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Performance of coriander (*Coriandrum sativum*) based intercropping systems

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ABSTRACT

There is need to enhance production of food grains, oilseed, pulses, spices, fruits and vegetables. Higher system productivity can be realized with the integration of different crops without compromising the yield of base crops. Hence a field experiment on effect of intercropping system on growth, yield and system productivity was conducted at National Research Centre on Seed Spices, Ajmer, Rajasthan during *rabi* 2004-05, 2005-06 and 2006-07. The experiment comprising of 13 treatments *viz.*, sole coriander, sole onion, sole garlic, sole carrot, coriander + garlic (1:1), coriander + garlic (1:2), coriander + garlic (2:2), coriander + carrot (1:1), coriander + carrot (1:2), coriander + carrot (2:2), coriander + onion(1:1), coriander + onion (1:2) and coriander + onion (2:2) was laid in randomized block design with three replications. Based on three year study it was observed that growth parameters, yield attributes and seed yield of coriander recorded was higher with coriander + intercrops in 1:1 ratio. The association of carrot with coriander at all ratios proved superior over onion and garlic. Besides sole cropping, the yield of intercrops recorded was higher 1:2 ratio as compared to 1:1 and 2: 2 but yield attributes of these intercrops obtained was higher in 1:1 ratio.. The highest coriander equivalent yield (2.11 t/ha), net return (Rs 50,701 / ha) and B:C ratio (2.16) was exhibited by 1:1 ratio followed by 2:2 ratio. Coriander + carrot with all ratios gave higher coriander equivalent yield, net return, benefit cost ratio and land equivalent ratio over coriander intercropped with onion/garlic. Thus coriander + carrot in 1:1 ratio is best for realizing higher system productivity and profitability.

***Key words**:* Coriander, Equivalent yield, Intercropping, Land equivalent ratio, Temporal resource

India has been recognized as a land of spices and at present it is the world's largest producer, consumer and exporter of the seed spices. Among the seed spices, coriander commonly known as *Dhania is* major crop belonging to Apeaceae family. In India, it is mainly cultivated in Rajasthan, Gujarat, Karnataka and Orrisa. Rajasthan ranks first in area and production of coriander in our country. Burgeoning population is exerting pressure on limited land and water resources for increasing production of food, fiber, fodder and fuel. Hence there is need to increase production of food grain, oilseed, pulses, spices as well as fruits and vegetables. Higher system productivity can be realized with the integration of different crops without compromising the yield of base crop. Ahlawat and Gangaiah (2010) reported higher system productivity in chickpea intercropped with linseed over sole chickpea. Mustard and chickpea intercropping have exhibited higher land equivalent ratio (1.41) over in sole crops (Thomas *et al*., 2010). The intercropping system is an important avenue in this direction which aimed at increasing productivity/ unit area/unit time and insurance against total crop failure under aberrant weather conditions (Mullick *et al.,*1993). Thus productivity of system can be enhanced with change in crop configuration for inclusion of other crops in the existing cropping system. Hence the study on effect of coriander based inter-cropping system with vegetable crops was undertaken with an objective to find most efficient inter cropping system for realizing higher system productivity.

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MATERIAL AND METHODS

The field experiment was conducted at Ajmer, Rajasthan during three consecutive *rabi* seasons of 2004-05, 2005-06 and 2006-07. The experiment was taken on the same site during all the three years. The soil of the experimental site was sandy loam with a pH of 8.92 having 0.21% organic carbon and 78.0, 15.70**,** and 199.25 kg/ha available N, P and K, respectively. The experiment comprising of 13 treatment viz., sole coriander, sole onion, sole garlic, sole carrot, coriander (*Coriandrum sativum*) intercropping with garlic (*Allium sativus*), carrot (*Dacus carota*) and onion (*Allium cepa*) at 3 row ratios (1:1,1:2 and 2:2) was laid in randomized block design with three replications. Sowing of coriander using 20 kg seed of

'ACr -1' was done at 45 cm row to row spacing in 1:1 and 1:2 ratio of coriander with carrot /onion/ garlic but in 2:2 ratio, sowing of coriander was done in pair of 30/70 cm. In between pairs, two rows of respective component crops *viz*., carrot, onion and garlic were accommodated. The onion (N-53), carrot (Pusa Kesar) and garlic (G-41) were accommodated in fixed ratio as per treatment keeping population of coriander (base crop) constant. In sole coriander, 60–17.7–16.7 kg N-P-K in sole onion, garlic and carrot, 90–22.1–33.3 and in inter cropping of 1:1 ratio 105–28.8–25.0 kg N-P-K/ha was applied but with 1:2 and 2:2 ratio 100% and 33% of recommended RDF of and intercrops were applied along with RDF of base crop. Full dose of P and K along with was applied at sowing of coriander and vegetable crops and remaining $^{2}/_{3}$ N was applied in two equal split doses at 30 and 60 days after sowing (DAS). The standard agronomic practices were applied for raising healthy coriander crop as well as carrot, onion and garlic. Four Irrigations each of 50 mm depth (immediately after sowing, 30, 55, and 85 DAS) were applied as per requirement of coriander, which took care of the demand of intercrops also. Yield of component crop was calculated based on proportionate area occupied by them. The yield of coriander, carrot, onion and garlic was converted into coriander equivalent yield as per prevailing rates in market and treatment evaluation was done accordingly. Economic analysis of the different treatment was done for drawing conclusion.

RESULTS AND DISCUSSION

Growth, yield parameters and yield of coriander

Significantly higher plant height, dry matter accumulation/ plant, number of branches /plant at maturity of coriander were recorded in sole coriander over all intercropping systems (Table 1). In respect to intercropping systems, significantly higher growth parameters of coriander were recorded with 1:1 ratio of coriander and component crops viz. carrot/onion/garlic being at par with 2:2 ratios. The higher plant height and dry matter accumulation/plant in sole coriander in 1:1 ratio intercropping was on account of less competition for sunlight, space, nutrient and water as compared to other ratio. Tiwari *et al*. (2002) reported depressing effect on growth and performance of fennel when intercropped with vegetable crop. Similarly Nandekar *et al.*(1995) reported decrease in growth parameters of potato with intercropping.

The higher yield attributes and yield of coriander with carrot, onion and garlic intercrops was recorded in 1:1 ratio that being at par with 2:2 ratio. Intercropping of coriander with carrot resulted in significantly higher yield and yield attributes of coriander over onion and garlic intercropping (Table 2).The higher yield attributes and yield of coriander in 1:1 ratio with all intercrops might be due to less competition for space, sunlight, water and nutrients between coriander and component crops which gave higher growth parameters resulting in higher translocation of photosynthates from source to sink resulting in higher yield and yield attributes of coriander. Tiwari *et al*. (2002) reported depressing effect on growth and performance of fennel when intercropped with vegetable crop. Similarly Nandekar *et al.* (1995) reported decrease in yield of potato with intercropping.

Yield attributes and yield of intercrops

Yield attributes and yield of intercrops recorded was higher in respective sole crops as compared to intercrop-

Table 1. Effect of intercropping system on growth and yield attributes of coriander (Pooled data of 2004-05, 2005-06 and 2006-07) at harvest

Intercropping system	Plant height (cm)	Dry matter accumulation/ plant (g)	Branches/ plant	Umbels/ plant	Umbellates/ umbel	Umbel diameter (cm)	Seeds/ umbellate	1,000 seed weight (g)	Seed yield/ plant (g)
Sole coriander	82.5	20.25	14.45	44.12	12.25	5.85	6.50	8.80	12.25
Sole onion									
Sole carrot									
Sole garlic									
Coriander + onion (1:1)	77.6	17.90	11.69	41.45	9.25	5.05	5.85	8.64	9.56
Coriander + onion (1:2)	74.6	16.20	10.48	38.26	8.28	4.16	5.25	7.80	7.85
Coriander + onion (2:2)	76.4	17.90	11.62	39.35	8.52	4.65	5.64	8.12	8.63
Coriander + carrot (1:1)	76.5	18.59	13.85	42.40	10.24	5.25	6.12	8.70	10.98
Coriander + carrot (1:2)	74.7	16.88	12.64	39.60	9.25	4.61	5.46	8.20	8.74
Coriander + carrot (2:2)	75.4	17.00	13.82	40.65	9.78	4.88	5.82	8.48	9.64
Coriander + garlic (1:1)	74.6	16.80	11.62	39.12	8.25	4.93	5.62	8.56	9.46
Coriander + garlic (1:2)	72.4	15.35	9.35	36.23	7.28	4.62	5.02	7.75	7.35
Coriander + garlic (2:2)	72.8	16.24	10.48	37.25	8.04	4.75	5.26	8.25	8.23
SEm ±	1.7	0.83	0.61	1.46	0.33	0.21	0.21	0.31	0.34
CD (P=0.05)	5.5	2.48	1.81	4.35	0.98	0.61	0.62	0.91	1.02

Mean of 3 years.

Table 2. Effect of different intercropping on growth and yield attributes of component crops (Pooled data of 2004-05, 2005-06 and 2006-07)

Cropping system	Individual root/bulb weight (g)	Length of root (cm)	Diameter of root (cm)	Equatorial diameter of bulb (cm)	Polar diameter of bulb(cm)	Cloves/bulb
Sole coriander						
Sole onion	43.45			4.25	3.94	
Sole carrot	58.32	13.24	4.5			
Sole garlic	18.24			3.75	3.04	14.25
Coriander + onion (1:1)	28.25			4.01	3.75	
Coriander + onion (1:2)	20.26			3.94	3.50	
Coriander + onion (2:2)	27.12			3.97	3.71	
Coriander + carrot (1:1)	35.25	12.14	3.8			
Coriander + carrot (1:2)	27.14	11.42	3.6			
Coriander + carrot (2:2)	33.14	11.82	3.7			
Coriander + garlic (1:1)	13.24			3.42	2.95	9.45
Coriander + garlic (1:2)	9.45			3.38	2.85	8.92
Coriander + garlic (2:2)	12.21			3.40	2.88	9.14

Table 3. Effect of intercropping systems on yield of coriander and component crops and system productivity (coriander equivalent yield)

Cropping system	Seed yield of coriander (t/ha)				Yield of intercrops (t/ha)				Pooled CEY yield of intercrops (t/ha)	Pooled total CEY (t/ha)
	2004-05	2005-06	2006-07	Pooled	2004-05	2005-06	2006-07	Pooled		
Sole coriander	1.42	1.56	1.61	1.53						1.53
Sole onion					16.25	17.25	19.15	17.55	1.03	1.03
Sole carrot					20.18	20.74	23.79	21.57	1.23	1.23
Sole garlic					4.85	4.86	5.41	5.04	1.44	1.44
Coriander + onion (1:1)	1.21	1.24	1.24	1.23	10.84	10.75	12.43	11.34	0.65	1.87
Coriander + onion (1:2)	0.88	1.02	1.1	1.00	11.75	11.86	13.89	12.50	0.72	1.71
Coriander + onion (2:2)	1.16	1.21	1.23	1.20	9.67	9.75	10.19	9.87	0.56	1.70
Coriander + carrot (1:1)	1.32	1.37	1.51	1.40	11.85	12.08	14.59	12.84	0.73	2.12
Coriander + carrot (1:2)	1.08	1.24	1.28	1.20	12.21	12.75	14.73	13.23	0.76	1.93
Coriander + carrot (2:2)	1.31	1.43	1.46	1.40	10.84	11.06	11.52	11.14	0.64	2.01
Coriander + garlic (1:1)	1.03	1.19	1.23	1.15	2.04	2.21	2.53	2.26	6.47	1.80
Coriander + garlic (1:2)	0.84	0.98	1.06	0.96	2.42	2.45	2.72	2.53	0.72	1.68
Coriander + garlic (2:2)	1.05	1.16	1.21	1.14	1.98	2.01	2.10	2.03	0.58	1.72
SEm ±	0.05	0.06	0.04	0.04	0.45	0.46	0.47	0.44	0.03	0.06
CD (P=0.05)	0.14	0.17	0.13	0.13	1.34	1.37	1.39	1.28	0.09	0.17

Mean of 3 years

ping with coriander. Further, perusal of data in Table 2 and 3 revealed that among different inter cropping ratios, the higher yield of intercrops was exhibited in 1:2 ratio over 1:1 and 2:2 ratio but yield attributes of all the intercrops recorded was higher in 1:1 intercropping ratio followed by with 2:2 ratio. Intercropping of coriander + carrot in all the ratios resulted higher economic yield of carrot as compared to onion and garlic. The higher yield of all the intercrops crops in 1:2 ratio was on account of higher plant population due to accommodation of more number of rows in between interspaces as compared to1:1 and 2:2 ratio.

System productivity

Significantly higher coriander equivalent yield (CEY) and land equivalent ratio (LER) of the system was recorded in intercropping as compared to sole cropping (Table 4). Coriander + carrot in all ratios resulted higher CEY and LER as compared to its intercropping with onion and garlic. Further analysis showed that 1:1 ratio with all intercrops proved superior resulting in higher CEY and LER over 1:2 and 2:2 ratio. Coriander + carrot in 1:1 ratio exhibited 39 and 50% higher CEY and LER, respectively over sole coriander. The higher CEY and LER in intercropping system was on account of additional yield of

Table 4. Effect of intercropping systems on economics and land equivalent ratio (LER) (Pooled data)

Cropping system	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B: C ratio	LER
Sole coriander	19,625	33,750	1.72	1.00
Sole onion	18,830	16,262	0.86	1.00
Sole carrot	22,745	20,391	0.90	1.00
Sole garlic	45,375	4,975	0.11	1.00
C. + onion (1:1)	24,240	41,285	1.70	1.45
C. + onion (1:2)	26,648	32,876	1.23	1.36
C. + onion (2:2)	24,240	37,000	1.53	1.34
C. + carrot (1:1)	23,450	50,701	2.16	1.50
C. + carrot (1:2)	25,345	42,020	1.66	1.38
C. + carrot (2:2)	23,470	46,581	1.98	1.41
C. + garlic (1:1)	31,755	31,135	0.98	1.20
C. + garlic (1:2)	33,350	25,415	0.76	1.13
C. + garlic (2:2)	31,348	28,697	0.92	1.15
SEm ±	1,097	1,383	0.05	0.04
CD (P=0.05)	3,203	4,038	0.13	0.12

Selling price of coriander Rs 35 /kg; Carrot, Rs 2.0/kg and onion Rs 2.0/kg and Garlic Rs. 10/kg
EY=Equivalent yield, LER= Land equivalent ratio, CEY= Coriander equivalent yield

intercrops without much reduction in yield of base crop. The highest CEY and LER in 1:1 ratio with carrot, onion and garlic was due to proportionately less reduction in coriander yield as compared with 1:2 ratio resulting in better yield of intercrop. Bhati (1992) reported higher fennel equivalent yield in intercropping as compared to sole crops. Similarly, Ahlawat and Gangaiah (2010) also reported higher system productivity in chickpea intercropped with linseed over sole chickpea. Thomas *et al*. (2010) reported the highest LER of 1.41 in mustard and chickpea intercropping over sole crops.

Economics

Intercropping of coriander+ carrot in 1:1 ratio exhibited significantly higher net return (Rs 50,701/ha) and B:C ratio (2.16) which was 50 and 26% higher, respectively over sole coriander. Coriander+carrot/onion/garlic in 1:1 ratio proved superior which resulted in higher net return and B:C ratio over 1:2 and 2:2 ratio. Similar benefits of intercropping on economics in fenugreek + mustard was reported by Yadav *et al,* (2003). Khurana and Bhatia (1995) in intercropping of onion and potato with fennel and Ahlawat and Gangaiah (2010) in chickpea + linseed reported similar results.

It is concluded that intercropping of coriander and carrot in 1:1 ratio is promising for higher productivity and profitability.

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