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Effect of Pruning Height on Shoot Biomass Yield of *Leucaena leucocephala*

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Abstract: An investigation on the effect of pruning height on shoot biomass yield of *Leucaena leucocephala* was carried out at the Agroforestry Farm, Bangladesh Agricultural University, during February to May 2005. The experiment was laid out in randomized complete block design with three replications. Treatments included four pruning heights; 3-5 (basal cut), 50, 100 and 150 cm above the collar zone. Yield of shoot biomass increased greatly with the increase in pruning heights. Higher pruning heights had a significantly higher number of branches, length of branches and leaves per plant than those of the lower heights. The 150 cm pruning height was found to yield the highest biomass followed by the 100 cm height. The 50 cm and the basal cut were statistically similar with regard to leaf biomass. Therefore, it was concluded that a higher pruning height should be practiced in *Leucaena* for higher shoot biomass yield.

Key words: Agroforestry systems, biomass production, pruning height, shoot growth

INTRODUCTION

In agroforestry systems, tree foliage is cut and utilized as green manure and forage. *Leucaena leucocephala*, locally known as ipil-ipil, is a fast growing tropical legume that can survive on poor soils because of its nitrogen fixation ability (Cronk and Fuller, 1995). Ipil-ipil has long been used as a high quality forage for ruminants, but it has also valued for its fuelwood, charcoal, pulp and timber (Brewbaker *et al*., 1985).

Ipil-ipil can be managed as a living fence, as hedgerows in alley-cropping systems or as a single tree in smallholders' cut and carry systems. Costa *et al*. (1992) reported that total biomass production, edible forage yield and protein content of ipil-ipil were significantly affected by cutting heights. Bashir and Nair (1989) observed more green leaf biomass production with increase in cutting height. Muir (1998) reported that cutting height had an effect on annual forage production of ipil-ipil with 5.47 t dry matter ha^{-1} for the 0.3 m height, 7.62 t for the 0.7 m height and 8.71 t for the 1.0 m height and wood production with 7.22 t ha^{-1} for the 0.3 m height, 9.33 t for the 0.7 m height, 11.55 t for the 1.0 m height. Field and OeMatan (1990) reported that maize yields were highest when the hedgerows of ipil-ipil were cut back to 10 cm height and pruned twice. He also found that ipil-ipil yields significantly higher biomass with less pruning frequency. Cutting height had a significant effect on shoot biomass of several legume trees as reported by Duguma *et al*. (1998), Hariah *et al*. (1992) and Galang *et al*. (1990). Duguma *et al*. (1998) reported that the effect of various pruning heights on biomass (leaves + small green branches) shows that biomass yield of some legumes increased with increased pruning height. Hariah *et al*. (1992) reported that lower pruning heights led to less biomass production and an increase in the number of branch roots originating from the stem base with six leguminous tree species such as *Calliandra calothyrsus*, *Cassia siamea*, *Erythrina orientalis*, *Peltophorum pterocarpum*, *Gliricidia sepium* and *Albizia falcatum*.

Leucaena can be coppiced, pruned, lopped or pollarded for forage production purposes. However in Bangladesh no studies have been reported with regard to forage production systems of ipil-ipil especially in agroforestry systems. Therefore, this study was undertaken to determine suitable pruning heights of ipil-ipil for production of maximum tender tree forage.

MATERIALS AND METHODS

Plant materials: In this study, *Leucaena leucocephala* (Lam.) de Wit. was used as planting materials. It belongs to the family Leguminosae (sub. family: Mimosoideae) and locally termed as ipil-ipil, subabul, ku-babul, white babool, kaniti, vilayati baral etc. (Khan and Alam, 1996). Approximately 2 year old saplings that were grown for various studies along the experimental plots as live fence were used for this study. Stems were beheaded and pruned off to get required length of

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cleared stocks and to be termed as pruning height. In all cases materials with equal diameter were selected.

Experimental sites: The experiment was conducted in the Agroforestry Farm situated in the central area of Agricultural Farm, Bangladesh Agricultural University (BAU), during February to May, 2005. The experimental area is located (AEZ-9) at 24° 75' N latitude and 90°50' E longitude at a height of 18 m above the sea level, (UNDP and FAO, 1988).

Climate: The experimental area is under tropical monsoon climate where rainfall is heavy. Humidity and temperature is also high during April to September. Low rainfall associated with low temperature prevails during October to March. The pre-monsoon hot season occurs from March to April with the highest temperature record of 38°C. Occasional thunder shower contribute to about 8% of rainfall received during the time (Rahman, 1987). The monthly mean relative humidity ranges from 74-87% based on dry and wet season.

Soil condition: The soil belongs to the Agro-ecological zone of Old Brahmaputra Floodplain. The soil of the experimental area is consisting of alluvial deposits. Two types of soil, calcareous grey flood plain and non-calcareous alluvial soils are found where non-calcareous grey flood plain soil occupies the major portion of the BAU campus. The soil was fertile and loamy to silt loam in texture, pH ranging from 6.3 to 7.2 (UNDP and FAO, 1988).

Land preparation: Initial land preparation was not necessary in this study as previously grown ipil-ipil stocks were used. Shallow spading on both sides of living fences was done. The grasses and roughages were removed. After pruning and beheading the stems, the stool beds were made pulverized.

Manure and fertilizer applications: In order to get proper shoot growth cowdung at the rate of 1500 kg ha^{-1} mixed with soil was used as a basal dose. Urea at the rate of 200 kg ha^{-1} was applied as side dressing at mid stage of the study.

Experimental design and treatments: The beheading and pruning off the previously grown stems were done to obtain the required pruning heights in the stool beds. Hence the treatments were as follows i.e., the stock beheaded at:

- 3-5 cm above collar zone (basal cut)
- 50 cm above collar zone
- 100 cm above collar zone
- 150 cm above collar zone

All the developing branches, older branches and leaves were removed from these stock materials to facilitate data collection only from regenerated shoot parts. All the pruning and beheading operations for preparation of stock materials with different pruning heights as stated above were done on February 23, 2005. The following parameters were studied with closer observation on regenerated shoots.

- Number of primary branches per sample
- Length of primary branches
- Total number of leaves per stock plant

The data were analyzed following Randomized Complete Block Design (RCBD) with three replications. The experimental plots were arranged randomly and the planting stocks for each of the treatment were selected randomly in order to obtain proper and unbiased data.

Data collection: Observations were made every day very closely up to a week. All the parameters were studied and data were recorded on day 7, 14, 21, 28, 42 and 60.

Statistical analysis: The raw data for each of the parameters were compiled and analysed to find variation resulting from experimental treatments on MSTATC package program (Gomez and Gomez, 1984). The means for all recorded data were calculated. Analysis of variance of all parameters was performed by F-variance test at 5% level of significance. The mean differences were evaluated by Duncan's Multiple Range Test (DMRT) and shown in Table 1-3.

RESULTS AND DISCUSSION

Effect of pruning height on branch development at different Days After Pruning (DAP): Initially, only a very few number of branches regenerated until day 7 and the number sharply increased at day 14 in all the treatments. After 14 DAP the increase in branch number was gradual in different treatments until day 60. The stocks with higher pruning heights always produced higher number of primary branches than those with lower pruning heights. The highest number (34.33) was observed with the tallest stocks (150 cm) at 60 DAP. The longer pruning heights (100 and 150 cm) gave statistically similar number of branches and the basal cut gave the lowest number (13.11) at 60 DAP (Table 1).

Effect of pruning height on the length of branches at different Days after Pruning (DAP): The length of branches was very low on day 7. It slowly increased at 14

Table 1: Effect of pruning height on the increase in number of branches at different Days After Pruning (DAP) in *Leucaena leucocephala*

	No. of branches					
Treatments	7 DAP	14 DAP	21 DAP	28 DAP	42 DAP	60 DAP
3-5 cm (Basal cut)	4.447b	8.777d	10.223b	11.333b	12.220c	13.113c
50 cm	2.333bc	15.223c	15.890b	17.890b	19.443b	21.890b
100 cm	1.667c	18.443b	23.003a	26.447a	28.110a	30.113a
150 cm	7.667a	20.333a	24.887a	29.890a	32.777a	34.333a
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	31.45	5.27	16.93	16.66	11.79	8.67

In column, figures having common letter(s) do not differ significantly whereas figures having dissimilar letter(s) differ significantly

Table 2: Effect of pruning height on the length of branches at different Days After Pruning (DAP) in *Leucaena leucocephala*

	Length of branches					
Treatments	7 DAP	14 DAP	21 DAP	28 DAP	42 DAP	60 DAP
3-5 cm (Basal cut)	7.337a	56.883b	162.407a	194.110c	491.110c	668.887c
50 cm	2.610b	60.553b	167.107a	302.110c	492.000c	744.443bc
100 cm	1.387c	61.187b	193.777a	364.003b	713.000b	1025.44ab
150 cm	8.223a	86.330a	190.220a	486.773a	874.333a	1150.223a
Level of significance	0.01	0.01	NS	0.01	0.01	0.05
CV (%)	11.31	5.18	13.89	6.41	6.77	17.09

In column, figures having common letter(s) do not differ significantly whereas figures having dissimilar letter(s) differ significantly

Table 3: Effect of pruning height on the number of leaves per plant at different Days After Pruning (DAP) in *Leucaena leucocephala*

	No. of leaves					
Treatments	7 DAP	14 DAP	21 DAP	28 DAP	42 DAP	60 DAP
3-5 cm (Basal cut)	6.590b	24.073c	46.220b	58.997d	111.220c	181.373c
50 cm	2.853c	33.890b	56.330b	73.700c	134.963bc	199.407c
100 cm	1.557c	40.700ab	72.183a	109.063b	203.330ab	282.890b
150 cm	9.110a	46.667a	76.890a	122.887a	252.183a	282.443a
Level of significance	0.01	0.05	0.01	0.01	0.05	0.01
CV (%)	23.22	13.26	8.21	3.18	19.72	9.80

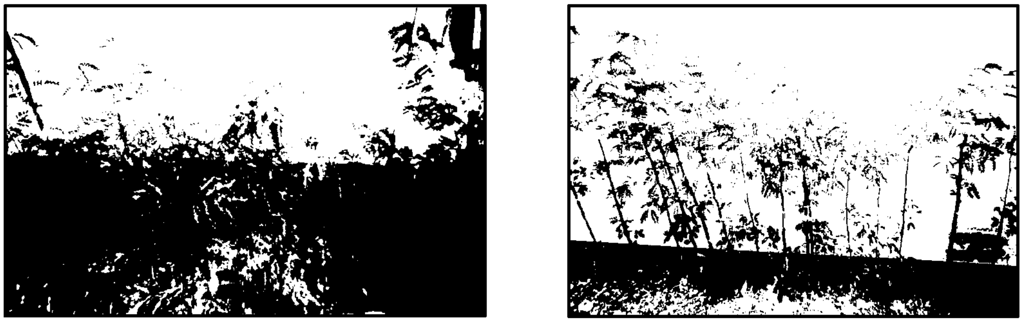
In column, figures having common letter(s) do not differ significantly whereas figures having dissimilar letter(s) differ significantly

DAP followed by a subsequent rapid increase afterwards. All the treatments with different pruning heights showed the increase in branch length almost in a similar fashion, although taller stocks (100 and 150 cm) appeared with a greater increase in branch length than that of shorter ones (Basal cut and 50 cm). The length of branches increased gradually as the day progresses and the length was significantly higher in the longer cutting heights (100 and 150 cm) than that in the shorter ones (Table 2).

Effect of pruning height on the number of leaves at different Days After Pruning (DAP): The increase in leaf number per plant was rapid similar to that of branch number and branch lengths in all the treatments over different DAP. As expected, higher number of leaves per branch was produced by longer branches on taller stocks (Table 3).

The yield of shoot biomass of *Leucaena leucocephala* was found to increase greatly with the increase in pruning heights. Higher shoot growth occurred at both 100 and 150 cm pruning height. The 150 cm pruning height resulted in the highest number of branches, length of branches and leaves per plant followed by 100 cm. The basal cut and 50 cm pruning height had statistically similar effect on number of leaves per plant and branch length (Fig. 1a and b). Results presented in this study are in agreement with several other researchers. Similar findings were reported by Costa *et al.* (1992) and Francisco *et al.* (1998). They reported that total biomass production of ipil-ipil was significantly affected by cutting heights. Francisco *et al.* (1998) observed that the best biomass yields in ipil-ipil were found with the higher cutting height (150 cm) and the least with the 40 cm cutting height. The study also supported the observations of several scientists who worked on different legume trees. Hariah *et al.* (1992) reported that lower pruning heights led to less biomass production and an increase in the number of branch roots originating from the stem base with six leguminous tree species such as *Calliandra calothyrsus*, *Cassia siamea*, *Erythrina orientalis*, *Peltophorum pterocarpum*, *Gliricidia sepium* and *Albizia falcatum*.

The increase in biomass production with increasing pruning height was possibly due to more reserve materials in taller stocks (100 and 150 cm) of *Leucaena leucocephala* that resulted in faster growth of young shoots and higher number of branches in longer cuttings. It may be concluded that a very good growth of young shoots occurred in *Leucaena leucocephala* with the higher pruning heights i.e., 100 and 150 cm. Therefore, the



a b

Fig. 1(a, b): New shoot growth observed on basal and 50 cm pruning heights

results of this study indicate that regular forage harvest through pruning of young shoots from beheaded stock plants would be commercially useful for the farmers of Bangladesh.

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