

## Influence of inter cropping systems with varying fertility levels on yield and profitability of fennel (*Foeniculum vulgare* Mill.)

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### ABSTRACT

An experiment on effect of intercropping system and fertility levels on yield and profitability of fennel was conducted at NRCSS, Ajmer during *rabi* season of 2003-04. The experiment consisting four levels of fertilizers (75 kg N+30 kg P<sub>2</sub>O<sub>5</sub>, 90 kg N+40 kg P<sub>2</sub>O<sub>5</sub>, 105 kg N+50 kg P<sub>2</sub>O<sub>5</sub>, 120 kg N+50kg P<sub>2</sub>O<sub>5</sub> per ha) and six levels of intercropping system viz. fennel+ radish (1:1), fennel+ radish (1:2), fennel + radish (2:2), fennel+ carrot (1:1), fennel + carrot (1:2), fennel + carrot (2:2) was conducted in factorial randomized block design with three replications. Application of increasing levels of fertilizers significantly increased fennel yield, carrot/ radish yield, fennel equivalent yield, gross return, net return and BCR and highest yield and economic return was obtained with the application of 120 kg N + 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>. The fennel based intercropping system in association of carrot with all ratios resulted higher yield and profitability as compared with radish at respective intercropping ratio. The highest fennel yield (17.35 q ha<sup>-1</sup>), fennel equivalent yield (26.42 q ha<sup>-1</sup>) gross return (Rs 66050/ ha<sup>-1</sup>), net return (Rs 38584/ ha<sup>-1</sup>) and BCR (1.40) was obtained in 1:1 intercropping ratio of fennel and carrot followed by with 1:2 ratio. Thus, sowing of fennel and carrot in 1:1 ratio with application of 120 kg N +50 kg P<sub>2</sub>O<sub>5</sub> is best for realizing the higher system productivity and profitability.

**Keywords:** Cropping systems, Fennel, Profitability, Yield.

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## INTRODUCTION

Among the seed spices fennel commonly known, as *Saunf* is major seed spice crop belonging to Apiaceae family. In India it is mainly cultivated in Rajasthan, Gujarat, MP, Karnataka, Gujarat ranks first in area and production of fennel in our country. In order to feed burgeoning population, it is necessary to increase production through vertical expansion rather than horizontal. The intercropping system aimed at increasing productivity per unit area, insurance against total crop failure under aberrant weather conditions (Mullick *et al.* 7). Therefore, integration of suitable vegetable crops with wide spaced seed spice crop is necessary. Among seed spices, fennel is a wide space crop best suited for intercropping with vegetable crops (Mehta *et al.* 5). Nutrient management in intercropping is an important area where it is necessary to supply nutrient for both the crops along with realizing higher nutrient use efficiency. Therefore, keeping in view the facts a study on effect of different intercropping system and fertility levels on productivity and profitability of fennel was undertaken with a view to find out best intercropping ratio and appropriate fertilizer level.

## MATERIALS AND METHODS

The field experiment on productivity and profitability of fennel as influenced by different intercropping systems and fertility levels was conducted at NRCSS, Ajmer (Raj) during *rabi* season of 2003-04. The soil of the experimental site was sandy loam with a pH of 9.2 having 0.22 percent organic carbon and 87.4, 20.5, and 158.7 kg per ha available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O respectively. The experiment comprising four levels of fertilizers (75 kg N + 30 kg P<sub>2</sub>O<sub>5</sub>, 90 kg N + 40 kg P<sub>2</sub>O<sub>5</sub>, 105 kg N + 50 kg P<sub>2</sub>O<sub>5</sub>, 120 kg N + 50 kg P<sub>2</sub>O<sub>5</sub> per ha) and six levels of intercropping system *viz.* fennel + radish (1:1), fennel+ radish (1:2), fennel + radish (2:2), fennel + carrot (1:1), fennel + carrot (1:2), fennel + carrot (2:2)) was laid in factorial randomized block design with three replications. 1/3<sup>rd</sup> N and full dose of P and K was applied at the time of sowing of fennel and vegetable crop and remaining 2/3<sup>rd</sup> N was applied in two equal split at 30 and 60 DAS, Sowing of fennel using 10 kg seed of Ajmer fennel-1 was done at 60 cm row to row spacing in 1:1 and 1:2 ratio of fennel and radish/carrot but in 2:2 ratio sowing of fennel was done in pair of 40/80 cm. The radish and carrot were accommodated in fixed ratio as per treatment keeping population of fennel (base crop) as constant. The standard agronomic practices were applied for raising healthy crop of fennel as well as radish and carrot. Irrigation was applied as per requirement of fennel, which met the demand of both carrot and radish also. The yield of both carrot and radish was estimated based on the marketable yield obtained per meter square and converted into yield q/ha. Afterward harvesting of

vegetable crop was done based on demand. Harvesting of fennel was done in stages keeping in view the maturity of umbels. The yield of fennel, carrot and radish was converted into fennel equivalent yield as per prevailing rates in market and treatment evaluation was done accordingly. Economic analysis of the different treatment was also done for drawing conclusion

## RESULT AND DISCUSSION

### *Yield of fennel, radish and carrot*

Application of increasing levels N and P significantly increased economic yield of fennel, carrot and radish. The highest yield of fennel, radish and carrot was obtained with the application of 120 kg N and 50 kg P<sub>2</sub>O<sub>5</sub> which was significantly higher over lower levels. The increasing levels of N and P supply sufficient nutrients for fennel, carrot and radish. The N and P are the major nutrients which plays very important role in various physiological and biochemical process in plants thereby resulting higher photosynthesis, better translocation of photosynthates from source to sink and energy transfer process in plants. Thus, increasing levels of N and P enhanced the yield of fennel, radish and carrot. Patel *et al.* (4) reported that application of increasing levels of nitrogen from 60 to 120 kg /ha progressively increased the seed, stover and biological yield of fennel.

Fennel and carrot in 1:1, 1:2 and 2:2 ratio significantly exhibited higher economic yield of fennel as compared to same ratio of fennel and radish but economic yield of radish was obtained higher as compared to carrot in all the intercropping ratios. The lower economic yield of fennel with radish association might be due to the fact that initial fast growth of radish suppresses the fennel resulting in weak plant. On the other hand association of fennel with carrot proved beneficial due to slow initial growth of carrot resulting less competition for nutrient, water and minerals. The highest economic yield of fennel was recorded when fennel & carrot was sown in 1:1 followed by 2:2 ratio and lowest in 1:2 ratio. The higher population of radish and carrot in 1:2 ratio exert higher competition for resources thereby resulting comparatively lesser yield of fennel. The result corroborate with the findings of Mehta *et al.* (6) who also reported higher yield of fennel with carrot.

### *System productivity and economic analysis*

The increasing levels of N and P significantly enhanced equivalent yield, gross return, net return, and BCR

**Table 1.** Effect of fertility levels and intercropping system on yield of fennel, component crops and fennel equivalent

Treatments		Fennel yield (q ha <sup>-1</sup> )	Carrot/ Radish yield (q ha <sup>-1</sup> )	EY yield of Radish/carrot	Total EY of system (q ha <sup>-1</sup> )	Cost of cultivation (Rs. ha <sup>-1</sup> )	Gross return (Rs. ha <sup>-1</sup> )	Net return (Rs. ha <sup>-1</sup> )	B: C ratio
<b>Fertilizer levels (kg ha<sup>-1</sup>)</b>									
<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>								
75	30	12.14	200.72	6.82	18.96	27050	47400	20350	0.75
90	40	13.71	212.10	7.21	20.92	27327	52300	24973	0.91
105	50	14.79	219.75	7.63	22.42	27604	56050	28446	1.03
120	50	15.80	227.16	7.72	23.52	27881	58800	30919	1.11
S.Em +		0.12	0.60	0.08	0.16	-	-	-	-
CD ( P=0.05)		0.37	1.80	0.24	0.49	-	-	-	-
<b>Inter cropping system</b>									
Fennel +Radish (1:1)		12.01	279.61	5.59	17.60	26916	44000	16534	0.60
Fennel +Radish (1:2)		10.06	288.23	5.76	15.82	28958	39550	12084	0.44
Fennel +Radish (2:2)		13.26	270.63	5.41	18.67	26524	46675	19209	0.70
Fennel + Carrot (1:1)		17.35	151.13	9.07	26.42	28016	66050	38584	1.40
Fennel +Radish (1:2)		15.69	154.58	9.27	24.96	28958	62400	34934	1.27
Fennel +Radish (2:2)		16.31	145.43	8.73	25.04	26524	62600	35134	1.28
S.Em		0.13	0.70	0.09	0.18	-	-	-	-
CD ( P=0.05)		0.38	2.10	0.27	0.55	-	-	-	-

Selling price of fennel Rs 25 /kg, Radish Rs 0.50 /kg and Carrot Rs 1.5 /kg

and the highest values of the economic parameters were obtained with the application of 120 kg N and 50 kg P<sub>2</sub>O<sub>5</sub>/ha. The higher economic return with increasing levels of N and P might be due to higher incremental return as compared to added cost resulting in higher BCR at higher levels of fertilizers. Ahlawat and Gangaiah (1) also reported higher system productivity in chickpea intercropped with linseed over sole chickpea.

Sowing of fennel with carrot in 1:1, 1:2 and 2:2 ratio exhibited significantly higher equivalent yield, gross return, net return and BCR as compared to fennel and radish in all the three ratios. 1:1 ratio of fennel with radish / carrot proved superior over 1:2 and 2:2 ratio in both the crops. The highest equivalent yield, gross return, net return and BCR were recorded with fennel and carrot in 1:1 ratio. These results are in conformity with finding of Yadav *et al.* (8), Mehta *et al.* (6) and Khurana, and Bhatia (3) also found that intercropping with fennel increased net returns

Thus it is inferred that intercropping of fennel and carrot in 1:1 ratio with application of 120 kg N and 50 kg P<sub>2</sub>O<sub>5</sub> is better for realizing higher yield net return and BCR.

## REFERENCES

1. Ahlawat and Gangaiah. 2010. Effect of land configuration and irrigation on sole and linseed (*Linum usitatissimum*) intercropped chickpea (*Cicer arietinum*). *Indian Journal of Agricultural Sciences*. **80** (3): 248–49.
2. Anwer, M.M., Mehta, R.S. and Meena, S.S. 2011. Intercropping of seed spices crops in mango orchards in proceeding.
3. Khurana, S. C. and Bhatia A.K. 1995. Intercropping of onion and fennel with potato. *Journal of the Indian Potato Association*. **22** ( 3-4) 140-145
4. Patel, B.S., Joshi, M.K., Patel, J.C. and Patel, N.B. 2007. Influence of irrigation based on IW/CPE ratio and nitrogen levels on yield and water use efficiency of fennel (*Foeniculum vulgare* Mill.) In Production, Development, Quality and Export of Seed Spices, S.K.Malhotra and B.B. Vashishtha (Eds) NRCSS, Ajmer(Raj), pp262-266
5. Mehta, R.S. and Malhotra, S.K. 2007. Seed spice based cropping system: In Production, Development, Quality and Export of Seed Spices, S.K.Malhotra and B.B.Vashishtha (Eds) NRCSS, Ajmer(Raj), pp 181-189.
6. Mehta, R.S., Meena, S.S. and Anwer, M.M. 2010. Performance of coriander (*Coriandrum sativum* L.) based intercropping system. *Indian J. Agron.* **55**(4) : 37-41
7. Mullick, S.P., More, S.M. Deshpande, S.S. and Patil, J.D. 1993. Intercropping for better stability in dryland watersheds. *Indian J. Agron.* **38**(4):527-530.
8. Yadav, P.C. Makhani Lal and Agarwal 2003. Intercropping of mustard in fenugreek a (*Trigonella foenymgraecum* L) under varying fertility levels. *J. Farming System Research & Development*. **8**(1):110-111.

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