ISSN 0258-7122
Bangladesh J. Agril. Res. 38(1): 137-143, March 2013

STUDY ON INTERCROPPING LEAFY VEGETABLES WITH OKRA (*Abelmoschus esculentus* L.)

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Abstract

A field experiment on intercropping of okra and leafy vegetables was conducted at Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and Agricultural Research Station, Burirhat, Rangpur during Kharif-I season of 2010 and 2011 to find out suitable crop combination for higher productivity and economic return. Seven treatments viz., sole okra (50 cm × 40cm), okra 100% (in row) + red-amaranth 100% (broadcast), okra 100% (in row) + red-amaranth 75% (broadcast), okra 100% (in row) + leaf amaranth 100% (broadcast), okra 100% (in row) + leaf amaranth 75% (broadcast), okra 100% (in row) + jute as patshak 100% (broadcast), okra 100% (in row) + jute as patshak 75% (broadcast) were used. Intercropping reduced okra yield but total productivity increased due to additional yield of vegetables. In both the locations, sole okra produced the highest yields (15.82 t/ha at Joydebpur and 13.79 t/ha at Burirhat). Among the intercropping treatments, the highest okra yields (15.42 t/ha at Joydebpur and 12.64 t/ha at Burirhat) were obtained from okra 100%+ red amaranth 75% combination. The lowest okra yield (13.16 t/ha at Joydebpur and 11.75 t/ha at Burirhat) was recorded in okra 100% + jute as patshak 100% combination. The highest okra equivalent yield (23.00 t/ha) was recorded in okra 100% + red amaranth 100% at Joydebpur and in okra 100% + leaf amaranth 100% (21.79 t/ha) at Burirhat. These treatment combinations also gave the highest gross margin (Tk. 227180/ha at Joydebpur and Tk. 214600/ha at Burirhat) and benefit cost ratio (5.66 at Joydebpur and 5.58 at Burirhat). The results revealed that cent percent red amaranth (broadcast) or leaf amaranth intercropped with cent percent okra might be suitable combination for higher productivity and economic return at Joydebpur and Burirhat, respectively.

Keywords: Okra, leafy vegetables and intercropping.

Introduction

Intercropping is a tool used for increasing cropping intensity in developing countries like Bangladesh. It increases total productivity through efficient utilization of land, labour, and growth resources (Ahmed e*t al.*, 2006). Greater productivity in intercropping system is commonly achieved by minimizing inter-

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specific competition and maximizing complementary use of growth resources (Islam, 2002). Inter-specific competition may be minimized through judicious choice of crops (Santalla *et al*., 2001). Usually plants differing in growth duration, height, rooting systems, and nutrient requirements are considered to grow together in intercropping systems (Reddy and Willey, 1981). Okra (*Abelmoschus esculentus* L.) is an important summer vegetable crop in Bangladesh, which is grown in Kharif-I season (February/March). Okra is a tall statured crop and is grown with wide spacing. So, short duration vegetables like red-amaranth, leaf amaranth (danta shak) and jute (patshak) may be introduced as intercrop by utilizing the inter-row space of okra for crop diversity and higher economic return. Summer vegetables crises may also be met up to some extent by intercropping of leafy vegetables with okra. Most intercropping research has focused on field crops (Tsubo *et al*., 2005 and Ghosh *et al*., 2006). Intercropping field crops with vegetables has also been intensively investigated (Ahmed *et al*. 2006 ; El-shaikh and Bekheet, 2004). However, relatively few studies have been conducted on vegetables plus vegetables intercropping systems. Therefore, this experiment was conducted to find out suitable crop combination for intercropping system along with proportion for higher productivity and economic return.

Materials and Method

The experiment was conducted at the research field of Agronomy Division, BARI, Joydebpur, Gazipur of Grey Terrace soil (AEZ-28) and Agricultural Research Station, Burirhat, Rangpur of Tista Meander Floodplain soil (AEZ-3) during the Kharif-I season of 2010 and 2011. Seven treatments viz. Sole okra (50 cm × 40 cm), okra 100% (in row) + red-amaranth 100% (broadcast), okra 100% (in row) + red-amaranth 75% (broadcast), okra 100% (in row) + leaf amaranth 100% (broadcast), okra 100% (in row) + leaf amaranth 75% (broadcast), okra 100% (in row) + jute as patshak 100% (broadcast), okra 100% (in row) + jute as patshak 75% (broadcast) were used. The unit plot size was 3.5 m x 4 m. The experiment was laid out in randomized completely block design with three replications. Seeds of okra (Green finger), red amaranth (var. BARI Lalshak-1), leaf amaranth (var. BARI Danta-1) and patshak (var. Binapatshak-1) were sown according to treatments on 10 March 2010 and 15 March 2011 at Joydebpur and 20 March 2010 and 19 March 2011 at Burirhat. Seed rate/ha were used as 5.0, 3.0, 3.0 and 15.0 kg for okra, red amaranth, leaf amaranth and jute, respectively. Fertilizers were applied in sole and intercrop plots at the rate of 90-30-60-15 kg/ha N, P, K, and S as urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum, respectively. Half of urea and all other fertilizers were used as basal. Remaining urea was applied around okra plant as top dress in two equal

split at 3rd and 5th weeks after sowing followed by irrigation. Red amaranth was harvested at 21 and 23 days after sowing (DAS) while leaf amaranth at 30 and 33 DAS; and jute (patshak) at 35 and 34 DAS, respectively, in 2010 and 2011. First harvest of okra was done at 40 and 48 DAS and harvesting was continued up to 136 and 124 DAS, respectively, in 2010 and 2011. The yield components data of okra were collected from 10 randomly selected plants from each plot. Collected data were analyzed statistically and mean separation was done by LSD test. Okra equivalent yield (OEY) was calculated as follows (Prasad and Srivastava, 1991).

$$\text{OKY (t/ha)} = \text{Yield of okra} + \frac{\text{Yield of intercrop vegetables} \times \text{market price of vegetables}}{\text{Market price of okra}}$$

Weather, especially rainfall was well distributed in 2010 (March 0 mm, April 52mm, May 301mm, June 494mm) that helps proper growth and development of the crops. But crop received comparatively less rainfall in 2011 (March 0 mm, April 0 mm, May 228 mm, June 99 mm) as a result supplemental irrigation was applied for proper growth and development of the crops.

Results and Discussion

Results obtained for the two years were almost similar and therefore pooled.

Yield and yield component of okra

Fruit length, number of fruits/plant and fruit yield of okra as influenced by intercropping system are presented in Table 1. Comparatively high fruit length was recorded in sole okra but it did not vary significantly due to intercropping at both the locations. Fruit length varied from 11.49 to 12.56 cm in different treatments at Joydebpur, while 10.96 to 11.94 cm at Burirhat. Number of fruits/plant in different treatments at Joydebpur was statistically identical and it ranged from 30 to 34 across the treatments but intercropping showed significant influence on number of fruits/plant at Burirhat. The maximum number of fruits/plant was observed in sole okra (38.50) and it was statistically identical with okra 100%, + red-amaranth 100%, okra 100% + amaranth 75%, and okra 100% + leaf amaranth 75% combination. The lowest number of fruits/plant was recorded in okra 100% + jute as patshak 100% combination.

Fruit yield/ha varied significantly due to intercropping system. At Joydebpur, higher fruit yield (15.82 t/ha) was recorded in sole okra, which was statistically identical with okra 100% + red-amaranth 100%, okra 100% + amaranth 75% and okra 100% + leaf-amaranth 75% combinations. The lowest fruit yield (13.16 t/ha) was found in okra 100% + jute as patshak 100% followed by okra 100% + leaf-amaranth 100%, okra 100%+ amaranth 75% combinations. Almost similar

results were found at Burirhat location where the highest fruit yield (13.79 t/ha) was recorded in sole okra, which was statistically identical with okra 100% + red-amaranth 100% or 75% and okra 100% + leaf-amaranth or jute as parshak 75%. The lowest fruit yield (11.75 t/ha) was recorded in okra 100% + jute as patshak 100% combination. Okra yield was reduced (3 to 15%) by intercropping probably because of competition of the two crops in mixture for growth resources. Muoneke and Ndukwe (2008) and Manga *et al.,* (2003) also reported similar results in intercropping systems.

Table 1. Yield components and fruit yield of okra as influenced by okra and leafy vegetables intercropping (pooled).

Treatments	Fruit length (cm)		Fruits/ plant (no.)		Fruit yield (t/ha)	
	Joydebpur	Burirhat	Joydebpur	Burirhat	Joydebpur	Burirhat
Sole okra	12.56	11.94	34.00	38.50	15.82	13.79
Okra 100% + red-amaranth 100%	12.55	11.05	34.00	36.50	15.31	12.72
Okra 100% + red-amaranth 75 %	12.14	11.14	31.00	36.00	15.42	12.64
Okra 100% + leaf amaranth 100%	11.80	10.74	30.00	31.50	13.71	11.86
Okra 100% + leaf amaranth 75%	11.70	11.52	31.00	35.50	14.68	12.55
Okra 100% + jute as patshak 100%	12.25	11.06	30.00	30.50	13.16	11.75
Okra 100% + jute as patshak 75%	11.49	10.96	31.00	33.50	14.18	12.34
LSD (0.05)	NS	NS	NS	4.30	1.48	1.46
CV (%)	7.20	6.20	6.80	6.99	5.80	6.6

NS = Not significant.

Okra equivalent yield

Okra yields, vegetables yields, and okra equivalent yields of both the locations are presented in Table 2. Cent percent leafy vegetables intercropped with okra produced higher yield than those of 75%. However, vegetables yield ranged from 6.59 to 10.17 t/ha at Joydebpur, while it ranged from 6.90 to 14.90 t/ha at Burirhat. Among the vegetables, leaf amaranth yield was higher than others at both the locations.

Table 2. Yield of main (okra) & intercrop (vegetables) and okra equivalent yield in intercropping system (pooled).

Treatments	Okra yield (t/ha)		Vegetable yield (t/ha)		Okra equivalent yield (t/ha)	
	Joydebpur	Burirhat	Joydebpur	Burirhat	Joydebpur	Burirhat
Sole okra	15.82	13.79	-	-	15.82	13.79
Okra 100% + red-amaranth 100%	15.31	12.72	9.23	10.86	23.00	19.95
Okra 100% + red-amaranth 75 %	15.42	12.64	6.59	9.25	20.91	18.80
Okra 100% + leaf amaranth 100%	13.71	11.86	10.17	14.90	22.19	21.79
Okra 100% + leaf amaranth 75%	14.68	12.55	9.38	11.85	22.50	20.45
Okra 100% + jute as patshak 100%	13.16	11.75	8.55	6.90	20.29	16.35
Okra 100% + jute as patshak 75%	14.18	12.34	7.71	6.06	20.61	16.37

Gazipur selling price (Tk./kg): Okra =.12.00; Vegetables = 10.00
Burirhat selling price (Tk./kg): Okra = 12.00; Vegetables = 8.00

Total productivity was expressed in okra equivalent yield. The highest okra equivalent yield (23.00 t/ha) was recorded in okra 100% + red amaranth 100% combination followed by okra 100% + leaf amaranth 75% (22.50 t/ha at Joydebpur location. At Burirhat, the highest okra equivalent yield (21.79 t/ha) was found in okra 100% + leaf amaranth 100% followed by okra 100% + leaf amaranth75% (20.45 t/ha) combination. At both the locations, okra 100% + jute as patshak 100% or 75% gave the lowest okra equivalent yield. Intercropping increased total productivity by 28 to 45% over sole okra. Muoneke and Mbah (2011) also reported 25-30% yield advantage in okra/cassava intercropping in Africa.

Cost benefits analysis

Gross return, gross margin, and benefit cost ratio (BCR) is shown in Table 3. The result showed that sole okra was lower in economic analysis than any of intercrop treatment indicates intercropping advantage at both the locations.

At Joydebpur, the maximum gross return (Tk. 276000/.ha) was recorded in 100% okra + 100% red-amaranth followed by okra 100% + leaf amaranth 75% (Tk. 270000/.ha) while at Burirhat, the highest gross return (Tk.261420/ha) was recorded in okra 100% + leaf amaranth 100% combination. The lowest gross returns at both the locations were recorded in okra 100% + jute as patshak 100% (Tk. 243480/.ha at Joydebpur and Tk. 196160/ha at Burirhat). Cultivation cost of

sole okra was lower than intercropping but additional yield of vegetables increased the profitability of intercropping over sole okra. The highest BCR (5.66) was recorded in okra 100% + red-amaranth 100% or okra 100% + leaf amaranth 75% followed by okra 100%+ leaf amaranth 100% (5.45) at Joydebpur while at Burirhat, the highest BCR (5.58) was recorded in okra 100% + leaf amaranth 100% followed by okra 100% + leaf amaranth75% (5.37). At both the locations, the lowest BCR (4.28 at Joydebpur and 3.91 at Burirhat) was recorded in sole okra.

Table 3. Cost benefit analysis of okra and leafy vegetables intercropping (pooled).

Treatments	Gross return (Tk./ha)		Cultivation cost (Tk./ha)		Gross margin (Tk./ha)		BCR	
	Joy	Buri	Joy	Buri	Joy	Buri	Joy	Buri
Sole okra	189840	165480	44320	42320	145520	123160	4.28	3.91
Okra 100% + red-amaranth 100%	276000	239420	48820	46820	227180	192600	5.66	5.11
Okra 100% + red-amaranth 75 %	250920	225620	47695	45695	203225	179925	5.26	4.94
Okra 100% + leaf amaranth 100%	266280	261420	48820	46820	217460	214600	5.45	5.58
Okra 100% + leaf amaranth 75%	270000	245360	47695	45695	222305	199665	5.66	5.37
Okra 100% + jute as patshak 100%	243480	196160	50020	48020	193460	148140	4.87	4.08
Okra 100% + jute as patshak 75%	247320	196460	48595	46595	198725	149865	5.09	4.22

Joy = Joydebpur, Buri = Burirhat, BCR=Benefit cost ratio

Results revealed that intercropping of okra and leafy vegetables could increase total productivity and economic return over sole okra. However, cent percent broadcast red amaranth or leaf amaranth intercropping with cent percent okra (as row crop) might be suitable combination for higher productivity as well as economic return for Joydebpur and Burirhat areas. Farmers could be motivated to grow leafy vegetables in okra field as intercrop instead of growing of sole crop.

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