Evaluation on growth and production of 13 provenances of gliricidia septum

A.J.V. Janes, R. Sutherland, M.A.P. Duarsa, H.P. Nastiti and I.G.L. Media

Universitas Udayana, Denpasar - 80232, Bali
Universitas Nusa Cendana, Kupang, NTT
Universitas Mataram, Mataram, NTB. Indonesia

Summary. The growth and production of 13 provenances of gliricidia, *Gliricidia sepium,* of calliandra, *Calliandra calothyrsus* provenance East Java, of acacia *Acacia villosa* provenance Camplong and leucaena, *Leucaena leucocephala* provenance Amarasi, were collected mid dry season at Besi Pae, Nusa Tenggara Timur (NTT), Indonesia. The test of provenances of gliricidia was carried out in order to evaluate alternative tree legumes, since the devastation of leucaena production by the psyllid, *Heteropsylla cubana.* Results showed that the provenance Guatemala I (14.84) calliandra and acacia are possible alternative tree legumes in NTT.

Introduction

Beef cattle are the only significant agricultural export from NTT, one of the 27 provinces in Indonesia. The dependence of this trade on forage supplies was illustrated when exports fell from 60,000 in 1986 to 50,000 head in 1987, the year after the leucaena psyllid arrived in NTT and halved leucaena fodder production (4). Hence, other trees which provide an adequate production of high quality leaf material need to be developed to improve pasture and fodder supply to ruminants.

Gliricidia, *Gliricidia sepium,* has been reported to have-a wide range of uses, including forage, fuelwood and green manure. It can be grown in many different production systems from pure woodlots to agroforestry mixtures, and may be managed under a variety of silvicultural regimes (2). Together with other tree legumes, such as calliandra, *Calliandra calothyrsus,* acacia, *Acacia villosa,* leucaena, *Leucaena leucocephala,* these legumes are classified as Nitrogen Fixing Trees (NFT), and have been shown to improve soil fertility (6). Nutritive value studies have identified gliricidia as a high quality forage for tropical areas and production studies have confirmed it as an important source of forage for livestock (3). Experiments have shown that gliricidia can increase live weight gain of cattle, goats and sheep in many tropical countries such as the Philippines, Thailand and Indonesia. Although, the acceptability of gliricidia forage by the animal when it is fed this material for the first time is often a problem, usually after a 4-6 week orientation period it will be accepted by animals. It has also been reported that wilting of the gliricidia fodder prior to feeding improves palatability (Nitis, pers. comm., 1992).

Oxford Forestry Institute (OH) collected gliricidia seed of a number of identified land races from the very extensive natural distribution in Mexico and Central America, to provide a broad genetic base and a solid foundation for genetic improvement. We tested 13 provenances of gliricidia from the OFI collection (chosen on the basis of expected suitability to the climatic and soil conditions in NTT) and one local provenance, Penfui, as well as two other tree legumes *Leucaena leucocephala* and *Acacia villosa* commonly grown in NIT.

Methods

Description of the site

The long term gliricidia evaluation experiment was established in January 1989 on an alluvial calcaric intergrade soil with pH ranging from 7 to 8, at the Nusa Tenggara Timur Livestock Development Project, situated some 100 km south-east of Kupang (the provincial capital). It is at 9? south latitude and about 50 metres above the sea level. The average annual rainfall is 800 mm distributed mainly between December and March.

Experimental design

This experiment was conducted in a completely randomised design. Sixteen provenances were used as treatments with six replications. The cultivars were 13 provenances of gliricidia *(Gliricidia sepium* Jacq. Steud) ie Venezuela I (12.86), Mexico (35.85), Nicaragua (29.84), Panama (13.86), Costa Rica (11.86), Colombia (24.86), Nicaragua (14.86), Guatemala I (14.84), Honduras I (25.84), Honduras II (24.84), Venezuela II (1.86), Guatemala II (16.84), and the local provenance, Penfui and three other species; *Leucaena leucocephala,* provenance Amarasi, *Calliandra calothyrsus,* provenance East Java and *Acacia villosa,* provenance Camplong. The seedlings were established from inoculated seed in November 1988 before being transplanted to the field in January 1989. Maize was sown as an intercrop and fertilizer was applied to the corn at the rate of 100 kg ha-I of TSP (21% P). The first harvest was carried out in November 1989 and the second in November 1991. The third harvest, reported in this paper, was conducted in July 1992.

Insect damage, plant height, number of stems, leaf dry weight and wood production were measured to evaluate the growth and productivity of these legumes. Wood production was determined by the fresh weight of all woody parts (excluding petioles). Insect damage was measured by estimating leaf damage and assigning one of four criteria scores, no leaf damage (I); light leaf damage (2); medium leaf damage (3); and heavy leaf damage (4). Data were analysed using GLM to deal with five missing plots. There was no significant difference between replicates but highly significant differences between treatments so the data was further analysed using a one way ANOVA and treatment differences were tested using the Duncan multiple range test and LSD 0.05

Results and discussion

All species and provenances observed in this experiment were relatively resistant to insect damage. No leaf damage by *Heteropsylla cubana* or other insects was found in leucaena, calliandra, acacia, and gliricidia provenances 35.85 and 29.84 (Table 1). The observation that no leaf damage occurred to leucaena seems to be contrary to the experience that it is susceptible to insect attack. The explanation may be that at the time of observation the leaves which suffered from insect attack (usually most intense during the wet) had already fallen. This may be the explanation for the low dry matter production of leucaena in this trial. The height of the various cultivars reached in this harvest were as described in Table I. Provenances 14.84 and 25.84 have the highest results and significantly different (P<0 05) to provenances 35.85, 14.86, 11.86 and leucaena. This growth parameter gives an indication that these provenances are well adapted to the local environment. The provenance 14.84 in its original environment can reach 800 cm height (2), the cutting regime would have restricted the height in this trial, although the big difference in rainfall 800 mm at Besi Pae, NTT compared to 3540 mm at the collection site of the provenance in Guatemala, may have restricted growth. Height of the cultivars is an important consideration in determining the use and management of the trees; branching habit is also important.

Provenance 14.84, together with provenances 12.86, local and acacia branched well. The more branched habit is valued by local farmers because it makes harvesting of forage easier and because bushier trees provide more intense shade which is more effective for grass weed control during the fallow period prior to the intercropping phase.

Calliandra was found to produce the highest yield of dry matter (DM) and this was significantly higher than all cultivars, except, the provenance 14.84 and acacia (Figure la). Calliandra has been widely reported as having good potential on infertile soils, producing a high yield of fodder and it is known to be resistant to psyllid attack (5). Relatively low dry matter production on gliricidia in the mid dry season is in line with other research results which report observations that gliricidia is very sensitive to the moisture stress which causes leaf abscission (1). This trial result and observations at the site indicated that most provenances used in this experiment were suffering from stress in the mid dry season in NTT. However, once again, provenance 14.84 had relatively high dry matter production which indicates a relatively good adaptation to the local environment.

Calliandra (6160 g) was found to produce the most wood (P>0.05) together with provenances 14.84 (4946 g) and 13.86 (4232 g) which were not significantly different to the others except 24.84 (867 g); 35.85 (763 g) and leucaena (593 g). Leucaena produced significantly less wood than the other provenances tested (P>0.05) (Figure lb). Wood production is very important for the local population for fuel.

The growth and production of the local provenance of gliricidia was found lower than the introduced provenances. This suggests that introducing new provenances may improve forage availability for ruminants during the critical dry season.

It can be concluded that provenance Guatemala I (14.84) showed good adaptation to the local environment and with calliandra and acacia is the possible alternative tree legumes for NIT of those tested species and provenances. At the time of observation none of the provenances used in this experiment were suffering insect attack. Further observations at differnt seasons are required to reach a conclusion concerning cultivar resistance to insect attack.

Table 1 . Insect damage, plant height. and branching on 13 provenances of gliricidia, calliandra, acacia, and leucaena.

Cultivars	Insect damage	Plant height (cm)	Branching
12.86	1.33	289.5ab*	7.50 ab
35.85	1.00	150.0 b	4.50abc
Leucaena	1.00	228.0 b	2.17 .
29.84	1.00	261.3 b	4.67abc
13.86	1.50	401.5ab	5.33abc
Calliandra	1.00	359.2ab	4.17abc
11.86	1.60	259.0 b	2.67 bc
Acacia	1.00	387.8ab	8.67 a
24.86	1.16	321.0ab	5.33abc
14.86	1.16	377.7ab	4.83ab.
14.84	1.16	500.7 a	7.00abc
25.84	1.33	494.2 a	3.33 bc
24.84	1.33	420.0ab	5.33abc
1.86	1.16	300.2ab	4.33abc
16.84	1.33	324.8ab	4.83abc
Local	1.33	361.0ab	7.50 ab

* Values in the same column with the same superscripts were not statistically different using Duncan's Multiple Range Test (P>0.05)

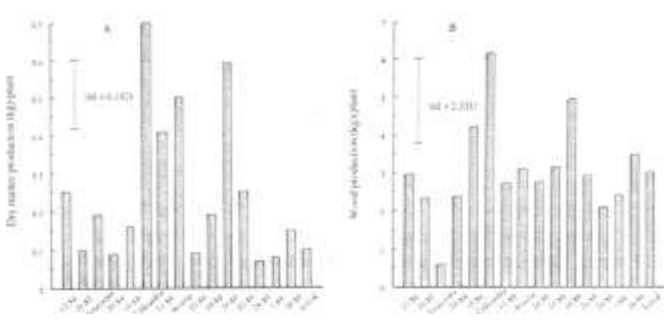

Figure 1 Dry matter production (A) and wood production (B) on 13 provenances of gliricidia, caliandra, acacia, and leucaena.

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