

Organic production of eggplant in multistoried agroforestry system

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Abstract: A field experiment was conducted at the Agroforestry Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur during October 2006 to March 2007 to evaluate the performance of an eggplant variety (Kajla) as the lower storey crop in multistoried agroforestry system. The treatments were Mehogany-cane, Deshi neem-cane and Eucalyptus-cane base agroforestry system. The trees were used as the upper storey; there was also a middle storey cane species and one control (open field) treatment. Significantly the longest plant (96.00 cm at 150 DAP) was found under Eucalyptus with cane followed by Deshi neem with cane. The shortest plant (79.00 cm at 150 DAP) was found in open field. On the other hand, the values of all other growth and yield contributing characters found highest in open field followed by Mehogany with cane and the lowest values were found in Eucalyptus with cane. The highest fruit yield was recorded in open field (92.24 t ha⁻¹) followed by Mehogany with cane (72.08 t ha⁻¹). A total of 10-15% fruits were found infested by fruit borer and this yield loss may be due to organic production. Open field always ensured the maximum yield but potentiality of other treatments may be ranked as Mehogany-cane > Deshi Neem-cane > Eucalyptus-cane.

Key word: Organic production, Eggplant, Multistoried Agroforestry systems.

Introduction

Eggplant (*Solanum melongena* L.) belonging to the family Solanaceae is a popular vegetable throughout the entire tropical and subtropical regions. It is grown extensively in Bangladesh, China, India, Pakistan and the Philippines. It is also a popular vegetable crop of France, Italy, USA, Mediterranean and Balkan areas (Bose and Som, 1986).

The average consumption of vegetables in Bangladesh is only 70 gram per capita per day including potato and sweet potato. Except tuber crops, it is only 30 grams against the FAO recommendation of 200 gram. To supply the minimum daily requirement of 200 gm, the national production of vegetables should be over 10 million tons. In addition, population of Bangladesh is increasing rapidly; therefore, demand for vegetables is also increasing simultaneously. Eggplant ranks second among the vegetables in terms of both acreage and production. Total production of vegetables in Bangladesh is 6,63,1000 tons where kharif eggplant and rabi eggplant contributed 1,10,000 & 2,30,000 tons, respectively (BBS, 2005).

Unfortunately, vegetable acreage are decreasing due to increasing the housing and other facilities for the over increasing population as well as increasing the area of boro rice and wheat in winter season. Under these situations, new techniques must be developed to bridge the wide gap between the supply and the demand for vegetables.

Recently, some techniques have already been advocated to overcome the future food challenges including vegetables, multistoried agroforestry is one of them. Michon *et al.* (1986) stated that multistoried agroforestry system is characterized by an intensive integration of forestry species and commercial crops forming a forest like system.

The multistoried agroforestry system is a profitable productions system and provides a buffer between villages and protected forest. Keeping this view in mind the research has been under taken to evaluate the performance of eggplant grown as the lower storey crop in multistoried agroforestry system.

Materials and Methods

A field experiment was conducted at the cane based Agroforestry Research Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during October 2006 to March 2007 to assess the performance of eggplant as a lower storied component of multistoried system. The site was between 25° 13' latitude and 88° 13' longitude, and about 37.5m above the sea level and land type a medium high land belonging to the old Himalayan Piedmont Plain area (AEZ 01). Land was well-drained as drainage system was well developed. The soil texture was sandy loam in nature. The soil P^H was 5.1. The structural class of the soil was fine and the organic matter content was around 1.06%, total nitrogen 0.103%, phosphorus 24.0 µ/g soil, potassium 0.26 me/g soil.

The cane based Agroforestry field is a young orchard of three multipurpose tree species namely *Swietenia macrophylla* (Mehogany), *Azadirachta indica* (Deshi neem) and *Eucalyptus camaldulensis* (Eucalyptus). The tree saplings were planted in three blocks at the spacing 3m×3m in the year 2004. The tree block was separated by 5 m. Cane species were planted in the middle of two tree species in north-south direction in August 2005, which formed middle storey. Between two lines of MPTs (in the alley) 3 m x 2.5 m plots are made for lower storey crop production. There were 5 plots for eggplant in each alley. There were 5 control plots in open field for eggplant. Hence, the experiment was conducted following single factor RCBD with 5 replications, which comprises 4 treatments i.e. Mehogany-cane, Deshi neem-cane, Eucalyptus-cane and open field. The test variety of eggplant was Kajla which was reported more tolerant than Nayantara and Uttara in artificial shade by Miah (2001). Eggplant seedlings were planted in the plots maintaining 50 cm x 40 cm distances. Cow dung @ of 20 t ha⁻¹ in 3 splits, 50% during the final land preparation and rest was applied twice equally at 30 and 60 DAP. Weeding was done periodically when ever necessary. Light irrigation was given just after transplanting. However, heavy irrigation was given twice; at 40 and 80 DAP, respectively. No chemical fertilizer and pesticides were

used as it was also an attempt to produce eggplant in organic basis. Fruit borer and bacterial wilt affected plants were removed from each plot. After all, 10-15% fruits of eggplant were found infested by the fruit borer. For data collection, 10 representative sample plants (eggplant) were selected and evaluated for growth parameters. The fruits of eggplant were plucked from the selected plants when they reached at the edible size or become matured and data for yield contributing characters were recorded. Data were analyzed with the help of MSTAT computer package program. The mean differences were adjusted by the Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Performance of eggplant

Plant height: The plant height of eggplant was significantly affected by the tree-cane association due to their shading and root interactions (Table 1). The highest plant height was obtained under Eucalyptus-cane treatment irrespective of sampling dates and the values were 24.00, 80.00 and 96.00 cm at 50, 100 and 150 DAPs, respectively. The lowest plant height was found in open field at all sampling dates (19.00, 65.00 and 79.00 cm at 50, 100 and 150 DAPs, respectively). The moderate performance of plant height was recorded under Mehogany-cane and Deshi neem-cane based systems.

Leaf number: The number of leaf plant⁻¹ of eggplant was significantly affected by the presence of tree and

cane (Table 1). The highest number of leaf plant⁻¹ was obtained in open field irrespective of sampling dates and the values were 15.00, 45.00 and 80.00 at 50, 100 and 150 DAPs, respectively. The lowest number of leaf plant⁻¹ was found under Eucalyptus-cane treatment at all sampling dates (11.75, 35.00 and 63.50 at 50, 100 and 150 DAPs, respectively). The moderate performance of number of leaf plant⁻¹ was recorded under Mehogany-cane and Deshi neem-cane.

Primary branch: The primary branch plant⁻¹ of eggplant was significantly affected by the upper storey tree and cane due to their shading and below ground interactions (Table 2). The highest number of primary branch plant⁻¹ was 3.00 obtained in open field and the lowest number of primary branch plant⁻¹ was 2.00 under Eucalyptus-cane. The primary branches counted under Mehogany-cane (2.70) and Deshi neem-cane (2.36) was statistically similar to that of open field and Eucalyptus-cane treatment. Lower photosynthesis under multistorey may be the causes of lower primary branch production of eggplant (Miah, 2001).

Secondary branch: The secondary branch plant⁻¹ of eggplant was significantly influenced by the double storey MPTs canopy (Table 2). The highest number of secondary branch plant⁻¹ was 18.00 obtained in open field followed by Mehogany-cane (16.33) and significantly the lowest number of secondary branch plant⁻¹ (10.33) was recorded under Eucalyptus-cane.

Table 1. Plant height and number of leaf of eggplant at different days after planting (DAPs) as the lowerstoried component of multistoried agroforestry system

Treatment	Plant height (cm) at DAP			Number of Leaf/plant at DAP		
	50	100	150	50	100	150
Open field	19.00d	65.00e	79.00cd	15.00a	45.00a	80.00a
Mehogany-cane	22.00b	67.00d	80.00cd	13.50b	39.00b	70.50bc
Deshi neem-cane	20.00c	70.00c	82.00bc	12.00c	38.00b	65.25cde
Eucalyptus-cane	24.00a	80.00a	96.00a	11.75cd	35.00c	63.50de

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly as per DMRT.

Fruit number: The number of fruit plant⁻¹ of eggplant was significantly influenced by the various shading of different MPT-cane association (Table 2). The influencing pattern was similar to that of secondary branch plant⁻¹. The highest number of fruit plant⁻¹ was 12.50 obtained in open field followed by Mehogany-cane (10.50). Significantly the lowest number of fruit plant⁻¹ was 8.50 found under Eucalyptus-cane.

Fruit length: The fruit length of eggplant was significantly affected by the tree-cane association (Table 2). The highest fruit length was 28.25 cm obtained in open field followed by Mehogany-cane

(26.50 cm). Significantly the lowest fruit length was 21.50 cm found under Eucalyptus-cane.

Fruit girth: The fruit girth of eggplant was significantly influenced by the tree-cane interactions (Table 2). The highest fruit girth was 10.50 cm obtained in open field. Significantly the lowest fruit girth was 8.50 cm found under Eucalyptus-cane. The fruit girth recorded under Mehogany-cane (9.25 cm) and Deshi neem-cane (8.80 cm) were statistically similar to both open field and Eucalyptus-cane treatment.

Fruit weight: The fruit weight of eggplant was significantly prejudiced by the tree-cane below ground

and upper ground interaction (Table 2). The highest fruit weight was 92.25 g obtained in open field. Fruit weight recorded under Mehogany-cane (85.50 g) and Deshi neem-cane (82.90 g) was statistically identical to that of open field. Significantly the lowest fruit weight was 78.52 g found under Eucalyptus-cane.

Yield: The yield plant⁻¹ of eggplant was significantly affected by the presence of cane and tree species due to shading as well as root interaction (Table 2). Significantly the highest yield plant⁻¹ was 1.153 kg obtained in open field followed by Mehogany-cane (0.897 kg) and significantly the lowest yield plant⁻¹ was 0.663 kg found under Eucalyptus-cane. The yield per plant was converted to ton per hectare and the yield was 92.24 t ha⁻¹ found in open field and the moderate yield was 72.08 t ha⁻¹ found under Mehogany-cane (Table 2). The lowest organic eggplant yield (54.00 t ha⁻¹) was found under Eucalyptus-cane treatment. Borer infested fruits were included in the yield

calculation of eggplant fruits. In the open field 10% fruits were found infested. Maximum borer infested fruits was found in Eucalyptus-cane treatment (15%) followed by Mehogany-cane (14.5%). Minimum borer infestation was recorded under Deshi neem-cane (13%).

Performance of tree species

Current annual increment of different growth parameter of MPTs was studied from multistoried Agroforestry system (Table-4). Among three MPTs Eucalyptus showed the maximum CAI for height (2.74 m) followed by Mehogany (1.52 m). The poor CAI for height found in Deshi neem (0.54 m). Incase of base girth Mehogany performed the best (8.30 cm) followed by Eucalyptus (8.20 cm) and then Deshi neem (6.90 cm). Incase of girth at the breast height Deshi neem was found highest (6.20 cm) followed by Mehogany (5.80 cm) and the lowest GBH (5.50 cm) was found in Eucalyptus (Table-4).

Table 2. Production of primary and secondary branches and number of fruit/ plant, fruit length, fruit girth, fruit weight and yield of eggplant in different multistoried agroforestry systems

Treatment	Primary branch /plant	Secondary branch /plant	Fruit/plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Yield/ plant (kg)	Yield (t ha ⁻¹)
Open field	3.000a	18.00a	12.50a	28.25a	10.50a	92.25a	1.153a	92.24a
Mehogany-cane	2.700ab	16.33b	10.50b	26.50b	9.250bc	85.50ab	0.897b	72.08b
Deshi neem-cane	2.367ab	13.00c	9.50c	24.50c	8.800bc	82.90ab	0.785c	63.44c
Eucalyptus-cane	2.000b	10.33d	8.50fd	21.50d	8.50c	78.52b	0.663d	54.00d

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly as per DMRT.

* MAP =Months After Planting

** NS = Not Significant

Table 3. Effect of upper storey trees on the plant height, number of leaf, number pinne , secondary stem, pinne length of cane species

Tree species	Plant height (cm)			Leaf/plant (number)			Pinne /leaf (number)			Secondary stem / plant (number)			Pinne length/leaf (cm)		
	6 MAP	12 MAP	18 MAP	6 MAP	12 MAP	18 MAP	6 MAP	12 MAP	18 MAP	6 MAP	12 MAP	18 MAP	6 MAP	12 MAP	18 MAP
Mehogany	63.50a	151.7a	192.9a	9.500a	20.42a	29.50a	17.33a	73.92a	99.44a	00	5.25a	8.000a	60.83 a	88.50a	109.8a
Deshi-neem	58.75b	145.2a	182.9ab	9.42a	19.75a	27.58a	13.58b	73.50a	94.42a	00	4.75b	7.667a	52.50 b	88.08a	104.2a
Eucalytus	55.42b	135.0b	175.7b	8.250b	15.25b	22.33b	13.92b	63.58b	85.00b	00	4.08b	7.08a	50.75 b	82.83ab	110.5a

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly as per DMRT.

Table 4. Current Annual Increment of the upper storey tree species

Parameter measured	Mehogany			Deshi neem			Eucalyptus		
	18 MAP	30 MAP	** CAI	18 MAP	30 MAP	** CAI	18 MAP	30 MAP	CAI
Height (m)	2.28	3.8	1.52	3.28	3.82	0.54	3.56	6.30	2.74
Base girth (cm)	12.45	20.75	8.3	10.35	17.25	6.9	12	20.50	8.2
Girth at the breast height (cm)	8.7	14.50	5.8	9.3	15.50	6.2	8.25	13.75	5.5
Canopy diameter (cm)	96	160	64	96	160	64	100	180	80

MAP = Months After Planting

CAI = Current Annual Increment

Performance of cane species

Significantly, the highest plant height of cane was found under Mehogany at all sampling stage (63.50, 151.7 and 192.9 cm at 6, 12 and 18 MAPs, respectively). Significantly, the lowest plant height was recorded as 55.42, 135.0 and 175.7 cm at 6, 12 and 18 MAPs, respectively under Eucalyptus (Table-3). Number of leaves plant⁻¹ of cane was also influenced by the upper storey MPT_s. Significantly the highest numbers of leaves/ plant at 6, 12 and 18 MAPs were observed 9.50, 20.42 and 29.50, respectively under Mehogany followed by Deshi neem (Table 3). The lowest number of leaves plant⁻¹ was observed 8.25, 15.25 and 22.33 respectively at 6, 12 and 18 MAPs under Eucalytus. The secondary stem plant⁻¹ at 6 MAPs was nill (00) in all treatments, but the highest secondary stem plant⁻¹ was observed under Mehogany (5.25 and 8.00 at 12 and 18 MAP, respectively) which was followed by Deshi neem. The lowest secondary

stem plant⁻¹ was found 4.08 and 7.08 at 12 and 18 MAPs, respectively under Eucalyptus.

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