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## Sunil D Chaudhari

Ph.D., Student, Department of  
Agronomy, C.P. College of  
Agriculture, S.D.A.U.,  
Dantiwada, Gujarat, India

## LJ Desai

Research Scientist, Centre for  
Research on IFS, C. P. College of  
Agriculture, S.D.A.U.,  
Dantiwada, Gujarat, India

## HN Chaudhary

Ph.D., Student, Department of  
Agronomy, C.P. College of  
Agriculture, S.D.A.U.,  
Dantiwada, Gujarat, India

## Feasibility of leafy coriander and leafy fenugreek as intercrop in cumin (*Cuminum cyminum* L.)

Sunil D Chaudhari, LJ Desai and HN Chaudhary

### Abstract

A field experiment was conducted on cumin (*Cuminum cyminum* L.) based intercropping system and its residual effect on summer greengram (*Vigna radiata* L. Wilczek) during two consecutive *rabi* and summer seasons of 2019-20 and 2020-21 at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the feasibility of leafy coriander and leafy fenugreek as intercrop in cumin. There were 21 treatment combinations during *rabi* consisting of three levels of nutrient management (Main plot), *i.e.*, (F<sub>1</sub>: FYM @ 10 t/ha, F<sub>2</sub>: Only RDF of crop and F<sub>3</sub>: FYM @ 5 t/ha + 75% RDF) and seven intercropping treatments (Sub-plot) (C<sub>1</sub>: Cumin sole, C<sub>2</sub>: Coriander sole (leafy vegetable), C<sub>3</sub>: Fenugreek sole (leafy vegetable), C<sub>4</sub>: Cumin + leafy coriander (1:1), C<sub>5</sub>: Cumin + leafy fenugreek (1:1), C<sub>6</sub>: Cumin + leafy coriander (2:1) in paired row of cumin at 20 cm, C<sub>7</sub>: Cumin + leafy fenugreek (2:1) in paired row of cumin at 20 cm were tried in split plot design with three replications. Two year pooled results of experiment showed that application of FYM @ 5 t/ha + 75% RDF to cumin recorded significantly higher seeds (517 kg/ha), cumin equivalent yield (630 kg/ha) and other yield attributing characters, while intercropping of cumin + fenugreek (2:1) in paired row of cumin at 20 cm recorded significantly higher seed yield (614 kg/ha), and equivalent yield (727 kg/ha). The highest gross return was secured with application of FYM @ 5 t/ha + 75% RDF of ₹ 35195/ha with net return of ₹ 38017/ha and 1.83 BCR, while in intercropping of cumin with leafy fenugreek (2:1) in paired row of cumin at 20 cm recorded highest gross profit of ₹107945/ha, net return of ₹ 60742/ha) and 2.29 BCR.

**Keywords:** Cumin, equivalent yield, intercropping, leafy coriander, leafy fenugreek, LER

### 1. Introduction

Cumin (*Cuminum cyminum* L.), locally known as 'Zeera', is an important seed spice crop of western India. Cumin is valued for its typical pleasant aroma from its essential oil, which ranges between 2.5-3.5 per cent in indigenous collections and upto 5.5 per cent in exotic ones. Cumin is short duration major seed spice crop of arid and semi arid regions of Gujarat and Rajasthan and more cost effective than other *rabi* crops due to fewer requirements of costly inputs but slight fluctuation in climatic condition may failure the crop therefore, it is known as risky crop. Fenugreek leaves and seeds are consumed in different countries around the world for different purposes such as medicinal uses, making food, roasted grain as coffee-substitute (in Africa), controlling insects in grain storages, perfume industries etc. Fenugreek can be a very useful legume crop for incorporation into short-term rotation and for hay and silage for livestock feed, for fixation of nitrogen in soil and its fertility etc. (Sadeghzadeh-Ahari *et al.*, 2009) [10]. In the present circumstance, it is not possible to increase production without bringing additional area under cultivation. Therefore, there is urgent need to enhancing productivity of system. The system productivity can be increased by using available area through vertical expansion of enterprises or intensification of cropping system. The intercropping system is a very important avenue in this direction which aimed at increasing productivity per unit area per unit time and insurance against total crop failure under aberrant weather conditions (Mullick *et al.* 1993) [7]. Efficient intercropping not only improves the productivity but also sustain soil fertility status (Singh *et al.*, 2013). Besides these farmers also secured with assured income from any crop against collapse of anyone. Wide spacing and slow growing nature during initial growth period of cumin with coriander and fenugreek make possible to raise short duration intercrops in between the rows. The scientific information on this aspect with definite row pattern is not available. Hence, an experiment was done to study the feasibility of inter crop of leafy coriander and leafy fenugreek with cumin.

### Corresponding Author:

#### Sunil D Chaudhari

Ph.D., Student, Department of  
Agronomy, C.P. College of  
Agriculture, S.D.A.U.,  
Dantiwada, Gujarat, India

## 2. Material and Methods

The field experiment was laid out during *rabi* and summer season of 2019-20 and 2020-21 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, District: Banaskantha (Gujarat). The soil was loamy sand in texture, neutral in soil reaction (7.15 pH), with low in organic carbon (0.14) and available nitrogen (142 kg/ha), medium in available phosphorus (35 kg/ha) and potash (240 kg/ha). The field experiment was laid out in three times replicated split-split plot design with seven intercropping systems (sole cumin, sole leafy coriander, sole leafy fenugreek, cumin + leafy coriander in 1:1 and 1:2 row ratios and cumin + leafy fenugreek in 1:1 and 1:2 row ratios) and three nutrient management levels (only FYM @ 10 t/ha, only RDF of crop and FYM @ 5 t/ha + 75% RDF). The seeds of variety *cv.* Gujarat Cumin 4, GDLC 1 and GM 2 were sown manually as per treatments with seed rate of 12, 15 and 15 kg/ha, respectively for cumin, leafy coriander and leafy fenugreek on the same day. The cutting of leafy coriander and leafy fenugreek crop was made in each intercrop treatments at 45 and 60 DAS. All the cultural operations were carried out as per need of crop and as per recommendation for both the crops. Observations on growth attributes, yield components and yield were recorded for cumin, leafy coriander and leafy fenugreek at harvest. The data have been analyzed for individual years as well as pooled as per standard procedure.

## 3. Results and Discussion

### 3.1 Growth, yield and yield attributes of cumin, leafy coriander and leafy fenugreek

Application of nutrient management had a beneficial effect on the growth parameters of cumin. Applications of FYM @ 5 t/ha + 75% RDF ( $F_3$ ) recorded significantly higher plant height (27.7 cm) and no of branches/plant (7.36). Yield attributes of cumin *viz.*, number of umbels/plant (25.47), number of umbellets/umbel (3.73) and number of seeds/umbel (5.06) and seed yield (517 kg/ha) also increased significantly with application of FYM @ 5 t/ha + 75% RDF (Table 1). The per cent increase in seed yield with the application of FYM @ 5 t/ha + 75% RDF was to the tune of 7.3 per cent over FYM @ 10 t/ha in pooled results. In case of intercropping, results showed that all the growth and yield attributing parameters of cumin were influenced significantly by different intercropping systems (Table 1). Intercropping of cumin + leafy fenugreek (2:1) (paired row of cumin at 20 cm) recorded significantly higher number of branches per plant (7.69), number of umbels per plant (25.85), number of umbellets per umbel (3.88,) and number of seeds per umbellate of cumin (5.16), which were at par with all other treatments, except cumin sole. Significantly higher per cent increase in seed yield under cumin + leafy fenugreek (2:1) with paired row of cumin at 20 cm was to the tune of 2.5 per cent over sole cumin. The increase in plant height due to nutrient management may be due to the synergistic effect of inorganic and organic nutrient management may be ascribed to the greater uptake of

nutrients by the plants favoring better cell division, elongation, amino acid and protein synthesis. Similar finding was reported by Choudhary *et al.* (2006) <sup>[4]</sup> in cumin for growth parameters. The increased in seed yield under integrated nutrient management might be due to FYM had increased the soil organic matter and improved the soil structure, water holding capacity and biological activity of soil. These finding are in accordance with finding of Mehta *et al.* (2012) <sup>[8]</sup> in fenugreek, Bedse *et al.* (2013) <sup>[2]</sup> in cumin. Significantly higher number of branches per plant of cumin was recorded with cumin + leafy fenugreek (2:1) under paired row cropping system (7.69) in pooled, intercropping of cumin + leafy fenugreek (2:1) (paired row of cumin at 20 cm) recorded significantly higher number of umbels per plant (25.85), number of umbellets per umbel (3.88,) and number of seeds per umbellate of cumin (5.16) in pooled. Significantly higher seed yield (614 kg/ha), which was at par with cumin + leafy coriander (2:1) (paired row of cumin at 20 cm) (606 kg/ha) and cumin sole (599 kg/ha) in pooled analysis. The per cent increase in seed yield under cumin + leafy fenugreek (2:1) (paired row of cumin at 20 cm) was to the tune of 2.5 per cent over sole cumin in pooled results. The higher yield attributes under cumin + leafy fenugreek (2:1) might be due to more space available to cumin in 2:1 row ratio (additive series) and nutrients available for growth and development of cumin, which led to higher photosynthesis owing to greater exposure of cumin crop to sunlight. It might also be due to conducive environment created by intercrop (fenugreek) as it fixed atmospheric nitrogen and increased its availability in soil, which might have also been utilized partly by cumin crop for better growth and development and ultimately increased the growth and yield attributes. Similar results were also reported by Awasthi *et al.* (2011) <sup>[1]</sup> in intercropping of fennel with chickpea.

In case of intercrops yield, application of FYM @ 5 t/ha + 75% RDF to crops recorded the highest fresh weight and dry weight of 2439 and 439 kg/ha at 45 DAS, 1201 and 224 kg/ha at 60 DAS and 3640 and 550 kg/ha total fresh and dry weight, respectively for leafy coriander (Table 2). Same treatment also recorded significantly higher fresh fenugreek leaves weight (2788, 1434 and 4221 kg/ha) at 45 DAS at 60 DAS and total fresh weight, respectively, while 503, 271 and 774 kg/ha dry weight at 45 DAS at 60 DAS and total dry weight, respectively. Similar observations were also made earlier in fenugreek, Godara *et al.* (2014) <sup>[5]</sup>, Jhankar *et al.* (2017) <sup>[6]</sup> in coriander and Sahu *et al.* (2020) <sup>[20]</sup> in fenugreek. The fresh and dry weight at 45, 60 DAS and total weight did not exert its significant effect among the intercropping of leafy coriander and leafy fenugreek with cumin in different row ratio. The reduction in the yield parameters under 1:1 and 2:1 row ratio might be due to competition between the component crops for nutrients, light and water which might have affected the growth of leafy coriander and leafy fenugreek. The results confirmed with reported by Tripathi and Dwivedi (2009) <sup>[13]</sup>, Boori *et al.* (2017) <sup>[3]</sup> in fennel and Padanad (2018) <sup>[9]</sup> in intercropping of vegetable with seed spices.

**Table 1:** Growth, yield and yield attributes of cumin as influenced by nutrient management and intercropping (Pooled data)

Treatment		Plant height (cm)	No. of banches/plant	No. of umbels/plant	No. of umbellates/umbel	No. of seeds/umbellate	Seed yield (kg/ha)
<b>(a) Nutrient management (F)</b>							
F <sub>1</sub>	Only FYM @ 10 t/ha	26.23	6.60	24.12	3.34	4.61	483
F <sub>2</sub>	Only RDF of crop	26.99	7.47	24.05	3.29	4.56	469
F <sub>3</sub>	FYM @ 5 t/ha + 75% RDF	27.70	7.36	25.47	3.73	5.06	517
S.Em.±		0.39	0.13	0.36	0.07	0.09	8.63
C.D. at 5%		1.27	0.43	1.16	0.24	0.28	28
C.V. %		7.93	9.94	7.92	11.50	9.85	9.66
<b>(b) Intercropping (C)</b>							
C <sub>1</sub>	Cumin sole	26.09	6.67	22.58	2.92	4.33	599
C <sub>4</sub>	Cumin + Coriander (1:1)	26.88	7.07	24.32	3.37	4.43	308
C <sub>5</sub>	Cumin + Fenugreek (1:1)	27.31	7.44	25.36	3.61	4.98	320
C <sub>6</sub>	Cumin + Coriander (2:1) (Paired row of cumin at 20 cm)	27.04	7.29	24.63	3.48	4.81	606
C <sub>7</sub>	Cumin + Fenugreek (2:1) (Paired row of cumin at 20 cm)	27.54	7.69	25.85	3.88	5.16	614
S.Em.±		0.50	0.13	0.45	0.07	0.09	8.68
C.D. at 5%		NS	0.38	1.28	0.20	0.26	25
Interaction F × C		NS	NS	NS	NS	NS	NS
S.Em.±		0.86	0.23	0.78	0.12	0.16	15.03
C.V. %		7.82	7.91	7.79	8.81	8.32	7.52

**Table 2:** Fresh weight and dry weight of leafy fenugreek as influenced by nutrient management and cumin based intercropping (Pooled data)

Treatment		Leafy coriander						Leafy fenugreek					
		Fresh weight of plant (kg/ha)			Dry weight of plant (kg/ha)			Fresh weight of plant (kg/ha)			Dry weight of plant (kg/ha)		
		45 DAS	60 DAS	Total	45 DAS	60 DAS	Total	45 DAS	60 DAS	Total	45 DAS	60 DAS	Total
<b>(a) Nutrient management (F)</b>													
F <sub>1</sub>	Only FYM @ 10 t/ha	2218	1091	3309	381	194	494	2483	1279	3762	444	239	684
F <sub>2</sub>	Only RDF of crop	2358	1155	3513	355	181	518	2631	1365	3995	485	260	745
F <sub>3</sub>	FYM @ 5 t/ha + 75% RDF	2439	1201	3640	439	224	550	2788	1434	4221	503	271	774
S.Em.±		48.44	23.67	72.02	11.51	6.08	10.10	80.45	41.22	122	13.45	7.32	20.76
C.D. at 5%		158	77	235	38	20	33	262	134	397	43.87	23.88	67.70
C.V. %		8.79	8.74	8.76	12.46	12.92	8.23	12.96	12.87	12.93	11.95	12.11	12.00
<b>(b) Intercropping (C)</b>													
C <sub>2</sub>	Coriander (Leafy vegetable)-Sole	3913	1923	5836	642	328	843	4425	2283	6708	801	430	1232
C <sub>4</sub>	Cumin + Coriander (1:1)	1431	703	2134	255	130	341	1657	854	2511	297	160	457
C <sub>6</sub>	Cumin + Coriander (2:1) (Paired row of cumin at 20 cm)	1671	821	2492	277	141	378	1819	940	2759	334	180	514
S.Em.±		45.92	22.39	68.29	10.27	5.43	9.68	68.21	34.66	102.91	11.60	6.33	17.91
C.D. at 5%		134	65	199	30	16	28	199	101	300	33.85	18.47	52.29
Interaction F × C		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.Em.±		79.53	38.79	118.28	17.79	9.40	16.77	118.14	60.03	178.24	20.09	10.96	31.03
C.V. %		8.33	8.27	8.31	11.13	11.53	7.89	10.99	10.82	10.93	10.30	10.46	10.35

### 3.2 Effect on cumin equivalent yield and LER

Different treatments significantly influenced the cumin equivalent yield and land equivalent ratio during the period of investigation and on pooled basis also (Table 3). Significantly highest cumin equivalent yield during the first year was recorded with application of only RDF to crop (710 kg/ha), while it was significantly highest in second year and pooled results by application of FYM @ 5 t/ha + 75% RDF (609 and 630 kg/ha, respectively). Intercropping systems brought significant differences in the cumin equivalent yield. Cumin equivalent yield in intercropping systems having additive series was higher over their respective sole crop yields as well as intercropping with replacement series. Among the different intercropping systems, cumin intercropping with fenugreek (2:1) having paired row of cumin recorded significantly highest CEY (934 and 830 kg/ha) in first year and in pooled

results, while significantly higher (727 kg/ha) during the second year, which was at par with Cumin + Coriander (2:1) (Paired row of cumin at 20 cm) (709 kg/ha). The higher cumin equivalent yield in intercropping system was on account of additional yield of component crop without much reduction in yield of base crop resulting in higher cumin equivalent yield. The highest cumin equivalent yield with leafy fenugreek and coriander was due to proportionately less reduction in yield of cumin as compared with other treatments in addition to better yield of component crop leading to higher cumin equivalent yield. Similarly, Mehta *et al.* (2015) [8] reported higher fennel equivalent yield in intercropping as compared to sole crops. Similarly, among various intercropping systems, the highest land equivalent ratio was observed in intercropping of cumin + leafy fenugreek (2:1) during both individual year (1.47 and 1.44, respectively) followed by cumin + leafy coriander (2:1)

(1.45 and 1.43, respectively) (Table 4). The highest LER under intercropping might be due to biological efficiency of system in terms of yield per unit area. Awasthi *et al.* (2011)<sup>[1]</sup>

recorded higher land equivalent ratio in intercropping system than their sole crops.

**Table 3:** Cumin equivalent yield as influenced by different treatments of the cumin based intercropping

Treatment		Cumin equivalent yield (kg/ha)		
		2019-20	2020-21	Pooled
<b>(a) Nutrient management (F)</b>				
F <sub>1</sub>	Only FYM @ 10 t/ha	613	547	580
F <sub>2</sub>	Only RDF of crop	710	459	585
F <sub>3</sub>	FYM @ 5 t/ha + 75% RDF	652	609	630
S.Em.±		11.54	13.68	8.95
C.D. at 5%		45	54	29
C.V. %		8.03	11.64	9.69
<b>(b) Intercropping (C)</b>				
C <sub>1</sub>	Cumin sole	681	523	602
C <sub>2</sub>	Coriander (Leafy vegetable)-Sole	469	429	449
C <sub>3</sub>	Fenugreek (Leafy vegetable)-Sole	535	497	516
C <sub>4</sub>	Cumin + Coriander (1:1)	523	426	474
C <sub>5</sub>	Cumin + Fenugreek (1:1)	574	457	516
C <sub>6</sub>	Cumin + Coriander (2:1) (Paired row of cumin at 20 cm)	893	709	801
C <sub>7</sub>	Cumin + Fenugreek (2:1) (Paired row of cumin at 20 cm)	934	727	830
S.Em.±		13.74	13.12	9.50
C.D. at 5%		39	38	27
Interaction F × C		NS	NS	NS
S.Em.±		23.81	22.73	16.46
C.V. %		6.26	7.32	6.74

**Table 4:** LER of the cumin based intercropping system

Treatment		Land Equivalent Ratio	Land Equivalent Ratio
		2019-20	2019-20
C <sub>1</sub>	Cumin Sole	1.00	1.00
C <sub>2</sub>	Coriander (Leafy vegetable)- Sole	1.00	1.00
C <sub>3</sub>	Fenugreek (Leafy vegetable)- Sole	1.00	1.00
C <sub>4</sub>	Cumin + Coriander (1:1)	0.89	0.88
C <sub>5</sub>	Cumin + Fenugreek (1:1)	0.93	0.90
C <sub>6</sub>	Cumin + Coriander (2:1) (Paired row of cumin at 20 cm)	1.45	1.43
C <sub>7</sub>	Cumin + Fenugreek (2:1) (Paired row of cumin at 20 cm)	1.47	1.44

**3.3 Economics:** Application of FYM @ 5 t/ha + 75% RDF (F<sub>3</sub>) recorded the highest gross return (₹81963/ha) and net return (₹38017/ha) over RDF of crop and FYM @ 10 t/ha, while intercropping of cumin + leafy fenugreek (2:1) in paired

row of cumin at 20 cm registered highest gross return (₹ 107945/ha) and net return (₹ 60742/ha) and these were closely followed by intercropping of cumin + leafy coriander (2:1) in paired row of cumin at 20 cm. (Table 5)

**Table 5:** Effect of nutrient management and cumin based intercropping on economics of cumin

Treatment	Mean				
	Equivalent yield (kg/ha)	Gross return (₹/ha)	Cost of cultivation (₹/ha)	Net profit (₹/ha)	BCR
<b>(a) Nutrient management (F)</b>					
F <sub>1</sub>	580	75384	45490	29894	1.66
F <sub>2</sub>	585	76000	41432	34568	1.83
F <sub>3</sub>	630	81963	43946	38017	1.87
<b>(b) Intercropping (C)</b>					
C <sub>1</sub>	602	78294	43217	35077	1.81
C <sub>2</sub>	449	58357	37781	20575	1.54
	516	67083	36972	30111	1.81
C <sub>4</sub>	474	61644	46490	15154	1.33
C <sub>5</sub>	516	67019	46085	20934	1.45
C <sub>6</sub>	801	104135	47608	56527	2.19
C <sub>7</sub>	830	107945	47203	60742	2.29

**4. Conclusions**

Based on the study of present experiment, it can be concluded that for achieving higher cumin equivalent yield, net return and better land utilization, cumin should be intercropped with

leafy fenugreek (2:1) in paired row system (20-40-20 cm) of cumin and fertilized with FYM @ 5 t/ha + 75% RDF (30-11.25-00, N-P 2 O 5 -K 2 O kg/ha).

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