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Yield gap analysis of front-line demonstrations in Cumin (*Cuminum cyminum* L.) under arid conditions of North Gujarat

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ABSTRACT

Front line demonstrations (FLDs) are an effective extension approach for demonstrating scientific cultivation practices under farmers' field conditions. A five-year FLD programme on cumin *(Cuminum cyminum* L.) was conducted at farmers' fields of Radhanpur and Santalpur talukas of North Gujarat during *rabi* seasons from 2018–19 to 2022–23. Fifty demonstrations were conducted to evaluate progressive interventions involving line sowing, weed management and an integrated improved production package. During 2018–19, line sowing increased seed yield from 712 to 732 kg/ha (2.81%). Line sowing combined with improved weed management during 2019–20 increased yield from 892 to 915 kg/ha (2.58%). During 2020–21 to 2022–23, the integrated improved production package increased mean yield by 4.60, 4.43 and 5.09% over farmers' practice, respectively. Pooled across 50 demonstrations, improved practice produced 755.56 kg/ha compared with 727.86 kg/ha under farmers' practice, representing an advantage of 27.70 kg/ha (3.81%). The B:C ratio ranged from 1.31–3.93 under IP compared with 1.11–3.41 under FP. The results demonstrate the practical value of FLDs for improving adoption, productivity, better economic efficiency and profitability of the cumin demonstrated technologies in the arid region of North Gujarat.

Keywords: Cumin, front line demonstration, line sowing, yield advantage

INTRODUCTION

Cumin (*Cuminum cyminum* L.) is an important seed spice crop extensively cultivated in the arid and semi-arid regions of Gujarat and Rajasthan. Gujarat is one of the major cumin-producing states of India, with productivity varying considerably among production regions. The crop is particularly important for farmers of North Gujarat because of its comparatively short duration and suitability to *rabi* season conditions. Despite the availability of improved varieties and production technologies, productivity at farmers' fields is frequently constrained by inadequate adoption of recommended crop management practices. Uneven crop establishment, broadcasting, inappropriate weed management, imbalanced nutrient application and inadequate management of diseases and insect pests may contribute to the yield gap between attainable and farmers' yields.

In the Narmada command area of North Gujarat including Radhanpur and Santalpur talukas, Dry Farming Research Station (DFRS), Sardarkrushinagar Dantiwada Agricultural University, Radhanpur has created opportunities for improving agricultural production through better access to irrigation and improved farm technologies under the Sardar Sarovar Narmada Nigam Limited (SSNNL) project. To promote the adoption of recommended agricultural practices and enhance crop productivity in the command area, frontline demonstrations (FLDs) on cumin were conducted under the SSNNL project. These demonstrations aimed to demonstrate improved production technologies directly on farmers' fields and to reduce the gap between existing farmers' practices and recommended practices.

Front line demonstrations provide an opportunity to evaluate and demonstrate recommended technologies under actual farmers' field conditions. Such demonstrations can help farmers observe the performance of improved practices in comparison with their existing practices and facilitate wider dissemination. Earlier FLD studies in cumin have reported higher productivity and economic returns from recommended varieties and production practices. In North Gujarat, information on the long-term performance of progressively improved cumin production practices

under farmers' field conditions is limited. Therefore, a five-year FLD programme was undertaken at DFRS, SDAU, Radhanpur to demonstrate improved cumin production technologies and assess their effect on seed yield under farmers' field conditions.

MATERIALS AND METHODS

Experimental site

The Front Line Demonstrations were conducted during the *rabi* seasons of 2018–19 to 2022–23 in farmers' fields of Radhanpur and Santalpur talukas of North Gujarat under the extension programme of Dry Farming Research Station, Sardarkrushinagar Dantiwada Agricultural University, Radhanpur. The region is characterized by arid climatic conditions, erratic rainfall, high evaporative demand, bright sunshine and frequent moisture stress. Soils of the region are generally sandy to loamy, with low organic matter and available nitrogen, medium available phosphorus and adequate to high available potassium; salinity occurs at some locations.

Data of farmers using their own practices for cultivation of cumin crops were also collected besides the data from local checks. Extension gap was calculated as given by (Samui *et al*., 2000) as:

Extension gap = Demonstration yield – Yield from farmers practice (Local check)

$$\text{Percent increase yield} = \frac{\text{Demonstration yield farmers yield}}{\text{Farmers yield}} \times 100$$

Front line demonstration interventions

The technologies demonstrated and farmer practices were presented in Table 1 .

Table 1 : Difference between technology intervention and farmers practice under FLD on cumin

Particulars	Technology intervention	Existing practice	Gap
Variety	GC-4 (wilt resistant)	Non-descript	Full gap
Seed rate	12-16 kg/ha	15-20 kg/ha	Higher seed rate
Sowing method	Line sowing (30 cm)	Broadcasting	Full gap
Seed treatment	Fungicide seed treatment	No seed treatment	Full gap
Fertilizer dose	40:15:00 kg NPK/ha	Higher fertilizer dose	Full gap
Weed management	Pre-emergence application of Pendimethalin @ 1.0 kg *a.i.*/ha	One or two hand weeding and sometime farmer give herbicide with irrigation water	Full gap
Plant protection	Integrated Disease Management	Used different pesticides	Uneven use of pesticide

Source : Scientific cultivation of Seed Spices (Gujarati language), Book published by Seed Spices Research Station, SDAU, Jagudan (2015-16)

Conduct of demonstrations and data collection

Ten demonstrations were conducted during each year, resulting in a total of 50 demonstrations over five years. The demonstrations were conducted in farmers' fields and compared with farmers' practice. Seed yield from both improved practice and farmers' practice was recorded in kg/ha .

RESULTS AND DISCUSSION

Technology intervention and farmers' practices under FLD on Cumin

The differences between the recommended technology interventions and existing farmers' practices in cumin are presented in Table 1. Major technological gaps were observed in variety, sowing method, seed treatment,

fertilizer dose and weed management. Farmers generally used non-descript varieties, broadcast sowing, higher seed rates and fertilizer doses, and did not follow recommended seed treatment and weed management practices. In plant protection, farmers used different pesticides unevenly instead of following integrated disease management practices. These gaps indicate the need for greater awareness and adoption of recommended technologies for improving cumin productivity and reducing cultivation costs.

Year-wise performance of cumin demonstrations

The performance of cumin under the FLDs varied among years, reflecting differences in the interventions demonstrated and seasonal field conditions (Table 2).

Table 2 : Performance of cumin under the FLDs during 2018-19 to 2022-23

Year	Major intervention	No. of demos.	Farmers' practice (kg/ha)	Improved practice (kg/ha)	Extension gap (kg/ha)	Per cent increase over farmer practices
2018–19	Improved production	10	712.0	732.0	20.0	2.81
2019–20	package:	10	892.0	915.0	23.0	2.58
2020–21	line sowing	10	613.3	641.5	28.2	4.60
2021–22	spray schedule, weed	10	771.8	806.0	34.2	4.43
2022–23	management, etc.	10	650.2	683.3	33.1	5.09

The performance of cumin under frontline demonstrations (FLDs) during 2018–19 to 2022–23 is presented in Table 2. The improved production practices consistently recorded higher seed yield than farmers' practices in all five years. The yield advantage ranged from 20.0 to 34.2 kg/ha. The percentage increase in yield over farmers' practice ranged from 2.58 to 5.09%. The results indicated that adoption of improved production practices, including line sowing, proper weed management and recommended plant protection measures, improved cumin productivity under farmers' field conditions. Similar results have been reported earlier by Jadav *et al.* (2009); Meena *et al*. (2012); Kumar *et al*. (2015); Choudhary *et al.* (2016); Patel *et al.* (2016) and Desai *et al.* (2020).

Pooled impact of FLDs

The pooled performance of cumin under frontline demonstrations is presented in Table 3. The improved practice recorded a mean yield of 755.56 kg/ha compared with 727.86 kg/ha under farmers' practice, resulting in a yield advantage of 27.70 kg/ha and a 3.81% increase in yield over farmers' practice. The results demonstrated the effectiveness of recommended production technologies in improving cumin productivity under farmers' field

Table 3 : Pooled performance of cumin under frontline demonstrations

Parameter	Farmers' practice	Improved practice
Number of demonstrations	50	50
Mean yield (kg/ha)	**727.86**	**755.56**
Yield advantage (kg/ha)	—	27.70
Yield increase (%)	—	3.81

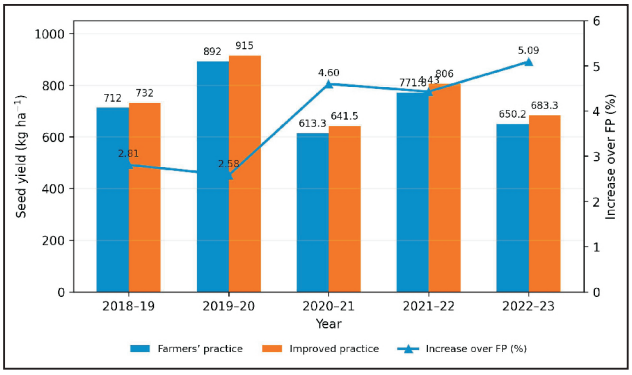


Fig. 1 Five-year comparison of seed yield and yield increase (%) of cumin under front line demonstrations.

Table 3 : Economics of Castor production under FLDs and local checks

Year	No. of demon.	Cost of cultivation (₹/ha)		Gross Return (₹/ha)		Net Return (₹/ha)		B:C ratio	
		FP	IP	FP	IP	FP	IP	FP	IP
2018–19	10	36240	32000	106800	109800	70560	77800	1.95	2.43
2019–20	10	36050	33400	124880	128100	88830	94700	2.46	2.83
2020–21	10	40600	38800	85862	89810	45262	51010	1.11	1.31
2021–22	10	44000	42900	164779	172081	120779	129181	2.74	3.01
2022–23	10	51500	48500	227570	239155	176070	190655	3.41	3.93

CONCLUSION

Front line demonstrations in patan district demonstrated that an integrated package of recommended cumin technologies was associated with higher yield and reported B:C ratios than farmers' prevailing practices. Across 50 demonstrations, the demonstration weighted mean yield was 755.56 kg/ha compared with 727.86 kg/ha under farmers' practice giving a 3.81% yield advantage and a pooled extension gap of 27.70 kg/ha. The principal extension priorities are improved varieties, line sowing, seed treatment, balanced fertilization, weed management and integrated plant protection practices.

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