioactive compounds of fennel seeds: Their current status, biofunctional properties, novel processing technologies, and application. *Curr. Nutr. Food Sci.*, **22(1)**, 1-16.
- Meena, M.L. and Aishwarya Dudi (2022). On Farm Testing of Chickpea (*Cicer arietinum* L.) Cultivars for Site-specific assessment under Rainfed condition of Western Rajasthan. *Indian J. Ext. Educ.*, **48(3&4)**, 93-97.
- Rajpoot, R.S., Rajhansa K.C., Harishankar, Kumar V., Singh K., Bobade P.R., Tekam D.S. and Kanwar P.C. (2021). Impact of front line demonstration on productivity of fennel cv. AF 2 through drip and fertigation in tribal belt of Korea district (Chhattisgarh). *J. Pharmacog. Phytochem.*, **10(1)**, 2354-2356.
- Ramniwas, Kanwat M. and Jat S.R. (2022). Impact through a front-line demonstration on yield and economics of fennel (*Foeniculum vulgare* Mill) in arid Kachchh of Gujarat. *J.*

- Agricult. Ecol.*, **14**, 125-130; <http://doi.org/10.53911/JAE.2022.14217>
- Singh, A.K. (2021). Integrated Crop Management Practices of Wheat through Frontline Demonstration in Bundelkhand Region. *Indian J. Ext. Educ.*, **58(1)**, 36-39.
- Singh, G. and Choudhary K. (2025). Advanced technological intervention for boosting fennel crop productivity in Rajasthan. In : Chauhan J.K., Pradhan K., Meena H.R., Sharma A.K., Kumar V., Noopur K. and Panwar A.S. (Eds.). *Agricultural Alchemy: Transformative Agriculture for Sustainable Rural Growth* 136-142.
- Singh, T., Renjith P.S., Singh S.P., Anand K.B., Rai K.N. and Rai T.N. (2024). Impact of Cluster Front Line Demonstration on Yield and Economics of *Kharif* sesame in Semi-arid Regions of Gujarat. *J. Exp. Agricult. Int.*, **46(12)**, 866-871. DOI: 10.9734/JEAI/2024/v46i123195.
- Tetarwal, A.S. and Ramniwas (2022). Popularization of Coriander Production Technology through Front Line Demonstrations in the Arid Zone of Gujarat. *Indian Res. J. Ext. Edu.*, **22(3)**, 224-23.
- Zeeshan, A., Akram H., Qasim S., Naseer A., Nazar F. and Rafique O. (2023). The healing touch of *Foeniculum vulgare* Mill. (fennel): A review on its medicinal value and health benefits. *J. Hlth Rehab. Res.*, 793-800.