Contribution from Tree Legumes to Mixed Grass-Legume Pastures

Valéria X. de O. Apolinário
Federal Rural University of Pernambuco, Brazil

José C. B. Dubeux Jr.
Federal Rural University of Pernambuco, Brazil

Mário de A. Lira Jr.
Federal Rural University of Pernambuco, Brazil

Rinaldo Luis Caraciolo Ferreira
Federal Rural University of Pernambuco, Brazil

Alexandre C. L. de Mello
Federal Rural University of Pernambuco, Brazil

See next page for additional authors

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Valéria X. de O. Apolinário, José C. B. Dubeux Jr., Mário de A. Lira Jr., Rinaldo Luis Caraciolo Ferreira, Alexandre C. L. de Mello, Diego de Lima Coelho, and Everardo V. S. B. Sampaio

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Valéria X de O Apolinário [A], José CB Dubeux Jr [A], Mário de A Lira [A], Rinaldo Luis Caraciolo Ferreira [B], Alexandre CL de Mello [A], Diego de Lima Coelho [A] and Everardo VSB Sampaio [C]

[A] Science Department, The Federal Rural University of Pernambuco, Brazil
[B] Forestry Department, The Federal Rural University of Pernambuco, Brazil
[C] DEN, The Federal Rural University of Pernambuco, Brazil

Contact email: vxozoot@yahoo.com.br

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Introduction

Legumes and associated microorganisms may fix N from atmosphere and benefit grass on mixed grass-legume pastures. Nitrogen may be transferred by different mechanisms, including direct transfer of N compounds by roots, decomposition of nodules, roots, litter from legume (Nair 1993), and through animal excreta after legume intake by cattle. Silvopastoral systems including tree legumes may become a viable option in tropical regions, considering the increasing prices of N fertilizers compared to farm products such as beef and milk.

This experiment evaluated legume contribution on mixed grass-legume pastures in the coastal region of Pernambuco State, Brazil.

Methods

The experiment was carried out at the IPA Experimental Station located in Itambé, coastal region of Pernambuco, Brazil. Treatments were: (1) signal grass + *Mimosa caesalpiniifolia* Benth. (Sabiá); (2) signal grass + *Gliricidia sepium* (Jacq.) Kunth ex Walp. (Gliricídia); and (3) monoculture of signal grass. A randomized block design was used with four replications per treatment. Experimental unit was a paddock with 660 m^2. Legume trees were planted in July, 2008, in double rows (10.0 m x 1.0 m x 0.5 m) on an already established signal grass pasture. Tree total biomass, its fractions, and nutrient concentrations were determined by cutting six trees of each species per plot, in two harvest dates (February and August, 2012). After cutting the trees, biomass was fractionated in leaves and stems with different diameter classes: thin (0-3 cm perimeter), medium (>3 up to 9 cm perimeter), and thick (> 9 cm perimeter). Samples from each biomass component were sent for $\delta^{15}N$ analyses in the 'Centro de Energia Nuclear na Agricultura – CENA', located in Piracicaba, São Paulo state. The $\delta^{15}N$ was determined using a mass spectrometer and estimated using the natural abundance technique. Data was analyzed using Proc Mixed from SAS (SAS Inst., 1996) and means compared by LSMEANS and PDIFF procedure, adjusted by Tukey (P< 0.05).

Results

Sabiá increased total biomass by 33% (10.3 to 13.7 kg DM/plant) and Gliricídia increased by 91% (8.9 to 17.0 kg DM/plant) from February to August 2012 (Table 1). In August 2012, Gliricídia had greater biomass than Sabiá. This likely occurred due to greater number of branches in Gliricídia than in Sabiá.

Table 1. Total Biomass (kg DM/plant) of tree legumes on a silvopastoral system with signal grass; Itambé, PE – Brazil.

Evaluation	Gliricídia	Sabiá
	kg DM/plant	
Feb-12	8.9 Aa	10.3 Aa
Aug-12	17.0 Aa	13.7 Ba
SE	2.56	

Means followed by the same letter, small case letters within the column and capital letters within the row, do not differ by LSMEANS (P>0.05).

Table 2. Leaf and stem biomass (kg DM/plant) of tree legumes on a silvopastoral system with signal grass; Itambé, PE – Brazil.

Plant component	Gliricídia	Sabiá
	kg DM/plant	
Leaf	0.7 Ab	0.5 Ac
Stem class 1 (0-3 cm perimeter)	1.3 Ab	1.5 Ab
Stem class 2 (>3 up to 9 cm perimeter)	1.2 Ab	2.1 Ab
Stem class 3 (> 9 cm perimeter)	5.6 Aa	6.2 Aa
SE	2.6	

Means followed by the same letter, small case letters within the column and capital letters within the row, do not differ by Tukey test (P> 0.05).

Interaction also occurred between treatment and plant fractions for fractionated biomass (Table 2). Leaves represented 7.8% of total biomass for Gliricídia and 4.6% for Sabiá. Leaf fraction may represent the major source of nutrients for grazing cattle in a silvopastoral system. Leaf is also usually the more easily decomposed fraction, releasing nutrients from legume litter to associated grass. It is also important to mention that around 62% of total biomass was composed by thick stems (> 10 cm perimeter) for both legumes.

Biological N_2 fixation differed between species (Table 3). Average $\delta^{15}N$ found respectively in leaves and stems of Gliricídia (1.49% and 0.45%) and Sabiá (2.48% and 1.3%) were low compared to the reference non-

Table 3. Nitrogen derived from atmosphere (%NDFA) and N content from tree legumes (NTL; kg N/ha); average of leaf and stem fractions across four replications.

Treatment	NDFA (%)	NTL (kg N/ha)
Gliricídia	73.6 a	68.3 a
Sabiá	61.7 b	57.7 a
SE	1.4	14.7

Means followed by the same letter within the column do not differ (P>0.05) by Tukey test.

fixing plant used in this study (*Solanum paniculatum* L.)which presented δ^{15}N% values of 7.4% and 5.68% for leaves and stem, respectively. This three fold difference between δ^{15}N% of tested legumes increases confidence that the obtained results represent biological N fixation (Högberg 1997). Biological N fixation ranged from 61.7 to 73.6% of total legume N (Table 3). This may be considered a real contribution from the tree legumes to the system in terms of N input.

Conclusion

Sabiá and Gliricídia showed potential for N biological fixation. Further investigation on N cycling and transfer to associated grass is necessary in order to fully understand the legume role in these silvopastoral systems.

References

Högberg P (1997) 15N natural abundance in soil-plant systems. *New Phytologist*, **137**, 179-203.

SAS Inst.Inc. (1996) ‘SAS statistics user’s guide. Release version 6.’ (SAS Inst.Inc.: Cary. NC)

Nair PKR (1993) ‘An Introduction to Agroforestry.’.(Kluwer, Dordrecht: The Netherlands)