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Biomass accumulation in a pasture of *Brachiaria decumbens* grown in a silvopastoral system with Eucalypt in the southeast of Brazil

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Introduction

Rapid population growth, together with the effects of climate change, increased the pressure over pastures worldwide. Croplands and pastures dominate approximately 40% of the planet, which has made them the main anthropogenic terrestrial biome. In the case of Brazil, pastures occupy 180 million hectares, and in the south of the country, 47% of productive land is pasture. Pastures are mainly open areas, without any tree cover, showing a desolating picture. There is, therefore, an opportunity to use these areas to silvopastoral systems with eucalypt as a way to relate timber and cattle production. This silvopastoral systems also allows diversifying products in the same unit of area, which adds value to the rural property through timber exploitation and its secondary products (Ribaski and Rakocevic, 2002). Besides, planting with eucalypts around a one-hectare plot can satisfy 50 to 75% of the wood needs of a five-member family. Solar radiation has been found the main factor in determining vegetative growth rates and their productivity (Bernardes *et al*., 1998), also there may occur a complementary use of radiation due to specific requirements when the combinations of crops in the agroforestry system is more efficient than the monocrops of each of their components (Castro and Bernardes, 2001). Estimating the growth of plants in mathematical models depends, to a big extent, on estimating solar radiation available and intercepted by the tree canopy. There are few studies about the use of solar radiation by the vegetation in a mixed species planting. The measures of radiation are rarely taken in studies and very few relate that factor to plant growth. Measures of solar radiation are still rarer in studies on agroforestry systems. There are clear indications that monocultures under use the resources available with negative effects on the productive system and the need for human intervention for their maintenance. There is the need to conduct experiments regarding the development of structures that maximize the capture and use of solar radiation with an increase in productivity. In this study, we relate solar radiation availability with grass growth. We hope to establish parameters to better conduct sustainable SSPs adapted to the tropical environment. As scientific evidences accumulate we hope to develop growth and production models for silvopastoral systems.

Materials and Methods

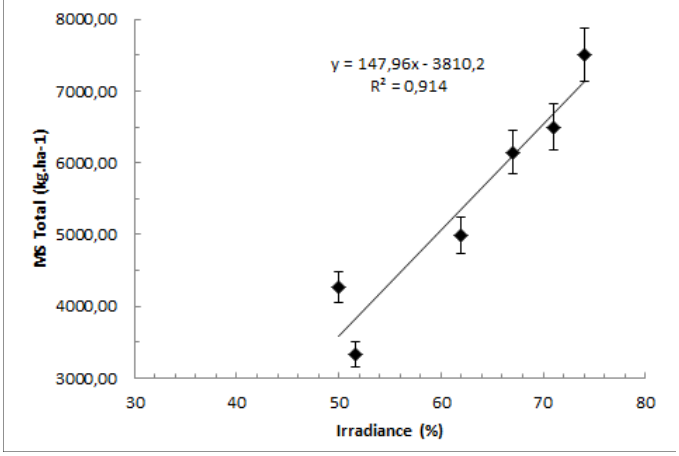
The experiment was conducted in the Experimental Field Station of Forestry Sciences Anhmebi/SP (EECFA), from the Forestry Department of ESALQ University of Sao Paulo. The soils that predominate are Latosoils and Quartzareni neosoils, the climate is Cwa according to Köppen with a mean temperature of 23°C and an annual precipitation of 1100 mm. In this study we examined the relationship between biomass production of *Brachiaria decumbens* and solar radiation availability. A hybrid species of *Eucalypt grancam* COP-1377 (*Eucalyptus grandis* x *Eucalyptus camaldulensis*), was planted in 2011 in two spacings: 24 and 42 m between alleys and 3x2 m between planting lines in a 10 ha area; in turn, the grass was present in the alleys. To collect the grass a systematic sampling was conducted at a distance of 7.5, 10.5, 13.5, and 19.5 m from the first planting line in both margins. For that purpose, a square wooden quadrat of 0.25 m^2 was placed at each point and the height of the grass were measured. All vegetative material inside the quadrat was collected and placed in coded paper bags. In the laboratory the grass was separated in three components: leaves, stalks and dead material, and oven dried at 65°C until reaching a stable weight. Dried vegetative materials were weighed in a precision scale to obtain the grass dried material. With the results we estimated the total dried material in kg/m^2. In the silvopastoral system the height and crown length of the *Eucalypt grancam* COP-1377 in between the margins of the inter-lines was determined and the percent solar radiation was estimated using the model proposed by Bernardes (2015):

$$\mathbf{Ir = ½ * \{sen\ [arctg\ ((d_1 - (cw_1^2/d_1))/Hr_1)] + sen\ [arctg\ ((d_2 - (cw_2^2/d_2))/Hr_2)]\}}$$

Where Ir is the percentage of the incident radiation available to the pasture, d is the distances from a certain position in the pasture to the tree rows, cw the crown width of the trees, Hr is the relative height of the trees (tree height - pasture height), in the row 1 and 2, respectively.

Results and Discussion

Fig. 1: Grass dry matter (kg ha^{-1}) as a function of the available irradiation (%) IR.



We observed that with 50% radiation, a production of 4269 kg ha^{-1} were obtained and with 74% radiation 7502 kg ha^{-1} were obtained, showing that *B. decumbens* does not tolerate intense shade and that with radiation level less than 65%, the pasture production gets reduced. These findings agree with Paciullo *et al.*, (2007). On the other hand, the production of *B. decumbens* was greater than in the SSP of Carvalho (1997) with 6.3 t ha^{-1}. Besides, we obtained 75% of the production in the open (9.97 t ha^{-1}) which shows that SSP maintains pasture production while adding another factor of rent: timber.

Conclusion

We observed a close dependence of biomass production with solar radiation. The use of a mathematical model proposed by Bernardes (2015) can be used to plan SSP.

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