Yield of Biomass from Ipil Ipil (*Leucaena leucocephala* Lam. de Wit) grown at different spacings

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Abstract

Biomass production by plants of Ipil Ipil *(Leucaena leucocephala)* planted at six different spacings at Pakistan Forest Institute was studied. The plants of 6 months, coppice shoots of 1 year and 2 year age were harvested for determination of biomass. It was found that spacing i.e. 0.50 × 0.50 m to 1.50 × 1.25 m gave more biomass than wider spacings where the yield had been almost the same. Harvesting annually or biennially did not make much difference in biomass production. However, for fuelwood production and cattle feed frequent harvesting is preferred. The plants may be planted at a wider spacing and retained for more than two years for uses like charcoal, poles, posts and agricultural implements.

Introduction

Ipil Ipil *(Leucaena leucocephala)* is a multipurpose tree species. It has gained much importance in recent years due to its usefulness for fuelwood, fodder, poles, posts and small timber as green manure and for windbreaks and shade being fast growing and nitrogen fixing tree. It is becoming popular with agronomists, farmers and foresters and is being regarded as miracle tree. It produces large quantity of biomass. To some extent it is succeptible to insect attack especially psyllid *(Heteropsylla cubana)* which desaps young shoots. (Napompeth & MacDicken, 1989), leaves and inflorescence resulting in complete defoliation of plants.

Although it is a tropical plant, still it grows well in subtropical regions upto an elevation of 500 m. It prefers well drained, deep, neutral and fertile sandy loam soils. It thrives well on soils with pH ranging from 5.5 to 8.0 but gives better result in pH 6.0-7.7 e.g. neutral or slightly alkaline soils (Anon, 1984).

This species can grow under a wide range of environmental conditions. It can withstand large variations in rainfall, sunlight, salinity and topography. It tolerates periodic inundation, fire, windstorm, slight frost and drought as well (Anon, 1984).

Due to its coppicing power and production of biomass as firewood or forage if repeatedly harvested, a study was laid out for determination of biomass at different intervals under six spacings.

Material and Methods

A spacing study of *Leucaena leucocephala* var. K-67 was laid in Peshawar (average annual rainfall 400mm) in May, 1985 in randomised complete block design with four replications. The following treatments (spacings) and number of plants were used in each replication:

	Treatment / Spacing	Plot size	Number of plants
A	0.50 × 0.50 m	14 × 10 m	560
B	0.75 × 0.75 m	14 × 10 m	234
C	1.00 × 1.00 m	14 × 10 m	140
D	1.25 × 1.25 m	14 × 10 m	88
E	1.50 × 1.50 m	14 × 10 m	54
F	1.75 × 1.75 m	14 × 10 m	40

About 6 month old tubed plants of Ipil Ipil were planted in 20 cm deep pits. Flood irrigation was prvided twice a month upto October, 1985. This practice was followed from April to October in the subsquent years.

Harvesting of Crop

The crop was harvested at different ages to assess the biomass production from each treatment.

In December, 1985 the whole crop was cut at a height of 10 cm above ground level. In December, 1986 when the coppice shoots were one year old, half of each plot in each spacing was coppiced for estimation of biomass. Again in December, 1987 all the coppice shoots both one and two-years old in the plots were clear cut.

The following measurements were recorded as a part of data collection at the time of each cutting operation.

i. Diameter at breast height and height of the sampled stems were recorded.
ii. For estimation of biomass the main stems were debranched alongwith the leaves and weighed separately.
iii. During the second and third cuttings the number of stems on each stump were counted.
iv. The number of stumps resprouted after the first and second fellings were also recorded.

The averages of diameter, height, weight of stems, branches with leaves and number of stems per stump were calculated. The average green weight of biomass per stump was projected on hectare basis for each spacing separately for different harvests as shown in the following tables 1 - 4:

Table 1

Biomass production (green weight) from 6 months old plants felled in December, 1985

Tonnes/ha

Replication	Spacing (m) 0.5 × 0.5	0.75 × 0.75	1.0 × 1.0	1.25 × 1.25	1.50 × 1.50	1.75 × 1.75
I	28.0	21.3	18.3	14.1	11.3	4.3
II	26.8	22.0	11.0	13.0	5.4	3.7
III	23.8	18.5	12.9	6.1	5.6	5.3
IV	17.4	16.6	9.8	5.2	4.1	5.1
Total	96.0	78.4	52.0	38.4	26.4	18.4
Average	24.0	19.6	13.0	9.6	6.6	4.6

Table 2

Biomass prduction (green weight) from one year old shoots coppiced December, 1985 and harvested in December, 1986

Tonnes/ha

Replication	Spacing (m) 0.5 × 0.5	0.75 × 0.75	1.0 × 1.0	1.25 × 1.25	1.50 × 1.50	1.75 × 1.75
I	56.8	61.5	51.7	42.8	44.2	28.1
II	72.8	59.7	40.5	33.8	32.7	32.9
III	75.2	43.7	35.0	30.6	28.4	36.9
IV	10.2	34.3	32.8	26.0	27.9	35.3
Total	224.0	199.2	160.0	133.2	133.2	133.2
Average	56.0	49.8	40.0	33.3	33.3	33.3

Table 3

Biomass production (green weight) from one year old shoots coppiced in December, 1986 and harvested in December, 1987

Tonnes/ha

Replication	Spacing (m) 0.5 × 0.5	0.75 × 0.75	1.0 × 1.0	1.25 × 1.25	1.50 × 1.50	1.75 × 1.75
I	58.0	43.8	25.0	27.7	33.1	19.6
II	62.2	43.3	26.5	27.7	23.7	19.1
III	63.0	39.7	26.5	27.2	27.2	18.6
IV	24.8	36.8	22.0	22.2	22.8	30.3
Total	208.0	163.6	100.0	104.8	106.8	87.6
Average	52.0	40.9	25.0	26.2	26.7	21.9

Table 4
Biomass production(green weight) from two year old shoots coppiced in December, 1986 and harvested in December,1987

Tonnes/ha

Replication	Spacing (m) 0.5 × 0.5	0.75 × 0.75	1.0 × 1.0	1.25 × 1.25	1.50 × 1.50	1.75 × 1.75
I	126.0	141.7	94.5	69.1	67.8	61.6
II	148.2	152.9	71.0	93.7	59.7	59.2
III	154.0	99.0	96.5	52.5	57.3	37.8
IV	115.8	40.0	70.0	30.3	55.2	79.0
Total	544.0	433.6	332.0	245.6	240.0	237.6
Average	136.0	108.4	83.0	61.4	60.0	59.4

Results

The data were analysed. Results of analysis are given below:

i. Table 1: Biomass production from 0.5 × 0.5 m spacing was significantly different from 0.75 × 0.75 m spacing which in turn was significantly different from other spacings. There had been continuous downward trend in biomass with the increase of spacing.

ii. Table 2: There had been no significant difference in first three spacings. However the close spacing gave significantly better results than the rest spacings.

iii. Table 3: In this case the first two spacings were significantly different from the following four spacings.

iv. Table 4: The same trend as given in the above table was observed in this case also.

Discussion

As is clear from the above analysis a maximum production of 24.0 tonnes/hectare was obtained from 0.5 × 0.5 m spacing for six months old plants. The biomass obtained from one year old coppice (December 1986 harvest) was almost double of the six months old plants for the first two spacings. The two year old coppice (December, 1987 harvest) yielded much more biomass than one year harvest. It is interesting to note that the biomass obtained from two years old coppice in all the spacings is higher than the cumulative total of two years harvest (December 1986 and December 1987 harvests combined). However no significant difference was noticed between two types of yields.

Conclusion

i The maximum biomass can be obtained by planting at a very close spacing i.e. 0.5 × 0.5 m and the production/ha decrease with the increase in spacing upto 1.25 × 1.25 m spacing. Beyond this, the yield is almost the same for larger spacings.

ii Harvesting annually or biennially does not make significant difference so far yield production is concerned. However, for the production of fuel-wood, cattle feed and for manure, annual harvesting is preferred.

iii. For other uses like charcoal making, agriculture implements etc. the plants may be retained for more than two years and planted at wider spacing i.e. 1.50 × 1.50 m and more.

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References

1. Anon. 1980. Firewood Crops Shrubs and Tree Species for Energy Production. National Academy of Sciences, Washington DC.

2. Anon. 1984. Leucaena: Promising Forage and Tree Crop for the Tropics. Second Edition, National Academy Press. Washington, DC.

3. Hussain, R. W. and M. I. Sheikh 1986. Biomass production by different species and clones of Poplar. Pak. Jour. For. Vol. 36(4). Pp. 197-204

4. Hussain, R. W. and M. I. Sheikh 1987. Production of biomass by two poplar clones in relation to spacing. Pak. Jour. For. Vol. 37(2). Pp. 81-88

5. Napometh, B and K. G. MacDicken 1989. Leucaena psyllid: Problems and Management. Proceedings of an international workshop held in Bogor, Indonesia. January 16-21, 1989. Funny Publishing Ltd, Partnership Bangkok, Thailand.

6. Sheikh, M. I. 1986. Biomass from *Leucaena leucocephala* (Ipil Ipil) at Peshawar. Technical Note No. 54 Forestry Research Series, P. F. I.