

Productivity and economics of fennel (*Foeniculum vulgare* Mill) based inter cropping system

A. U. Amin, S. M. Patel*, S. G. Patel and S. P. Patel

Centre for Research on Seed Spices, Sardarkrushinagar Dantiwada
Agricultural University, Jagudan- 382 710, Mehsana, Gujarat

Abstract

A field experiment was conducted at Centre for Research on Seed Spices, Sardarkrushinagar Dantiwada Agricultural University, Jagudan (Gujarat), during *kharif* 2006-2007 to 2009-2010 to determine the suitable intercrops for *kharif* transplanted fennel. On pooled data basis, the effects of different treatments on growth and yield attributes of fennel were significant, except numbers of seeds per umbel and test weight. Different intercrop treatments affect the fennel equivalent yield and gross realization significantly. Among different intercrop treatments and sole fennel crops, fennel + green gram (1:1 ratio) inter cropping system recorded the maximum fennel equivalent yield (3341 kg ha⁻¹), gross realization (Rs. 156924 ha⁻¹), net realization (Rs. 119311 ha⁻¹) and ICBR (1:1.33).

Key words: Cauliflower, fennel, green gram, equivalent yield, marigold

Introduction

Among the seed spices fennel commonly known as saunf is major seed spice crop belonging to Apiaceae family. Fennel is long duration cold weather seed spice crop of arid and semi arid regions of country. It grown during *kharif* and *rabi* season in Gujarat state. It is mainly cultivated for its seed, which have pleasant fragrance, aromatic taste and act as a stimulant and carminative. Escalating population all over the world specially in Asian countries is putting pressure on accessible natural resources for meeting the increasing demand for food, fodder, shelter and fuel production. The per capita availability of land is declining year after year. Thus, the possibility of horizontal expansion of agricultural enterprises is very limited. Only scope lies in vertical expansion of agriculture, which is only possible through increase in productivity of resources per unit area per unit time. 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.*, 5). Among seed spices, fennel is a wide space crop best suited for intercropping with vegetable crops (Mehta *et al.*, 4). Intercropping can increase the production and productivity by better utilization of resources and thereby minimize the risk and brings stability (Mehta and Malhotra 3). Due to initial slow growth rate, wide spacing and late transplanting time (i.e. 15th August) of fennel, growing of various *kharif* crops is more feasible as inter crop. Inclusion of *kharif*

grain pulses, vegetables, oilseed or cereals as intercrops with fennel may found more feasible to fulfill the food requirement of nation and increase the productivity and profitability of farmers (Yadav *et al*, 7). Scientific information on these aspects is scanty. Hence, an experiment was planned to find out the suitable intercropping system based on fennel.

Materials and methods

A field experiment was conducted at Centre for Research on Seed Spices, Sardarkrushinagar Dantiwada Agricultural University, Jagudan (Gujarat), during *kharif* 2006-2007 to 2009-2010. Seven treatments consisting different *Kharif* crops, *Viz.*, cowpea, green gram, sesame, cauliflower, groundnut and marigold grown with fennel in 1:1 row arrangement along with sole fennel were studied in randomized block design with four replications. Soil of experimental field was loamy sand in texture with neutral in reaction with poor in organic matter (0.28 %), medium in available phosphorus (28.0 kg/ha⁻¹ and high in available potash (258 kg/ha⁻¹) and slightly alkaline in soil reaction (7.80 pH).

Results and discussion

Effect on growth and yield attributes

On pooled data basis, the effect of different intercropping treatments on growth and yield attributes of fennel was significant except number of seeds per umbel and test weight (Table 1). Raising of green gram as inter crop with fennel with 1:1 row arrangement recorded the tallest

Table 1: Growth and yield attributes of fennel as influenced by different treatments

Treatments	Plant height (cm)	Branches plant ⁻¹	Umbels plant ⁻¹	Umbellate umbel ⁻¹	Seeds umbellate ⁻¹	Test weight (gm)	Volatile oil (%)
T ₁ : Sole fennel	165.11	9.16	32.41	39.52	41.14	6.09	1.08
T ₂ : Fennel+ Cow pea (1:1)	163.23	8.56	33.05	37.88	37.74	6.17	1.23
T ₃ : Fennel +green gram(1:1)	169.47	9.26	33.45	38.19	39.70	6.04	1.16
T ₄ : Fennel +Sesame (1:1)	156.94	8.34	33.03	36.99	39.61	5.88	1.30
T ₅ : Fennel +Cauliflower (1:1)	165.69	8.68	33.70	36.44	39.56	5.93	1.13
T ₆ : Fennel +Groundnut (1:1)	158.88	9.11	31.99	35.09	40.16	6.02	1.11
T ₇ : Fennel +Marigold (1:1)	152.63	6.81	27.19	32.28	35.41	5.50	1.04
Sem (±)	2.01	0.38	0.63	1.02	0.16	0.15	0.036
C.D. at 5%	5.65	1.08	1.76	2.86	NS	NS	0.10
C.V. %	4.93	16.55	7.20	11.36	11.59	6.40	13.22
Y x T	NS	NS	NS	NS	NS	S	S

plants and maximum number of branches per plant of fennel, whereas, umbels per plant and umbellates per umbel were maximum under sole fennel crop. Minimum values of growth and yield attributes were recorded under fennel + marigold inter crop system due to smothering effect to marigold on fennel. Similar trend was also noticed by Ashok *et al.*, (1), when fenugreek was inclined as intercrop in fennel crop.

Effect on fennel equivalent yield and gross realization

Different inter crop treatments affect the fennel equivalent yield and gross realization significantly (Table 2 and 3) during course of investigation and in pooled data also. Fennel + green gram (1:1) inter cropping

system recorded maximum fennel equivalent yield and gross realization and was at par with fennel + cowpea (1:1) inter cropping system. During 2008-2009, T₃: Fennel +green gram(1:1) was at par with T₂: Fennel+ Cow pea (1:1) and T₆: Fennel +Groundnut (1:1), but in 2009-2010 it was at par with T₁: Sole fennel, T₂: Fennel+ Cow pea (1:1) and T₅: Fennel +Cauliflower (1:1). Ashok *et al.*, (1) in a study of fennel based intercropping reported that there was 6 % increase in fennel equivalent yield when fenugreek was grown as intercrop. Similar trend was also observed by Boori *et al.*, (2) for fennel and fenugreek at 1:1 and Mehta *et al.*, (4) for fennel and carrot in 1:1 ratio is better for realizing higher system productivity, net return and BCR. Due to smothering

Table 2: Fennel equivalent yield (kg ha⁻¹) as influenced by different inter cropping treatments

Treatments	Fennel equivalent yield (kg ha ⁻¹)				
	2006-07	2007-08	2008-09	2009-10	Pooled
T ₁ : Sole fennel	2593	2447	2729	2518	2572
T ₂ : Fennel + Cow pea (1:1)	3109	2983	3674	2664	3308
T ₃ : Fennel + green gram (1:1)	3530	3309	3735	2790	3341
T ₄ : Fennel + Sesame (1:1)	2167	2626	3483	2233	2665
T ₅ : Fennel + Cauliflower(1:1)	2970	2601	2933	2700	2801
T ₆ : Fennel + Groundnut (1:1)	2597	2650	3514	2523	2821
T ₇ : Fennel + Marigold (1:1)	2478	1811	1968	1963	2025
SEm (±)	181	146	82	153	143
C.D. at 5%	538	433	243	459	425
C.V. %	13.04	11.08	5.19	12.23	1051
Y x T	-	-	-	-	S
SEm (±)	-	-	-	-	145
C.D. at 5%	-	-	-	-	411

Table 3: Gross realization (₹ ha⁻¹) of fennel as influenced by different inter cropping treatments

Treatment	Gross realization (₹ ha ⁻¹)				
	2006-07	2007-08	2008-09	2009-10	Pooled
T1: Sole fennel	103704	97884	136464	151059	122277
T2: Fennel + Cow pea (1:1)	124361	119326	183699	159862	146812
T3: Fennel + green gram (1:1)	141206	132346	186751	167394	156924
T4: Fennel + Sesame (1:1)	86602	105037	174162	133995	124964
T5: Fennel + Cauliflower(1:1)	118805	104056	146649	162011	132880
T6: Fennel + Groundnut (1:1)	103880	106005	175570	151378	134208
T7: Fennel + Marigold (1:1)	99115	72443	98368	117769	96906
SEm (±)	7244	5825	4097	9189	6726
C.D. at 5%	21525	17308	12174	27303	19984
C.V. %	13.04	11.07	5.12	12.33	10.18
Y x T	-	-	-	-	S
SEm +	-	-	-	-	6849
C.D. at 5%	-	-	-	-	19363

effect of marigold, fennel + marigold (1:1) system recorded the lowest equivalent yield and gross realization.

Effect on fennel yield

Fennel + green gram (1:1) cropping system recorded the highest fennel yield during the course of investigation. Growing of cowpea or green gram as inter crops with fennel increased the yield of fennel as compared to sole fennel. However, growing of sesame, cauliflower, groundnut and marigold with fennel decreased the yield of fennel, as compared to sole fennel crop. These intercrops might suppress the growth of fennel which resulted in poor seed yield. Tiwari *et al.* (6) reported depressing effect on growth and performance of fennel

when intercropped with vegetable crop. Minimum seed yield of fennel was recorded under treatment T₇, i.e. fennel + marigold intercropping system (Table 4)

Economics

Maximum net realization, BCR and ICBR were recorded when green gram grown as inter crop with fennel in 1:1 row arrangement (T₃) and these were closely followed by treatment T₂ i.e. growing of cowpea as intercrop with fennel with 1:1 row arrangement. Yadav *et al.*, (7) reported that intercropping of carrot with ajwain followed by fennel recorded higher gross realization. The minimum net realization, BCR and ICBR were recorded under growing of marigold grown as inter crop with fennel in 1:1 row arrangement (Table 5).

Table 4: Fennel seed yield kg ha⁻¹ as influenced by different intercropping treatments

Treatment	Fennel seed yield (kg ha ⁻¹)				
	2006-07	2007-08	2008-09	2009-10	Pooled
T1: Sole fennel	2593	2447	2779	2518	2584
T2: Fennel + Cow pea (1:1)	2628	2476	3206	2253	2641
T3: Fennel + green gram (1:1)	2879	2648	3175	2317	2755
T4: Fennel + Sesame (1:1)	1931	1810	2631	1892	2066
T5: Fennel + Cauliflower(1:1)	2460	2287	2272	2255	2319
T6: Fennel + Groundnut (1:1)	2134	1953	2975	2134	2299
T7: Fennel + Marigold (1:1)	1552	1133	1054	1272	1253

Table 5: Economics of different inter cropping treatments

Treatment	Gross expenditure (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	BCR	Net ICBR	Productivity (kg ha ⁻¹ day ⁻¹)	Net income (₹ ha ⁻¹ day ⁻¹)
T 1 : Sole fennel	32265	90012	2.49	-	11.60	405
T 2 : Fennel+ Cow pea (1:1)	37498	109314	2.92	1:1.21	12.67	419
T 3 : Fennel +green gram (1:1)	37613	119311	3.17	1:1.33	12.80	457
T 4 : Fennel +Sesame (1:1)	37257	87707	2.35	1:0.97	10.21	336
T 5 : Fennel +Cauliflower(1:1)	45167	87713	1.94	1:0.97	12.79	401
T 6 : Fennel +Groundnut (1:1)	41933	92275	2.20	1:1.03	10.80	354
T 7 : Fennel +Marigold (1:1)	41234	55672	1.35	1:0.62	8.62	237

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