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Effect of technological interventions on cumin yield at farmers' field

G. Lal[1*], R.S. Mehta[1], D. Singh[2] and M.K. Choudhary[2]

[1] National Research Centre on Seed Spices, Ajmer, Rajasthan, India

[2] Krishi Vigyan Kendra, Pali, Rajasthan, India

Abstract

Cumin is one of the important major seed spice crops, considered to be a remunerative cash crop mainly grown in the western part of the country particularly in Rajasthan and Gujarat occupying about 507850 hectares area with annual production of about 314220 tonnes. Front line demonstrations on cumin consisting two important varieties (GC-4 and RZ-209) with the scientific interventions viz., line sowing, seed treatment (Bavistin @ 2.5 g kg^{-1} seed and *Trichoderma viride* @ 4 g kg^{-1} seed, to protect from soil born fungi) and application of recommended doses of nutrients (40 kg ha^{-1} each N and P) for balanced nutrition with appropriate plant protection schedule (two sprays of malathion @ 0.2%, two sprays of dithane M-45 @ 0.2% and one spray of karathane @ 0.1%) were carried out at four farmers' fields in villages viz., Sindhion Ki Dhani, Baldon Ki Dhani, Rampura and Bagawas in Pali district of Rajasthan during *Rabi* season of 2012-13. Study revealed that overall 39.82 % yield was increased over farmers' traditional practice under the FLD of improved variety with the technological interventions with the yield of 625 kg ha^{-1}. The overall average extension gap 177.50 kg ha^{-1} of with technology gap (375 kg ha^{-1}) and technology index (37.50) was recorded. The overall average additional returns of Rs. 23075 ha^{-1} was obtained under the demonstration fields with the maximum additional returns of Rs. 26000 ha^{-1} obtained in F_4 field due to higher grain yield. Both the varieties with recommended package of practices can be recommended in western Rajasthan for successful cultivation of cumin for fulfilling the demand of domestic and export markets.

Key words : Cumin, technological interventions, yield, economic returns.

Introduction

Cumin (*Cuminum cyminum* L.) belonging to family Apiaceae, is one of the important major seed spice crops grown mainly in Rajasthan and Gujarat states of the country. Annually, it is grown in about 507850 hectares area producing about 314220 tonnes (Anonymous, 1). Average national productivity of this crop is remaining very less (619 kg ha^{-1}) due to low level of awareness among the farming community about area specific recommended package of practices, less availability of high yielding and resistant varieties, lower adoption of recommended plant production and protection technologies. Introduction of high yielding varieties tolerant to diseases can do the wonders in the growing area. Application of appropriate doses of fertilizers at right time with other recommended practices (irrigation and intercultural operations etc.) also play a crucial role with respect to the productivity of cumin. Besides these, effective management of biotic and a-biotic stresses at crucial time with the help of available chemicals and organic means is also very important to increase the productivity and production of the crop.

Pali, situated in the arid fringes of Rajasthan, represented by sandy loam to loamy silt soil with temperature range from 2 to 48^o C and receives about 420 mm rainfall annually. The farmers of this district are trying to adopt the improved varieties and scientific technologies, however many of them still doing the farming with available local varieties and conventional practices. Keeping these facts in mind, two high yielding varieties of cumin with the scientific interventions like seed treatment and recommended dose of fertilizer application through front line demonstrations were tested on four farmer's fields by National Research Centre on Seed Spices (NRCSS) in four different villages of the district with the following objectives:

1. To exhibit the performance of high yielding cumin varieties with scientific interventions (package of practices).
2. To compare the yield levels of FLD fields and local cultivar with farmers practice.
3. Economic analysis and comparison of scientific interventions and farmers' practice.

Materials and methods

The present study was carried out by the National Research Centre on Seed Spices (NRCSS), Ajmer during *Rabi* season of 2012-13 on the farmers' fields of four villages viz., Sindhion Ki Dhani (F_1), Baldon Ki Dhani (F_2),

*Corresponding author: Email: glal67@yahoo.co.in

Rampura (F_3) and Bagawas (F_4) of Pali district. Each demonstration was of 0.5 ha in area. The soils of the district is generally sandy loam to loamy silt and calcareous in texture, contains low nitrogen, low to medium phosphorus and medium to high potash having organic carbon from 0.20 to 0.40 %.

Two varieties of cumin viz., GC-4 and RZ-209 were tested through Front Line Demonstrations (FLDs) with seed treatment, application of phosphate and nitrogen fertilizers and appropriate plant protection schedule as interventions compared with local variety grown with farmer's practices. The materials and inputs required for the study with respect to front line demonstration (technological interventions) and farmers' practice are given in Table 1.

In demonstration plots, a few critical inputs in the form of quality seed, balanced fertilizers, agro-chemicals were provided and non-monetary inputs like timely sowing in lines and timely weeding and irrigation were also performed. Whereas, traditional practices were maintained in case of farmers' practice. The farmers under demonstrations were facilitated by the NRCSS and KVK, Pali scientists in performing field operations like field preparation, sowing, sprays, weeding, harvesting etc. during the course of study through trainings and visits.

Table 1. Details of scientific interventions and existing farmers' practices for cumin cultivation.

S. No.	Intervention	Farmers' practice	Scientific proven technology demonstrated
1.	Use of seed	Locally available seed	GC-4 and RZ-209 as improved varieties from CRRS (SDAU), Jagudan and SKRAU, Bikaner
2.	Sowing method	Broadcasting	Line sowing by tractor operated seed cum fertilizer drill
3.	Seed treatment	No seed treatment	Seed treatment by Bavistin (2.5g kg^{-1} seed) and *Trchoderma viride* (4g kg^{-1} seed)
4.	Fertilizer application	25:0:0 kg NPK ha^{-1}	30:40:0 and 40:40:0 kg NPK ha^{-1})
5..	Plant protection measures	Irregular use of chemicals	Two sprays of malathion (0.2%), two sprays of dithane M-45 (0.2%) and one spray of karathane (0.1%) for the control of aphids, blight and powdery mildew, respectively

The seed was treated with *Trichoderma viride* (4g kg^{-1}) and Bavistin (2.5g kg^{-1}) in a closed container and then shade dried for some time before sowing. Line sowing was performed with the help of multi seed spices seed cum fertilizer drill developed by CIAE, Bhopal. The phosphorous was supplied through DAP (46% P_2O_5) before sowing at the time of field preparation. The nitrogen was given in three split doses. First through DAP (18 % N) before sowing in the field as basal dose (15.65 kg N) and remaining through urea (46% N) after 40 and 65 days of sowing as top dressing. Two sprays of malathion (0.2%) at 15 days interval (with the incidence of aphids), two sprays of dithane M-45 (0.2%) at 15 days interval (at 60 and 75 DAS) and one spray of karathane (0.1%) for the control of aphids (with the initial appearance of symptoms), blight and powdery mildew, respectively were applied. Growing of locally available variety of cumin without seed treatment and application of only 25 kg ha^{-1} nitrogen at 60-70 days after sowing with irregular/ indiscriminate use of pesticides and fungicides is the farmer's practice prevailing in the area. The sowing was done during second week of November. The front line demonstrations were conducted to study the gaps between the potential and demonstration yield, extension gap and technology index. Data with respect to yield and output for FLD plots and on local practices commonly adopted by the farmers of the area under study were collected and evaluated.

The grain yields of demonstration units were recorded and analysed. Different parameters as suggested by Yadav *et al.* (6) were used for calculating gap analysis, costs and returns. The details of different parameters are as under:

Extension Gap = Demonstration Yield (DY) – Farmers' Practice Yield (FPY)

Technology Gap = Potential Yield (PY) – Demonstration Yield (DY)

$$\text{Technology Index} = \frac{PY-DY}{PY} \times 100$$

Additional Cost = Demonstration Total Cost – Farmers' Practice Total Cost

Effective Gain = Additional Return – Additional Cost

Additional Return = Demonstration Return – Farmers' Practice Return

Net returns = Total (Gross) Returns – Total Cost of Production

Incremental B: C Ratio = Additional Return / Additional Cost

Results and discussion

Grain yield

The grain yield was significantly improved with the interventions given in demonstrations as compared to farmers' existing practices. Maximum yield (650 kg ha^{-1}) under FLDs was recorded in the F_4 field, which was 44.44 per cent higher than the yield (450 kg ha^{-1}) obtained under farmers' practice. The increase range in grain yield under demonstrations was 34.78 to 44.44 per cent higher than farmers' local practices. On the basis of the above study, it is inferred that an overall yield advantage of 39.82 per cent over farmers' practices was recorded with the yield of 625 kg ha^{-1} under demonstrations carried out with improved varieties and scientific cultivation practices (Table 2).

Gap analysis

Data (Table 2) revealed that an extension gap of 160 – 200 kg ha^{-1} was found between demonstrated technology and farmers' practice and on average basis the extension gap was 177.50 kg ha^{-1}. The extension gap was highest (200 kg ha^{-1}) in F_4 field and lowest (160 kg ha^{-1}) in F_2 field. Such gap might be attributed to adoption of improved technology especially high yielding varieties sown with the help of seed cum fertilizer drill with balanced nutrition and appropriate plant protection measures in demonstrations which resulted in higher grain yield than the traditional farmers' practices. These results are in the agreement of the findings of Singh *et al.* (4).

The investigation further exhibited a wide technology gap among different fields. It was lowest (350 kg ha^{-1}) in F_4 field and highest (410 kg ha^{-1}) in F_3 field. The average technology gap of all the fields was 375 kg ha^{-1}. The difference in technology gap in different fields is due to better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the course of study with the other factors like monitoring by farmers, soil type and fertility status of the fields. Similarly, the technology index for all demonstrations in the study was in accordance with technology gap. Higher technology index reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology. In this study overall 37.50 per cent technology index was recorded, which varied from 35 % (F_4) to 41 % (F_3).

Economic analysis

Different variables like seed, fertilizers and pesticides were considered as cash inputs for the demonstrations as well as farmers' practices. Data of economic analysis presented in Table 3 exhibited that on overall average basis, an amount of Rs. 21800 ha^{-1} was incurred under demonstrations and Rs. 16500 ha^{-1} under Farmers' practice (FP). An average additional amount of Rs. 5300 ha^{-1} was incurred under demonstrations than FP. Economic yield as a function of grain yield and sale price were taken into consideration. Maximum additional returns (Rs. 26000 ha^{-1}) were obtained in F_4 field due to higher grain yield and the overall average additional returns of Rs. 23075 ha^{-1} was obtained under the demonstration fields. The higher additional returns and effective yield obtained under demonstrations could be due to improved variety, scientific proven technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The lowest and highest incremental benefit: cost ratio (IBCR) was 3.92 and 4.916 in the F_2 and F_4 fields, respectively depends on produced grain yield. Overall average IBCR was found as 4.35. The results of the study confirm the findings of Lathwal (3) on black gram, Singh *et al.* (5) on seed spices and Dayanand *et al.* (2) on mustard.

Conclusion

The average yield of the FLDs with improved varieties and scientific technologies was 28.41 per cent higher than the yield under farmers' practice. Front line demonstration programme was effective in changing attitude, skill and knowledge by using improved varieties and recommended package of practices of cumin cultivation including adoption. Both the varieties of cumin (GC-4 and RZ-209) can be recommended for western arid Rajasthan with technological interventions like line sowing, seed treatment with bavistin (2.5 g/kg) and application of 40 kg/ha each of nitrogen and phosphorous with two sprays of malathion (0.2%), two sprays of dithane M-45 (0.2%) and one spray of karathane (0.1%) to obtain the yield and economic advantage over local existing conventional practices.

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Table 2. Grain yield and gap analysis of technological interventions on cumin at farmers' field

Field	Area	Potential yield	Demo. yield	F.P. yield	Yield increase over F.P.	Ext. gap	Tech. gap	Tech. index
	(ha)	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	(%)	(kg ha^{-1})	(kg ha^{-1})	(%)
F_1	0.5	1000	640	470	36.17	170	360	36
F_2	0.5	1000	620	460	34.78	160	380	38
F_3	0.5	1000	590	410	43.90	180	410	41
F_4	0.5	1000	650	450	44.44	200	350	35
Overall average	0.5	1000	625	447.50	39.82	177.50	375	37.50

Demo.= Demonstration, FP=Farmers' practice, Ext.= Extension, Tech.= Technology

Table 3. Economic analysis of technological interventions on cumin at farmers' field

Field	Cost of cash inputs	Fixed cost	Total cost		Add. cost in demo.	Sale price of grain	Total returns		Additional returns in demo.	Effective gain	INC B:C ratio
	(Rs. ha^{-1})	(Rs. ha^{-1})	(Rs. ha^{-1})		(Rs. ha^{-1})	(Rs. qt^{-1})	(Rs. ha^{-1})		(Rs. ha^{-1})	(Rs. ha^{-1})	(IBCR)
			Demo.	FP			Demo.	FP			
F_1	6800	15000	21800	16500	5300	13000	83200	61100	22100	15800	4.17
F_2	6800	15000	21800	16500	5300	13000	80600	59800	20800	15500	3.92
F_3	6800	15000	21800	16500	5300	13000	76700	53300	23400	18100	4.41
F_4	6800	15000	21800	16500	5300	13000	84500	58500	26000	20700	4.91
Overall average	6800	15000	21588	16500	5300	13000	81250	58175	23075	17525	4.35

Demo. = Demonstration, INC = Incremental, FP = Farmers' practice

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