Carbon sequestration potential by different eucalyptus genotypes

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Introduction

Carbon sequestration can be defined as the carbon dioxide (CO_2) removal process from the atmosphere and subsequent release of oxygen (O_2) for several terrestrial or aquatic organisms, avoiding the permanence of this gas in the atmosphere.

Carbon sequestration by trees is a kind of Clean Development Mechanism (CDM), in which trees remove CO_2 from the atmosphere and stock it in different plant compartments (leaves, branches, stems and roots). With a large territory, favorable climate for plant growth throughout the year and advanced silvicultural technology, Brazil has strong vocation for forestry, fully complying with the provisions of the CDM.

Eucalyptus plantations are highly efficient in atmospheric CO_2 removal, because they can store large amounts of carbon in all plant parts. Due to Brazilian favorable climatic conditions (rainfall and photoperiod), it is possible to obtain high conversion rates of CO_2 into biomass by eucalyptus trees, due to rapid growth and consequently high productivity.

In Brazil, a large part of eucalypt plantations supply pulp and paper industry, maintaining therefore the carbon stored. Due to the high productivity, eucalyptus cultivation cycles for pulp and paper production last seven years in average, favoring atmospheric CO_2 capture, once growth rate for younger trees is higher compared to older trees. However, due to genetic diversity, different eucalyptus genotypes have different growth rates, which result in different carbon accumulation capacities.

Thus, the objective of this research was evaluating the productivity of eucalyptus relating it to potential carbon sequestration and accumulation by different genetic materials.

Material and Methods

The experiment was carried out at the Embrapa Beef Cattle research center in Campo Grande, Mato Grosso do Sul State, Brazil, located between the geographical coordinates: 20º27'02" S and 54º43'07" W.. Soil was a distroferric red latosol (LVdf), Climate under Köppen classification is a transition zone between Cfa and Aw wet tropical. Mean annual rainfall is 1,560 mm, with rainy summer and a dry light cold winter.

Experimental design was randomized block, with seven treatments and three repetitions. Seven Eucalyptus genotypes were used: 1277 (*E. camaldulensis* x *E. grandis*), I- 144 (*E. urophyla*), I-224 (*E. urophyla* x *E. grandis*) GG 100 (*E. urophyla* x *E. grandis*), H13 (*E. urophyla* x *E. grandis*), H77 (*E. urophyla* x *E. grandis*) and *Corymbia citriodora* (single genotype from seminal seedlings). All genotypes are classified as multi purpose. Each experimental plot had 48 plants, with 3 meters x 2 meters spacing (1,666 plants per hectare).

Measurements of total height and diameter at breast height (DBH) were performed at 48 months after planting. From the height and DBH data, the volume of timber per plant was calculated (using the form factor equal to 0.45) as well was the volume of timber per hectare, using the equation proposed by Porfírio-da-Silva et al. (2009).

The carbon contet on stem was determined using CN analyzer (Sumika Chemical Sumigraph CN 900), according to methodology employed by Kanda et al. (2004). CO_2 eq. was estimated using a conversion factor of 3.67.

Analysis of variance was carried out and, when there were significant differences up to 5% significance between means, these means were compared by Scott Knott test with 5% probability, using SISVAR software (Ferreira, 2008).

Results and Conclusions

Table 1 shows that 48 months after planting, genetic materials studied showed statistically significant differences for all traits. The DBH values of clones I-144 and I-224 were similar to those for the GG 100 and 1277 clones, but the GG 100 and 1277 clones showed greater heights of plants.

Analyzing volume of timber per tree, it can be noticed a formation of three distinct groups, where H77 and H13 clones and *C. citriodora* genotype had the worst performers and GG 100 clones and 1277 the best production of timber per tree, with the others genotypes in the intermediate group. Production of timber per hectare was linearly influenced by these results, keeping the same groupings for that characteristic.

Table 1. Averages of diameter at breast height (DBH), height, volume of timber per tree (Vol./tree) and volume of timber per hectare (Vol./hectare) of different eucalyptus genotypes.

Genotype	DBH (cm)	Height (m)	Vol./tree (m^3 $tree^{-1}$)	Vol./hectare (m^3 ha^{-1})
C. citriodora	0.09 b	8.97 b	0.02 c	40.74 c
H77	0.10 b	9.51 b	0.03 c	57.65 c
H13	0.10 b	10.14 b	0.04 c	63.88 c
I-224	0.13 a	10.65 b	0.06 b	100.36 b
I-144	0.12 a	11.27 b	0.05 b	93.56 b
1277	0.13 a	12.41 a	0.07 a	123.06 a
GG 100	0.13 a	13.61 a	0.08 a	140.55 a
CV (%)	8.54	8.99	21.51	20.04

Means followed by the same letter in the column are not different by Scott-Knott test ($P > 0.05$).

Wood yield (m^3 ha^{-1}) has direct relation with the capacity to sequester and store carbon from the atmosphere by trees, so it can be seen in Figure 1 that the GG 100 and 1277 clones were superior to others when the accumulated carbon content is considered in the tree stem and the equivalent carbon dioxide amount removed from atmosphere.

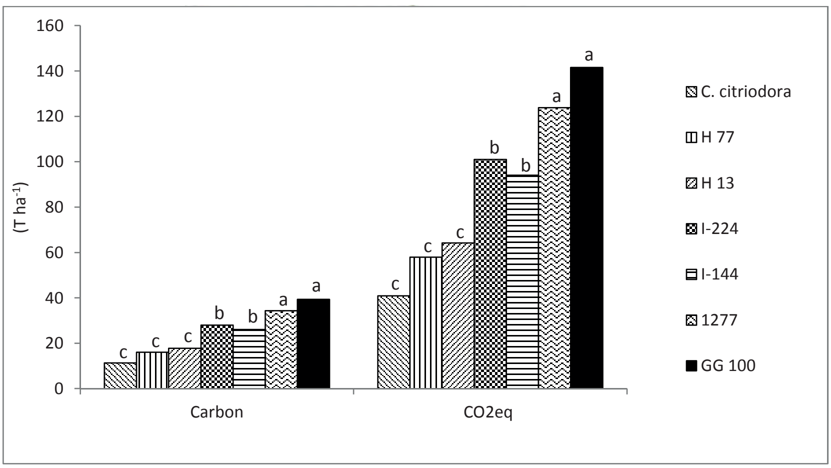

Figure 1. Accumulated carbon amount in the tree stem and amount of CO_{2eq} removed from the atmosphere by the different eucalyptus genotypes at 48 months of age.
Bars with the same letter within each characteristic, do not differ by Scott-Knott test ($P > 0.05$).

Thus, it can be concluded that there is variability in the carbon sequestration capacity by different eucalyptus genotypes and the GG 100 and 1277 clones have the greatest potential for environmental services when it comes to capturing atmospheric carbon dioxide.

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