J. Agrofor. Environ. 6 (1): 125-128, 2012 ISSN 1995-6983

Intercropping of fennel with chili

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Abstract: Field experiments were conducted at the Regional Agricultural Research Station, Jamalpur and Spices Research Sub Center, Faridpur during rabi season of 2010-2011 to find out suitable combination for higher productivity and economic return from chili-fennel intercropping systems(s). The treatments were: T_1= Sole chili (broadcast), T_2 = Sole fennel (broadcast), T_3 = Sole fennel (60cm × 30cm), T_4 = Chili (100% broadcast) + 50% fennel (60cm × 30cm), T_5 = Chili (100% broadcast) + 25% fennel (60cm × 60cm), T_6 = Chili (100% broadcast) + 33% fennel (90cm × 30cm), and T_7 = Chili (100% broadcast) + 17% fennel (90cm × 60cm). The result indicated that fruit yield of chili reduced significantly in all combinations of chili-fennel intercropping systems in both the locations. Maximum LER (1.29) and Chili Equivalent Yield (14.11 t/ha at Jamalpur and 12.53 t/ha at Faridpur) were obtained from 100% chili (broadcast) + 50% fennel (60cm × 30cm) i.e. T_4 treatment. Among the intercropping treatments, 100% chili + 33% fennel (90cm × 30cm) gave the maximum BCR (2.82 at Jamalpur and 2.61 at Faridpur) followed by 100% chili + 50% fennel (60cm × 30cm). The highest gross margin (Tk 1,35,546/ ha) was obtained from T_4 treatment at Jamalpur and T_6 treatment (Tk. 116842/ha) at Faridpur. The results of the experiment indicated that T_6 treatment at Faridpur and T_4 at Jamalpur might be suitable intercrop intercrop combination of fennel chili for higher productivity.
Keywords: Fennel, intercrop, sole & chili.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources. Yield advantages is often attributed to the fact that different crops complement each other and make better use of resources when grown together rather than separately. Besides, intercropping also acts as insurance for resource poor farmers if one crop fails, they get some yield of another crop. Intercropping offers a possible solution to raise productivity through temporal intensification in a country like Bangladesh where the possibility to bringing more land under cultivation is limited. Yield advantages through intercropping have been reported by many workers (Willey, 1979). Chili is an important winter spices in Bangladesh which is grown in rabi season. Due to decreasing of cultivable land, some farmers of char area of Bangladesh have been practicing chili-fennel intercropping instead of sole cropping. Fennel is also the winter spices in Bangladesh. Farmers grow chili in broadcast method and they treated chili as main crop. Fennel takes more than five months while chili takes less duration than fennel for maturity. Pruthi (2001) reported that fennel can be grown as a mixed or intercrop with chili. This experiment was conducted to find out suitable combination of intercropping fennel with chili for higher productivity and economic return.

Materials and Methods

The experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi season of 2010-2011. The treatments were sole chili, sole fennel, chili (100% broadcast) + 50% fennel (60cm × 30cm), chili (100% broadcast) + 25% fennel (60cm × 60cm0, chili (100% broadcast) + 33% fennel (90cm × 30cm) and 100% chili (broadcast) + 17% fennel (90cm × 60cm). Local variety of chili and advance line of fennel was used in the experiment. Planting was done on 10 November at Jamalpur and 15 November at faridpur in 2010. The trial was setup in a RCB design with three replications. Unit plot size was 6m × 3.6m. For sole fennel, fertilizers were used at the rate of 60-20-38 kg/ ha NPK and for sole chili and chili-fennel intercropping systems 120-80-120-20-4 kg/ha NPKS Zn in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate, respectively. Half urea and full amount of other fertilizers were applied as basal during find land preparation. Irrigation was applied thrice at 25, 50 and 70 DAS and after each irrigation remaining urea was top dressed in three equal splits. Chili was harvested twice at 124 - 155 DAS. Fennel was harvested at 160 DAS. Five plants of chili were marked earlier to count the number and weigh of fruit/plant. Yield attributes of fennel were also recorded from five plants selected randomly earlier and yield data was recorded considering the whole plot. Chili equivalent yield (CEY) was calculated considering the farm gate price at the harvesting time following the formula as stated by Aujeneyulu *et al*. (1982). Land Equivalent Ratio (LER) was calculated following Alabi and Esobhawan (2006). Economic analysis was done in terms of total cost of cultivation, net return and BCR in both the locations. Data recorded on yield and yield attributes were analyzed statistically following CROPSTAT programme. Mean separation was done as per LSD test at 5% level of significance.

Results and Discussion

Jamalpur

Yield and yield attributes of chili: Plant height of chili differed significantly and the tallest plant was found in sole chili (Table 1). Similar result was obtained by Kadali *et al.* (1989). The results indicated that number of branch/plant was reduced significantly when more population of fennel attained in the treatment (Table 1). The highest number of branch/plant was produced in sole treatment. The lowest number of branch/plant was produced by the treatment T_4. Alabi and Esobhawan (2006) reported higher number of branch in sole chili than intercropping systems. Number of fruit/plant also differed significantly among the treatments. It was found that the treatment T_1 gave the highest number of fruit plant^{-1} which was significantly different from other treatments. The second highest number of fruit plant^{-1} was found in the treatment T_7. The results in terms of number of fruit plant^{-1} exhibited that number of chili reduced drastically with the increased population of fennel under

intercropping situation. The lowest number of fruit plant^{-1} was recorded from the treatment T_4. There was no significant difference in respect of length of fruit. Differences for weight of fruit plant^{-1} were observed like number of fruit plant^{-1}. The highest fruit yield was obtained from the T_1 (sole chili) which was significantly different from the other treatments. The second highest fruit yield of chili was obtained from the treatment T_7 and it was statistically similar to that of T_5 and T_6 treatments. The lowest fruit yield was obtained from the T_4 treatment.

Yield and yield attributes of fennel: All the characters of fennel studied in the experiment differed significantly (Table 2). The tallest plant was found in the treatment T_3 (sole fennel with line sowing) and it was similar to that of T_1 (sole fennel with broadcast sowing). Number of branch plant^{-1} increased significantly with lower plant population of fennel (T_7) while the lowest number of branch plant^{-1} was found in T_2 treatment Number of umbel plant^{-1} also increased significantly in the treatments T_3, T_6 and T_7. The highest number of seed umbel^{-1} was obtained from the treatment T_6 which was significantly different from the others. The lowest number of seed umble^{-1} was obtained from T_7 followed by T_5 treatments. Thousand seed weight variation was found non-significant. Seed yield of fennel varied significantly and it decreased as per reduction of plant population in the intercropping systems. The highest seed yield was obtained from T_3 (sole) while the lowest was obtained from T_7 possibly because of minimum plant population of fennel in the intercropping system.

Table 1. Yield and yield attributes of chill as influenced by intercropping with fennel during 2010-2011 (Jamalpur)

Treatment	Plant height (cm)	No. of branch plant^{-1}	No. of fruit plant^{-1}	Length of fruit (cm)	Fruit wt. plant^{-1} (g)	Fruit yield (t ha^{-1})	LER	CEY (t ha^{-1})
T_1	70.1	5.9	45.3	5.71	107.7	6.60	1.00	6.60
T_2	-	-	-	-	-	-	1.00	12.32
T_3	-	-	-	-	-	-	1.00	14.05
T_4	58.3	4.3	10.6	5.04	26.8	3.50	1.29	14.11
T_5	61.5	5.8	19.7	5.63	44.3	3.90	1.24	13.03
T_6	61.7	4.5	20.1	5.65	44.9	3.91	1.28	13.56
T_7	67.0	5.0	31.9	5.41	39.3	4.20	1.15	11.44
F-test	*	**	**	NS	**	**	-	-
$LSD_{0.05}$	7.18	0.71	6.29	-	6.82	0.49	-	-
CV(%)	5.9	7.4	13.1	12.7	6.9	5.9	-	-

T_1= Sole chili (broadcast), T_2 = Sole fennel (broadcast), T_3 = Sole fennel (60cm × 30cm), T_4 = Chili (100% broadcast) + 50% fennel (60cm × 30cm), T_5 = Chili (100% broadcast) + 25% fennel (60cm × 60cm), T_6 = Chili (100% broadcast) + 33% fennel (90cm × 30cm), and T_7 = Chili (100% broadcast) + 17% fennel (90cm × 60cm).

Table 2. Yield and yield attributes of fennel intercropped with chili during *rabi* 2010-2011 (Jamalpur)

Treatment	Plant height (cm)	No. of branch plant^{-1}	No. of umble plant^{-1}	No. of seed umbel^{-1}	1000-seed wt. (g)	Seed yield (t ha^{-1})
T_1	-	-	-	-	-	-
T_2	137.6	5.1	34.2	416.2	4.02	1.54
T_3	150.0	8.2	46.4	357.6	3.95	1.76
T_4	126.8	7.6	34.4	372.2	4.36	1.33
T_5	131.1	8.1	39.4	341.1	4.17	1.14
T_6	127.3	7.6	41.1	457.4	4.79	1.21
T_7	133.7	10.9	44.6	312.2	4.12	0.91
F-test	*	**	*	**	NS	**
$LSD_{0.05}$	13.68	2.24	7.79	40.10	-	0.14
CV (%)	5.6	15.6	10.7	5.9	9.01	5.7

T_1= Sole chili (broadcast), T_2 = Sole fennel (broadcast), T_3 = Sole fennel (60cm × 30cm), T_4 = Chili (100% broadcast) + 50% fennel (60cm × 30cm), T_5 = Chili (100% broadcast) + 25% fennel (60cm × 60cm), T_6 = Chili (100% broadcast) + 33% fennel (90cm × 30cm), and T_7 = Chili (100% broadcast) + 17% fennel (90cm × 60cm).

Table 3. Yield and economic performance intercropping of fennel with chili during 2010-2011 (Jamalpur)

Treatment	Yield (t ha^{-1})		Cost of cultivation (Tk ha^{-1})	Gross return (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
	Chili (fruit)	Fennel (seed)				
T_1	6.60	-	64,654	99,000	34,346	1.53
T_2	-	1.54	42,294	1,84,800	1,42,506	4.36
T_3	-	1.76	47,494	2,11,200	1,63,706	4.44
T_4	3.50	1.33	76,554	2,12,100	1,35,546	2.78
T_5	3.90	1.14	71,654	1,95,300	1,23,646	2.72
T_6	3.91	1.21	72,354	2,03,850	1,31,496	2.82
T_7	4.20	0.91	68,774	1,72,200	1,03,426	2.50

Price- Chili Tk 15/- kg^{-1}; Fennel Tk 120/- kg^{-1}; T_1= Sole chili (broadcast), T_2 = Sole fennel (broadcast), T_3 = Sole fennel (60cm × 30cm), T_4 = Chili (100% broadcast) + 50% fennel (60cm × 30cm), T_5 = Chili (100% broadcast) + 25% fennel (60cm × 60cm), T_6 = Chili (100% broadcast) + 33% fennel (90cm × 30cm), and T_7 = 100% chili (broadcast) + 17% fennel (90cm × 60cm).

Land Equivalent Ratio (LER) and Chili Equivalent Yield (CYE): LER and CEY were found maximum in chili (100%) + fennel 50% (60cm × 30cm) combination (T_4) followed by (100% broadcast) + 33% fennel (90cm × 30cm) (T_6) The lowest LER and CEY was obtained from T_7 among the intercropping systems (Table 1).

Economic performance: Cost of cultivation and gross return (Table 3) were maximum in the treatment combination Chili (100%) + Fennel (50%) (60cm × 30cm) (T_4). Sole fennel (60cm × 30cm) gave the highest gross margin (Tk 1,63,706 ha^{-1}) and BCR (4.44). Among the intercropping systems, the treatment chili 100% + fennel 50% (60cm × 30cm) (T_4) gave the highest gross margin (Tk 1,35,546 ha^{-1}) with BCR 2.78 followed by T_6 (gross margin Tk 1,31,496 ha^{-1} and BCR 2.82). Higher benefit in chili intercropping systems was reported by Suresha (2007).

Table 4. Yield and yield attributes of chill as influenced by intercropping with fennel during 2010-2011 (Faridpur)

Treatments	Plant height (cm)	No. of branch $plant^{-1}$	No. of fruits $plant^{-1}$	Fruit length (cm)	Fruit wt. $plant^{-1}$ (g)	Fruit yield (t ha^{-1})	LER	CEY (t ha^{-1})
T_1	60.00	5.0	39.93	6.31	116.02	4.92	1.00	4.92
T_2	-	-	-	-	-	-	1.00	10.08
T_3	-	-	-	-	-	-	1.00	11.26
T_4	68.87	4.1	15.33	6.13	45.99	2.31	1.45	12.53
T_5	58.73	4.3	22.11	5.92	63.89	2.34	1.37	11.65
T_6	63.10	4.8	20.05	8.31	66.17	2.73	1.51	12.62
T_7	60.07	5.2	28.52	6.06	87.84	3.23	1.37	10.40
LSD (0.05%)	NS	0.24	2.98	NS	28.43	0.72	-	-
CV (%)	10.31	8.3	6.29	22.98	19.87	9.68	-	-

NS = Non-significant, LER – Land Equivalent Ratio, CEY – Chili Equivalent Yield

Table 5. Yield and yield attributes of fennel intercropped with chili during *rabi* 2010-2011 (Faridpur)

Treatments	Plant height (cm)	No. of branch $plant^{-1}$	No. of umbels $plant^{-1}$	No. of seed $umbel^{-1}$	1000-seed wt. (g)	Yield (t/ha)
T_1	-	-	-	-		-
T_2	114.6	4.8	31.86	336.00	3.89	1.26
T_3	118.5	6.9	50.13	326.40	3.96	1.41
T_4	116.2	5.58	44.13	274.33	4.0	1.24
T_5	113.3	7.01	53.00	300.00	3.98	1.13
T_6	112.6	6.5	41.36	277.73	3.95	1.20
T_7	110.7	7.3	51.86	293.60	3.96	0.90
LSD (5%)	NS	1.39	8.02	23.39	NS	0.15
CV (%)	6.07	12.06	9.71	9.51	8.51	7.13

NS = Non-significant

Table 6. Yield and economic performance intercropping of fennel with chili during 2010-2011 (Faridpur)

Treatments	Yield (t ha^{-1})		Cost of cultivation (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
	Chili (fruit)	Fennel (seed)				
T_1	4.92	-	65,500	73,800	8300	1.26
T_2	-	1.26	43,294	1,51,200	1,07,906	3.49
T_3	-	1.41	46,850	168,900	1,22,050	3.61
T_4	2.31	1.24	76,747	1,87,950	1,11,203	2.45
T_5	2.34	1.13	71,664	1,74,750	1,03,086	2.43
T_6	2.73	1.20	72,454	1,89,300	1,16,842	2.61
T_7	3.23	0.90	68,980	1,56,000	87,020	2.26

Price – Chili Tk. 15 Kg^{-1}, Fennel Tk. 120 Kg^{-1}

Faridpur

Yield and yield attributes of chili

Plant height of chili was not differed significantly among the different treatments (Table 4). Highest plant height (68.87) was observed from T_4 treatment and the lowest (58.73) in T_5 treatment. The results indicated that number of branch $plant^{-1}$ was reduced significantly when more population of fennel attained in the treatment. The highest number of branch $plant^{-1}$ (5.2) was produced in T_7 treatment. Number of fruits/plant also differed significantly among the treatments. There was no significant difference in respect of length of fruit. The highest fruit yield (4.92 t ha^{-1}) was obtained from T_1(sole chili) which was statistically differ from the other treatments. The second highest fruit yield (3.23 t ha^{-1}) of chili was obtained from the treatment T_7 and it was statistically similar with T_6 treatment. The lowest fruit yield (2.31 t ha^{-1}) was obtained from the T_4 treatment.

Yield and yield attributes of fennel: Number of branch plant^{-1}, umbels plant^{-1}, seed umbel^{-1}, fruit yield (t ha^{-1}) was differed significantly among the different treatments (Table 5). Plant height was non-significant among the treatments. Number of branches/plant increased with lower plant population of fennel while the lowest number of branch plant^{-1} (4.8) was found in T_2. Number of umbel plant^{-1} was highest (53.00) in T_5 treatment and it was lowest (31.86) in T_2 treatment. The number of seeds/umbels was highest (336) in T_2 treatment. Thousand seed weight variation was found non-significant. Seed yield of fennel varied significantly and it was decreased as per reduction of plant population in the intercropping systems. The highest seed yield (1.41 t ha^{-1}) was obtained from T_3 treatment while the lowest (0.90t ha^{-1}) was obtained from T_7 treatment.

Economic performance: Sole fennel (30cmx30cm) gave the highest gross margin (Tk.2,44,951) and BCR (3.61). But the intercropping system, the highest chili equivalent yield (12.62t/ha) was recorded in T_6 treatment while the gross return (Tk.1,89,300) and BCR (2.61) was also highest in T_6 treatment(Table 6).

Cultivation of fennel as intercrop with chili was found profitable than sole cropping of chili. The farmers could obtained maximum profit from the intercropping systems of chili 100% (broadcast) + fennel 50% (60 cm x 30 cm) and chili 100% (broadcast) + fennel 33% (90 cm x 30 cm) at Jamalpur and chili 100% (broadcast) + fennel 33% (90 cm x 30 cm) at Faridpur.

References

Alabi R A and Esobhawas A O. 2006. Relative Economic value of Maize-Okra intercrops in rainforest zone. Nigeria J. Central European Agric. 7(3): 433-438.

Aujeneyulu V R, Singh S P and Ali M. 1982. Effect of competition free period technique and pattern pearl millet planting in growth and yield of mungbean and total productivity in solid pearl millet and pearl millet/mungbean intercropping system. Indian J. Agron. 27(3): 219-226.

Kadalli V G, Banakapur, V M and Patil A A. 1987. Studies on companion cropping of onion with chili and French bean. J. Maharashtra Agric. University. 14: 378-379.

Pruthi J S. 2001. Minor spices of India. ICAR, New Delhi.

Suresha B A, Allollo T B, Patil M G, Desai B K and Syed A. 2007. Yield and economics of chili based intercropping system. Karnataka J. Agric. Sci. 20(4): 807-809.

Willey R W. 1979. Intercropping: its importance and research needs. Part I. Competition and yield advantages. Field Crop Absts. 32(1): 1-10.