

# GROWTH, DEVELOPMENT AND FOLIARY ULTRASTRUCTURAL PARAMETERS OF DIFFERENT EUCALYPTUS GENETIC MATERIALS

Lucas Aparecido Manzani Lisboa<sup>1</sup>, Allan de Marcos Lapaz<sup>1</sup>, Thadeu Henrique Novais Spósito<sup>2</sup>, Ronaldo da Silva Viana<sup>1</sup>, Paulo Alexandre Monteiro de Figueiredo<sup>1</sup>

<sup>1</sup>São Paulo State University (Unesp), College of Agricultural and Technological Sciences, Dracena – lucas.lisboa@unesp.br; allanlapaz60@gmail.com; ronaldo.viana@unesp.br; paulo.figueiredo@unesp.br

<sup>2</sup>State Technical School Prof. Dr. Antônio Eufrásio de Toledo, Presidente Prudente - thadeusposito@agronomo.eng.br

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## Abstract

Currently eucalyptus is used as raw material in different industrial segments. The aim of this study was to evaluate the growth, development and ultrastructural parameters in different eucalyptus genetic materials. The randomized block experiment was carried out in ten treatments and five replicates, with different genetic materials: six hybrids:I-144; H-13; 110; NA-151; NA-189 (*Eucalyptus urophilla* S. T. Blake x *Eucalyptus grandis* W. Hill); Grancam 1277 (*Eucalyptus grandis* W. Hill x *Eucalyptus camaldulensis* Dehnh.); and four pure genetic materials:0020 (*Eucalyptus saligna* Sm.); 0010 (*Eucalyptus resinifera* Sm.); *Eucalyptus pellita* F. Muell. and *Corymbia torelliana* (F. Muell.) K. D. Hill & L. A. S. Johnson. Approximately four years after planting, the following variables were determined: plant height (AP), diameter at breast height (DAP), spad index (ISPAD), adaxial cuticle thickness (ECAD), abaxial cuticle thickness (ADX), abaxial epidermal thickness (EEAB), xylem diameter (DX), phloem diameter (DF) and palisade parenchyma length (CPP). The materials NA - 151 (*Eucalyptus urophilla* x *E. grandis*) and Grancam 1277 (*E. grandis* x *E. camaldulensis*) presented higher plant height (AP). The materials 0020 (*E. saligna*); 0010 (*E. resinifera*) and *Corymbia torelliana* presented smaller diameter at breast height (DAP). In general, the *Corymbia torelliana* genetic material had the lowest values in the ultrastructural foliar parameters.

**Keywords:** Leaf morphology, *Eucalyptus* spp., *Corymbia* spp., genetical enhancement.

## Resumo

**Avaliação do crescimento, desenvolvimento e parâmetros ultraestruturas foliares em diferentes materiais genéticos de eucalipto.** Atualmente, o eucalipto é utilizado como matéria-prima em diferentes segmentos industriais. Este trabalho teve por objetivo avaliar o crescimento, desenvolvimento e parâmetros ultraestruturais foliares em diferentes materiais genéticos de eucalipto. Foi instalado um experimento em blocos casualizados, com dez tratamentos e cinco repetições, constituídos por diferentes materiais genéticos, sendo: seis híbridos: I-144; H-13; 110; NA-151; NA-189 (*Eucalyptus urophilla* S. T. Blake x *Eucalyptus grandis* W. Hill); Grancam 1277 (*Eucalyptus grandis* W. Hill x *Eucalyptus camaldulensis* Dehnh.); e quatro materiais genéticos puros: 0020 (*Eucalyptus saligna* Sm.); 0010 (*Eucalyptus resinifera* Sm.); *Eucalyptus pellita* F. Muell. e *Corymbia torelliana* (F. Muell.) K. D. Hill & L. A. S. Johnson. Aproximadamente quatro anos após o plantio, foram determinadas as seguintes variáveis: altura de planta (AP), diâmetro à altura do peito (DAP), índice spad (ISPAD), espessura da cutícula adaxial (ECAD), espessura da cutícula abaxial (ECAB), espessura da epiderme adaxial (EEAD), espessura da epiderme abaxial (EEAB), diâmetro de xilema (DX), diâmetro do floema (DF) e comprimento do parênquima paliçádico (CPP). Os materiais NA - 151 (*Eucalyptus urophilla* x *E. grandis*) e Grancam 1277 (*E. grandis* x *E. camaldulensis*) apresentaram maior altura de planta (AP). Os materiais 0020 (*E. saligna*); 0010 (*E. resinifera*) e *Corymbiaturelliana* apresentaram menor diâmetro à altura de peito (DAP). De maneira geral, o material genético *Corymbiaturelliana* apresentou os menores valores nos parâmetros ultraestruturais foliares.

**Palavras-chave:** Morfologia foliar ultrastructural parameters.

## INTRODUCTION

Eucalyptus is a tree species belonging to the Myrtaceae family. It is used in various reforestation programs as a result of its rapid growth and good adaptation to different soil and climate conditions, favoring remnant native forest preservation. It is a widely used tree as raw material in different industrial segments linked to cellulose, paper, coal, among other sectors. In addition, its leaves have been used for essential oils extraction (FIGUEIREDO *et al.*, 2011). Its leaves are evergreen, opposite and simple, with entire margins with oil glands (DONATO; MORRETES, 2009; BÜNDCHEN *et al.*, 2015).

The foliar morphoanatomic study is of great importance to know the species characteristics, since it is closely related to the plant biomass increase, as well as to the adaptability and available abiotic resources use (PIRES *et al.*, 2015; ARAGÃO *et al.*, 2014; JAMES; BELL, 2001). According to Trevisan *et al.* (2013), the study of the interaction of the leaves with wood quality and its respective volume must be cautious as the biotic and abiotic factors can influence cambial activity and, consequently, increase wood heterogeneity.

The species within the gender *Eucalyptus* L'Hér. may present genetic variability. According to Butler *et al.* (2017), it has been observed two little interchromosomal translocation between the species *E. globulus* Labill. and *E. grandis* W. Hill x hybrid of *E. urophylla* S. T. Blake. Thus, the proper choice of genetic material in breeding research is fundamental for more productive forests generation with adaptability in different regions, having greater resistance to biotic and abiotic factors. Between the species of this gender the ones that are more distinguish are *E. grandis*, *E. urophylla*, *E. camaldulensis* Dehnh., *E. saligna* Sm., and their interspecific hybrids, like "urograndis", which also stand out between the most planted.

The gender *Corymbia* K. D. Hill & L. A. S. Johnson has been less researched than the gender *Eucalyptus* (HEALEY *et al.*, 2016b). The species *C. citriodora* (Hook.) K. D. Hill & L. A. S. Johnson, *C. maculata* (Hook.) K. D. Hill & L. A. S. Johnson and, mainly, *C. torelliana* (F. Muell.) K. D. Hill & L. A. S. Johnson have been growing in importance under the aspect of cross-breeding to obtain interspecific hybrids with high biomass production (REIS *et al.*, 2014; BUTLER *et al.*, 2017).

However, little is known about the differences of leaf ultra structural features of these species, making necessary to research and emphasize them, moving towards the best use of their genetic material. Considering this, this study aimed to evaluate the growth, development and foliar ultra structural parameters in different eucalyptus genetic materials.

## MATERIAL AND METHODS

In March, 2013, for the accomplishment of the present study, it was selected an area in the State Technical School Prof. Dr. Antônio Eufrásio de Toledo, in the municipality of Presidente Prudente, state of São Paulo, with the following geographic coordinates 22° 10' 35,884" S e 51° 22' 35,984" W and 460 m of altitude. According to Köppen, the climate of the region is classified as Aw, with rainy summers and dry winters, and it presents average annual rainfall of 1.250 mm. The area presents a terrain with approximate slope of 5%, soil classified as Red Yellow Argisol (EMBRAPA, 2013). At the time of the experiment, the solo presented the following chemical characteristics: pH - CaCl<sub>2</sub> 6,0; MO g dm<sup>-3</sup> - 9,5; P mg dm<sup>-3</sup> (resin) - 8,0; K mmol<sub>c</sub> dm<sup>-3</sup> (resin) - 1,7; Ca mmol<sub>c</sub> dm<sup>-3</sup> (resin) - 51,0; Mg mmol<sub>c</sub> dm<sup>-3</sup> (resin) - 7,3; H + Al mmol<sub>c</sub> dm<sup>-3</sup> - 11,6; Al mmol<sub>c</sub> dm<sup>-3</sup> - 0,0; sum of bases mmol<sub>c</sub> dm<sup>-3</sup> - 60,0; CTC mmol<sub>c</sub> dm<sup>-3</sup> - 71,6; and bases saturation (V%) - 83,8. Liming was performed in the total area. Soil preparation and fertilization in pits were made with 04-30-10 formulation (NPK), according to Rajj *et al.* (1996).

In April 2013, the experiment in randomized blocks was installed, with ten treatments composed by five repetitions, totaling 50 plots with 20 eucalyptus plants. The treatments were constituted by different genetic materials, being six hybrids: I-144; H-13; 110; NA-151; NA-189 (*Eucalyptus urophylla* S.T. Blake x *Eucalyptus grandis* W. Hill); Grancam 1277 (*Eucalyptus grandis* W. Hill x *Eucalyptus camaldulensis* Dehnh.); and four pure genetic materials: 0020 (*Eucalyptus saligna* Sm.); 0010 (*Eucalyptus resinifera* Sm.); *Eucalyptus pellita* F. Muell. e *Corymbia torelliana* (F. Muell.) K. D. Hill & L. A. S. Johnson.

The used spacing was of 3 x 2 m with clonal seedlings of approximately 90 days of age deriving from the nursery of the Experimental Station of Forest Sciences (University of São Paulo), located in the municipality of Itatinga (SP). During the phases of growth and development of the plants in the field, the cultural and phytosanitary necessary treatments have been carried through.

In January 2017, when the plants had little less than four years, ten plants per plot were randomly selected to determine the following parameters: plant height (AP), determined through a digital clinometer ten meters away from the trunk; diameter at breast height (DAP), determined by means of direct reading with the help of a forest caliper, in centimeters; spad index (ISPAD), determined by means of direct reading of the digital meter CCM-200 model in leaves from the middle third of the plant.

Afterwards, random leaves were collected from the middle third of the plants of each plot to determine the leaf nitrogen tenor and morphoanatomical parameters. For the determination of foliar nitrogen tenor (N), leaf samples of each treatment were subjected to drying in a forced convection and air exchange oven at 65 °C until they reach constant weight. These samples were ground in rotating knives mill of Willey kind. Later, it was weighted 0.1 gram of each sample for digestion in sulfuric acid and determined the nitrogen tenor of those samples.

For evaluation of ultra structural characteristics, leaf fragments were removed from the middle of limbo with about five centimeters in length and fixed in FAA 70 (37% formaldehyde, 70% acetic acid and ethanol in the proportion of 1.0:1.0:18.0-V/V) for 24 hours. Then, they were washed and stored in 70% alcohol. The leaf fragments were sent to the Vegetable Morphophysiology and Forage-growing Laboratory of the Faculty of Agricultural and Technology Sciences of the São Paulo State University, located in the city of Walnut Creek, in São Paulo state, where they went through dehydration, cleaning, embedding and inclusion procedures, according to Krause Arduim (1997).

With the aid of a table microtome 8.0 µm transversal sections were made in each embedded leaf fragment containing the leaf midrib. For each embedded material, it was mounted a histological slide. For this assembly, it was chosen the first transversal section that presented the most preserved material, i.e. without damage or injuries caused by cutting in the plant tissues. The chosen sections have been fixed with adhesive with albumin. The sections were stained with safranin at 1% and mounted on slide and cover slip with adhesive Entellan® (KRAUS; ARDUIM, 1997).

Measurements of leaf parameters were performed in the leaf's central vein. The blades were observed in an optical microscope Olympus®, model BX43, containing a camera attached to take photographs of the cuts. The photographs were used for measurements of anatomical parameters by image analysis program cellSens Standard®, calibrated with the same microscopic ruler of photographs magnification.

Each experimental plot was represented by the average of 10 measurements of the analyzed parameters: thickness of adaxial cuticle (TADC), thickness of abaxial cuticle (TABC), adaxial epidermis thickness (ADET), abaxial epidermis thickness (ABET) diameter of xylem (DX), diameter of the phloem (DP) and Palisade cell length (PCL), according to Carlquist (1975).

In the data statistical analysis, the parameters were submitted to variance analysis by the F test ( $p < 0.05$ ) and their means compared by the Skott-Knott test at 5% probability. The statistical program used was the Assisat 7.6 Beta (SILVA; AZEVEDO, 2016).

## RESULTS

In the plant height (AP), the materials that presented the highest averages were NA-151 (*Eucalyptus urophilla* x *E. grandis*) and Grancam 1277 (*E. grandis* x *E. camaldulensis*), respectively, while the other species did not differ from each other, as shown in Table 1. On the other hand, for the parameter diameter at breast height (DAP), the materials with the lowest mean values were: 0020 (*E. saligna*), 0010 (*E. urophilla* x *E. grandis*) and *Corymbia torelliana*, being this last species the one which showed the smallest value.

Table 1. Average values of plant height (AP), diameter at breast height (DAP), spad index (ISPAD) and nitrogen tenor (N) of genetic material of the *Eucalyptus* and *Corymbia* genres, four years after planting.

Tabela 1. Valores médios de altura da planta (AP), diâmetro em altura de peito (DAP), índice de spad (ISPAD) e teor de nitrogênio (N) de material genético dos gêneros *Eucalyptus* e *Corymbia*, quatro anos depois de plantados.

	AP (m)	DAP (cm)	ISPAD (Unid.)	N (%)
I-144	15,26b	14,21a	24,22c	1,71c
H-13	14,60b	15,07a	32,36a	2,21b
110	15,46b	14,28a	21,48c	2,06c
NA-151	19,34a	16,25a	33,88a	2,55a
NA-189	15,06b	14,41a	17,18c	1,85c
Grancam 1277	18,40a	14,65a	27,30b	2,18b
0020	14,58b	13,32b	21,62c	1,66c
0010	16,10b	12,55b	25,22c	2,01c
<i>E. pellita</i>	16,46b	13,82a	29,32b	1,93c
<i>C. torelliana</i>	12,57b	12,09b	21,12c	1,81c
F	2,5977*	2,7634*	9,3448**	5,0176**
CV (%)	17,11	11,54	15,39	13,49
MG	15,78	14,07	25,37	2,00

\*\* : significant at the level of 1% probability ( $p < 0.01$ ); \* : significant at the level of 5% probability ( $0.01 \leq p < 0.05$ ); F: f value calculated in the variance analysis; CV: coefficient of variation; MG: overall average. The mean followed by the same letter does not differ statistically between themselves by Scott-Knott test at 5% probability level.

\*\* : significativo ao nível de 1% de probabilidade ( $p < 0,01$ ); \* : significativo ao nível de 5% de probabilidade ( $0,01 \leq p < 0,05$ ); F: valor do f calculado na análise de variância; CV: coeficiente de variação; MG: média geral. As médias seguidas pela mesma letra não diferem estatisticamente entre si pelo Teste de Scott-Knott ao nível de 5% de probabilidade.

With respect to the index spad (ISPAD) parameter, materials NA-151 (*Eucalyptus urophilla* x *E. grandis*) and H-13 (*E. urophilla* x *E. grandis*) presented the highest averages. For the leaf nitrogen tenor, just the material NA-151 (*E. urophilla* x *E. grandis*) showed the highest concentration of this element.

In the variable thickness of the adaxial cuticle (ECAD), Grancam 1277 materials (*Eucalyptus grandis* x *E. camaldulensis*), H-13 (*E. urophilla* x *E. grandis*), 0010 (*E. resinifera*) and *E. pellita* presented the best results as shown in Table 2. On the other hand, the thickness of the abaxial cuticle (ECAB), 0010 material (*E. resinifera*) presented the highest average.

Table 2. Average values of the thickness of the adaxial cuticle (ECAD), thickness of cuticle abaxial (ECAB), thickness of the adaxial epidermis (EEAD) and abaxial epidermis thickness (EEAB) of the genetic material of the genre *Eucalyptus* and *Corymbia*, four years after planting.

Tabela 2. Valores médios de espessura da cutícula adaxial (ECAD), espessura da cutícula abaxial (ECAB), espessura da epiderme adaxial (EEAD) e espessura da epiderme abaxial (EEAB) do material genético do gênero *Eucalyptus* e *Corymbia*, quatro anos depois de plantados.

	ECAD ( $\mu\text{m}$ )	ECAB ( $\mu\text{m}$ )	EEAD ( $\mu\text{m}$ )	EEAB ( $\mu\text{m}$ )
I-144	3,93b	5,16b	12,97b	11,24b
H-13	4,79a	4,47b	11,96b	12,51a
110	3,13b	3,39b	11,35b	9,44b
NA-151	3,85b	4,39b	9,69c	9,40b
NA-189	3,59b	4,22b	9,73c	10,48b
Grancam 1277	5,45a	4,63b	10,27c	10,59b
0020	3,48b	4,24b	11,81b	11,01b
0010	4,57a	6,51a	11,12b	10,66b
<i>E. pellita</i>	4,96a	4,76b	15,82a	14,38a
<i>C. torelliana</i>	3,92b	3,83b	6,92d	7,02c
F	4,0840**	3,8143*	7,3490**	6,1225**
CV (%)	19,65	21,11	17,25	16,46
MG	4,17	4,56	11,16	10,67

\*\* : significant at the level of 1% probability ( $p < 0.01$ ); \* : significant at the level of 5% probability ( $0.01 \leq p < 0.05$ ); F: f value calculated in the variance analysis; CV: coefficient of variation; MG: overall average. The mean followed by the same letter does not differ statistically between themselves in the Scott-Knott test at 5% probability level.

\*\* : significativo ao nível de 1% de probabilidade ( $p < 0,01$ ); \* : significativo ao nível de 5% de probabilidade ( $0,01 \leq p < 0,05$ ); F: valor do f calculado na análise de variância; CV: coeficiente de variação; MG: média geral. As médias seguidas pela mesma letra não diferem estatisticamente entre si pelo Teste de Scott-Knott ao nível de 5% de probabilidade.

It is important to point out that only the material *Corymbia torelliana* presented the minor averages for the parameters of thickness of the adaxial epidermis (EEAD) and thickness of the abaxial epidermis (EEAB) (Table 2).

In the parameter diameter of xilema (DX), statistics difference was verified, where the H-13; 110, NA-189 and *Corymbia torelliana* materials had presented the minor average, while in the phloem diameter (DF), only *C. torelliana* presented the lesser value, as demonstrated in Table 3.

Table 3. Average values of the diameter of xilema (DX), phloem diameter (DF) and length of palisade cell (CPP) of the genetic materials of the genera *Eucalyptus* and *Corymbia*, four years after the plantating.

Tabela 3. Valores médios de diâmetro do xilema (DX), diâmetro do floema (DF) e comprimento da célula paliçada (CPP) dos materiais genéticos dos gêneros *Eucalyptus* e *Corymbia*, quatro anos após o plantio.

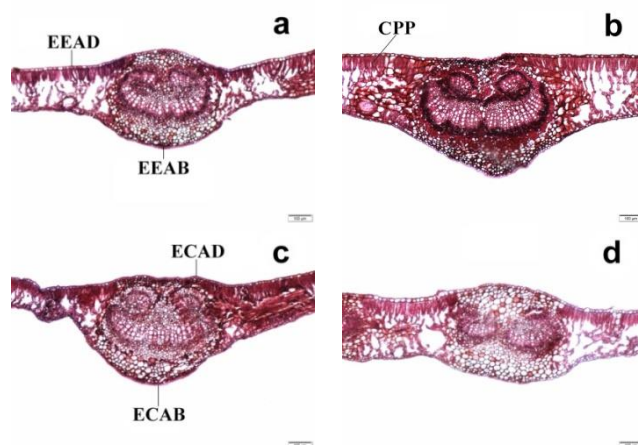
	DX ( $\mu\text{m}$ )	DF ( $\mu\text{m}$ )	CPP ( $\mu\text{m}$ )
I-144	19,57a	6,79a	51,77a
H-13	17,62b	5,05c	52,42a
110	16,04b	5,51b	45,80a
NA-151	21,30a	5,67b	38,87a
NA-189	15,80b	5,25c	42,88a
Grancam 1277	18,95a	5,99b	45,62a
0020	20,54a	6,98a	43,21a
0010	19,17a	5,79b	47,84a
<i>E. pellita</i>	21,32a	5,94b	51,26a
<i>C. torelliana</i>	15,51b	4,00d	25,42b
F	6,0386**	5,1200**	5,5921**
CV (%)	10,92	14,78	17,17
MG	18,58	5,70	44,48

\*\* : significant at the level of 1% probability ( $p < 0.01$ ); \* : significant at the level of 5% probability ( $0.01 \leq p < 0.05$ ); the averages followed by the same letter does not differ statistically between the Scott-Knott test at 5% probability; F: f value calculated in the variance analysis; CV: coefficient of variation; MG: overall average.

\*\* : significativo ao nível de 1% de probabilidade ( $p < 0,01$ ); \* : significativo ao nível de 5% de probabilidade ( $0,01 \leq p < 0,05$ ); F: valor do f calculado na análise de variância; CV: coeficiente de variação; MG: média geral. As médias seguidas pela mesma letra não diferem estatisticamente entre si pelo Teste de Scott-Knott ao nível de 5% de probabilidade.

In the palisade cell thickness (EPP), again, the material *Corymbia torelliana* showed lower average (Table 3).

In Figure 1, it is understood the difference of dimensions of the leaf tissue between the materials at the cellular level. In Figure 1J, in the material originated of species *C. torelliana*, it is possible to observe a sheet less thick and with less length of the palisade cell (EPP) in relation to other species.



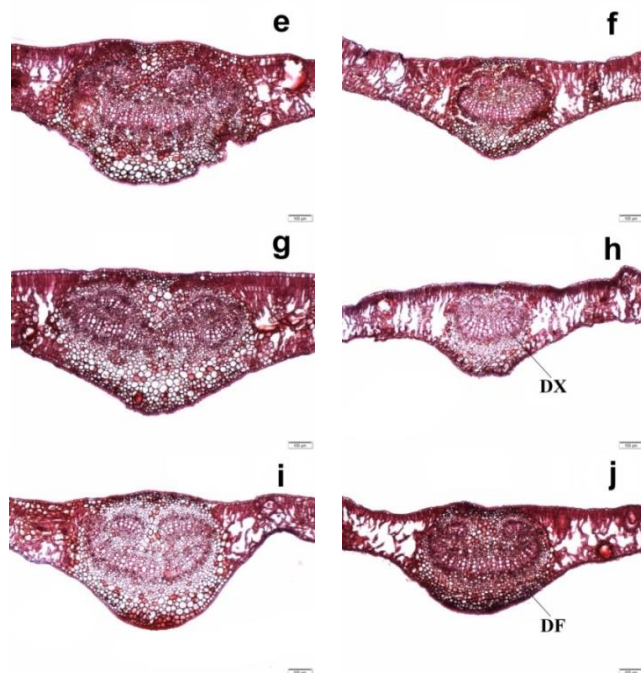


Figure 1. Transverse cuts in the leaves of the genetic materials evidencing the analyzed tissues. ECAD: thickness of the adaxial cuticle; ECAB: abaxial cuticle thickness; EEAD: thickness of the adaxial epidermis; EEAB: thickness of the epidermis abaxial; DX: diameter of xylem; DF: diameter of the phloem; and EPP: thickness of the palisade cell. 1A-I: genre *Eucalyptus*; 1J: genre *Corymbia*.

Figura 1. Cortes transversais nas folhas dos materiais genéticos evidenciando os tecidos analisados. ECAD: espessura da cutícula adaxial; ECAB: espessura da cutícula abaxial; EEAD: espessura da epiderme adaxial; EEAB: espessura da epiderme abaxial; DX: diâmetro de xilema; DF: diâmetro do floema e EPP: espessura do parênquima paliçádico. 1A-I: gênero *Eucalyptus*; 1J: gênero *Corymbia*.

## DISCUSSION

In the parameter diameter at breast height (DAP), the species *Corymbia torelliana* was the one that was the least outstanding. It is assumed that this response occurs because this material is pure and not hybrid as most of the materials under study. According to Butler *et al.* (2017), the genetic materials *E. grandis* e *C. torelliana* present chromosomal rearrangement between themselves, although in low rates, which can be coupled to different responses obtained in these parameters for both genera. It is important to emphasize that the species DNA does not always present a considerable relation with the phenotype, being characterized by low heritability.

Reis *et al.* (2014) report that the planting of *Corymbia torelliana* species was not accepted in commercial areas due to its poor performance in growth characteristics (AP and DAP), corroborating the data obtained in this study (Table 1). However, for forestry, this species plays a fundamental role at the cross-breeding in order to obtain interspecific hybrids with good performance in volume and quality of wood, which can facilitate its chemical structure degradation in Industrial reactions (HEALEY *et al.* 2016a; BARBOSA; FILOMENO; Teixeira, 2016; FORD *et al.*, 2011). The authors reported that the selection of superior hybrids, natural or by artificial pollination has taken place on species *Corymbia* spp., as well as in the species *C. citriodora*; *C. variegata* (F. Muell.) K. D. Hill & L. A. S. Johnson, *C. henryi* (S. T. Blake) K. D. Hill & L. A. S. Johnson e *C. maculata*.

The spad index values of this study were similar to those found by Pinkard *et al.* (2006) when they studied the correlation of the spad index with nitrogen concentration in leaves of plants grown in protected conditions or in the field, which corroborates the results of this work, in which the material that showed the highest index spad revealed the biggest nitrogen content in its leaves (table 1). The same authors also found differences between the species of eucalyptus trees for this chemical element. Sharwood *et al.* (2016), studying the effect of nitrogen in carboxylation of the RuBisCO molecule (ribulose 1.5-bisphosphate Carboxylase oxygenase) in species of *Eucalyptus globulus* Labill. found that the leaf position in the canopy of the plant and the time taken to collect the material influenced the carboxylative reactions and on leaf ultra structure.

The material 0010 (*Eucalyptus urophilla* x *E. grandis*) was one of the most outstanding materials in the thickness of the cuticles. However, this advantage did not reflect in its development, as observed in AP and DAP (Table 1), because thicker cuticles provide greater resistance to chemical and physical damages. This is due to its composition being composed primarily of waxy lipids, fatty acids and esters, which increases its impermeability and foliar rigidity. It is important to emphasize that concentrations of these substances may vary, as reported by Racovita and Jetter (2016), which verified values of 1.7 to 1.9  $\mu\text{g}^{-1} \text{cm}^2$  wax in the species *Phyllostachys aurea* Rivière & C. Rivière (Poaceae).

In an analogous way to the cuticle, the epidermis also plays a role of resistance, acting as a physical barrier to mechanical and herbivory damage of larvae and insects. This happens to be an indication that this feature is one of the most important in the resistance to rust fungus in the family Pucciniaceae (*Pucciniaapsidii* G. Winter), due to the material *Eucalyptus pellita* presenting greater thickness in the epidermis. As evidenced by Santos *et al.* (2014), when they had studied the resistance of eucalyptus *E. pellita* to rust, was verified that the heritability of the resistance to the rust was estimated between 32.7% 37.3%. Due to the complexity of the results obtained in their work, the authors had verified that the resistance to the rust has origin related to the greater and minor expression genes.

Regarding the xylem, the results obtained by Santini Júnior *et al.* (2010), when studying eucalyptus species, were not significant for the thickness and size of the xylem fibers, but it was verified that the species *Corymbia torelliana* presented the smallest diameter and a smaller number of vessels, corroborating the results of this work. Even if the material *C. torelliana* has presented the lowest foliar ultra structural results, this effect may not interfere in the quality of the wood, because, according to Conti Júnior (2008), the wood of this species can be used in furniture industry and construction by presenting smaller waste and lower rates of cracks (REIS *et al.*, 2014).

The difference observed in the length Palisade cell (table 3 and Figure 1J) may have triggered fewer chloroplast number, which leads to a less efficient photosynthetic rate, leading to a lesser development of plants, as demonstrated in the table 1. The material *C. torelliana* was the one which presented the smallest medium for the AP and DAP parameters. Still, this smaller development can be coupled to the smaller caliber of the phloem (table 3 and Figure 1J), leading to a lower efficiency in the distribution of photoassimilate.

The anatomical characteristics of a leaf or even its chemical composition present variability between trees of the same species or even in their cross-breedings, not demonstrating a unique pattern among the studied materials (OLIVEIRA *et al.*, 2012; TREVISAN *et al.*, 2013). Morphologically, one of the features presented by the leaves exposed to the Sun is the adequacy in relation to their surface and their volume, i.e., they present less leaf area with greater thickness. This way, they are smaller and heavier per unit of area in relation to the ones cultivated in the shade (ARAGÃO *et al.*, 2014; BÜNDCHEN *et al.*, 2015).

However, the levels of one exactly organism can present anatomical differences between the ones which situates in the superior portion of the crown and the ones of the inferior portion, due to radiation intensity that reaches them (PIRES *et al.*, 2015). Therefore, it is fundamental the understanding of leaf plasticity and its ultra structural dimensions in the tissues, due to its specific characteristics performed in the vegetal organs, that are directly related to its way of development (BRYANT; TRUEMAN, 2015).

## CONCLUSIONS

- The materials NA – 151 (*Eucalyptus urophilla* x *E. grandis*) and Grancam 1277 (*E. grandis* x *E. camaldulensis*) presented higher plant height (AP).
- The materials 0020 (*Eucalyptus saligna*), 0010 (*E. resinifera*) and *Corymbia torelliana* presented smaller diameter at breast height (DAP).
- In general, the genetic material *Corymbia torelliana* presented the lowest values to the evaluated foliar ultra structural parameters.

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