

EFFET OF DENSITY, FERTILITY AND GENETICS ON SPECIFIC LEAF AREA, LEAF ARE INDEX AND CARBON ALLOCATION TO ABOVE-GROUND PLANT COMPARTMENTS IN EUCALYPTUS PLANTATIONS IN CONGO

HY Gomat¹ F Bikindou¹, J Blanco², U Mayinguidi¹, Y Nouvellon², L Saint-André²

¹CRDPI (ex UR2PI) BP 1291 Pointe-Noire/ Congo
²CIRAD, UPR 80, Écosystème de Plantation, F-34398, Montpellier, France

CONTEXT

- In view of the sustainable management of 43,000 ha of *Eucalyptus* plantations near Pointe-Noire, powerful tools based on the understanding of ecosystem functioning are needed, to simulate tree, stand growth and to assess the impact of plantations on soil properties.
- Soils near Pointe-Noire are sandy (more than 90% of sand), chemically poor in K, total N and organic matter and are characterized by a low cation exchange capacity.
- Large number of genotypes were select, resulting in about 170 different clones planted.

OBJECTIVE

The objective of this study was to assess the impact of genotype, fertilization, and stand density on leaf biomass, SLA, and LAI.

MATÉRIAL and METHODS

Hypothesis

The optimum of plantation density and fertilization regime can be found for each clone and each ecological situation, allowing simultaneous maximisation of wood production, carbon sequestration and soil fertility sustainability. Three factors are likely to affect soil-plant interactions and therefore wood production:

- 1) efficiency of light interception (fAPAR), which depends on both leaf area index (LAI, leaf biomass * specific leaf area, SLA) and canopy structure (leaf angles and canopy clumping);
- 2) light use efficiency (LUE), defined by the ratio between above-ground net primary production (ANPP) and absorbed light (APAR);
- 3) carbon allocation between tree compartments.

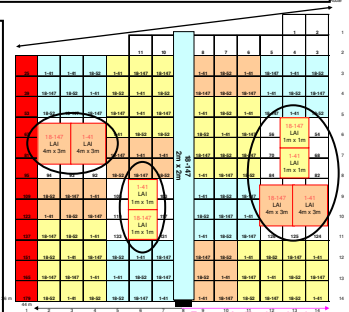
Experimental design

The experimental site was set up in 2007. The site includes two contrasted fertilization regimes, crossed with two different clones (18-147 and 1-41) and two stand densities (833 and 10.000 trees/ha). Twelve *unit plots were set up for each clone and each density in the two zones of fertilization (Plan 1). LAI, leaf biomass and SLA were sampled regularly during 2 years (photo 1). *unit plot densities 833 trees per ha = 12 trees and unit plot for plot 10 000 trees per ha = 81 trees

Destructive measurements of tree leaf biomass, leaf area, and SLA (photo 1)

Twelve trees (or less than 12 for densities 833 trees per ha because for mortality) were sampled at each date.

Before each sampling Ht and DBH were measured on all units plots every six month (and every two month for plot sample).



Plan 1: experimental site of Luvuiti



Photo 1: destructive measurement

Photo 1: For each selected tree, DBH, total height (Ht) and height to green crown base, (Hb) was measured. The green crown length (L = Ht - Hb) was divided into three equal-length sections (lower, middle and upper). All leaves of each section were removed, taken to the laboratory, and weighed. 30 leaves were randomly selected in each section, and their fresh mass and area were immediately measured. The leaves were then dried at 65 °C to constant weight. The dry weights of these sub-samples were used in conjunction with their measured area to calculate specific leaf area for each crown section. The foliage dry weight of each crown section was calculated from the foliage fresh weight and the dry to fresh weight ratio of the sub-samples

FIRST RESULTS (Growth and SLA)

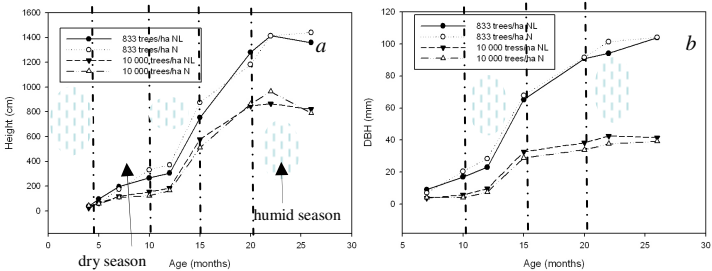


Figure 1: Change of height (a) and DBH (b) over time by stand densities and regime fertilization for clone 18-147

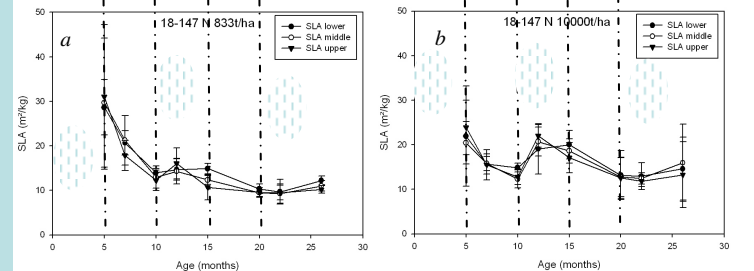
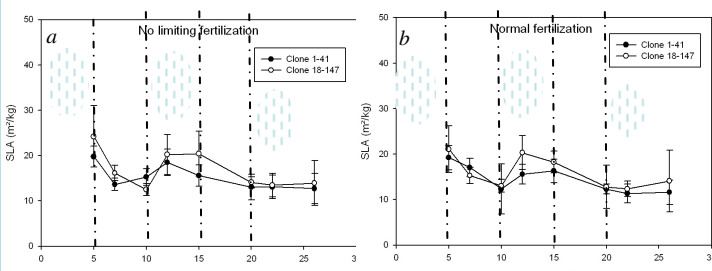


Figure 2: Variations of SLA with section, tree age and season for clone 18-147, Normal fertilization, Stand Densities: a) 833 trees/ha b) 10 000 trees/ha



Figures 3: Variations of SLA with genotype, tree age, season when stand density is fixed (10000 trees/ha): a) Non limiting fertilization, b) Normal fertilization.

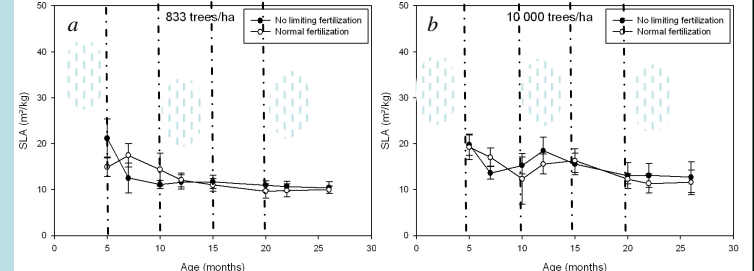


Figure 4: Variations of SLA with fertilization regime, tree age, season for clone 1-41 and stand densities: a) 833 trees/ha b) 10 000 trees/ha

Growth of stand

Height: At the same densities, and whatever the fertility regime, the height of clone 18-147 is always higher than that of clone 1-41
 The height and DBH of trees from stands with 833 trees/ha are higher than that of stand of 10 000 trees/ha (Figure 1a et b).
 Individually, trees are then much smaller at 10000 t/ha than at 833 trees/ha but the reverse is observed for the global wood production (if assessed by the stand basal area)
 Clone 1-41, 10000 trees/ha :
 Non limiting Fertilization = 13 m²/ha, Normal Fertilization = 13 m²/ha; 833 trees/ha : Non limiting Fertilization = 7.8 m²/ha, Normal Fertilization = 6.7 m²/ha
 Clone 18-147, 10000 trees/ha :
 Non limiting Fertilization = 10.6 m²/ha, Normal Fertilization = 11.6 m²/ha; 833 trees/ha : Non limiting Fertilization = 6.2 m²/ha, Normal Fertilization = 5.7 m²/ha

Variation of specific leaf area

The results show an exponential decrease of the SLA over time with a strong seasonal effect (high during the first year and slighter during the second year). (Fig.2)
 Variations of SLA are more pronounced in high density (10 000 trees per ha) and in the non-limiting fertilization conditions.
 The seasonal effect is more pronounced for the 18-147 clone than for the 1-41 clone, with a small time lag for the latter at normal fertilisation regime. (Fig. 3 et 4)