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ESTIMATES OF YIELD SAWN WOOD OF EUCALYPTUS AGED 15 YEARS IN CLFI SYSTEM

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ABSTRACT
Trees in the Crop-Livestock-Forest Integration (CLFI) systems represent an opportunity to increase income on the farm through the sale of wood. Sawn wood is the product with the highest value and highest rate of return for producers. The objective of this work was to evaluate the potential of production and yield of eucalyptus wood in CLFI system with growth projection for the age of 15 years, in the Brazilian Cerrado. In October 2011, 333 eucalyptus ha^{-1} trees were planted, arranged in simple rows at 15 x 2 m spacing, in an CLFI system. With the sampling of 40 trees, the growth was evaluated annually. After 97 months, the trees reached an average height of 27.8 meters, with an average diameter at breast height of 21.9 cm and an average volume of 153.6 m^3 ha^{-1} of wood. Wood production was projected for 15 years age, in which 220.34 m^3 ha^{-1} of wood would be produced, 50.64 m^3 ha^{-1} of which could be used as sawmill wood. The producer can view attractive markets for the commercialization of his product and plan its sale, when estimating the potential of wooden pieces that may be benefited from its tree population at any given time.
Key words: Crop Livestock Forest Integratio; wood splitting; projection

INTRODUCTION

Trees in Crop Livestock Forest Integration system (CLFI) provide important environmental and economic benefits to agricultural production in this system. Favoring the cycling of nutrients, contributing to the maintenance of soil fertility (SALTON et al., 2014) and presenting a great potential to carbon sequestration (ASSAD et al., 2019), the forestry component also adds wood production, as an opportunity to increase income on the property.

The market for planted forest products, including sawn wood, has been growing in recent years. According to the Brazilian Tree Industry, only 4% of the area planted with forests is destined for the solid wood products industry (IBA, 2019). Rural producers who have invested in the CLFI system, in addition to selling wood for coal to the energy sector, may also have the opportunity to offer wood to the sawn wood segment, enabling the formation of new regional poles that consume wood (DANIEL et al., 2019). The sawn timber market provides highest value and higher rates of return to producers (PAIXÃO et al., 2006; TONINI et al, 2019).

In CLFI systems, the forest component must remain long enough for large diameters logs to be obtained, of high quality can be obtained for noble purposes, such as the manufacture of furniture and lamination, since the number of plants per area is low (FRANCHINI et al., 2018). The influence of age is an extremely important factor, as it contributes to the formation of adult wood, with greater density and a higher percentage of heartwood (PLASTER et al., 2012; SERPA et al., 2013). Sette Jr. et al. (2012) report that the basic density of E. grandis trees increases with advancing age, forming the adult wood. And density is considered one of the basic indicators for most wood applications, for example, medium density wood may be suitable for furniture, cellulose and paper, etc. Higher density wood may be indicated for structural purposes, such as the manufacture of houses and bridges (CAIXETA et al., 2003).

In this sense, the objective of this work was to estimate the production potential and wood yield of an CLFI system after 15 years of its establishment, planted in the Brazilian Cerrado. For the purpose of this study, the age of 15 years was considered, when the eucalyptus reaches wood with reasonable maturity to obtain sawn pieces, due to the greater proportion of heartwood in relation to sapwood, based on information from sawmills in activities that operate with eucalyptus wood (oral communication).

MATERIAL AND METHODS

The CLFI system was established in Sete Lagoas city, in Brazil, at Embrapa Milho e Sorgo, in October 2011, composed of six simple lines of the GG100 clone, of Eucalyptus Grandis x urophylla, with 100 meters in length, in 15 x 2 meters spacing, forming a stand of 333 trees per hectare. The city is located in the central region of Minas Gerais state, at 708 m altitude, with a Cwa climate (dry in winter and hot in summer) (KÖPPEN, 1936 cited by ALVARES et al., 2013), and average annual rainfall of 1,335 mm. The soils were classified as typical dystrophic Red Latosols (LVd) are within the subcaducifolian Cerrado area.

One month before planting, 2 t ha^{-1} of dolomitic limestone were applied to the experimental area. The seedlings were planting with 200 kg ha-1 of simple superphosphate fertilizer. After seven days, 120 g $plant^{-1}$ of NPK 06-30-06 + 0.5% B + 1.5% Zn were applied, with 60 days, 120 g $plant^{-1}$ of NPK 20-00-20, to 13 months, 200 g $plant^{-1}$ of 20-00-20 and, at 16 months, 15 g $plant^{-1}$ of boric acid. At 24 months, the trees branches were removed up to 1/3 of their height.

During the 2011/2012, 2012/2013 and 2013/2014 crop growing season, the corn/ grass/ eucalyptus consortium was made. Corn (AG 8088 VT PRO) was sown between the eucalyptus rows in November, together *Urochloa brizantha* cv. Piatã. Fertilization of 400 kg ha^{-1} of NPK 08-28-16 were added to the soil at planting and 250 kg ha^{-1} of urea in the top dressing. The corn was harvested in May, and the pasture remained until the beginning of October, when the grass was desiccated for planting the new crop. After the initial three years, only the grass was kept between the eucalyptus lines, grazed by cattle, in the ICF system.

Eucalyptus growth was evaluated annually, with measures of diameter at breast height (DBH) measured with suta, and the total height (H) was measured with an electronic hypsometer, in 10% of the population. The volume (m^3 ha^{-1}) was estimated by an equation adjusted with the model by Schumacher and Hall (1933). The growth projection was carried out for the age of 15 years. The methodology used the Weibull distribution with three parameters, adjusted by the percentile method (WENDLING et al., 2011), and regression functions created from the relationship between the data for monitoring planting. Its implementation is part of the CalcMadeira software, still in its primitive version (COSTA et al., 2020).

RESULTS AND DISCUSSIONS

At 97 months of growth, the trees reached an average height of 27.8 meters, with an average diameter at breast height (DBH) of 21.9 cm. The estimated average volume of wood was 153.6 m^3 ha^{-1} (Figure 1).

A greater production of eucalyptus tree in CLFI in the Brazilian Cerrado is described in the literature (OLIVEIRA NETO et al., 2013; LEMOS JÚNIOR et al., 2016). The development of plants depends on intrinsic characteristics of the site, such as climatic and nutritional factors. In the region of Sete Lagoas, in the years 2013 to 2016, there was a predominance of water deficit (see CAMPANHA et al., 2017), which certainly compromised the growth of trees.

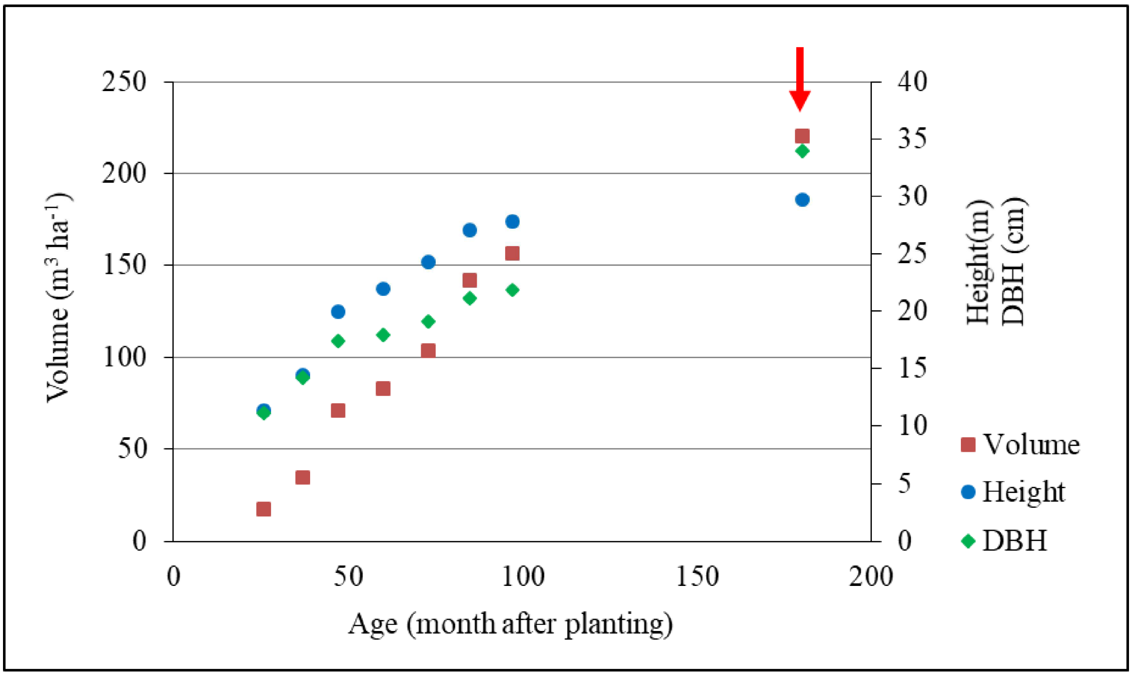

Figure 1. Average volume, height and diameter at breast height (DBH) per hectare, of eucalyptus trees at different ages, in CLFI system in the Brazilian Cerrado. The arrow indicates the projected values for 180 months.

As at the age of eight the eucalyptus is not yet suitable for cutting sawn wood, requiring diameters larger than 18 cm to delimit the commercial height, the production of wood was projected for the year 2026, a period in which 15 years of planting would be completed. The results of the split and the dimensions used for the pieces are shown in Table 1. The total volume was 220.34 m^3, with 50.64 m3 being used in sawn pieces with a 30% yield in relation to the volume of logs (171.01 m^3). The residue, referring to the wood that was not used in the sawmill, results in a surplus of 167.17 m^3 of wood that could be used for firewood, charcoal or wood chips.

With the possibility of estimating the quantity and volume of pieces of wood that may be benefited, the producer will be able to plan the appropriate moment for their sale, whether in the present or future. Although larger trees, in diameter and height and at an older age, can reach cut dimensions for products with higher added value, the cut intervention in a stand depends a lot on the need for financial resources and market opportunities seen by the producer.

Table 1. Projection of production and splitting of eucalyptus wood, for 180 months (15 years), planted in 1 ha in the CLFI system in the Brazilian Cerrado.

Use for swan wood	Cutting priority	Width (cm)	Thickness (cm)	Pieces by use (quantity)	Volume used (m^3)
batten	9	2 - 10	2 - 4		
big slat	8	5 - 7	2 - 2		
rafter	7	5 - 8	4 - 8		
prop	6	7 - 8	7 - 8		
slat	5	2 - 5	1 - 2	383	0.41
beam	4	8 - 16	4 - 8		
board	3	10 - 100	1 - 4	2,140	26.53
plank	2	16 - 100	4 - 7		
big plank	1	16 - 100	7 - 16	683	23.70
a) Volume of swan wood*				3,205	50.64
b) Volume of wooden tips (= d-c)					49.33
c) Wood logs volume					171.01
d) Total volume of pieces of wood					220.34
e) Sawdust residue (= d-a)					167.17

CONCLUSIONS

The integration of grain production with livestock, in CLFI systems, presents itself as potential in relation to the forestry component, as eucalyptus planted in this system have production conditions for the supply of sawn wood. Expectations for the production of wood with higher added value can be a better alternative for the rural producer who has the availability of permanence of his trees for long periods. In this sense, the work developed here provides subsidies so that the producer can visualize attractive markets for the commercialization of his product, being the estimate of the split of the wood an important tool for the planning of the cutting of the trees.

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