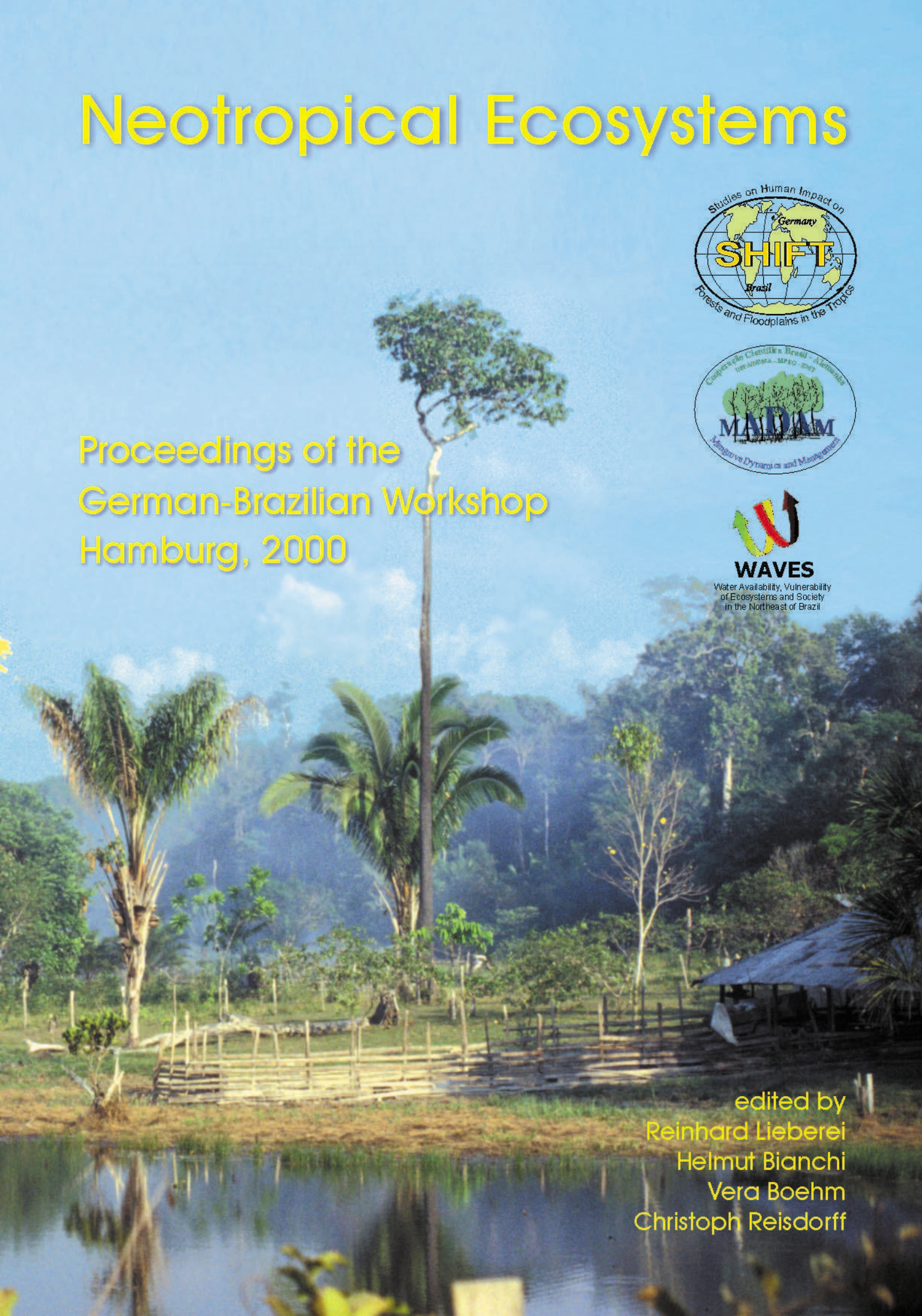
Neotropical Ecosystems



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WAVES
Water Availability, Vulnerability of Ecosystems and Society in the Northeast of Brazil

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Fallow Vegetation Enrichment with Leguminous Trees in the Eastern Amazon of Brazil: Trees Performance

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Abstract

Factors as rudimental technology, demographic growth, land use intensification and lack of adequate agricultural polices are contributing to shorter the fallow periods used in slash-and-burn agriculture in the Eastern Amazon of Brazil. Planting trees as an enrichment of fallow vegetation can aid biomass accumulation of fallow vegetation. Using leguminous trees might be advantageous due to the benefits of nitrogen fixation. This paper shows the performance of five leguminous trees (*Acacia angustissima Kuntze, Clitoria racemosa* G. Don*, Inga edulis* Mart., *Acacia mangium* Willd. and *Sclerolobium paniculatum* Vogel) planted to enrich fallow vegetation. During the enrichment process, the interpretation of growth dynamics of all planted trees demonstrates the existence of the following phases of tree development: "adaptation", "growth explosion", "competition" and "stability". To be successful in fallow vegetation enrichment, planted trees must have fast initial growth and withstand initial fallow competition. Fast and moderate growing species such as *A. mangium, I. edulis* and *A. angustissima* could be preferably planted in wider spacing (2500 trees ha^{-1}), whereas slow growth species such as *S. paniculatum* and *C. racemosa* would be planted in tight spacing (5000 trees ha^{-1}).

Keywords

Fallow vegetation, Leguminous tree, Amazon region, Fallow enrichment

1 Introduction

Factors as rudimental technology, demographic growth, land use intensification and lack of adequate agricultural polices are contributing to shorter the fallow periods used in slash-and-burn agriculture in the Eastern Amazon of Brazil. Planting trees as an enrichment of fallow vegetation can aid biomass accumulation of fallow vegetation. Using leguminous trees might be advantageous due to the benefits of nitrogen fixation. This paper shows the performance of five leguminous trees planted to enrich fallow vegetation.

2 Material and Methods

The enrichment of fallow biomass, conserving the fallow vegetation as a base for biodiversity and keeping the short fallow time, was studied in the Eastern Amazon of Brazilian based on a traditional slash-and-burn system of maize (cultivar BR 106, planted in January 1995 at 1.0 m x 0.5 m; SOUZA et al., 1999) and cassava (cultivar "olho verde", planted in February 1995 at 1 m x 1 m). Using experimental plots of 10 m x 8 m in four randomized blocks, the leguminous trees *Acacia angustissima* Kuntze, *Clitoria racemosa* G. Don, *Inga edulis* Mart. and *Acacia mangium* Willd. were planted after maize harvest (June 1995) and four months after cassava had been planted (February 1995) at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m, with exception of *Sclerolobium paniculatum* Vogel which was planted only in 2 m x 1m. Trees and cassava grew together for eight months until the cassava be harvested (February 1996). After the last cassava weeding (between October-November 1996) the fallow vegetation started to grow as an enriched fallow. To evaluate the silvicultural performance of trees, the height was measured every 2 months up to 12 months of age and again after 18 and 24 months. The diameter at breast height at 1.3 m (Dbh) was taken only when the trees had a diameter of at least 1 cm.

3 Results/Discussion/Conclusions

The values of tree survival at 24 months of age were as follows: *C. racemosa* (99%), *A. angustissima* (98%), *I. edulis* (97%), *A. mangium* (91%) and *S. paniculatum* (90%). At 24 months of age trees planted to enrich fallow vegetation showed different behaviors relating to height- and Dbh growth (Tab. 1). The *A. mangium* trees were the tallest, followed by *I. edulis, A. angustissima* and *C. racemosa*. That same tendency of superiority of *A. mangium* trees height was observed for the Dbh. Plant spacing did not influence growth in height, but caused significant impacts on growth in Dbh. Comparing plant spacing, regardless leguminous tree species, the lowest value was observed at the spacing of 1 m x 1 m (3.2 cm) followed by 2 m x 1 m (3.9 cm) and 2 m x 2 m (4.3 cm) (LSD test [$p<0.05$]; all treatments were statistically different).

Trees Species	n	Height (m)	Dbh (cm)
A. mangium	12	7.1 ± 0.2 a	5.6 ± 0.5 a
*S. paniculatum**	4	4.9 ± 0.3 *	3.9 ± 0.1 *
I. edulis	12	4.7 ± 0.3 b	3.5 ± 0.3 b
A. angustissima	12	4.5 ± 0.2 b	3.2 ± 0.3 bc
C. racemosa	12	3.4 ± 0.3 c	3.0 ± 0.3 c

Data followed by the same letter are not statistically different; LSD test ($p<0.05$)
*Planted only at spacing 2 m x 1 m and not included in this statistical analysis

Tab. 1: Averages and standard errors of Dbh and height of trees at 24 months of age for *A. angustissima, C. racemosa, I. edulis, S. paniculatum* and *A. mangium* planted for fallow enrichment at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m

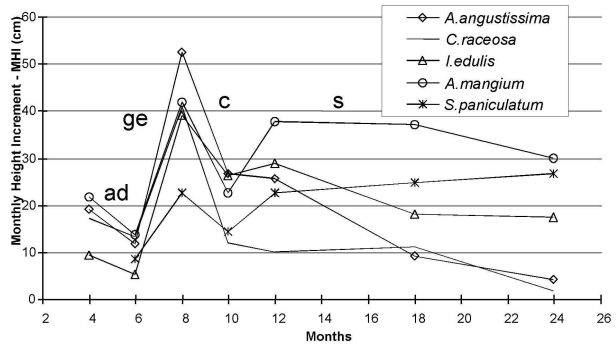

Fig. 1: Monthly medium increment in height – MHI for leguminous trees *A. angustissima, C. racemosa, I. edulis, A. mangium* and *S. paniculatum* planted to enrich the fallow vegetation at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m

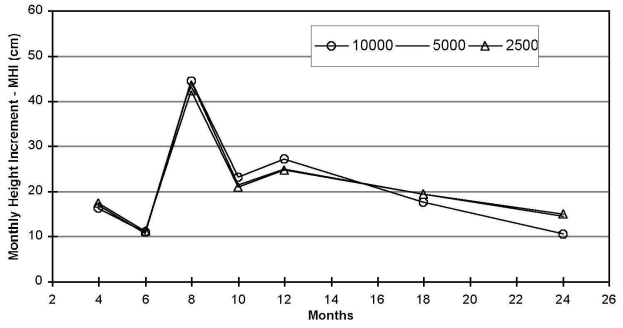

Fig. 2: Monthly medium increment in height - MHI for leguminous trees *A. angustissima, C. racemosa, I. edulis, A. mangium* and *S. paniculatum* (A) and for spacing of plantations at 1 m x 1 m, 2 m x 1 m and 2 m x 2 m

The monthly dynamics of tree growth, evaluated by average height increment - MHI during the study period, showed the same tendency for species planted and for studied spacing (Figs. 1 and 2).

The interpretation of growth dynamics demonstrates the existence of the following phases of tree development: "adaptation" (ad), "growth explosion" (ge), "competition" (c) and "stability" (s).

i) Adaptation: until the 6th month (December 1995) all planted leguminous trees grow, but this growth rate is smaller when compared to that presented at the 4th month. This decrease in MHI may be associated with the fact that planted trees were investing in root development, in the adaptation to the new environment. It was, however, the period of lowest precipitation;

ii) Growth explosion: from the 6th month to 8th month, when the rainy season begins, rapid growth in height is observed for all leguminous trees planted. *Acacia angustissima* showed the fastest growth during this phase;

iii) Competition: still during the rainy period, a decrease of MHI values from the 8th month to the 10th month was observed. The cassava was harvested at the 8th month, and therefore, it can be surmised that after harvest, the fallow vegetation could also develop quickly and as a result, there was a tendency to constrain growth the planted leguminous trees, showing the existing competition for site resources. Alternatively, some root disturbance during cassava harvest may have set back the planted trees; and

iv) Stability: from 10th month onwards MHI values of trees showed different behaviors, and two groups of species could be characterized. The first is composed of *A. mangium, I. edulis* and *S. paniculatum* that showed tendencies of recover their growth rates, although with different magnitudes attributed to each species and less than observed between the 6th and 8th months. In the second group *A. angustissima* and *C. racemosa* decreased their rate of height growth. From 12 months of age, MHI values for all species, except *S. paniculatum*, showed a decrease until 24 months of age. Although the species planted in the fallow vegetation continued growing, this growth occurred with less intensity. It

was visually observed that, at 12 months of age, *A. angustissima* buffered from drying of shoot sprouts during the dry period, which resprouted at the beginning of the rains. The same effect, although with lesser intensity, was also observed for *C. racemosa*. This fact can explain the low MHI values for those two species, particularly for *C. racemosa* during the last observation the age of 24 months.

The analysis of MHI values over the experimental period facilitated visualization of the growth dynamics of the trees planted for fallow enrichment, but comparisons of the average of monthly general height increments (MGHI) permitted the establishment of growth ranking of the trees studied. According to this, the trees studied were ranked as: *A. mangium* was considered as of fast growth (32 cm month-1), followed by *S. paniculatum* (22 cm month-1), *I. edulis* (22 cm month^{-1}), and *A. angustissima* (17 cm month^{-1}) were classified as of intermediary growth and *C. racemosa* (11 cm month^{-1}) as of slow growth.

To be successful in fallow vegetation enrichment, planted trees must have fast initial growth and withstand initial fallow competition. Fast and moderate growing species such as *A. mangium, I. edulis* and *A. angustissima* could be preferably planted in wider spacing (2500 trees ha^{-1}), whereas slow growth species such as *S. paniculatum* and *C. racemosa* would be planted in tight spacing (5000 trees ha^{-1}).

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