

Productivity and Economics of Brinjal (*Solanum melongena* L.) Groundnut (*Arachis hypogaea* L.) Intercropping

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ABSTRACT

The productivity and economic efficiency of brinjal (*Solanum melongena* L.) groundnut (*Arachis hypogaea* L.) intercropping was assessed at the Agronomy farm of the Eastern University of Sri Lanka during 2007/2008. This experiment was designed in a Randomized Complete Block Design with five treatments, each replicated three times. The planting pattern comprised brinjal as mono crop with the spacing of 90 cm × 60 cm (T1), groundnut as mono crop with the spacing of 45 cm × 30 cm (T2), alternative planting of brinjal at 90 cm × 60 cm and groundnut at 90 cm × 30 cm (T3), 60/150 cm paired row planting of brinjal with two rows of groundnut in between paired rows (T4) and 75/120 cm paired row planting of brinjal with one row of groundnut in between paired rows (T5). Yields of both plants were measured at harvest. Also, land equivalent ratio, gross return, net return, cost-benefit ratio and monetary equivalent ratio were calculated as per standard equations. The results revealed that compared to monocropping brinjal yield, T4 gave 38% additional yield followed by T3 (20%). Maximum Land Equivalent Ratio (LER) was recorded in T4 (1.57) and minimum LER was recorded in T5 (1.31). Gross return and cost - benefit ratio were increased by 50.69% and 47.35% respectively in T4 compared to T1. And also monetary equivalent ratio (1.49) was higher in T4. All intercropping system gave substantially high net income over monocropping. As compared to brinjal monocropping, net income has been increased by 60.62% in T4 followed by T3 (50.86%). This experiment showed that 60/150 cm paired row planting of brinjal with two rows of groundnut in between paired rows (T4) would be the most suitable planting system to enhance land use efficiency and increase the income in sandy regosol.

Key words: Cost-benefit ratio, gross return, land equivalent ratio, monetary equivalent ratio, net return.

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INTRODUCTION

The most common cropping system in the world is intercropping in which various crops are associated in the same piece of land at the same time. It is widely practiced by farmers, especially in the tropics. It is an advanced agro-technique and is considered to be an effective and potential mean of increasing crop production per unit area and time, particularly for farmers with small holdings. The main concept of intercropping is to increase productivity and reliability of production. Moreover, intercropping gives a greater stability of yield over monoculture (Willey and Reddy, 1981). Besides, it ensures greater resource use efficiency (Pathick and Malla, 1979). One of the main reasons for higher yields in intercropping is that the component crops are able to use natural resources differently and make overall use of natural resources better than grown separately (Willey, 1979). Intercropping a non-legume with legume crop is a judicious practice, where nitrogen is the most limiting plant nutrient in most of the soils. Intercropping legumes leads to give an opportunity to increase the input of fixed nitrogen into the cropping system and contribute nitrogen to a greater extent at least to meet a fair portion of the crop required. The most apparent gain from intercropping legumes and non-legumes is the opportunity for nitrogen use complementarities (Anil *et al.*, 1998; Fukai and Trenbath 1993; Tofinga *et al.*, 1993).

Sri Lanka is an agricultural country blessed with wide agro climatic zones and crops. Farmers in the dry zone show an interest in cultivating crops in the Solanaceae and Leguminaceae families. Brinjal (*Solanum melongina* L.) belongs to the family Solanaceae and it is a hardy plant compared to other vegetables grown in Sri Lanka. Because of its hardiness, it can be successfully grown in all agro-climatic

regions except the upcountry-wet zone. Also it has an ability to tolerate drought. Brinjal has both medicinal and nutritional values. Brinjal pod has antioxidants and it helps to keep heart diseases away. Edible pod (100 g) has protein (1.4 g), fiber (1.3 g), carbohydrates (4.0 g), phosphorus (47.0 mg) and also essential minerals and vitamins (Bose *et al.*, 1986). Groundnut (*Arachis hypogaea* L.) is one of the major oilseed crops cultivated in Sri Lanka under family Leguminaceae. Raw nuts (100 g) are rich in fat (47.5 g) protein (26.0 g) and minerals (Department of Agriculture, 2006). Lindemann and Glover, (2003) stated that groundnut, soya bean and Cowpea are good nitrogen fixers and are able to fix up to 280 kg/ha.

Intercropping provides higher cash return than growing one crop alone (Kurata, 1986). Profitability of intercrops depends on yield levels and cost of production and net returns. Net returns from intercrops may be increased if yields are increased and the overall production costs are minimized. However degree of profitability varies with the type of intercrop. Dry zone of Sri Lanka has potential for intensifying cultivation, if suitable cropping system is adopted. Brinjal and groundnut are considered as compatible crops in intercropping due to its family, growing habits. Also both crops are well suitable for dry zone of Sri Lanka. Due to the local adaptability, high demand and high nutritive value of both brinjal and groundnut, this attempt was made to assess the profitability of different intercropping patterns of brinjal and groundnut.

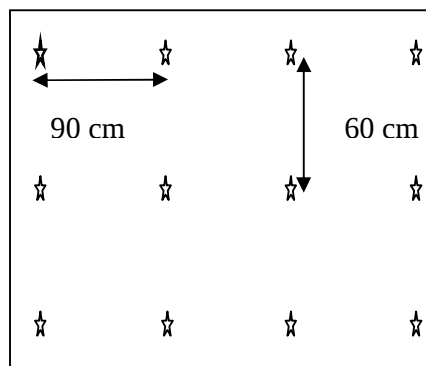
MATERIALS AND METHODS

A field experiment was carried out to study the productivity and economics of brinjal (*Solanum melongena* L.) groundnut (*Arachis hypogaea* L.) at the Agronomy farm of the Eastern University of Sri Lanka during 2007/2008. Experimental site comprise sandy regosol. All the treatments were arranged in a Randomized Complete Block Design (RCBD) with three replications having a plot size of 3.0 m x 1.5 m. Each block was separated by 1 m

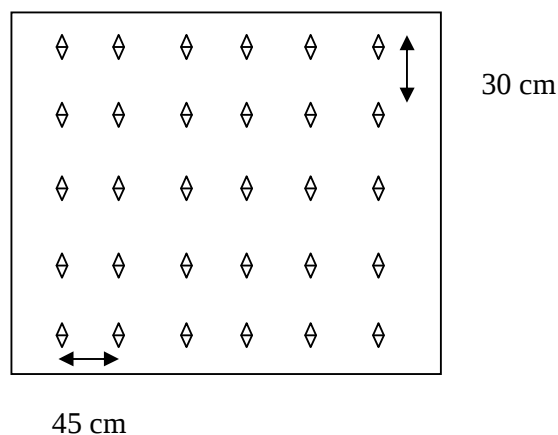
wide path and the space between the plots was 0.5 m.

In this experiment, treatments were T1, T2, T3, T4 and T5 as follows:

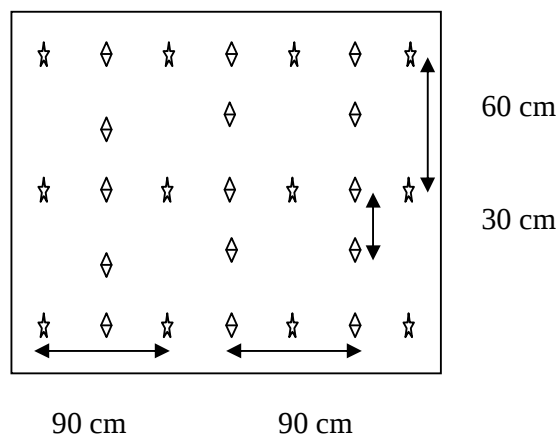
T1: Brinjal as mono crop with the spacing of 90 cm × 60 cm.



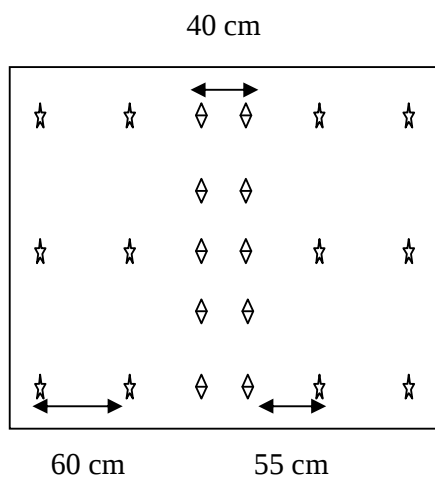
T2: Groundnut as mono crop with the spacing of 45 cm × 30 cm.



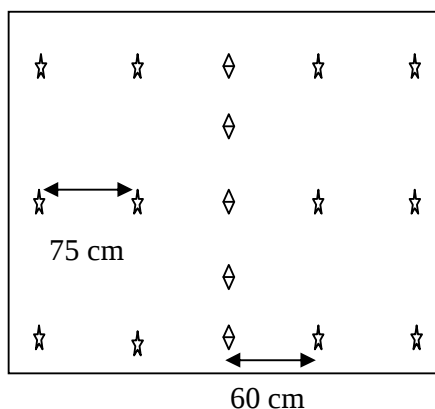
T3: Alternative planting of brinjal (90 cm × 60 cm) and groundnut (90 cm × 30 cm).



T4: 60/150 cm paired row planting of brinjal with two rows of groundnut in between paired rows.



T5: 75/120 cm paired row planting of brinjal with one row of groundnut in between paired rows.



★ - Brinjal ◇ - Groundnut

Brinjal, variety *Paluhamam Purple* and groundnut variety *Indi* were used for this experiment. Land was prepared and raised into 3 m x 1 m beds. Soil was sterilized by burning. Seeds of brinjal were sown in rows and straw mulch applied and watered twice a day. Seedlings were transplanted when they were at 3rd week after sowing. At 1st week after transplanting of brinjal, groundnut seeds were sown directly in field. Agronomic practices such as watering, weeding and fertilizer application were done as recommended by the Department of Agriculture of Sri Lanka. Yields of both plants were measured at

harvest. Apart from yields, land equivalent ratio, gross return, net return, cost-benefit ratio and monetary equivalent ratio were calculated by using standard equations as mentioned below.

Land Equivalent Ratio (LER)

$$LER = \frac{\text{Yield of intercrop brinjal}}{\text{Yield of monocrop brinjal}} + \frac{\text{Yield of intercrop groundnut}}{\text{Yield of monocrop groundnut}}$$

Gross return: Yield was multiplied by the price per unit weight.

Net return: It was calculated by subtracting cost of cultivation from gross return.

Cost-Benefit ratio (C/B ratio)

$$C/B \text{ ratio} = \frac{\text{Gross return}}{\text{Total variable cost of cultivation}}$$

Monetary Equivalent Ratio (MER)

$$MER = \frac{(ra + rb)}{Ra}$$

Where ra & rb are monetary returns from a and b , Ra is the highest sole crop monetary return, $ra = Pa \times Ya$, $rb = Pb \times Yb$ and Pa & Pb are prices of unit weight of crop a and b , while Ya & Yb denotes yield of a and b .

These data were subjected to Analysis of Variance using SAS software. Treatment means that were significant were separated using the Duncan's multiple range test at $p = 0.05$.

RESULTS AND DISCUSSION

Crop Yield

The yield of brinjal and groundnut in both mono cropping and intercropping is shown in Table 1. There was a significant difference ($P < 0.05$) in yield of both brinjal

and groundnut. Brinjal yield varied from 14.40 tons/ha (T1) to 19.97 tons/ha (T4). Wolfe (2000) stated that producing two crops from one garden is the benefits of intercropping. In the present study, brinjal yield was increased by 38.68% in T4 compared to monocropping brinjal yield. This may have resulted due to the nitrogen fixing ability of groundnut. Enhancement in yield of brinjal was found in brinjal grown with French bean (Arvind, 2002). Yield of groundnut varied with groundnut plant density. It was high in monocropping treatment compared with intercropping treatments. It ranged from 1.15 tons/ha (T5) to 8.40 tons/ha (T2). Tarimo (1997) reported that groundnut plant density was associated with yield components. Legume - non legume intercropping increases total grain and nitrogen yield (Barker and Blamey, 1985; Singh, *et al.*, 1986).

Land Equivalent Ratio (LER)

The land equivalent ratio has been generally accepted as an agronomically sound index for assessing yield advantages derived from intercropping. Mashingaidze (2004) reported that land was effectively utilized and yield was improved in intercropping. The land equivalent ratio, divide the intercrop yield of brinjal by yield of its pure stand and add that to the intercrop yield of groundnut divided by its yield of pure stand and so on. LER of intercropping treatments is shown in Table 2. The values of LER indicated better land use in all intercrop treatments. Yield advantages between 57% (LER=1.57) in T4 and 31% (LER=1.31) in T5 were registered indicating intercropping was beneficial in all treatments, however more advantages in low density of groundnut. This is agreed with Ossom *et al.* (2009). In all intercropping treatments, the land equivalent ratio indicated the increased productivity and recorded high LER in relation to their monocropping. LER values exceeding unity indicates a yield advantages from intercropping compared with monocropping. High LER was obtained in radish –vegetable amaranthus (Seran and Brintha, 2009a) and Groundnut-

maize (Ghosh, 2004). In this study, all intercropping showed advantages compared with monocropping.

Gross Return and Net Return

There was a significant difference ($P<0.01$) in gross return among the treatments. As compared to monocropping brinjal, intercropping treatments gave higher gross return, it increased by 50.69% in T4 followed by T3 (42.01%). High gross return in T4 may be due to high brinjal yield in T4. Net returns provide the actual income of the farmers. Intercropping provides higher cash return than monocropping (Malik *et al.*, 1998). Net return was significantly varied ($P<0.01$) among the treatments (Figure 1). Net return from intercropping was higher than those from monocrop brinjal and monocropping groundnut. Similar result was obtained when brinjal intercropped with french bean (Prasad and Mohan, 1995). Higher net return under intercropping was may be due to higher total productivity under intercropping by nitrogen fixing ability of groundnut. Higher net return was reported in capsicum –vegetable Cowpea (Seran and Brintha, 2009b). Among intercropping, T4 provided high return (60.62%) than T1, followed by T3 (50.86%). Elanchezhyan *et al.* (2008) reported that brinjal intercropped with cluster bean was cost effective due to lowest shoot damage.

Cost - Benefit Ratio

This index provides an estimate of the benefit a farmer derives for the expenditure they incurred in adopting a particular cropping system. Cost - benefit ratio of brinjal and groundnut intercropping is shown in Figure 2. It was highly significant ($P<0.01$) among tested treatments. Among the intercropping, it was high in T4 (8.65) followed by T3 (8.32). Elanchezhyan *et al.* (2008) reported that highest cost benefit ratio was recorded in brinjal, cluster bean intercropping system.

Monetary Equivalent Ratio (MER)

Monetary equivalent ratio used to measures the economic superiority of cropping system. There was significant difference ($P < 0.05$) in MER among intercropping. MER ranged from 1.50 (T4) to 1.26 (T5). T4 significantly differed ($P < 0.05$) from T3 and T5. Intercropping commonly gave greater monetary returns than obtained from either crop grown alone (Ahmed and Rao, 1982).

Table 1: Yields of brinjal and groundnut (tons/ha)

Treatments	Brinjal yield	Groundnut yield
T1	14.40 d	-
T2	-	8.40 a
T3	17.42 b	3.03 b
T4	19.97 a	1.64 c
T5	17.10 c	1.15 d

Value represents mean $\pm$ standard error of three replicates. Means followed by the same letter in each column are not significantly different according to Duncan's Multiple Range Test at 5 % level.

Table 2: Land equivalent ratio in each intercropping treatment

Treatments	LER
T3	1.56 a
T4	1.57 a
T5	1.31 b

Value represents mean $\pm$ standard error of three replicates. Means followed by the same letter are not significantly different according to Duncan's Multiple Range Test at 5 % level.

Table 3: Monetary equivalent ratio of brinjal and groundnut intercropping

Treatments	MER
T3	1.41 b
T4	1.50 a
T5	1.26 c

Value represents mean $\pm$ standard error of three replicates. Means followed by the same letter are not significantly different according to Duncan's Multiple Range Test at 5 % level.

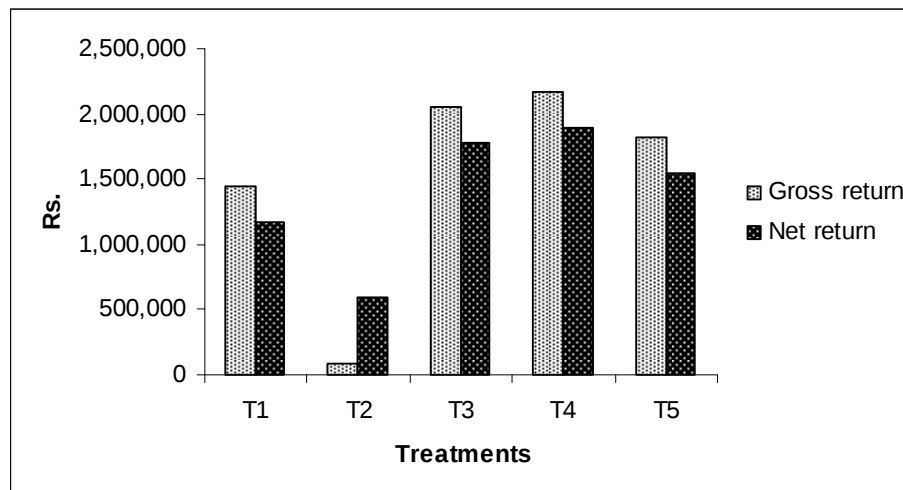


Figure 1 - Gross and net returns from brinjal and groundnut intercropping (Rs/ha)

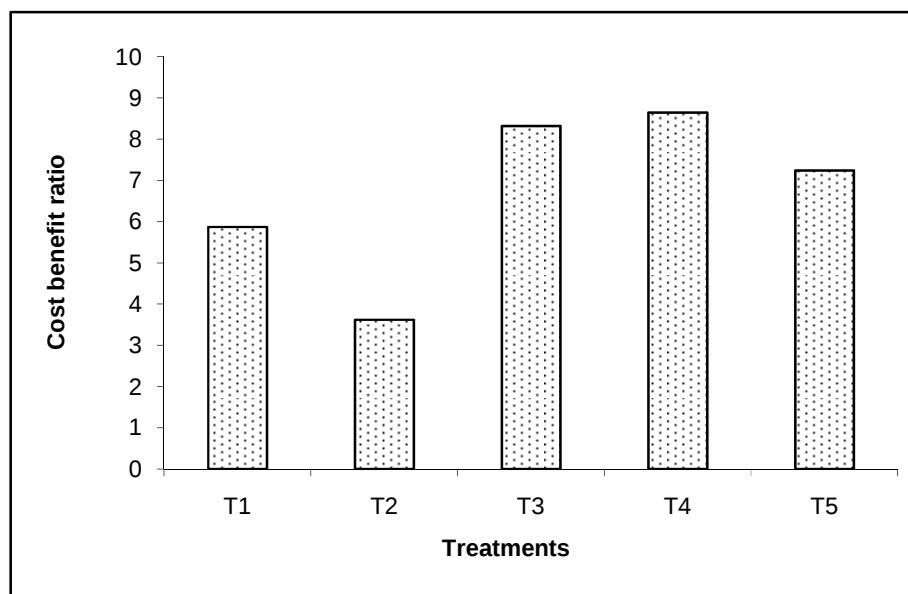


Figure 2 - Cost - benefit ratio of brinjal and groundnut intercropping

CONCLUSION

From this study, it can be concluded that growing brinjal and groundnut enhances land use efficiency. It ranged from 1.31 (T5) to 1.57 (T4). Yield of brinjal was significantly affected by intercropping system. Brinjal crop planted in T4 produced significantly higher yield (19.97 tons/ha) as compared to rest of the treatments. Cost - benefit ratio and MER were high in T4 (8.65 and 1.50 respectively) followed by T3 (8.32 and 1.41 respectively). The present study concluded that 60/150 cm paired row planting of brinjal with two rows of groundnut in between paired rows (T4) would be the most profitable planting system in sandy regosol. Hence, the above mentioned paired row system is recommended to farmers to obtain more economic advantages among the tested treatments in sandy regosol.

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