Growth of Tree Legumes under Coconuts in North Sulawesi

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Abstract

Thirteen introduced and local tree legumes were evaluated for growth and yield under coconuts with a light transmission of 70% in the wet tropical environment of North Sulawesi. The introduced accession of *Calliandra* sp. produced by far the highest leaf yields, but *Flemingia macrophylla. Gliricidia sepium, Calliandra calothyrsus* (local), *Desmodium rensonii* and *Codariocalyx gyroides* also showed potential.

IN North Sulawesi, leguminous shrubs and trees such as *Gliricidia sepium* and a local variety of *Erythrina* sp. are commonly used as fences and as live stakes under coconuts to provide shade for climbers such as vanilla. These species also provide high quality forage which could be used as a supplement to the low quality naturally occurring grasses. At present there is little information on the adaptation and productivity of the range of tree legume germplasm available for growing under coconuts in North Sulawesi.

This paper reports the results of an evaluation of the growth and yield of a selection of introduced and local tree legume species growing under a coconut plantation.

Materials and Methods

This experiment was conducted at Kayawatu (Lat. 1°30' N) near Manado Airport in North Sulawesi. The total annual rainfall of 2700 mm is relatively evenly distributed except for a period of lower rainfall (100-150 mm per month) from July to September. The soil was a sandy loam with a pH of 6.0. With the exception of phosphorus, the fertility of the soil was high. Transmission of photosynthetically active radiation (PAR) at the site under mature tall coconuts averaged 70% at 10 a.m. on a sunny day.

There were nine introduced (seed supplied by Mr Ron Williams, Australian Tropical Forages Genetic Resource Centre) and four local species included in this trial (Table 1). The introduced species were inoculated with known suitable *Rhizobium* strains and all plants were raised in a nursery before being transplanted into the field in August 1988. The local species were planted vegetatively using 30 cm long stakes. Nine plants of each species were planted into separate plots in two rows of 1 x 1 m.

The plants were rated for plant survival, disease and insect incidence, flowering and seed production, initially monthly and later before each harvest. The first harvest was taken four months after planting and subsequently every two months for a total of nine harvests (December 1988 to June 1990).

The main stem and all branches were cut at a height of 1 m. The cut material was weighed fresh in the field and then separated into leaf, stem and inflorescence. Samples were sun-dried before oven-drying at 70°C.

Results and Discussion

Many of the *Flemingia macrophylla* seedlings did not survive transplanting and only two of the original nine plants survived to the first harvest. The seedlings grew poorly and a disease problem was suspected. The surviving two plants grew well and no further disease symptoms were observed. Similarly, only two of the nine vegetatively propagated *Sesbania grandiflora* plants survived to the first harvest. The yield of these two species is therefore based on only two plants and has to be considered with caution.

Survival of the established plants varied with species. All plants of *Desmodium distortum* were uprooted in a storm shortly after the first harvest and died. *Desmodium discolor* plants started to lose vigour after the third harvest and most plants died within the next two harvests. *Desmodium salicifolium*, a low-growing shrub, grew well up to harvest 6 but plants started to die after this harvest. The only other species which lost plants during the course of the experiment was *Sesbania grandiflora*. The two established plants yielded well up to harvest 6, but subsequently, yield dropped sharply and one of the two plants died after harvest 7.

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No disease symptoms were observed on any of the established plants and insect damage was minimal, except for psyllid damage which was severe on *Leucaena leucocephala* cv. Cunningham and less severe on *Leucaena pallida.*

Some flowering and seed production was observed year-round on most species despite the regular cutting. Highest seed yields were observed on *Desmodium salicifolium, Flemingia macrophylla* and *Codariocalyx gyroides.* Species which did not flower throughout the experimental period included *Leucaena leucocephala, Leucaena pallida, Sesbania grandiflora, Gliricidia sepium* and *Erythrina* sp.

The total dry weight and leaf proportion over nine harvests are presented in Table 1. *Calliandra* sp. CPI 108458 gave the highest total yield (leaf + stem) of more than 3300 g/tree. Other high yielding species which produced more than 2000 g were *F. macrophylla* and *Desmodium rensonii. Calliandra* sp. (local), *Gliricidia sepium* (local) and *Codariocalyx gyroides* were the next highest-yielding species. The highest leaf dry weight was produced by *Calliandra* sp. and *F. macrophylla,* followed by *G. sepium* (local) and *Calliandra* sp. (local). Among the high-yielding species, *D. rensonii* and *C. gyroides* had a high proportion of stem.

Leaf yield of the five highest-yielding species over nine harvests is presented in Figure 1. Leaf yield of *Calliandra* sp. was the highest among all species throughout the experiment, but *F. macrophylla* also produced high leaf yields in the later harvests. *Desmodium rensonii* and *C. gyroides* produced high leaf yields initially but these were lower in later harvests. These two species appear to be shorter-lived than the other high-yielding trees but, because of their high initial growth rate, these species may be suitable in ley farming systems or may be used to overcome short-term feed limitations. While producing a high leaf yield initially, yield of *G. sepium* declined in later harvests. It is interesting to note the difference in productivity between the local and introduced *Calliandra* sp. accessions. It appears that there is scope to select higher-yielding accessions within this species. The introduced accession of *Calliandra* sp. in this trial produced some root suckers which may prove unacceptable to farmers.

In the drier environment of South Sulawesi, Ella et al. (1989) found little difference between leaf yield of *C. calothyrsus, L. leucocephala* and *G. sepium,* while the yield of *Calliandra* sp. was clearly superior in North Sulawesi. Presumably, the yield of *L. leucocephala* was severely limited by psyllid damage in our experiment while the experiment reported by Ella et al. (1989) was conducted prior to the arrival of psyllids.

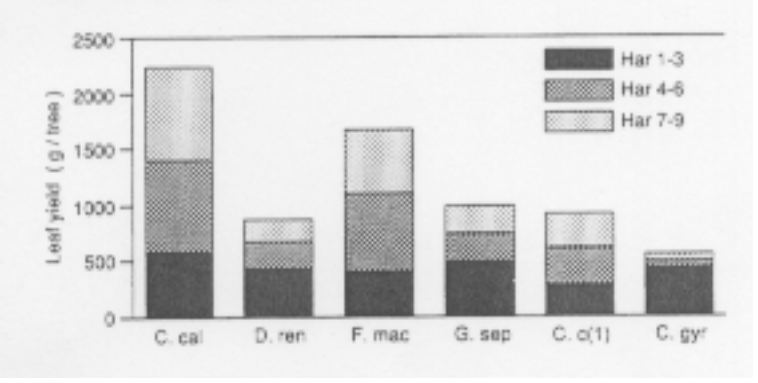

Fig. 1. Leaf yield (g DW/tree) of the highest-yielding tree species grown under coconuts at Manado, North Sulawesi.

Explanation for abbreviations :

C. cal = *Calliandra* sp. CPI 108458;
D. ren = *Desmodium rensonii* CPI 76099;
F. mac = *Flemingia macrophylla* CPI 100793;
G. sep = *Gliricidia sepium* (local);
C. c(l) = *Calliandra calothyrsus* (local);
C. gyr = *Codariocalyx gyroides* CPI 49082.

Table 1. Total accumulated dry weight (g/tree) of tree legumes in Manado.

Species	Leaf DW (g/tree)	Stem DW (g/tree)	Inflorescence DW (g/tree)	Total DW (g/tree)	Leaf (%)
Calliandra sp. CPI 108458	2231	1120	1	3352	67
Flemingia macrophylla CPI 100793	1654	794	60	2508	66
Desmodium rensonii CPI 76099	860	1234	21	2115	41
Calliandra calothyrsus (Local)	922	583	2	1507	61
Gliricidia sepium (Local)	980	496	0	1476	66
Codariocalyx gyroides CPI 49082	557	534	36	1127	49
Erythrina sp. (green leafed type) (Local)	414	380	0	794	52
Leucaena pallida CPI 91309	487	421	0	908	54
Leucaena leucocephala cv. Cunningham	486	373	0	859	57
Desmodium distortum CPI 28324	155	428	2	585	27
Desmodium salicifolium CPI 70257	300	231	57	588	51
Sesbania grandiflora (Local)	266	146	0	412	65
Desmodium discolor CPI 39075	115	122	3	240	48

Conclusion

Of the 13 tree legume species evaluated, *Calliandra* sp. CPI 108458 produced by far the highest leaf yields. Other potentially useful species were *F. macrophylla*, *C. calothyrsus* (local), G. *sepium* (local), *D. rensonii* and *C. gyroides.*

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Reference

Ella, A., Jacobsen, C., Stür. W.W. and Blair, G. 1989. Effect of plant density and cutting frequency on the productivity of four tree legumes. Tropical Grasslands, 23, 28-34.