ISSN 0258-7122 (Print), 2408-8293 (Online)
Bangladesh J. Agril. Res. 50(1): 1-12, March 2025

PRODUCTIVITY AND PROFITABILITY OF BRINJAL - ONION INTERCROPPING RELAY WITH SNAKE GOURD

M. R. ALI[1], M. A. H. KHAN[2]*, J. RAHMAN[3] AND M. A. HOSSAIN[4]

Abstract

The experiment was carried out on brinjal-onion intercropping with relay snake gourd without trellis at Regional Agricultural Research Station (RARS) Jamalpur during 2020-21 and 2021-22 to find out the suitable crop combination for increasing crop productivity, profitability and maximization of land utilization.The treatments were.T_1 = Brinjal (100 %) + 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%) + 6 row onion + relay snake gourd (2m×1.5m), T_3 = Brinjal (100%) + 6 row onion + relay snake gourd(3m×1.5m), T_4 = Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m) and T_5 = Sole brinjal (100cm×60cm), T_6 = Sole onion (10cm×6cm) and T_7 = Sole snake gourd (1m×1.5m).Brinjal (BARI Begun-8), Onion (BARI Piaj-4) and Snake gourd (BARI Chichinga-1) were used as test materials. The experiment was laid out in a randomized complete block design with five compact replications. Brinjal was the main crop, onion and snake gourd were intercrop and relay crop in the study. Significantly the higher yield was obtained in sole crops. Treatment, brinjal paired row + 12 row onion with relay snake gourd (T_4) gave the highest equivalent yield of brinjal, onionand snake gourd 51.28, 42.74 and 51.28 tha^{-1}, respectively which provided yield advantages of 85, 128 and 142 % over their respective sole crops. The highest land equivalent ratio (2.16), gross return (Tk 12,82,000 ha^{-1}) and benefit cost ratio (5.13) were achieved in T_4.

Keywords: Intercropping, equivalent yield, relative yield and benefit cost ratio.

Introduction

In Bangladesh economy agriculture is the single largest producing sector and contributes about 11.38 % to the total Gross Domestic Product (GDP). Majority of the farmers are marginal and smallholders and their land size is on an average 0.05 to 2.49 acres for marginal and 1.50 to 2.49 acre for small, respectively (MoA, 2022). Demand for food has been increasing with the rapid population increase while land accessibility has been diminishing. Thus, the only way to increase agricultural production is to increase yield per unit area (Hirpa, 2014). Increasing

[1,2&3]Principal Scientific Officer, Agronomy Division, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute (BARI), Jamalpur, and [4]Principal Scientific Officer, Horticulture Division, Regional Agricultural Research Station, BARI, Jamalpur, Bangladesh

food demand for the over population is creating challenge to the country for increasing productivity of the limited land. Thus, cultivation of long duration crops is discouraged, instead short duration intercrops, relay crops and mixed crop are emphasized for cultivation to ensure food security for a large number of populations. Accordingly, relay intercropping is a time demanding technology for crop cultivation with efficient time budgeting.

Brinjal (*Solanum melongena* L.) is one of the utmost common and extensively cultivated vegetable crops in Bangladesh. It is a wide spaced (100 cm × 60 cm) crop and life span ranges 240-280 days. It is a long duration crop grows slowly in first growth stage and establishment of full canopy takes 6-8 weeks. This privilege can be taken for growing onion in between the rows as intercrops. Onion crop can easily be intercropped with brinjal at early growth stage for their short stature and quick growing habit. Intercropping has been considered advantageous in terms of economy of space, saving on tillage, as well as utilization of available nutrients and moisture in unused space. Intercropping is an effective and the economical production system as it not only increases the production per unit area and time, but also increases the resource use efficiency and economic stock of the growers Bhatti *et al*. (2013). Presently, intercropping is gaining acceptance among small holding farmers as it provides a yield advantage over sole cropping through yield stability and helps achieving diversified domestic needs Bhatti *et al*. (2013). Multiple cropping facilitates the farmers to cultivate two or three crops in a year especially in those areas where growing season is shrinking for sequential farming due to climate change (Jabbar *et al*. 2010). Inter or relay cropping systems are more stable than sole cropping. Relay cropping has been recognized especially for smallholder farmers because of its potential to increase land use efficiency and reduce fertilizer consumption enhance crop yield and nutrient accumulation and improve biological activities Ghosh *et al*. (2006). Relay cropping is a beneficial tool that results in better utilization of residual soil moisture from previous crops and reduces cost of production per unit area with efficient use of natural resources Jabbar *et al*. (2005)

In Bangladesh small and marginal farmers constitute 79.4% of our farming community and their cultivated lands are decreasing day by day (MoA, 2022). Besides, multiple cropping may ensure proper utilization of resources towards increased production per unit area and time on a sustainable basis Ahmad *et al*. (2013). Brinjal is an important vegetable crop in Bangladesh. Onion is also an important spices crop in Bangladesh. Brinjal growers are used to grow onion as intercropping in some pocket areas of Bangladesh. Traditionally, the farmers of these areas practice the intercropping brinjal-onion with relay snake gourd. For getting higher productivity and economic return, it is in need to find out the optimum combination of brinjal-onion intercropping with relay snake gourd system. However, various studies have been conducted in the past about vegetables

intercropping system but results on brinjal-onion intercropping with relay snake gourd are very scanty. Thus, this study was undertaken to find out the suitable crop combination under intercropping of brinjal + onion with relay snake gourd without trellis for increasing system productivity, profitability and maximization of land utilization.

Materials and Methods

The experiment was conducted at Regional Agricultural Research Station, Jamalpur under Agronomy Division, Bangladesh Agricultural Research Institute (BARI) during 2020-21 and 2021-22 under AEZ-9. The experimental field is situated at approximately $24^0 55'$N latitude and $89^0 46'$E longitude with the altitude of 20.16 m above the sea level. The geographical position of the area is between $24^0 17'$ N latitude and $89^0 90'$ E longitude. The meteorological data of the experimental site showed that the higher average temperature prevails in May to August and the lower in December and January. There is minimum precipitation in December and January. Maximum rainfall was received during the months of April to September. The meteorological data in 2020-21, monthly mean maximum 31.88^0C and minimum 20.11^0C air temperature and annual total rainfall 1556.6 mm and in 202122, monthly mean maximum 31.04^0C and minimum 20.80^0Cair temperature and annual total rainfall 1484.85 mm were prevailing in the study area (Appendix 1.)

The experiment was laid out in a randomized complete block design with five compact replications. The experiment consisted of five treatments, viz., T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd (2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd (3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake (1.75m×1.5m),T_5= Sole brinjal (100cm×60cm),T_6= Sole onion(10cm×6cm),T_7= Sole snake gourd (1m×1.5m). The unit plot size was 6.0 m × 3.0 m and spacing for brinjal was 100 cm × 60 cm. Brinjal was the main crop, onion and snake gourd were the inter and relay crops in the study. The variety BARI Begun-8, BARI Piaj-4 and BARI Chichinga-1 were used as test materials. The crop brinjal seedlings, onion seedlings and snake gourd seedlings were transplanted on 10 November 2020, 15 November 2020, 18 April 2021 and 15 November 2021, 17 November 2021 and 19 April 2022, respectively. Onion and snake gourd were sown in lines between the brinjal rows maintaining the spacing of the respective treatments. The recommended fertilizer doses @ 173-30-125-18-2 kg ha^{-1} NPKSB along with cowdung 5 t ha^{-1}, 90-40-75-25-2-1 kg ha^{-1} NPKSZnB and 100-40-60-20-2-2 kg ha^{-1} NPKSZnB along with 5 t ha^{-1} ,respectively were applied separately in monoculture brinjal, onion and snake gourd were applied in the form of urea, triple super phosphate, muriate of potash, gypsum, Zinc sulphate and borax. In sole brinjal and intercrop all of cowdung, P, S, Zn, B and one-third of N, half of K were

applied during final land preparation. Remaining N was applied in three equal splits at 15, 50 and 70 days after transplanting (DAT) and remaining K was applied in two equal splits at 15 and 50 days after transplanting. In sole onion, all of P, S, Zn and B and half of N and K were applied as basal during final land reparation. Remaining N and K were applied in two equal slits at 25 and 50 DAP for bulb production. In snake gourd, all of cowdung, P, S, Zn, B and one third of N and K were applied in pit 5-7 days prior planting and mixed thoroughly with the soil. Remaining N and K were applied during 20, 35 and 50 DAT around the plants as side dressing under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. Mulching, weeding, irrigation and crop protection measures were taken properly for normal growth of the crops. Brinjal harvest started from 10 February 2021 and continued up to 6 April 2021and 15 February 2022 and continued up to 16 April 2022, onion harvested on 10 March 2021 and 13 March 2022, and snake gourd harvest started on 29 May 2021 and continued up to 8 August 2021and 27 May 2022 and continued up to 12 August 2022 in two consecutive years. The yield of brinjal, onion and snake gourd was calculated in tons per hectare considering the whole plot as harvest area. Ten plants of brinjal from each plot were selected randomly to collect data on yield components.

Yield of individual crop was converted into equivalent yield on the basis of the prevailing market price of individual crop following Prasad and Srivastava (1991). Brinjal equivalent yield (BEY) = Yield of intercrop brinjal + $\frac{\text{Yio}\times\text{Po}}{\text{Pb}}$ +$\frac{\text{Yisg}\times\text{Psg}}{\text{Pb}}$, Onion equivalent yield (OEY) = Yield of intercrop onion+ $\frac{\text{Yib}\times\text{Pb}}{\text{Po}}$ + $\frac{\text{Yisg}\times\text{Psg}}{\text{Po}}$ and Snake gourd equivalent yield (SgEY) = Yield of intercrop snake gourd + $\frac{\text{Yio}\times\text{Po}}{\text{Psg}}$ + $\frac{\text{Yib}\times\text{Pb}}{\text{Psg}}$ Where, Yio= Yield of intercrop onion, Po= Price of onion, Yisg= Yield of intercrop snake gourd, Psg= Price of snake gourd and Yib= Yield of intercrop brinjal and Pb= Price of brinjal

Relative yields (RY) based on grain yields were calculated according to the formula of De Wit and van den Bergh (1965) Relative Yield of Brinjal (RYB): $\frac{\text{Yib}}{\text{Ysb}}$, Relative Yield of Onion (RYO): $\frac{\text{Yio}}{\text{Yso}}$, Relative Yield of Snake gourd (RYSg):$\frac{\text{Yisg}}{\text{Yssg}}$ and Relative Yield Total (RYT): RYb + RYo + RYsg Where, Yib= Intercrop yield of brinjal, Ysb= Sole yield of brinjal, Yio= Intercrop yield of onion, Yso= Sole yield of onion, Yisg = Intercrop yield of snake gourd and Yssg = Sole yield of snake gourd.

Pooled analysis was done as there was no significant difference in yield and yield contributing characters between two years. The collected data on different parameters were statistically analyzed using analysis of variance technique with the help of computer package program STAR and the means were separated by

Least Significance Difference (LSD) test at 5% level of significance. Economic analysis was done on the basis of prevailing market price of the commodities. The inputs used included seed, fertilizer, labour and insecticides. The two years average results were analyzed for economic benefits using the methodology prescribed by CIMMYT (1988).

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Gross return}}{\text{Total cost}}$$

Results and discussion

Plant population of different treatments

Plant population per unit plot ($18m^2$) of different component crops are presented in Table 1. The plant populations in all treatments of brinjal were same (30) as because during planting the number of brinjal line per plot was six (6) and number of brinjal plants per line was five (5). Similarly, plant populations of onion were same as four hundred (400) due to number of onion line per plot forty (40) and number of onion plants per line ten (10) but snake gourd populations per plot were different as because the line spacing of was different among the treatments of brinjal + onion intercropping system with relay snake gourd.

Table 1. Plant population of component crops as influenced by intercropping onion with relay snake gourd without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Brinjal (Plant/18 m^2)	Onion (Plant/18 m^2)	Snake gourd (Plant/18 m^2
T_1	30	400	12
T_2	30	400	6
T_3	30	400	4
T_4	30	400	7
T_5	30	-	-

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd(2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm)

Effect of intercropping on yield attributes of brinjal

Yield attributes of brinjals influenced by intercropping with onion and snake gourd are presented in Table 2. The result indicated that all the yield attributes were significantly influenced due to brinjal + onion intercropping system with relay snake gourd. The tallest plant (112.93cm) was recorded from sole brinjal (100cm×60cm) treatment which was statistically at par with other treatments except brinjal paired row + 12 rows onion with relay snake gourd (1.75×1.5m)

treatment. The shortest plant height (102.80 cm) was recorded from brinjal paired row+ 12 row onion + relay snake (1.75×1.5m) treatment due to maximum crop competition. The highest branchesplant^{-1} (4.53) were found from sole brinjal treatment and the lowest (4.00) was brinjal (100%) + 6 row onion + relay snake gourd (1.0m×1.5m) treatment. The highest number of brinjal plant^{-1} (28.80) was achieved from sole brinjal treatment and the lowest (20.60) was brinjal (100%) + 6 row onion+ relay snake gourd (1.0m × 1.5m) treatment. The highest single brinjal weight (95.60g) was recorded from sole brinjal treatment and the lowest was (69.01g) from brinjal (100%) + 6 row onion+ relay snake gourd (1.0m × 1.5m) treatment. The highest weight of brinjal (1.66 kgplant^{-1}) was recorded from sole brinjal treatment and the lowest weight of brinjal (0.94kgplant^{-1}) was found from brinjal (100%) + 6 row onion + relay snake gourd (1m×1.5m) treatment. Sole brinjal produced higher yield attributes compared to different intercropping systems might be due to less competition among the plants for sun light, nutrients, water and space than intercropped and relay systems. Less competition among plants leads to better growth and development of plants as well as fruits yield in monoculture. These results are in agreement with the findings of Chowdhury *et al*. (2022).

Table 2. Yield attributes of brinjal as influenced by intercropping onion with relay snake gourd without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Plant height (cm)	No. of branches Plant^{-1}	No. of brinjal Plant^{-1}	Single brinjal weight (g)	Yield of brinjal (kgplant^{-1})
T_1	110.20	4.00	20.60	69.01	0.94
T_2	111.13	4.33	23.20	80.47	1.33
T_3	109.60	4.41	25.40	82.80	1.42
T_4	102.80	4.13	22.20	77.96	1.23
T_5	112.93	4.53	28.80	95.60	1.66
LSD $_{(0.05)}$	6.17	0.87	4.98	7.55	0.08
CV (%)	3.08	3.72	6.40	4.94	3.07

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd(2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm)

Yield of components crops as influenced by inter and relay cropping systems

Two years pooled yield of brinjal, onion and snake gourd are presented in Table 3. The highest brinjal, onion and snake gourd yields were recorded from sole crops. Brinjal gave 14 to 29, onion gave 31 to 39 and snake gourd gave 25-58% lower yield in intercropped and relay crop system as compared to their corresponding

monoculture presumably due to higher competition among the plants for sun light, nutrients, water and space in intercropped and relay situation than sole crop. Contrary, in the sole cropping treatment the highest yield was attributed due to the higher number of branches per plant, number of brinjal per plant, and single brinjal weight

The yields of brinjal, onion and snake gourd were significantly influenced by intercropped onion and relay snake gourd without trellis. Among the intercropping and relay combinations the higher yield of brinjal (20.05 t ha^{-1}), onion (12.86 tha^{-1}) and snake gourd yield (15.80 tha^{-1}) were recorded in T_4 treatment (Brinjal paired row+12 row onion + relay snake gourd) and the lower yield of brinjal (19.67 t ha^{-1}), onion yield (11.41 tha^{-1}) and snake gourd yield (8.92 tha^{-1}) from T_1 (Brinjal (100 %) + 6 row onion + relay snake gourd). This might be due to higher plant population in T_4 treatment. Similar results reported by Rahman *et al*. (2020) who found that higher brinjal yield was observed in relaying snake gourd .

Table 3. Yield of component crops (whole plot basis) as influenced by intercropping onion with brinjal and relay snake gourd systems without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Yield (t/ha)					
	Brinjal	% yield decrease over sole	Onion	% yield decrease over sole	Snake gourd	% yield decrease over sole
T_1	19.67	29	11.41	39	8.92	58
T_2	22.17	20	11.49	38	12.65	40
T_3	23.67	14	11.80	37	10.22	52
T_4	20.05	28	12.86	31	15.80	25
T_5	27.66	-	-	-	-	-
T_6	-	-	18.65	-	-	-
T_7	-	-	-	-	21.18	-
LSD $_{(0.05)}$	1.19	-	1.64	-	1.71	-
CV (%)	5.73	-	6.14	-	5.39	-

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd (2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm),T_6= Sole onion (10cm×6cm)and T_7= Sole snake gourd (1m×1.5m).

Cost and return analysis of brinjal intercropping onion with relay snake gourd systems

Cost and return of different brinjal intercropping systems were analyzed taking into account the prices prevailed at local market. On the basis of two years average

result, all the intercrop combinations gave monetary advantages over sole crops (Table 4). The highest gross margin (Tk. 10,32,100ha^{-1}) was found in brinjal paired row +12 row onion+ relay snake gourd in brinjal, onion and snake intercropping system (T_4) which gave an additional income of Tk. 461310, 704580 and 651190 ha^{-1}over brinjal, onion and snake gourd sole cropping, respectively. Cost of production of all intercropping systems were more than sole crops because inclusion of component crops, involvement of higher seed cost as well as cost of more labour engaged in different operations. Intercropping of onion and relay snake gourd brought about an increase in return per taka investment. It was evident that intercropping was beneficial and recorded higher benefit cost ratio (BCR) than monoculture of brinjal, onion and snake gourd. Among the intercropping systems the highest BCR (5.13) was obtained from brinjal paired row + 12 row onion + relay snake gourd intercropping system which further indicated the superiority to T_4over other treatments (Table 3). These results are in agreement with the findings of Islam *et al*. (2016) who reported that monetary return, BCR as well as other intercropping determinants were also higher in Brinjal 100% + garlic 60% intercropping system than other treatments and sole cropping of brinjal.

Table 4. Cost and return analysis of brinjal onion intercropping with relay snake gourd systems without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Gross return (Tk.ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk.ha^{-1})	BCR
T_1	10,57,000	2,49,560	8,07,440	4.24
T_2	12,17,750	2,49,670	9,68,080	4.86
T_3	12,65,750	2,49,920	10,15,830	5.06
T_4	12,82,000	2,49,900	10,32,100	5.13
T_5	6,91,500	1,80,710	5,70,790	3.83
T_6	4,66,250	1,38,730	3,27,520	3.36
T_7	5,29,500	1,48,590	3,80,910	3.56

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd (2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm), T_6= Sole onion (10cm×6cm) andT_7= Sole snake gourd (1m×1.5m).

Sale price/kg: Brinjal=Tk. 25.00, Onion = Tk. 30.00, Snake gourd= Tk. Tk. 25.00

Equivalent yield of component crops

Total productivity of system was expressed in brinjal, onion and snake gourd equivalent yield. Equivalent yield and relative yield of component crops are presented in Table 5. All intercropping systems gave higher brinjal, onion and snake gourd equivalent yield than that of their respective sole crop. It's indicated that higher biomass production and consequently more efficient use of land and available resources under intercropping than sole cropping. Among those, the highest brinjal, onion and snake gourd equivalent yield 51.28, 42.74 and 51.28 tha^{-1} were recorded from brinjal (100%) + 12 row onion + relay snake gourd in between two paired rows of brinjal (T_4) which covered the yield advantages of 85, 128 and 142% over their respective sole crops. Such yield advantage might be due to combined yield of component crops. Similar results were also reported by Begum et al. (2015) in chilli + garlic and chilli + onion intercropping systems.

Table 5. Equivalent yield of brinjal onion intercropping with relay snake gourd systems without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Brinjal equivalent yield (t/ha)	Onion equivalent yield (t/ha)	S. Gourd equivalent yield (t/ha)	% increase BEY over sole brinjal	% increase OEY over Sole onion	% increase SgEY over sole snake gourd
T_1	42.28	35.23	42.28	53	89	100
T_2	48.71	40.51	48.61	76	117	130
T_3	50.63	40.05	48.05	83	115	127
T_4	51.28	42.47	51.28	85	128	142
T_5	27.66	-	-	-	-	-
T_6	-	18.65	-	-	-	-
T_7	-	-	21.18	-	-	-

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd (2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm), T_6= Sole onion (10cm×6cm)and T_7= Sole snake gourd (1m×1.5m).

Partial relative yield and land equivalent ratio

The partial relative yields and land equivalent ratio of intercropped brinjal, onion and relay snake gourd are presented in Table 6. The partial relative yields of intercropped brinjal, onion and relay snake gourd varied from 0.71 to 0.86, 0.61 to

0.69 and 0.42 to 0.75, respectively. Brinjal yield was reduced from 29 to 14%, onion yield was reduced 39 to 31% and relay snake gourd yield was reduced 58 to 25%amongtheintercropping and relay system. The yield was reduced due to lower plant population. The result showed that $T_4$was well accommodative in competitiveness in brinjal + onion + relay snake gourd system (Table 5). The results are in agreement with the finding of Islam *et al.* (2016).

The values of Land Equivalent Ratio (LER) in different intercropping systems were found greater than unity indicating higher land use efficiency of intercropping systems over the respective monoculture (Table 5). Yield advantages occurred in intercropping was mainly due to development of both temporal and spatial complementarities. However, total relative yield value (2.16) was the highest in brinjal (100%) + 12 row onion + relay snake gourd(1.75m×1.5m) in between paired rows of brinjal (T_4), where brinjal, onion and snake gourdachieved 72, 69 and 75% of their sole yields, respectively indicating higher biological and economic efficiency. It also expressed that by intercropping brinjal with onion and relay snake gourd a farmer can produce 20.05, 12.86 and 15.80 t ha^{-1}brinjal, onion and snake gourd, respectively in one hectare of land instead of growing them separately as sole crop. The results are in agreement with observations made by Ali *et al*. (2016) who reported that total LER values of intercropping were higher than that of monocrop corn and soybean.

Table 6. Partial relative yields and Total relative yield of brinjal onion intercropping with relay snake gourd systems without trellis during 2021-22 and 2022-23 at RARS, Jamalpur (Pooled data)

Treatments	Partial (LER			Total (LER)
	Brinjal	Onion	S. gourd	
T_1	0.71	0.61	0.42	1.74
T_2	0.80	0.62	0.60	2.02
T_3	0.86	0.63	0.48	1.97
T_4	0.72	0.69	0.75	2.16
T_5	1.00	-	-	1.00
T_6	-	1.00	-	1.00
T_7	-	-	1.00	1.00

Note: T_1= Brinjal (100%)+ 6 row onion + relay snake gourd (1m×1.5m), T_2= Brinjal (100%)+ 6 row onion + relay snake gourd (2m×1.5m), T_3= Brinjal (100%)+ 6 row onion + relay snake gourd(3m×1.5m), T_4= Brinjal paired row+12 row onion + relay snake gourd(1.75m×1.5m)and T_5= Sole brinjal (100cm×60cm),T_6= Sole onion (10cm×6cm)and T_7= Sole snake gourd (1m×1.5m).

Conclusion

Two years average result indicated that intercropping brinjal with onion and relay snake gourd gave higher productivity as well as economic return than monoculture of the component crops. The equivalent yields, relative yields, total relative yield and gross return were found higher in brinjal (100%) + 12 rows onion + relay snake gourd (1.75m×1.5m) system. Thus, it is concluded that a planting pattern comprising on brinjal (100%) +12 rows onion + relay snake gourd(1.75m×1.5m) in between two paired rows of brinjal intercropping system could be adopted for better productivity and maximum profit. The farmers of Jamalpur regions of AEZ-9 could be suggested to cultivate brinjal intercropping with onion and relay snake gourd as an alternative of sole cropping.

References

Ahmed, F., M. N. Islam, M. S. Alom, M. A. I. Sarker and M. A. Mannaf.2013. Study on intercropping leafy vegetables with okra (*Abelmoschus esculentus* L.). *Bangladesh J. Agril. Res.* **38**(1): 137-143.

Ali, B., R. A. Halim, R. Othman, M. M. Yusof and A. R. M. Atashgahi..2016. Productivity, relative yield and plant growth of forage corn intercropped with soybean under different crop combination ratio. *Legume Research-An Int. J.* **39** (4): 558-564. Doi:10.18805/Lr.v0iOF.10755.

Begum, S.A., M.S. Zaman and A.S.M.M. R. Khan. 2015. Intercropping of root crops with chilli in char lands of Mymensingh. *Prog. Agri.* **26** (2): 109-114.

Bhatti, I.H., R.Ahmad, A.Jabbar, M., Nadeem, M.M. Khan and S.N. Vains.2013. Agronomic performance of mash bean as an intercrop in sesame under different planting patterns. *Emirates J. Food and Agri.* **25**: 52-57.

Chowdhury, J. A., A. A. Begum, S. S. Kakon, M. Z. Ali, M. A. H. Khan and M. R.Karim.2022. Comparative productivity and profitability of chilli-legume vegetable intercropping systems. *Bangladesh J. Agron.* **25** (2): 51-66.

CIMMYT. 1988. From Agronomic Data to Farmer Recommendations: An EconomicTraining Manual. International Maize and Wheat Improvement Centre, Mexico, D. F. Pp.1-79.

De Wit, C.T. and van den Bergh. 1965. Competition between herbage plants. *Netherlands J. Agril. Sci.* **13**:212-221.

Ghosh, P.K., M.C. Manna, K.K. Bandyopadhyay, A.K. Ajay, R.H. Tripathi, K.M. Wanjari, A.K. Hati, C.L.Misra and R.A.S. Acharya.2006. Interspecific interaction and nutrient use in soybean/sorghum intercropping system. *Agron. J.* **98**: 1097–1108.

Hirpa, T. 2014. Response of maize crop to spatial arrangement and staggered inter-seeding of haricot bean. *Int. J. Environ*. 3: 126-138.

Islam, M. R., M. F. Hossain,M. A. K. Mian, J. Hossain and M. A.Alam. 2016. Outcome of intercropping garlic with brinjal for the small holder farmers of Bangladesh. *Indian J. Agril. Res.* **50** (2): 177-182.

Jabbar, A., R. Ahmad, E.Ullah and M.S. Nazir. 2005. Agro-economic performance of diversified rice-based relay cropping systems at zero and conventional tillage under strip plantation. *Pakistan J. Agri. Sci.* **12**:18– 21.

Jabbar, A., R. Ahmad, I.H. Bhatti, A.Rehman, Z.A. Virk and S.N. Vains. 2010. Effect of different rice-based intercropping systems on rice grain yield and residual soil fertility. *Pakistan J. Bot.* **42**: 2339–2348.

MoA 2022. Ministry of Agriculture. 2022. HandBook of Agricultural Statistics. Government of the People's Republic of Bangladesh. http://www.moa.gov.bd/statistics/ statistics.htm

Prasad, K., and R.C. Srivastava. 1991. Pigeon pea (*Cajanus cajan*) and (*Glycine max*) intercropping system under rainfed situation. *Indian J. Agril. Sci.* **61**: 243-246.

Rahman, J., A. A. Begum, F. S. Shikha, A. Akter and R. R. Saha. 2020. Relay intercropping of different gourds with brinjal in charland area. *Acta Scientifica Malaysia (ASM)*, 4 (1): 11-13. *DOI:* http://doi.org/10.26480/asm.01.2020.11.13

Appendix1. Monthly air temperature, relative humidity and total rainfall in the experimental area of Jamalpur, during 2020-21 to 2021-22

Month	Temperature (°C)				Average RH (%)		Total rainfall (mm)	
	Avr. Max		Avr. Min					
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
July	37.19	36.87	27.63	26.33	82.78	73.30	127.20	42.75
August	35.44	34.93	26.94	26.60	83.51	75.40	143.25	39.00
September	33.13	33.73	25.07	27.27	75.78	84.38	10.50	191.50
October	33.38	32.33	22.19	25.00	84.18	74.60	205.75	81.00
November	29.92	29.84	19.22	17.89	76.83	82.00	46.00	49.50
December	24.31	25.63	13.51	13.29	78.35	85.30	22.80	21.00
January	23.15	26.31	11.87	11.57	74.71	83.58	40.00	44.30
February	26.26	28.09	13.29	14.73	71.71	74.25	73.60	71.00
March	31.51	31.26	18.47	19.10	67.52	66.80	99.70	84.60
April	33.13	33.18	21.48	22.37	74.70	74.77	281.20	293.30
May	32.93	34.79	23.09	24.36	77.13	79.00	360.30	350.40
June	32.13	35.60	19.60	21.07	77.96	84.80	146.30	218.50
Yearly average	31.04	31.88	20.11	20.80	77.10	78.18	1556.6	1484.85

Source: Weather yard, Regional Agricultural Research Station, BARI, Jamalpur.