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PERFORMANCE OF DIFFERENT EGGPLANT VARIETIES AT DIFFERENT LIGHT LEVELS FOR AGROFORESTRY SYSTEM

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ABSTRACT

A field experiment was conducted to determine the effect of different reduced light levels on the growth and yield of eggplant. There were four light treatments i.e. 75, 50 and 25% PAR along with one control treatment (full sunlight i.e. 100% PAR). The varieties of eggplant were Nayantara, Kajla and Uttara. All these varieties of eggplant showed statistically similar plant height at each light levels, but varied significantly among the different light levels. In general, plant height of all varieties of eggplant increased with the decrease of light levels and the tallest plant was observed under 25% PAR irrespective of varieties. Number of primary branches and number of leaf per plant of all varieties varied significantly under reduced light conditions. However all these three varieties produced the highest number of fruit per plant at 100% PAR and reduced gradually with the reduction of light levels. Yield (t/ha) of eggplant irrespective of varieties were the highest under 100% PAR. However, yields decreased gradually with decrease of light levels. The yield of Nayantara, Kajla and Uttara at 100%, 75%, 50% and 25% PAR level were 50.51, 49.35, 44.48, 48.18, 47.8, 43.6; 46.81, 47.75, 33.13 and 27.13, 21.27, 11.77 t/ha, respectively. The results indicated that Kajla was the most shade tolerant followed by Nayantara upto 50% reduced light levels, based on yield performance, Uttara was the less tolerant to shade among the three varieties of eggplant.

***Key words**: Reduced light, eggplant, growth, yield components and yield*

INTRODUCTION

Egg plant (*Solanum melongena* L.) belonging to the family Solanaceae is a popular vegetable cultivated throughout the entire tropical and subtropical regions of the world (Bose and Som, 1986).This vegetable is very important for its day neutral nature and grown extensively all the year round in Bangladesh. But due to some environmental limitations only a few varieties are grown during the rainy season. The bulk of its production is obtained during the winter season. Egg plant is a familiar vegetable for its easier cooking quality, better taste and lower market price. The average consumption of vegetables in Bangladesh is only 70 g per head per day including potato and sweet potato. Except tuber crops, it is only 30 g against the FAO recommendation of 200 g. To supply the minimum daily requirement of 200 g vegetables/ head/ day, national productions of vegetables should be over 10 million tons. In addition, population of Bangladesh is increasing rapidly; therefore, demand for vegetables is increasing simultaneously. Egg plant 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 egg plant and rabi egg plant produced respectively 1,10,000 & 2,30,000 tons (BBS, 2005). Unfortunately, these limited areas are decreasing due to increasing the housing and other facilities of 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

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gap between supply and demands for vegetables. Agroforestry is the best alternative as it can produce the vegetables in association with perennial tree species. Light is the basis of photosynthesis and photosynthesis is the basis of crop production. In agroforestry system, light limitation is a common phenomenon for lower storey crops, which may be the most important cause of lower photosynthesis as well as lower yield. After all many fruits and timber orchard are going to establish all over the country especially in the high land. Initially there is no scarcity of sun light as their canopy remains minimum up to 3 to 4 years. These young orchards can easily be used for eggplant production as agroforestry systems. Shade tolerant limits of different crops are different, not only that within the same species all varieties are not equally responded to same shade level. Before prescribing for large scale farmer's production of eggplant in agroforestry system, it is essential to know the performance of the eggplant varieties in different light levels.

MATERIALS AND METHODS

The study was conducted at the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) farm during the period from November, 1999 to March, 2000 with four different light treatments i.e. 100, 75, 50 and 25% photosynthetically active radiation (PAR). The reduced light levels (75, 50 and 25% PAR) were made by using mosquito nets of different sieve sizes. The mosquito nets were imposed up to 2.13 meter over the plots. The treatments were arranged in a randomized complete block design (RCBD) with three replications. The size of each plot was 2.5mx2.5m i.e., 6 square meter. The test varieties of eggplant were Nayantara, Kajla and Uttara. The seedlings of these varieties were collected from the Bangladesh Agricultural Development Corporation (BADC) farm, Gazipur and healthy uniform sized seedlings were transplanted with a spacing of 60 cm x 50cm in the plots on 30 November, 1999. Recommended doses of fertilizers were applied in the plots (BARC, 1997). All cow dung, TSP and half of the Urea and MP were incorporated during the final land preparation. The remaining Urea and MP were top dressed in two equal instalments at the time flowering and fruiting. The crop was irrigated properly after each top-dressed and thereafter, as and when needed. Recommended cultural operations were done in time. Five representing plants were tagged from each plot for data collection. Growth characters such as plant height, number of leaf per plant, number of primary branch per plant, number of total branches per plant were measured. Fruits were harvested time to time when it attained its edible size and fruit length, fruit diameter, individual fruit weight and number of fruit per plant were recorded as yield contributing characters. Fresh yield per plant was determined from summation of each fruit weight of a plant and then converted in to ton per ha. Data were analysed using MSTAT and mean separation was done followed by DMRT.

RESULTS AND DISCUSSTION

Plant height

All the test varieties of eggplant showed statistically similar height at each light levels, but varied significantly among the different light levels (Table 1). In general, plant height of all varieties of eggplant increased with the decrease of light levels and the tallest plant was observed under 25 % PAR irrespective of varieties. This was probably due to higher apical dominance under shade condition (Hillman, 1984). In this light level, Kajla, Uttara and Nayantara varieties scored 103.83 cm, 101.57 cm and 110.42 cm plant height, respectively.

These values were statistically similar to the plant height under 50% PAR level. The height of Kajla, Uttara and Nayantara under 50% PAR were 100.90 cm, 96.57 cm and 99.43 cm, respectively. The shortest plants was observed under 100% PAR regardless of varieties (Kajla, Uttara and Nayantara became 77. 43 cm, 74.40 cm and 76.78 cm, respectively) which were statistically similar to that of 75% PAR. The height of Kajla, Uttara and Nayantara under 75% PAR were 86.52 cm, 80.80 cm and 89.83 cm, respectively.

Table 1. Plant height (cm) of brinjal varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	77.43 a B	86.52 a B	100.90 a A	103.82 a A
Kajla	74.40 a B	80.80 a B	96.57 a A	101.57 a A
Uttara	78.78 a B	89.83 a B	99.43 a A	110.42 a A

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Primary branch

Number of primary branches per plant of all varieties varied significantly under reduced light conditions (Table 2). Among the three varieties, Nayantara affected severely by the extreme shade level, Kajla affected moderately but Uttara was less affected. Of the three varieties, the highest number (5.87) of primary branch was found in Kajla and followed by Uttara (5.73) under full sunlight. Under 75% PAR level, Nayantara (5.17) and Uttara (4.85) showed statistically identical number of branches but Kajla showed significantly the lowest number of primary branch. Under 50% and 25% PAR level all varieties produced statistically similar number of primary branches, each variety influenced differently by different light levels.

In case of Nayantara, number of primary branches increased slightly at 25% reduced light but decreased drastically at 50% reduced light and continued this trend at 75% reduced light also. In case of Kajla, number of primary branches per plant decreased significantly even at 25% reduced light (75% PAR) but further reduction of light levels did not decrease significantly as compared to 25% reduced light. In Uttara variety, number of primary branches did not vary significantly from full light to 50% reduced light levels, but decrease significantly 75% PAR. The lower number of branches under shaded conditions might be due to higher auxin production which ultimately suppressed the growth of lateral branches (Miah *et al.*, 1999).

Table 2. Number of primary branch per plant of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	5.00 b AB	5.17 a A	3.93 a BC	2.95 a C
Kajla	5.87 a A	4.27 b B	4.33 a B	3.67 a B
Uttara	5.73 a A	4.85 a A	4.67 a A	3.03 a B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Table 3. Number of total branches per plant of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	15.20 a A	15.63 b A	13.58 b A	10.08 b B
Kajla	16.87 a A	17.20 a A	17.47 a A	12.40 a B
Uttara	17.98 a A	19.58 a A	18.53 a A	13.33 a B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Leaf number

Number of leaf per plant of eggplant were significantly influenced by reduced light levels (Table 4). At each light levels, Uttara produced the maximum number of leaf per plant (145.48, 169.17, 158.87 and 113.43 leaf at 100, 75, 50 and 25 % PAR, respectively) and Nayantara produced the minimum number of leaf (122.93, 129.17, 120.10, and 86.25 leaf per plant under 100, 75, 50 and 25 % PAR level, respectively).

Among the three eggplant varieties, number of leaf per plant produced at full sun light to 50% reduced light, were not affected significantly, whereas 75 % PAR produced the highest number of leaf per plant irrespective of varieties. But number of leaf produced under 25% PAR was significantly lower compared to number of leaf produced under 75 % PAR. Shading studies with pepper in the West Indies indicated that shade increased leaf surface area, cell division and cell expansion, and the overall dry matter weight by more than 40% (Schoch, 1972).

Table 4. Number of leaves per plant of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	122.93 a AB	129.17 b A	120.10 b AB	86.25 a B
Kajla	120.07 a AB	155.27 a A	141.00 a A	99.07 a B
Uttara	145.48 a AB	169.17 a A	158.87 a A	113.43 a B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Number of fruit

Number of fruit per plant of eggplant revealed that Nayantara was the most tolerant variety relatively to other varieties to reduced light levels. Nayantara produced statistically similar number of fruit per plant up to 50% reduction of light, but Kajla and Uttara showed similar phenomena up to 25% reduction of light (Table 5). However, the potentiality of Nayantara in terms of number of fruit per plant was much lower compared to other two varieties. The variety Uttara produced the highest number of fruit per plant at all light levels followed by Kajla and Nayantara. However all these three varieties produced the highest number of fruit per plant at 100% PAR and reduced gradually with the reduction of light levels. Lower number of fruits per plant under relatively more and prolong shaded condition was probably due to poor photosynthetic capacity of plants. The decrease in photosynthetic capacity of shaded plant was attributed to both stomatal and mesophyll cell properties (Woledge, 1977).

Table 5. Number of fruit per plant of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	6.78 c A	6.00 c A	6.28 b A	4.33 b B
Kajla	16.25 b A	15.30 b AB	14.77 a B	9.18 a C
Uttara	20.40 a A	19.70 a A	15.47 a B	9.20 a C

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Fruit length

Among the three varieties of eggplant the fruit length of Kajla and Uttara affected by the heavy shade level but the fruit length of Nayantara had no affection. Kajla produced significantly the longest fruit than any other of the two varieties at all light levels. Kajla and Uttara produced significantly the shortest fruit under 25% PAR level. Nayantara produced statistically similar length of fruit under all light levels.

Table 6. Fruit length (cm) of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	9.07 b A	9.00 b A	9.17 b A	7.00 b A
Kajla	14.47 a A	13.50 a A	12.67 a A	10.17 a B
Uttara	10.17 b A	9.83 b A	9.33 b A	6.87 b B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Fruit diameter

Diameter of fruit of eggplant varieties varied significantly irrespective of varieties and light levels. At each light level, Nayantara produced significantly the highest diameter of fruit and Uttara produced significantly the lowest diameter of fruit. Among the three eggplant varieties, Nayantara produced its maximum fruit diameter under 75% PAR (85 mm), where as Kajla and Uttara produced their maximum diameter of fruit at 100% PAR (40.13 and 34.17 mm). The fruit diameter of Kajla and Uttara gradually decreased with the decrease of light level. Although all varieties of eggplant showed statistically similar diameter of fruit up

Table 7. Fruit diameter (mm) of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	81.11 a A	85.00 a A	81.70 a A	72.80 a B
Kajla	40.13 b A	39.50 b A	39.67 b A	34.67 b B
Uttara	34.17 c A	33.83 c A	30.30 c AB	26.47 c B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Fruit weight

The weight per fruit of eggplant varieties was significantly varied irrespective of varieties and light levels (Table 8). The fruit weight showed almost similar pattern as found in fruit diameter. At each light levels Nayantara produced significantly the highest fruit weight (223.19 g, 241.83 g, 222.67 g and 186.83 g at 100, 75, 50 and 25% PAR, respectively) followed by Kajla (90.72 g, 93.30 g, 96.00 g and 70.63 g was found at 100%, 75%, 50% and 25% PAR, respectively). Uttara produced significantly the lowest weight per fruit at each light level (65.28 g, 66.42 g, 64.40 g and 37.80 g at 100, 75, 50 and 25% PAR, respectively). Nayantara and Uttara varieties produced their heaviest fruit at 75% PAR which were statistically similar to their fruit of 100% PAR and 50% PAR. In Kajla heaviest fruit was found under 50% PAR but in all varieties fruit weight varied insignificantly up to 50% PAR level. All the three varieties produced their smallest fruit, under 25% PAR level.

Table 8. Weight per fruit (g) of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	223.19 a A	241.83 a A	222.67 a A	186.83 a B
Kajla	90.72 b AB	93.30 b A	96.00 b A	70.63 b B
Uttara	65.28 c A	66.42 c A	64.40 c A	37.80 c B

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

Yield

Yield per plant of eggplant varieties varied significantly by the reduced light level. Eggplant yield per plant was gradually decreased as shade levels increased. Among the three varieties of eggplant, Uttara affected severely by the heavy shade levels, Nayantara affected moderately and Kajla was less affected in respect of yield per plant (Table 9). Nayantara and Kajla produced statistically similar yield up to 50% reduction of light level, but Uttara could produce statistically similar yield up to 25% reduction of light level. At 50 %PAR, yield reduction in Kajla and Nayantara was 3.80 and 7.60%, respectively as compared to 100% PAR. The result of yield per plant revealed that Kajla was the most tolerant than Nayantara and Uttara in reduced light levels. Uttara produced significantly the lowest yield at each light levels. Similar trend of yield in Indian spinach and Red amaranth was observed by Wadud (1999).

The changing pattern of yield ton per hectare was similar to the yield per plant by the reduced light levels, as the yield per plant was converted into t/ha. Nayantara produced 50.51, 48.18, 46.81 and 27.13 ton/ha at 100, 75, 50 and 25% PAR, respectively, which is followed by Kajla (49.35, 47.8, 47.75 and 21.27 ton/ha at 100, 75, 50 and 25% PAR, respectively). Uttara produced significantly the lowest yield at each light level (44.48, 43.61, 33.13 and 11.77 t/ha at 100%, 75%, 50% and 25% PAR, respectively). The highest yield was obtained from Nayantara at 100% PAR followed by Kajla. The lowest yield (11.77 t/ha) was obtained from Uttara at 25% PAR level.

Table 9. Yield per plant of eggplant varieties under different light levels

Varieties	Light regimes (% PAR)			
	100	75	50	25
Nayantara	1513.23 a A	1450.98 a A	1398.36 a A	825.78 a B
Kajla	1474.21 a A	1427.49 a A	1417.92 a A	648.38 b B
Uttara	1334.56 b A	1308.47 b A	996.26 b B	347.76 c C

In a column means followed by a small letter and in a row by a capital letter are not significantly different at the 0.05 level by DMRT.

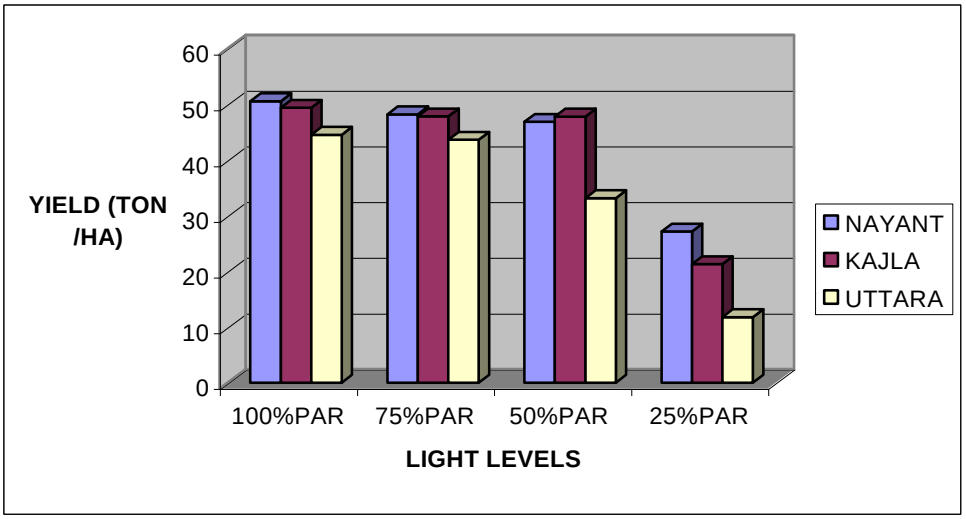

Figure 1. Yield of eggplant varieties (t/ha) under different light levels

Relationship between fresh yield of Eggplant and light

Linear relationships between light (%PAR) and fresh yields of all the three varieties of eggplant were estimated as Y= 0.286 X + 25.28 (R^2 = 0.7316) for Nayantara, Y= 0.3372 X + 20.47 (R^2 = 0.6463) for Kajla and Y = 0.4344 X + 6.095 (R^2 = 0.8488) for Uttara. The R^2 values of the equations for Nayantara, Kajla and Uttara were 0.7316, 0.6463 and 0.8488, respectively, which were high and significant (Figure 2). The R^2 values indicated that 73.16, 64.63 and 84.88% yield of Nayantara, Kajla and Uttara were attributed due to %PAR. The relationship also stated that the yield of Nayantara, Kajla and Uttara were changed at the rate of 0.29 t/ha, 0.34 t/ha and 0.43 t/ha respectively for per unit of changing of %PAR.

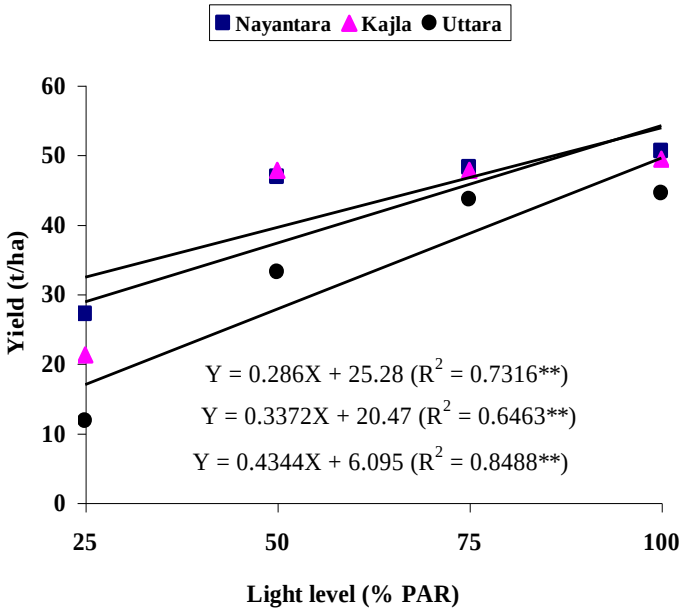

Figure 2. Relationship between light level (% PAR) and yield of different eggplant varieties

CONCLUSION

From the results it is clear that Kajla and Nayantara can be grown in the partial shade of agroforestry system but the result was based on artificial shade, so it is essential to evaluate the performance of these eggplant varieties under the tree canopy before advocacy for large scale production in agroforestry system.

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