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Effects of growth regulators on the content of nutrients in leaves of a clone of *Eucalyptus grandis*

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Workshop Information

I Workshop of Plant Biology (I Workshop de Biologia Vegetal) was held in the Bioscience Institute – UNESP, campus of Rio Claro, Brazil, during August 20 and 21, 2012. Workshop was a scientific event organized by Post-graduate students from that Institute aiming to integrate Post-graduate and Graduate students from different areas related to Plant Biology (Anatomy, Ecology, Evolution, Morphology, Physiology, and transitional areas) from different Universities. Workshop Organization offered a large number of speaking activities, scientific discussions, and extra short-courses to improve the knowledge and formation of students in Plant Biology.

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INTRODUCTION

Growth regulators are synthetic substances applied exogenously on plants having actions similar to known groups of plant hormones (auxins, gibberellins, cytokinins, growth retarders, inhibitors, and ethylene) (Davies 2004). The plant growth regulators can act directly on different cell structures and cause them physical, chemical and biological (Castro and Vieira 2001).

Cytokinins can promote the transport of nutrients to the leaves from other plant organs, a phenomenon known as "mobilization of nutrients induced by cytokinin". Experiments have shown that nutrients are preferentially transported and accumulated in tissues treated with cytokinins, and suggested that the hormone stimulates the mobilization of nutrients, creating a new source-sink ratio (Taiz and Zeiger 2009). According to (Ribeiro et al. 1987), in induces sprouting, this hormone also plays the role of carrier of nutrients and hormones carrier to the apex of the plant. Among some products used as cytokinin are calciocianamide, thidiazuron (TDZ) and thiourea. The calciocianamide is a growth regulator belonging to the group of cytokines, according to Taiz and Zieger (2009), that stimulates cell division and according to Perussi (2009), the product leads to earlier and uniform bud break, increasing the total percentage of shoots and buds.

One of the most used cytokinins has been thidiazuron (TDZ). According to Petri et al. (1992), the TDZ is a synthetic cytokinin used in culture to cause defoliation of cotton, and tissue culture in vitro to induce sprouting.

According to Delatorre et al. (1997), some results indicate that the thiourea stimulates germination of estilosante mainly through the production of ethylene. It is known that thiourea acts on the entry of potassium in the embryonic axis, changes the respiratory mechanism acts on the remobilization of reserves, abolishes the requirement for light (Hernandez-Nistal et al. 1983) and interacts with ABA (abscisic acid) reducing its inhibitory effects (Mayer and Poljakoff-Mayber 1984).

This study aimed to evaluate the effects of applyed calciocianamide, TDZ and thiourea on the contents of macro and micronutrients in the leaves of shoots of an eucalyptus clone in two different siter.

MATERIAL AND METHODS

The present study was conducted using plants of a clone of eucalyptus (*E. grandis* x *E. urophylla*) due to being more responsive and homogeneous plant material on the issue of coppicing, besides having greater commercial importance. These stands were planted at a spacing of 3.00 x 2.75 m, in Brotas (SP) and Mogi Guaçú (SP). The predominant soils of the region of Brotas are Quartzipsamments and the predominant soils in Mogi Guaçú are Red Yellow Latosol (Demattê 2000).

This experiment consisted in the application of growth regulators to induce sprouting on stumps at the third day after clear cutting the forest. The experimental design was randomized blocks with four treatments and four replicates per treatment with 16 plants per plot. For the coppicing conduction with the addition of growth regulators were applied the following treatments were applied: T2 – complete ad.; T10 – complete ad. + calciocianamide; T11 - complete ad. + TDZ; T12 – complete ad. + Thiourea. The growth regulators were applied by brushing on the cambial region of the stemps.

Table 1. Levels of macro and micronutrients found after foliar shoots of a clone of *E. grandis*, at six months old, with application of growth regulators installed in the municipalities of Brotas and Mogi Guaçú, SP.

Trat.	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
	g kg $^{-1}$						mg kg $^{-1}$				
					Brotas/SP						
T2	22,6 a	1,3 a	8,7 a	4,1 b	2,3 b	1,3 a	51,8 a	7,6 a	60,1 a	323,4 b	10,8 a
T10	24,8 a	1,5 a	8,4 a	5,6 a	3,1 a	1,5 a	57,9 a	9,4 a	57,5 a	491,9 a	15,3 a
T11	23,2 a	1,4 a	9,0 a	4,6 a	2,6 a	1,4 a	57,4 a	9,0 a	57,9 a	395,4 a	12,3 a
T12	22,3 a	1,3 a	8,7 a	4,0 b	2,4 a	1,3 a	56,0 a	7,2 a	56,5 a	354,1 a	11,0 a
Mean	**23,2**	**1,4**	**8,7**	**4,5**	**2,6**	**1,4**	**55,8**	**8,3**	**58,0**	**391,2**	**12,3**
					Mogi Guaçú/SP						
T2	22,1 a	1,4 a	8,0 a	4,4 a	1,5 a	1,3 a	35,1 a	8,0 a	54,5 b	396,9 a	10,1 a
T10	21,9 a	1,3 a	7,8 b	4,8 a	1,5 a	1,1 a	34,1 a	8,4 a	74,0 a	365,5 a	9,8 a
T11	21,5 a	1,4 a	8,4 a	4,2 a	1,6 a	1,2 a	34,7 a	9,3 a	74,5 a	426,7 a	10,5 a
T12	22,0 a	1,4 a	7,8 b	4,5 a	1,6 a	1,2 a	29,4 a	8,6 a	88,0 a	376,3 a	10,2 a
Mean	**21,9**	**1,4**	**8,0**	**4,5**	**1,6**	**1,2**	**33,3**	**8,5**	**72,7**	**391,4**	**10,1**

Means followed by same letter do not differ significantly by Tukey test at 5% level of probability. T2 – complete ad.; T10 – Complete ad. + calciocianamide; T11 - Complete ad. + TDZ; T12 – Complete ad. + Thiourea

To analyze the nutrient content in leaves, there were collected at each cardinal point five leaves of the upper third of the crown in the penultimate flushing of leaves from the branches of four trees per plot generating a total of 20 leaves / tree. These samples gave rise to a composite sample per plot and were placed individually in plastic bags. The samples of plant tissues after drying in an oven with forced air at 65 ° C to constant weight were processed in mill type Willey (model MA680 / 1) and were chemically analyzed at the Laboratory of Applied Ecology (LEA), Department of Forest Sciences ESALQ.

The results were processed with SAS 9.1 statistical software for Windows. To evaluate the effect of treatments (independent variables) on the dependent variables, the results were submitted to ANOVA and mean comparisons by Tukey test, adopting a significance level of 5% (Storck et al. 2000).

RESULTS AND DISCUSSION

In the area of Brotas, no difference among the levels of N, P, K, S, B, Cu, Fe, and Zn in leaves *vs* treatments ($P > 0.05$). Ca and Mg differed among treatments and between blocks while the Mn differed only among treatments (Table 1). In Mogi Guaçú area, the K present in the leaves differ in relation to treatments and among blocks while the Mn values differed only between treatments. The other nutrients did not differ in their levels among treatments and between blocks.

Nutrient contents in the leaves in the experiment with addition of plant regulator, in Brotas K showed only the difference among treatments while in Mogi Guaçú significant difference only for the Ca Levels of other nutrients showed no difference from the application of growth regulators.

The application of growth regulators did not influence the levels of macro and micronutrients analyzed, their values were very close or even in some cases lower than those of control as the N, S and B. There was little variation in levels of B among treatments. The blank showed the highest levels of boron in leaves. However, the lowest levels, in descending order, were observed for treatments T11, T10 and T12, respectively.

Studies by Camili (2007) with the use of growth regulators on sprouting showed no significant effect on fertility. These data corroborate those presented in this

work, where the products used to break bud dormancy and induce sprouting of *E. grandis*, did not show any difference in nutrient content in leaves.

After the analysis made on the content of nutrients in eucalyptus leaves, it was found that there was no difference among levels and growth regulators tested. The non-differentiation among the treatments and nutrient content may have been derived from the action of growth regulators studied, since one of these functions is the regulation of stock and the mobilization of nutritive materials (Larcher 2006). However, the use of growth regulators did not interfere with the development of a positive height and diameter, and number of sprouts.

Although there were no field responses up to a year, studies by Florentino et al. (2011) found that the development of explants from *E. grandis* grown *in vitro*, was directly proportional to the concentration of BAP.

CONCLUSION

The application of growth regulators on tree stumps gave a slight increase in the levels of most nutrients absorbed and fixed in the leaves of a clone of *E. grandis*.

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