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INTERCROPPING FRENCH BEAN WITH BRINJAL AT VARYING PLANTING SYSTEM

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Abstract

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2014-15 and 2015-16 to find out suitable crop combination for higher productivity and economic return. Six different treatments viz. T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%) were evaluated. The results revealed that the highest mean fruit yield of brinjal (44.26 t ha^{-1}) and french bean (20.96 t ha^{-1}) was obtained in sole cropping of component crops. Under intercropping, the highest brinjal yield (38.61 t ha^{-1}) was recorded in brinjal normal row + 1 line french bean between brinjal, while, the highest french bean yield (16.06 t ha^{-1}) in brinjal normal row + 2 lines french bean between brinjal. The highest mean brinjal equivalent yield (58.72 t ha^{-1}) and land equivalent ratio (1.50) was also obtained in brinjal normal row + 2 lines french bean between brinjal. The highest gross return (Tk. 4,69,760 ha^{-1}), gross margin (Tk. 3,66,440 ha^{-1}), and BCR (4.54) were obtained in brinjal normal row + 2 lines french bean between brinjal and the lowest in sole french bean. The overall results indicated that among the intercrop combinations brinjal normal row + 2 lines french bean between brinjal was found suitable for total productivity and economic return of the system.

Introduction

Intercropping system is an important feature of tropical agriculture. It is a cropping system which integrates crop production with soil conservation. Benefits of intercropping may be briefed as: better use of resources, improvement of soil fertility by legume components of the system, soil preservation through covering the bare land between the rows, reduction of biotic and abiotic risks by increasing diversity, suppression of weed infestation. One of the advantages of this system is that it gives an assurance against crop failure which is common in developing countries. The value of intercropping system has been gaining recognition because of its ability to reduce damage caused by pest and diseases, ensure greater yield stability by producing some yield even though some of the component crops failed. It increases total productivity per unit area through maximum utilization of land, labor and growth resources (Craufard, 2000; Marshal

and Willey, 1983). Inclusion of legumes enhances crop and nitrogen yields of the non-legumes (Wood and Mayers 1987). Brinjal is an important winter vegetable crop in Bangladesh, which can be grown throughout the year. It is grown with wider spacing. So, in the inter-row space of brinjal french bean can be grown as intercrop for higher economic return as well as soil nutritious status can be improved. Therefore, this experiment was conducted to find out suitable crop combination of brinjal with french bean for higher productivity and economic return.

Materials and methods

The experiment was conducted at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2014-15 and 2015-16. Six different treatments were employed in this study viz. T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%). The experiment was laid out in randomized complete block (RCB) design with three replications. The unit plot size was 4.5 m ×3.0 m. The land of the experimental plot was prepared into good tilth. Fertilizers were applied @ 160-48-120-20-3-0.9 kg ha^{-1} N-P-K-S-Zn-B for both the sole brinjal and intercrop combinations. Except N and K, full amount of all other fertilizers were applied in pit before 1 week of transplantation. N and K was applied in 3 equal splits at 21, 35 and 50 DAT in brinjal as ring method followed by irrigation. Under intercropping situation no additional fertilizer was applied for french bean. But in sole french bean, fertilizers were applied @ 120-40-60-12-3 kg ha^{-1} N-P-K-S-Zn, respectively. Half of N and full amount of other fertilizers were applied at final land preparation and the rest N was top dressed at 35 days after sowing (DAS). Thirty days old seedlings of brinjal was transplanted on 20 November 2014 and 08 November 2015, respectively and french bean was sown 10 days after planting of brinjal in line according to the treatment combinations. Seeds of BARI Begun-10 and BARI Jharsheem-2 were used in both the years. Intercultural operations like watering, weeding and pest control were done as and when required. First harvesting of brinjal was done at 119 DAP (Days After Planting) and the harvesting was continued up to 208 DAP. French bean was harvested three times at 87, 98 and 115 DAS. Yield components of brinjal and french bean were taken from randomly selected 10 plants from each plot. Yields of both the crops were taken from whole plot. Treatments were compared in terms of land equivalent ratio and % land save using the formula developed by Willey (1985). Collected data of all crops were analyzed statistically by using MSTAT software packages and mean differences for each character were compared by Least Significant Difference (LSD) test (Gomez and Gomez 1984). Brinjal equivalent yields (BEY) were computed using the formula of Bandyopadhaya (1984).

Results and Discussion

Yield attributes of Brinjal

The plant height, branch $plant^{-1}$, fruit $plant^{-1}$ and fruit weight $plant^{-1}$ were significantly influenced by intercrop combination and sole cropping of brinjal in both the years (Table 2). The tallest plant (125.20 cm in 2014-15 and 100.73 cm in 2015-16) was recorded in brinjal paired row (100%) + 4 lines french bean between brinjal (53%) and the shortest plant (115.50 cm in 2014-15 and

93.53 in 2015-16) in sole brinjal in both the year. The highest branch plant^{-1} (7.10) in 2014-15 was obtained in sole brinjal but there was no significant difference in 2015-16. The maximum number of fruit plant^{-1} (55.70 in 2014-15 and 36.53 in 2015-16) was recorded in sole planting of brinjal. Similarly, the highest fruit weight plant^{-1} (2510.40 g in 2014-15 and 1792.60 g in 2015-16) was obtained in sole planting of brinjal and the lowest in brinjal paired row (100%) + 4 lines french bean between brinjal (53%) regardless of year. Intercropping combinations had affected the fruit / plant and fruit weight.

Table 1. Yield attributes of brinjal under sole and intercropping situation

Treatments	Plant height (cm)		Branch plant^{-1} (no.)		Fruit plant^{-1} (no.)		Fruit weight plant^{-1} (g)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	115.50	93.53	7.10	7.60	55.70	36.53	2510.40	1792.60
T_3	122.00	98.00	5.40	7.33	46.30	30.87	2269.00	1434.26
T_4	123.30	100.20	4.90	7.40	44.40	29.13	2007.80	1330.80
T_5	124.96	99.80	5.10	6.73	45.20	27.53	2010.20	1251.47
T_6	125.40	100.73	5.40	7.40	45.70	28.93	1988.30	1236.27
$LSD_{(0.05)}$	1.83	2.71	1.88	NS	2.95	3.54	135.03	359.00
CV (%)	4.00	3.46	9.92	9.36	3.30	6.14	3.32	11.53

T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%).

Yield attributes of French bean

The plant height and pod plant^{-1} significantly influenced by intercrop combination and sole cropping (Table 1) but insignificant in branch/ plant and length of pods in both the years. The highest plant height (55.60 and 58.47cm) was observed in brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and the lowest (51.29 and 52.60cm) in sole cropping of french bean in both the years. The maximum pod plant^{-1} (33.87 in 2014-15 and 33.50 in 2015-16) was obtained in sole cropping of french bean and the minimum was in brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and brinjal paired row (100%) + 4 lines french bean between brinjal (40%) in 2014-15 and 2015-16, respectively.

Table 2. Yield attributes of french bean under sole and intercropping situation

Treatment	Plant height (cm)		Branch plant^{-1} (no.)		Pod plant^{-1} (no.)		Pod length (cm)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_2	51.29	52.60	9.97	6.37	33.87	33.50	11.77	11.30
T_3	53.81	56.70	8.45	7.33	31.04	32.07	13.36	12.17
T_4	54.42	55.93	8.27	6.90	29.42	31.43	12.71	11.70
T_5	55.60	58.47	8.12	7.23	27.00	25.80	13.43	12.13
T_6	54.94	56.50	8.00	8.07	28.29	24.67	11.37	11.03
$LSD_{(0.05)}$	2.78	3.12	NS	NS	2.46	3.72	NS	NS
CV (%)	2.73	2.96	8.01	11.85	4.33	6.69	6.98	6.77

T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%).

Yield, Brinjal Equivalent Yield and LER

The brinjal and french bean yield significantly influenced by intercrop combinations and sole sowing situations (Table 3). The highest yield was recorded in sole cropping. The highest yield in sole crop might be due to the utilization of wider space and less competition for natural resources. Ali *et al.* (2003) also reported similar result. Under intercropping, the highest brinjal yield was recorded in brinjal normal row + 1 line french bean between brinjal might be due to less competition of different growth resources and the lowest in brinjal paired row (100%) + 4 lines french bean between brinjal (53%). Yield reduction percent of brinjal in intercropping over sole is highest (23.04 in 2014-15 and 26.45 in 2015-16) in brinjal paired row (100%) + 4 lines french bean between brinjal (53%) and lowest (9.33 in 2014-15 and 16.77 in 2015-16) in brinjal normal row (100%) + 1 line french bean between brinjal (33%). On the other hand, the highest french bean yield under intercrop situation was recorded in brinjal normal row (100%) + 2 lines french bean between brinjal (66%) and the lowest in brinjal normal row + 1 line french bean between brinjal. Yield reduction percent of french bean in intercropping over sole is highest in brinjal normal row (100%) + 1 line french bean between brinjal (33%) (33.49 in 2014-15 and 50.96 in 2015-16) and lowest (13.30 in 2014-15 and 32.73 in 2015-16) in brinjal normal row (100%) + 2 line french bean between brinjal (66%).

The equivalent yield of brinjal was influenced by different cropping systems (Table 4). Brinjal equivalent yields (BEY) in all intercropping systems were higher than sole brinjal indicating higher productivity of intercropping systems. Similar results were mentioned by Alom *et al.* (2013). Among the treatments systems, maximum mean brinjal equivalent yield (BEY) was 58.72 t ha^{-1} was obtained in brinjal normal row (100%) + 2 lines french bean between brinjal (66%), followed by brinjal normal row (100%) + 1 line french bean between brinjal (33%) over both brinjal and french bean sole sowing. In this study the mean LER values in all the intercropping systems were higher indicating the yield advantage of intercropping over sole cropping of brinjal (Table 3). Hence, intercropping rendered better productivity than their sole stand. The result was in agreement with the findings of Juskiw *et al.* (2000). The land equivalent ratio (LER) was also higher in brinjal normal row (100%) + 2 lines french bean between brinjal (66%), and the lowest in brinjal paired row (100%) + 4 lines french bean between brinjal (53%).

Table 3. Yield of brinjal and french bean, brinjal equivalent yield (BEY) and land equivalent ratio (LER) under sole and intercropping situations

Treatment	Yield (t ha^{-1})				BEY (t ha^{-1})		LER	
	Brinjal		French bean					
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	47.56	40.97	-	-	47.56	44.27	1.00	1.00
T_2	-	-	20.15	21.78	25.19	26.21	1.00	1.00
T_3	43.12	34.10	13.40	10.68	59.87	53.66	1.57	1.39
T_4	39.26	33.80	17.47	14.65	61.09	56.35	1.68	1.50
T_5	38.75	31.59	14.23	12.68	56.53	47.44	1.53	1.36
T_6	36.60	30.13	14.03	12.66	54.14	45.95	1.47	1.33
$LSD_{(0.05)}$	4.26	4.99	1.29	2.51	-	-	-	-
CV (%)	5.49	7.86	4.32	9.07	-	-	-	-

T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%).

Cost and return analysis

The cost and return analysis of sole and intercropping of brinjal and french bean are presented in Table 4. The result revealed that the highest gross return (Tk. 469760 ha^{-1}) and gross margin (Tk. 366440 ha^{-1}) were obtained in brinjal normal row (100%) + 2 lines french bean between brinjal (66%). The lowest gross return and gross margin were obtained from both sole brinjal and sole fernch bean. The highest benefit cost ratio (4.57) was also obtained from brinjal normal row (100%) + 2 lines french bean between brinjal (66%) and the lowest in sole french bean (2.69).

Table 4. Cost and return analysis of brinjal and french bean under sole and intercropping situations (average of two years)

Treatment	BEY (t ha^{-1})	Gross return (Tk. ha^{-1})	Cost of cultivation (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1	45.91	354120	98320	255800	3.60
T_2	25.70	209650	78000	131650	2.69
T_3	56.76	454080	102040	353260	4.45
T_4	58.72	469760	102792	366440	4.57
T_5	51.98	415840	102320	314520	4.06
T_6	50.04	400320	102430	298000	3.90

Market price: Brinjal Tk 8 kg^{-1}, French bean Tk 10 kg^{-1}
T_1 = Sole brinjal (75 cm x 60 cm), T_2 = Sole french bean (30 cm x 10 cm), T_3 = Brinjal normal row (100%) + 1 line french bean between brinjal (33%), T_4 = Brinjal normal row (100%) + 2 lines french bean between brinjal (66%), T_5 = Brinjal paired row (100%) + 3 lines french bean between brinjal (40%) and T_6 = Brinjal paired row (100%) + 4 lines french bean between brinjal (53%).

Conclusion

The overall results indicated that among the intercrop combinations brinjal normal row + 2 lines french bean (30 cm x 10 cm) between brinjal was found suitable for total productivity and economic return of the system.

References

Alom, M.S., B. L. Nag, M. N. Islam, F. Ahmed and S. Akther. 2013. Performance of different crop species with pointed gourd (*Trichosanthes dioica Roxb.*) Bangladesh J. Agril. Res. 38(3): 523-529.

Bandyopadhyay, S. N. 1984. Nitrogen and water relations in grain sorghum-legume intercropping systems. Ph. D. Dissertation, Indian Agricultural Research Institute, New Delhi.

Craufard, P. Q. 2000. Effect of plant density on the yield of sorghum-cowpea and pearl millet-cowpea intercrops in northern Nigeria. Exp. Agric. 36(3): 379–395.

Gomez K. A. and A. A. Gomez. 1984. Statistical procedures for agricultural research, International Rice Research Institute, Los Banos, Philippines, John Wiley and sons, New York. p. 680.

Juskiw, P. E., Helm, J. H. and Salmon, D. F. (2000). Competitive ability in mixture of small grain cereals. Crop Sci. 40: 159-164.

Marshall, B. and R. W. Willey. 1983. Radiation interception and growth in an intercrop of pearl millet/groundnut. Field Crops Res. 7(2): 141-160.

Willey, R. W. 1985. Evaluation and presentation of intercropping advantages. Exp. Agric. 21(2): 119-133.

Wood, I. M. and R. J. K. Myers. 1987. Food legumes in farming system in the tropics and subtropics. pp. 34-45. In *food legume improvement for Asian farming system*. ACIAR Proceedings Series no. 18 (Wallis, E.S. and D.E. Byth, eds). Canberra, Australia: Australian Center for International Agricultural Research.