PERFORMANCE OF TOMATO UNDER GHORANEEM AND SISSOO BASED AGROFERESTRY SYSTEMS

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ABSTRACT

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A field experiment was conducted at the farmer's field adjacent to the Hajee Mohammad Danesh Science and Technology University, Dinajpur during October 2005 to March 2006 to investigate the growth and yield performance of tomato under eight years old Sissoo and three years old Ghora neem trees. The treatments were two timber species i.e T_2: Ghoraneem (*Melia azedarach*) and T_3: Sissoo (*Dalbergia sissoo*) with one control plot (T_1: open field). Except plant height all the growth and yield contributing characters of tomato showed the highest values under open field followed by ghoraneem. Under sissoo significantly tallest plant (12.3 cm) was recorded but all other parameters were found significantly lowest. The study revealed that tomato can easily be grown under three years ghoraneem orchard without significant yield loss although open field produced the highest yield (71.11 t ha^{-1}) eight years sissoo orchard should not be allowed for tomato production as the yield under sissoo was severely poor.

Keywords: Growth and yield, agroforestry system, Sissoo, Ghoraneem

INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is a well known and very popular vegetable grown successfully throughout the Bangladesh. This fruit vegetable is popular for its nutritional value and diversified use like salad, juice, sauce etc. It contains 1.98g protein, 320 IU vitamin-A, 1.8 mg iron and 31 mg vitamin-C in 100 g edible tomato (Bose and Som, 1986). The average consumption of vegetable in Bangladesh is 70g per head per day including potato and sweet potato. Except tuber crops, it is only 30 g as against the FAO recommendation of 200g. To supply the minimum daily requirement of 200g vegetable/head/day, national production of vegetable should be over 10 million ton in addition, population of Bangladesh is increasing rapidly ,therefore ,demand for vegetable is increasing simultaneously whereas as the areas under vegetable production including tuber crops are 3,27,000 ha that produce 2.76 million metric tons of vegetable yearly (BBS,1998). Unfortunately these limited areas are decreasing due to increasing the area of Boro rice and wheat in winter season. Under the circumstances agroforestry may be the best alternative to minimize the gap between demand and production. Agroforestry, the integration of tree and crop vegetable on the same area of land is a promising production system for maximizing yield (Nair, 1990) and maintaining friendly environment. Growing annual crops in association with trees is becoming popular day by day for their higher productivity. In Bangladesh, a large number of vegetable are grown of which most of them are grown in winter season. Among the different winter vegetable, tomato is the important one. Though Tomato is very common to all and has good production potential in our climate but it was not systematically tested in agroforestry system or in natural shade condition to see its production ability under partial shade condition. A vary little scientific research work was done in this field. Many fruit orchard and woodlot are found in the northern part of the country. But a very few orchards are used for cultivation of vegetable. For identifying the compatible tree-vegetable combination, particularly under story species i.e. different vegetable should be screened out in terms of their adaptability and yield under different tree canopies of various shade levels. For this purpose, tomato is selected to grow under two MPTs to know its shade tolerances limits in the northern part of Bangladesh in terms of growth and yield

METERIALS AND METHODS

A field experiment was conducted at the farmer's field adjacent to the Hajee Mohammad Danesh Science and Technology University, Dinajpur during the period from October 2005 to March 2006 under upland condition. The site of the experiment was situated between $25^0 28'$ to $25^0 47'$ North latitude and $88^0 34'$ to $88^0 47'$ East longitudes at the elevation of 37.58 meter above the sea level. The experiment was laid out in a medium high land belonging to the AEZ-1(Old Himalayan Piedmont Plain). The soil texture was sandy loam (sand, silt and clay are 62, 25 and 13 % respectively) with a pH 5.1 and the organic matter content was around 1.20 percent. The characteristics of the soil were previously tested in the soil science department, HSTU, Dinajpur. The seedlings of tomato (variety Ratan) were colleted from BADC, Dinajpur. Tomato was grown under two tree species namely, Ghora neem (T_2) and Sissoo (T_3). There was also a control plots in

open field (T_1) adjacent to the orchard. The study was done under eight years old Sissoo and three years old Ghora neem established maintaining 3m x 3m distance. Each Tree species was pruned every year. The structural characteristics of two tree species were as follows:

Timber plants	Plant height (m)	Diameter at breast height (cm)	Average light intensity of the study period (lux day^{-1})	Shade status (%)
Ghora neem	11.65	38.5	31250	Moderate (Approx. 40%)
Sissoo	15.3	45.6	20050	Heaviest (Approx. 68%)

The experiment was followed Randomized Complete Block Design (RCBD) with three replications. Individual plot size was 2.5 m X 2.5 m. Fertilizer doses were 5 ton, 140 kg, 30 kg and100 kg as cow dung, N, P and K per hectare, respectively. After a few days of transplanting gap filling was done by the healthy seedlings of the same variety previously planted in the border area. Sticking, watering and weeding were done as per requirement. Tomato was harvested in several picking when the fruits appeared at just yellow color during 90 to 115 days after planting (DAP). Ten plants of tomato were selected randomly from each plot for data collection, plant height, number of primary branches per plant, number of leaves per plant and number of effective cluster per plant were determine from the sample plant during final harvesting. Number of fruits per plants, number of fruits per cluster, fruit diameter and fruit wet were measured when fruit attained to addible size. Fresh yield was determined from summation of each fruit weight of a plant and than converted to ton per hectare.

RESULTS AND DISCUSSION

Plant Height

Tomato plant cultivated under different tree shade grew more vigorously than these grew in the open field. It exhibit significantly longer height irrespective of treatments of tree shade with the increased of shade levels (decreased of light levels), plant height increased significantly. The shortest plant was (89.27 cm) found in open field (T_1) and the tallest plant (121.1 cm) was recorded under Sissoo canopy (T_3) due to its heaviest shade condition. The moderate plant height (99.53 cm) observed under Ghora neem canopy (T_2). Significantly taller plant height under heavy shade in Okra was reported by Ali (1999). Plant grown in low light levels was found to be more applicably dominant than those grown in high light environment resulting in the taller plant under shade (Hillman, 1984).

Primary Branch

Primary branches per plant were influenced by shade of different tree canopies. Number of primary branches per plant was also decreased gradually with the increased of shade levels. The maximum number of primary branches (9.53) obtained in open field was statistically identical to that of under Ghora neem canopy (9.20). Significantly the lowest number of primary branches (5.50) was recorded under Sissoo canopy compared to other treatment (Table1). The lower number of primary branches under shaded conditions might be due to higher auxin production in plant grown under shaded condition which ultimately suppressed the growth of lateral branches (Miah, et al., 1999).

Leaf Number

Number of leafs [per plant was significantly varied by different shade levels. Significantly the height number of leaves per plant (95.07) was recorded under Ghora neeem canopy (T_2). The second highest number of leaves per plant (86.27) was observed in open field (T_1) which was statistically similar to that of Gora neeem canopy. The lowest number of leaves per plant (70.40) was observed under Sissoo canopy (T_3) (Table 1). Similar result was also reported by Ali (1999). The Lowest number of leaves per plant at the heaviest shade condition may be due to lower production of photosynthates under low light conditions for a longer period (Miah, *et al.*, 1999). Also similar result was reported by (Miah, 2001).

Effective Clusters Plant^{-1}

The highest number of cluster per plant (10.15) was recorded in open field (T_1) which was statistically similar to that of found under Ghora neem (9.92). Significantly the lowest number of clusters per plant (8.33) was recorded under Sissoo canopy which was the heaviest shade condition among the three treatments (Table 1).

Table 1. Growth characters of Tomato under different tree canopies of various shade levels.

Treatments	Plant height (cm)	No. of primary branches/plant	No. of leaves/plant	No. of effective clusters/plant
T_1	89.27c	9.53a	86.27a	10.15a
T_2	99.53b	9.20a	95.07a	9.92a
T_3	121.1a	5.50b	70.40b	8.33b

Mean followed by a common letters are not significantly different at the 5% level of DMRT.

Fruits Plant^{-1}

Number of fruits per plant is the most important yield contributing characters which also significantly influenced by different shade levels. The maximum number of fruits per plant was found in the open field (29.30), which was statistically similar to that of found under moderate shade of Ghora neem canopy (26.63) and significantly the lowest number of fruits per plant was found under heaviest shade of Sissoo canopy (10.40) (Table 2). The lower number of fruits per plant under relatively more and prolonged shaded condition was probably due to poor photosynthetic capacity of plants. The decreased in photosynthetic capacity of shaded plant was attributed to both stomatal and mesophyll cell properties. These results indicate that Tomato can be grown even under moderate shade of Ghora neeem canopy without significant loss the number of fruits per plant as compared to open field.

Fruits Cluster^{-1}

Number of fruits per cluster gradually decreased with the increased of shade levels. The highest number of fruits per cluster (2.90) was found under full sunlight, which was followed by Ghora neem shade (2.33). The lowest number of clusters per plant (1.15) was observed under treatment Sissoo shade. The values of number of fruits per cluster of different treatments were statistically different (Table 2).

Table 2. Yield and yield contributing characters of Tomato under different tree canopies of various shade levels

Treatments	No. of fruit/plant	No. of fruit/cluster	Fruit diameter (mm)	Weight /fruit (g)	Yield/plant (g)
T_1	29.30a	2.90a	44.82a	63.44a	1853.00a
T_2	26.63a	2.33b	43.91a	61.70a	1631.00a
T_3	10.40b	1.15c	29.31b	24.97b	753.60b

Mean followed by a common letters are not significantly different at the 5% level of DMRT.

Fruit Diameter

Fruit diameter of tomato grown under different shade levels followed almost a similar pattern of variation like number of fruits per plant. The maximum fruits diameter recorded under full sunlight was (44.82 mm).Followed by the fruit diameter (43.91 mm) found under Ghora neem canopy which was statistically similar to that of full sunlight. Significantly the lowest fruit diameter (29.31mm) was recorded under Sissoo canopy. The lower fruit diameter under the heaviest shade level may be associated with the lower mobilization of reserved assimilates to reproductive organ. Similar findings in case of Mungbean was also reported by Ali (1998).

Fruit Weight

Individual fruit weight also decreased as the shade levels increased. The fruit weight of open field and grown under Ghora neem canopy varied significantly. The maximum fruit weight was observed under full sunlight (63.44 g) grown under Ghora neem canopy. Which was closely followed by the fruit weight (61.70 g) whereas, the plants grown under Sissoo canopy in artificial shade condition produced significantly the lowest fruit weight (24.97 g). Similar results were also reported by Miah (2001).

Yield

Tomato yield per plant was also significantly influenced by different shade level of different tree canopies. The trend of yield per plant was almost similar to that of number of fruits per plant. Among the tree light levels, the highest yield per plant (1853.00 g) was recorded in the open field which was statistically identical to that of grown under Ghora neem canopy (1631.00 g). Significantly the lowest yield per plant (753.6 g) was found under Sisso canopy. Tomato yield per plant was converted to total yield in ton/ha. The total yield of Tomato showed almost similar

pattern of variations among the three light levels as tomato yield per plant. The highest yield in (71.11 t/ha) was recorded under full sunlight. The yield (65.24 t/ha) was recorded under Ghora neem canpopy was statistically similar to that of full sunlight. Significantly the lowest yield (33.14 t/ha) was recorded under heaviest shade of Sissoo canopy.

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