J. Agrofor. Environ. 6 (1): 43-46, 2012 ISSN 1995-6983

Boundary plantation of Eucalyptus and its effect on Chilli and Sweet gourd

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Abstract: An experiment was conducted at Char gobadia which is situated by the side of Brahamputra River adjacent to Bangladesh Agricultural University, Mymensingh, to study the growth &yield of two winter vegetables i.e. Chilli and Sweet gourd under different spacing (T_0-control, T_1-3 ft-distance from tree , T_2-6 ft- distance from tree , T_3-9 ft- distance from tree) of Eucalyptus tree. Experiment was conducted during October 2011 to March 2012 in a Randomized Complete Block Design with three replications. It was observed that the growth and yield of Chili and Sweet gourd increased rapidly as distance increased from the tree. The tallest plant and the highest length of leaves were found under treatment T_0. All the parameters i. e. plant height, diameter, leaf length, leaf breadth, number of fruits plant^{1}, weight of fruits plant^{-1}, yield etc. increased gradually with increasing distance from i.e. in T_1 to T_2 to T_3. The highest yield of Sweet gourd (13.05 tha^{-1}) and Chilli (4.1 tha^{-1}) observed under treatment T_0. The lowest yield of Sweet gourd (7.20 tha^{-1}) and Chilli (3.30 tha^{-1}) observed under treatment T_1. It concluded that boundary plantation of Eucalyptus has negative effect on the growth and yield of Chilli and sweet gourd.
Key words: Eucalyptus, chilli, sweet gourd, boundary plantation, agroforestry.

Introduction

Population is increasing rapidly throughout the world and the rate of increase is very high in developing countries like Bangladesh. The country which has only 8.16 million hectare of arable land is one of the most densely populated countries of the world struggling hard to feed her more than 150 million people. Population has doubled in the last 30 years and population density is now 964 persons per square kilometer (BBS,2011). The country has only a land area of 14.39 million hectares, but to the ever growing population per capita land area is decreasing at an alarming rate of 0.005 ha/cap/year since 1989 (Hossain and Bari, 1996) and, therefore, steadily declining the land : man ratio. The current food deficit of around 2 million tons is like to be increased further with decreasing land: man ratio. Rather, the capacity of our land is decreasing day by day due to intensive cropping and use of high input technologies. As a result, the country has been facing acute shortage of timber, fuel wood and most essential forest products. Estimated present wood demand of the country is about 13.2 million cubic meters. Against this current demand, the supply of wood is about 8.2 million cubic meters. Thus, it appears that there is a big gap between supply and demand of forest product. Therefore, to meet the domestic requirement of timber and fuel wood, there is no other way for expansion of natural forest but there is only way to increase the plantation forest. Global warming due to deforestation is now-a-days a recognized fact and no country is free from its bad effect. Bangladesh is also facing serious environmental problems like frequent cyclones, floods, tidal bores etc. Vegetables may play a vital role in this aspect. Generally vegetables are rich sources of minerals, vitamins and essential amino acids. They are considered as a cheap natural source of supplementary food and can be grown in a short duration. Being labor intensive, vegetable production creates opportunities for employment. Forestry plays an important role in maintaining environmental equilibrium and socio-economic implement of the people. A country needs 25% of forest land of its total area for ecological stability and sustainability. Unfortunately, Bangladesh is endowed with only 17.08% (BBS, 2011) of unevenly distributed forests. However, actual tree cover is less than 10% (Akter *et al*., 1989). The central region where the population density is the highest, has the least forest resources, thus substantial depletion of forest resources has occurred in the last few decades, and now it is reduced to less than 0.02 ha per person, one of the lowest ratio in the world (BBS, 2011). Under these alarming situations, agricultural production as well as forest resources must be increased by using modern or new techniques. Recently, some techniques have been advocated to overcome the future challenges, agroforestry is one of them. Agroforestry, the integration of the tree, crop and vegetable on the same area of land is a promising production system for maximizing yield (Nair, 1980) and maintaining friendly environment. Growing of crops/ vegetables in association with trees is becoming popular day by day for their higher productivity, versatile/multipurpose use and environmental consciousness among the peoples (Sheikh and Khaleque, 1982). In Bangladesh a large number of vegetables are grown of which most of them are grown in winter season. Financial returns from vegetables showed that winter vegetables production is more profitable than the production of most field crops (BBS, 1998). Among the different winter vegetables, Sweet gourd and Chilli are the important winter vegetables in Bangladesh. Sweet gourd is important for its quick growing nature and high yielding potential. It is easily cultivated as a companion crop or inter crop. Chilli is a well known and a very popular vegetable grown successfully throughout Bangladesh. Chilli is popular for its diversified use and its nutritional value. During the early period of tree establishment farmers plant annual crops (vegetables) at the base area and surrounding area of the saplings. Cultivation of vegetables can ensure optimizing use of our land resources and ultimately increases our total yield. The competition between vegetable and sapling for growth resources such as light, water and nutrients are minimum at the early stage of tree establishment. Traditionally, farmers grow shade loving vegetables under different trees in their cropland, homesteads and surrounding areas. In the view of proper utilization of homesteads, hilly areas or other shaded places and to increase the production of winter vegetables, the present study was under taken with the broad objective to evaluate the performance of two winter vegetables as lower layer crops under Eucalyptus *(Eucalyptus camaldulensis*) trees. The present research work was undertaken to observe the morphological characters, yield and yield attributes of Chilli and Sweet gourd which is covered by boundary plantation of Eucalyptus; and to evaluate the effect of planting distance on the yield performance of Chilli and Sweet gourd.

Materials and Methods

Experimental site: The research work was carried out at the Char Gobadia which is situated by the side of the old Bramhaputra River during the period from October 2011 to March 2012.

The place is geographically located at about 24°75' North latitude and 90°50' East longitudes (FAO, 1988). The experimental site is situated under tropical monsoon climate characterized by heavy rainfall during the months from April to September and then scanty rainfall during the rest period of the year. The experiment was laid out in a low land belonging to the AEZ Old Himalayan Flood Plain area (FAO, 1981). The soil texture was sandy loam with a pH 6.6. The structure of the soil was fine and the organic matter content was 1.80%.

Planting material: The planting materials of the study were the seeds of Chilli (*Capsicum annuum*) and Sweeet gourd (*Cucurbita moschata*). The seeds of Chilli, and Sweeet gourd were collected from BRAC seed centre, Mymensingh. Chilli and Sweet gourd were grown by the boundary plantation of Euclayptus tree maintaining standard spacing. There were also control plants of Eucalyptus.

Tree establishment and management: The study was done under 6 month's old Eucalyptus tree. At first 25 cm deep pits were dug at 9 feet distance in the experimental field then the pits were fallow for few days. After that the pits were filled with surrounding soils and then the seedlings of the tree were placed into the central portion of the pits. After the tree plantation sufficient irrigation was done at the base of the tree. Irrigation was done two times in a day by the watering cane.

Experimental design and layout: Two vegetables such as Chlli and Sweet gourd were laid out following the Randomized Complete Block Design (RCBD) with single factorial arrangement of multistoried production system. Four treatments were used in this study. Three replications were followed for each treatment for each crop. So, in total 3 plots were set up.

Treatment of the study: There were four treatments were used in this experiment viz. T_0= Eucalyptus tree without association of vegetable (control), T_1= Vegetable grown 3 ft distance from the tree, T_2 =Vegetable grown 6 ft distance from the tree and T_3 =Vegetable grown 9 ft distance from the tree.

Crop establishment and management: After preparation of land the two vegetables viz. Chilli and Sweet gourd were directly sown in the experimental plot on 10 October 2011. Those seedlings were collected from horticulture Farm, BAU Mymensingh. The spacing is 20 x 20 cm for all winter vegetables. After emergence, finally Chilli and Sweeet gourd were thinned out by maintaining 15, 25 and 30 days, respectively. All management practies i.e. fertilizer application, weeding, irrigation, thinning out, pest and disease control etc. were done whenever it necessary.

Harvesting: Sweet gourd was harvested at 95 days after seed sowing. It was harvested at several picking. Chilli was harvested in several picking when the fruits appeared green and medium size. The Chilli was harvested during 75 to 90 days after sowing.

Sampling and data collection: Ten plants of Chilli were randomly selected from each plot for data collection. The parameters under study were as follows: Plant height(cm), no. of primary branch, length of branch(cm), no. of leaves, length of leaves (cm), no. of flowers, no. of fruits and length of fruits (cm). Four plants of Sweet gourd were randomly selected for data collection. The parameters under study were as follows: No. of leaves, leaf size, vein length, no. of branch, length of branch, no. of flowers, no. of fruits, length of fruits and diameter of fruits.

Statistical analysis: The recorded data were compiled and analysed by RCBD design to find out the statistical significance of the experimental results. The means for all recorded data were calculated and the analyses of variance for all the characters were performed. The mean differences were evaluated by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) and also by Least Significant Difference (LSD) test.

Results and Discussion

Performance of Chilli in association with Eucalyptus

Plant height: It was observed that the plant height of chilli was affected significantly at 1% level of significance (Table-1). The result revealed that the highest plant height (44.67 cm) was produced by T_0 (which is considered as control). Second highest plant height (35.67 cm) was produced under T_3 (9 ft distance from the tree) and the lowest result (23.67 cm) was observed at T_1 (3 ft distance from the tree).

Table 1. Effect of Eucalyptus(Eucalyptus camaldulenssis) tree at different distances on the yield contributing characters of Chilli

Treatment	Plant height	No. of primary branch	Length of branch (cm)	No. of leaves	Length of leaves	No. of flowers	No. of fruits	Length of fruits (cm)	Weight of fruits per plant (g)
T_0	44.67 A	17.67 A	20.67 A	142.3 A	1.000 A	45.00 A	41.00 A	5.333 A	180 A
T_1	23.67 D	4.000 D	14.00 D	82.00 D	0.5000 D	35.00 D	33.00 C	2.667 B	140D
T_2	26.67 C	9.333 C	16.67 C	122.3 C	0.7000 C	39.00 C	36.00 C	3.000 B	156 C
T_3	35.67 B	14.33 B	18.00 B	130.3 B	0.7667 B	42.00 B	38.00 B	3.667 B	167 B
LSD	0.9989	1.597	0.88	1.913	0.06318	0.5756	1.913	1.597	1.362
Level of significance	**	**	**	**	**	**	**	*	**

No. of Primary Branch: It was found that the number of primary branch of chilli was affected significantly at 1% level of significance (Table-1). The result found that the highest number of primary branch of Chilli (17.67) was produced by T_0 (which is considered as control). Second highest number of primary branch (14.33) was produced under T_3 (9 ft distance from the tree) and the lowest result (4.00) was observed at T_1 (3 ft distance from the tree).

Length of branch: Different treatments had significant effect on length of branch of Chilli at final harvest. The maximum length of branch (20.67 cm) was recorded under treatment T_0 (which is considered as control). The minimum length of branch of Chilli

(14.00 cm) was obtained under treatment T_1 (3 ft distance from the tree). All these values are statistically different. However the length of branch of Chilli was increased with the distance from the tree.

No. of leaves: At 1% level of significance the number of leaves of chilli were affected significantly (Table-1). The result revealed that the highest number of leaves of chilli (142.3) was obtained under treatment T_0 (which is considered as control) and second highest number of leaves of chilli (130.3) was recorded under treatment T_3. The lowest number of leaves of chilli (82.00) which produced under treatment T_1 (3 ft distance from the tree) due to various competitions like light, water, nutrient etc.

Length of leaves: Leaf length of Chilli was significantly affected by different distance condition, where the largest leaf length (1 cm) was obtained under T_0 (which is considered as control). Second largest leaf length (0.7667 cm) produced under treatment T_3 (6 ft distance from the tree). Significantly the lowest leaf length (0.50 cm) was recorded under treatment T_1 (3 ft distance from the tree).

No. of flowers: Number of flowers per plant of Chilli grown under different distance was affected significantly. The maximum number of flowers per plant (12.00) was recorded at T_0 (which is considered as control). The minimum number of flowers per plant (3.00) was obtained under T_1 (3 ft distance from the tree) and the second highest no of flowers per plant (6.667) was observed under T_3 (9 ft distance from the tree). Number flowers per plant of Chilli was more at T_0 which was better than any other treatments due to less competition with the tree.

No. of fruits: A significant difference was showed in number of fruits per plant at 1% level of probability. The maximum number of fruits (12.00) are recorded at the treatment T_0(which is considered as control). The minimum number of fruits (4) were produced at T_1 due to various competition.

Length of fruits: It was observed that the length of fruits of chilli was affected significantly at 5% level of significance (Table-1). The result revealed that the highest length of fruits (5.333 cm) was produced by T_0 (which is considered as control). Second highest number of fruits (3.667 cm) was produced under T_3 (9 ft distance from the tree) and the lowest result (2.667) was observed at T_1 (3 ft distance from the tree).

Yield of Chilli (ton/ha): The yield of chilli was affected significantly at 1% level of significance (Table-1). The result observed that the highest yield (4.1 tha^{-1}) was obtained under treatment T_0 and the second highest yield of chilli (3.80 tha^{-1}) was recorded at T_3. The yield of chilli produced under treatment T_1 (3.3 tha^{-1}) was significantly lower than other treatments. At the close distance with the tree different types of competitions such as water, nutrient, spacing is very prominent. Shading effect of tree also reduces the growth and yield of the crops.

Performance of Sweet gourd in association with Eucalyptus

Vein length: It was observed that the vein lengtht of Sweet gourd was affected significantly at 1% level of significance (Table-2). The result revealed that the highest vein lengtht (4.2 m) was produced by T_0 (which is considered as control). Second highest plant height (4m) was produced under T_3 (9 ft distance from the tree) and the lowest result (2.8 m) was observed at T_1 (3 ft distance from the tree).

No. of leaves: At 1% level of significance the numbers of leaves of sweet gourd were affected significantly (Table-2). The result revealed that the highest number of leaves of (42) was obtained under treatment T_0 (which is considered as control) and second highest number of leaves of (36) was recorded under treatment T_3. The lowest number of leaves of (29) which produced under treatment T_1 (3 ft distance from the tree).

Length of leaves: Leaf length of was significantly affected by different distance condition, where the largest leaf length (18 cm) was obtained under T_0 (which is considered as control). Second largest leaf length (17 cm) produced under treatment T_3 (9 ft distance from the tree). Significantly the lowest leaf length (15 cm) was recorded under treatmentT_1 (3 ft distance from the tree).

Table 2. Effect of Eucalyptus***(Eucalyptus camaldulensis)*** tree at different distances on the yield contributing characters of Sweet gourd

Treatment	Vein length	No. of branch	Length of branch	No. of leaf	Length of leaves	Breadth of leaves	No. of flower	No. of fruit	Fruit length	Fruit diameter	Weight of fruit per plant (kg)
9 ft distance from the tree (T_3)	4 b	6 b	158 b	36b	17 b	13 b	10 b	5 b	24 a	32 b	24
6 ft distance from the tree (T_2)	3 c	5 c	150 c	33c	15 c	13 b	7 c	3 c	22 c	28 c	18
3ft distance from the tree (T_1)	2.8d	4 d	145d	29d	15 d	11 c	7 c	3 c	20 d	25d	16
Control (T_0)	4.2a	8a	165 a	42a	18 a	15 a	13 a	7.0 a	27 a	37 a	29
F test	**	**	**	**	**	*	**	**	**	**	**
C V	1.65	6.72	1.29	1.65	2.48	6.57	6.24	10.06	4.3	6.57	8.56

Breadth of leaves: Different treatments had significant effect on length of breadth of leaves of Sweet gourd at final harvest. The maximum breadth of leaves (15 cm) was recorded from the plant grown under treatment T_0 (which is considered as control). The minimum breadth of leaves of Sweet gourd (11 cm) was obtained from the plant grown under treatment T_1 (3 ft distance from the tree). All these values statistically different. However the breadth of leaves of Sweet gourd was increased with the distance of tree.

No. of Branch: It was found that the number of branch of Sweet gourd was affected significantly at 1% level of significance (Table-2). The result found that the highest number of branch of Sweet gourd (8) was produced by T_0 (which is considered as control). Second highest number of primary branch (6) was produced

under T_3 (9 ft distance from the tree) and the lowest result (4) was observed at T_1 (3 ft distance from the tree).

Length of branch: Different treatments had significant effect on length of branch of Sweet gourd at final harvest. The maximum length of branch (165 cm) was recorded from the plant grown under treatment T_0 (which is considered as control). The minimum length of branch of Sweet gourd (145 cm) was obtained from the plant grown under treatment T_1 (3 ft distance from the tree). All these values are statistically different. However the length of branch of Sweet gourd was increased with the distance from the tree.

No. of flowers: Number of flowers per plant of sweet gourd grown under different distance was affected significantly. The maximum number of flowers per plant (13.00) was recorded at T_0 (which is considered as control). The minimum number of flowers per plant (7.00) was obtained under T_1 (3 ft distance from the tree) and the second highest no of flowers per plant (10) was observed under T_3 (9 ft distance from the tree). Number flowers per plant of sweet gourd at T_0 which was better than any other treatments due to less competition with the tree.

No. of fruits: A significant difference was showed in number of fruits per plant at 1% level of probability. The maximum number of fruits (7.00) are recorded at the treatment T_0 (which is considered as control). The minimum number of fruits were produced at T_1(3.00) due to various competition.

Length of fruits: It was observed that the length of fruits of sweet gourd was affected significantly at 1% level of significance (Table-2). The result revealed that the highest length of fruits (27 cm) was produced by T_0 (which is considered as control). Second highest length of fruits (24 cm) was produced under T_3 (9 ft distance from the tree) and the lowest result (20 cm) was observed at T_1 (3 ft distance from the tree).

Fruit diameter: It was found that the fruit diameter of Sweet gourd was affected significantly at 1% level of significance (Table-2). The result found that the highest fruit diameter of Sweet gourd (37 cm) was produced by T_0 (which is considered as control). Second highest fruit diameter (32 cm) was produced under T_3 (9 ft distance from the tree) and the lowest result (25 cm) was observed at T_1 (3 ft distance from the tree).

Yield of Sweet gourd: The yield of Sweet gourd was affected significantly at 1% level of significance (Table-2). The result observed that the highest yield (13.05 tha^{-1}) was obtained under treatment T_0 and the second highest yield of Sweet gourd (10.80 tha^{-1}) was recorded at T_3. The yield of Sweet gourd produced under treatment T_1 (7.2 tha^{-1}) was significantly lower than other treatments. Similar type of research work also done by Toser (2011), Morshed (2012) and Nahid (2012) in Jamalpur district.

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