

## Effect of pruning on tree height and trunk circumference in five agroforestry tree species

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Accepted 1<sup>st</sup> August 2005

### ABSTRACT

The research was conducted to find out suitable tree species when subjected to pruning for better output in the homestead agroforestry systems. Five selected tree species viz. 1. *Melia azedarach* (Ghora neem) 2. *Swietenia macrophylla* (Mahogany), 3. *Mangifera indica* (Mango) 4. *Artocarpus heterophyllus* (Jackfruit) 5. *Psidium guajava* (Guava) and two management practices involving one pruning management and the other unpruning condition were used in the experiment. Pruning started at three years age of saplings. Trees were pruned four times a year at three month intervals. All tree species showed a significant positive increase in tree height due to pruning of their foliage and branches. Under pruning condition, significantly higher increments in height was observed in *Melia azedarach* (197.83 cm) followed by *Swietenia macrophylla* (57.5 cm), *Psidium guajava* (54.33 cm), *Mangifera indica* (53.33 cm) and *Artocarpus heterophyllus* (48.67 cm). All tree species when pruned showed a significant positive increase in circumference compared to those unpruned at 60 cm and 90 cm height from the ground level.

**Keywords:** Tree height, Circumference, Saplings, Pruning, Species, and Growth

### INTRODUCTION

The forests of Bangladesh have been recorded to cover 35% of the land in 1971 and 25% in 1936, but today this has shrunk to only 7% (Anonymous 1989). Available literatures so far suggest that a country requires atleast 25% forestland in order to balance ecosystem and thereby maintain healthy environment. Due to rapid growth of population, people migrate to forest area and are encroaching and cultivating food crops. Forest resources in Bangladesh are

therefore destroyed at an alarmingly rate. The annual rate of deforestation is 8000 ha (FAO, 1981). Fuel shortage in Bangladesh has led to increasing use of cowdung and agricultural residues, causing loss of soil fertility and crop yield (Miah. *et al.*, 1989).

There is very little tree cover in village homesteads, which accounts for only 0.27 million hectares. Out of 64 districts, as estimated 28 districts have no public forestland (Islam, 1991). Homestead trees are estimated to produce about 65 to 70% of saw logs and

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about 90% of fuel wood consumed in Bangladesh (Byron, 1984). In order to increase the tree cover and overcome fuel shortage, an alternate production practice has been introduced, called agroforestry system. The most prevalent species in the homestead was betelnut, followed by coconut, jackfruit, date plum, banana, mango, mahogany, bamboo and guava (Chowdhury and Satter 1992). The traditional Bangladeshi home gardens are arranged in a multistory pattern rich in biodiversity. Due to the population pressure, this homestead rainforest has lost its productive capacity as before, giving lower returns which cannot meet the demands of poor families in Bangladesh. After tree planting, we need to ensure the trees grow and produce as quickly as possible. The traditional homestead agroforestry does not take into consideration the proper tree management like training, pruning, spacing etc. and suitability of species to soil and microclimate. Training and pruning of shoots are necessary in all stages of growth in order to have desired trunk and canopy structures of the multipurpose tree species. Depending upon the position of cuts on the branches, the tree canopy may be narrow or medium as required for a particular agroforestry system (Hossain, 1994). The present study was conducted to find out suitable tree species over pruning management for better output of the homestead agroforestry systems in Bangladesh.

## MATERIALS AND METHODS

The experiment was carried out at Kishoregang, Jaldhaka and Domar Upazilla of Nilphamari district in Bangladesh during the period from April 2001 to April 2002 with five important tree species. The experimental area was medium highland of sandy loam soils and belongs to the Tista meander floodplain under

Agro Ecological Zone-3 (Anonymous 1980). The experiment was laid out in a factorial Randomized Complete Block Design with three replications. Selected homestead in each upazilla was considered as one replication. The factor A consisted of five multipurpose tree species viz. 1. *Melia azedarach* (Ghora neem), 2. *Swietenia macrophylla* (Mahogany), 3. *Mangifera indica* (Mango), 4. *Artocarpus heterophyllus* (Jackfruit) 5. *Psidium guajava* (Guava) and the factor B consisted of two management practices involving one pruning management and the other unpruning condition. The saplings of the tree species were below one year old and collected from the Rana nursery, Rangpur on 25<sup>th</sup> July 1999. These saplings were planted on the 5<sup>th</sup> August 1999 in the homestead of Kishoreanj, Jaldhaka and Domar upazilla of Nilphamari district in Bangladesh. In each upazilla, 2 households were selected and 5 saplings of selected tree species were supplied and planted. Trees of one household were kept unpruned while that of the other was pruned. Manure and fertilizer was applied per homestead @ Cow dung 40 kg, Ash 15 kg, Urea 3kg, TSP 4kg and MP 2Kg. The above fertilizers were applied two times in a year with equal splits for the selected tree species. Pruning of side branches and leaves of trees started in July 2001 after two years of sapling establishment in August 1999. About one year old saplings were planted and therefore the total age when pruning started, was almost 3 years including age of sapling before planting. Trees were pruned four times at every after 3 months interval July, October, January and April 2002 at the end of study. Data were recorded four times on height and circumference of 5 selected tree species during 24-26 July 2001, 24-26 October 2001, 24-26 January 2002 and 24-26 April 2002, respectively from the 3 households under pruning and 3 households under unpruning

management. Tree height was measured in centimeter (cm) from the surface of the soil to the main stem apex by a measuring tape. Tree circumference at 30 cm height, 60 cm height and 90 cm height as measured above the ground level by measuring tape.

The data were analyzed statistically using "Analysis of Variance (ANOVA)" of Randomized Complete Block Design (RCBD) with factorial arrangements of treatments and the difference among treatment means were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

The agro-meteorological data (temperature and rainfall) during the study period (April 2001-April 2002) are shown in Table-1. There was a distinct dry season from November to May and wet season from June to October. Despite the sharp dry season, tree growth did not suffer much probably due to their deep rooting systems.

## Effect of tree species on tree height and trunk circumference

There was a significant effect of pruning on the tree height and trunk circumference growth of 5 selected tree species (Table-2). *Melia azedarach* (Ghora Neem) attained significantly greater height (156.25 cm) followed by *Swietenia macrophylla* (51.58 cm), *Mangifera indica* (48.58 cm), *Artocarpus heterophyllus* (43.42 cm) with *Psidium guajava* being the lowest of all.

The trunk circumference growth of *Artocarpus heterophyllus* increased significantly at 30 cm height (5.17 cm), 60 cm height (4.42 cm) and 90 cm height (5.17 cm) from the ground level. *Mangifera indica*, *Swietenia macrophylla* and *Melia azedarach* showed such increase in their circumference across different heights in the order of 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> respectively. But exceptions that *Swietenia macrophylla* was statistically identical with *Mangifera indica* at 60 cm height and *Melia azedarach* identical with *Swietenia*

Table-1: Monthly meteorological data during the experimental period (April 2001 to April 2002).

Month	Temperature (°C)			Total rainfall (mm)	Sun shine (hours)
	Maximum	Minimum	Mean		
April/01	34.8	21.33	28.06	5.2	21.8
May/01	32.97	23.25	28.11	222	23.6
June/01	32.96	25.46	29.21	567	20.7
July/01	33.53	26.53	30.13	158	17.8
August/01	33.80	25.87	29.83	318	20
September/01	32.43	25.66	29.05	461	14.8
October/01	31.27	23.43	27.35	719	20.4
November/01	29.57	13.23	23.80	47	22
December/01	24.67	12.30	18.69	0	18.1
January/02	24.57	11.83	18.20	6	20.8
February/02	28.17	13.67	20.92	18	26.2
March/02	31.30	17.87	24.58	12	25.8
April/02	30.67	21.40	26.03	166	20.9

Source: Meterological department, Dinajpur, Bangladesh.

**Table -2:** Effect of tree species on tree height and trunk circumference over 6 months (Average over pruning management).

Tree species	Tree height (cm)	Trunk circumference (cm) at		
		30 cm height	60 cm height	90 cm height
<i>Melia azedarach</i>	156.25 a	2.08 d	3.42 b	2.00 c
<i>Swietenia macrophylla</i>	51.58 b	2.50 c	2.33 c	2.25 c
<i>Mangifera indica</i>	48.58 c	3.08 b	2.50 c	2.58 b
<i>Artocarpus heterophyllus</i>	43.42 d	5.17 a	4.42 a	5.17 a
<i>Psidium guajava</i>	36.50 e	1.50 e	1.75 d	1.42 d
CV (%)	4.2	6.9	6.2	7.9
Level of significance	*	*	*	*

\*=Significant at 5% level of probability

*macrophylla* at 90 cm height from ground level. This variation in growth of different tree species could be argued in different ways apart from their different genetic differences. *Psidium guajava* is a shorter duration and stature tree, *Melia azedarach* is also short term but quick growing, *Swietenia macrophylla* though long duration had initially fast growth, *Mangifera indica* and *Artocarpus heterophyllus* in contrast longer duration with slow height. These findings are in agreement with those of Madamba, J. C. (1985).

### Interaction effect of pruning management and tree species

#### Effect of pruning on tree height

The height of the tree species over six months showed a significant difference among 5 selected tree species as affected by pruning managements (Figure 1). Under pruning condition, significantly higher increase in height was observed in *Melia azedarach* (197.8 cm) followed by *Swietenia macrophylla* (57.5cm), *Psidium guajava* (54.33cm), *Mangifera indica* (53.33cm) and *Artocarpus heterophyllus* being the lowest (48.67cm).

Unpruned *Melia azedarach*, *Psidium guajava* and *Artocarpus heterophyllus* showed

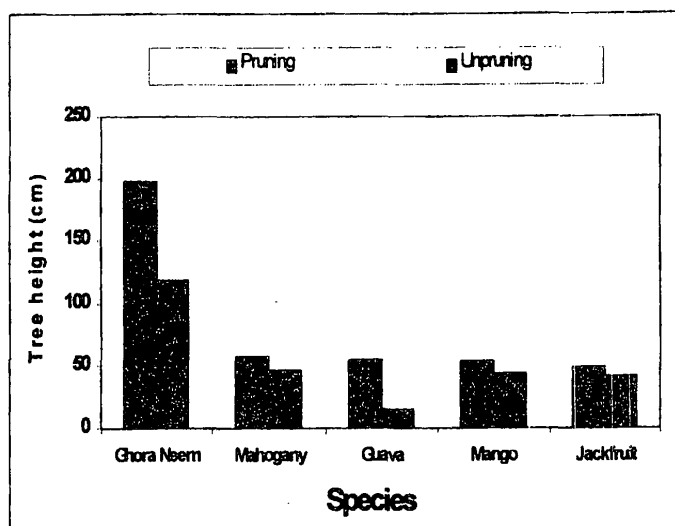


Figure 1. Interaction of pruning management and tree species on tree height

a significant difference but there was no significant difference in apical growth between *Swietenia macrophylla* and *Mangifera indica*. This result indicated that in general pruning enhanced apical growth and in particular *Swietenia macrophylla* and *Psidium guajava* benefited most from the pruning practice. *Swietenia macrophylla* differed significantly from *Mangifera indica* due to pruning (57.50cm vs 53.33cm respectively) over unpruning (45.69cm vs 43.83cm, respectively). *Psidium guajava* growth (54.30cm) was statistically identical with *Mangifera indica*

(53.30cm) but *Psidium guajava* was significantly lower in lateral growth (18.67cm) compared to *Mangifera indica* (43.83cm). The pruning of leaves and branch increased the distribution of tree canopy in space which eventually might have helped proper utilization of solar radiation and higher assimilate production. These results corroborated with the findings of Hossain, M.A. (1994). The variation in height increase among different tree species could be the results of significant interactions between the genetic makeup of the tree species and the environment (Baker, 1990).

#### Effect of pruning on trunk circumference

All pruned tree species had shown significant positive increase in circumference compared to unpruned trees at 30 cm and 90 cm height from the ground level (Table 3). However, *Psidium guajava* and *Mangifera indica* did not significantly differ (1.67cm and 3.17 cm, respectively) from unpruning (1.33 cm and 3.0 cm respectively) at 30 cm above ground level. These results indicated that the circumference increase of *Psidium guajava* and *Mangifera indica* was not influenced by pruning at their base. *Artocarpus heterophyllus* showed

significantly higher trunk circumference growth than the other tree species at the base 30 cm and at the breast height (60 cm and 90 cm) irrespective pruning management. *Psidium guajava* was the lowest of all.

There was no significant difference in increase of circumference between *Swietenia macrophylla* (3.17cm) and *Mangifera indica* (3.17cm) at 30cm height under pruned condition although it was higher with *Mangifera indica* (3.0cm) than with *Swietenia macrophylla* (1.83cm) under unpruned condition. *Swietenia macrophylla* was significantly higher in trunk circumference growth (2.17 cm) than *Psidium guajava* (1.75 cm), *Melia azedarach* and *Swietenia macrophylla*, being significantly different from other species in their trunk circumference growth, appeared statistically at per at 90 cm height (2.33 cm and 2.67 cm, respectively) under pruning condition. These results indicate that *Swietenia macrophylla* (Mahogany) was faster in trunk circumference growth at the base height 30 cm and *Psidium guajava* (Guava) at the breast height 60 cm due to pruning. This suggests *Swietenia macrophylla* (Mahogany) being a high value timber tree would provide significant higher wood yield if they are regularly pruned. Also *Psidium guajava*

Table-3: Interaction of pruning management and tree species on trunk circumference (Over 6 months)

Tree species	Trunk circumference (cm) at					
	30 cm height		60 cm height		90 cm height	
	pruning	unpruning	pruning	unpruning	pruning	unpruning
<i>Melia azedarach</i>	2.50 Ac	1.70 Bcd	3.83 Ab	3.0 Bb	2.33 Ac	1.67 Bb
<i>Swietenia macrophylla</i>	3.17 Ab	1.83 Bc	2.5 Acd	2.17 Bc	2.67 Ac	1.83 Bb
<i>Mangifera indica</i>	1.67 Ad	1.33 Ad	2.33 Ad	1.17 Bd	1.67 Ad	1.17 Bc
<i>Artocarpus heterophyllus</i>	3.17 Ab	3.0 Ab	2.67 Ac	2.33 Bc	3.33 Ab	1.83 Bb
<i>Psidium guajava</i>	5.50 Aa	4.83 Ba	4.67 Aa	4.17 Ba	5.67 Aa	4.67 Ba
CV (%)	6.9		6.2		7.9	
Level of significance	*		*		*	

\*= Significant at 5% level of probability

N.B. Small letter represents difference in a column and capital letter for row

(Guava) being a fruit tree would enhance fruit production by enhanced trunk circumference growth at breast height if pruned regularly.

Hence pruning of over lapped leaves and branches might have helped divert assimilates into economic part which in turn might have helped value addition for timber and or fruits or together. The above results corroborated with the findings of Miah (1995) who observed significant interaction effects between tree species and pruning management on the breast circumference growth.

## CONCLUSION

The overall results indicated that there was a positive effect of shoot pruning on the height and circumference of trees under study. *Melia azedarach* (Ghora Neem) performed best in terms of both tree height and trunk circumference, while *Artocarpus heterophyllus* (Jackfruit) in terms of circumference and *Swietenia macrophylla* (Mahogany) in terms of height increase. In terms of circumference *Mangifera indica* (Mango) was found neutral in terms of circumference. Considering the economic importance, *Melia azedarach* (Ghora Neem) and *Artocarpus heterophyllus* (Jackfruit) can be promoted in Kishoreganj, Jaldhaka and Domar of Bangladesh under Agro Ecological Zone 3. *Swietenia macrophylla* (Mahogany) also be promoted considering its higher height increase and thus higher bole height.

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