International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume:04, Issue:03 "May-June 2018"

SEEDLINGS OF *Ficus gomelleira* Kunth. AT DIFFERENT LIGHT CONDITIONS AND RECIPIENT VOLUME IN MATO GROSSO STATE, BRAZIL

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ABSTRACT

Natural forests are the main sources of raw material for the timber industry in Mato Grosso State of Brazil. *Ficus gomelleira* is one of the species explored and the knowledge of techniques to produce seedlings for the formation of commercial reforestation or conservationists is necessary. The aim of this study was to verify the development of seedlings at different levels of shading and volume of the container. The experimental design was completely randomized in the 4x4 factorial scheme (4 levels of shading, 70%, 50%, 30% and 0% and 4 volumes of substrates, 50, 110, 290 and 400 cm^3) with 20 plants per plot. The evaluated characteristics were height, diameter, number of leaves, root dry mass, aerial part dry mass and total plant dry mass. The recipients with 290 and 400 cm^3 combined with 0 and 30% shading provided the highest values of root dry mass (46.18, 51.83, 43.87, 42.66 g), total dry mass (56.39, 63.28, 57.32, 62.80 g) and Dickson Quality Index (2.11, 2.43, 2.03, 2.25). The highest dry mass values of the aerial part were obtained with 400 cm^3 recipient and under shading condition. The largest diameter and height of the plant in 70% of shading. The highest quality seedlings were obtained in full sun in the containers with 290 cm^3 or 400 cm^3. But considering the economy in substrates are indicated 290 cm^3 recipients.

Keywords: Seedlings quality, Shading, Substrate volume, Morphological parameters

INTRODUCTION

The Moraceae family has approximately 800 species of the genus *Ficus* L. distributed in the tropical region, of which 100 to 120 occur in the Neotropical Region, being recognized 76 native species in Brazil (Pelissari & Romaniuc Neto, 2013) and *Ficus gomelleira* Kunth. is one of these species that occurs in the northern region of Mato Grosso State. *Ficus gomelleira* was one of the

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50 native forest species planted in 2000 ha by ONF (Office National des Forets), from 1999 to 2003, at the São Nicolau Farm in the Municipality of Cotriguaçu in Mato Grosso State, as part of the commitment assumed by Peugeot French company with the "Carbon Well", when the installation of the factory of the brand in Brazil.

Natural forests are the main sources of raw material for the timber industries of Mato Grosso (IBAMA 2008) and in the period from 2004 to 2010 the state commercialized 411 forest species distributed in 97 genera and 34 botanical families (Ribeiro 2013) and among them *Ficus gomelleira*. For most species the techniques of seedling production and development of forest plantations are unknown, which puts the conservation and future exploitation.

The growing demand for native forest species for the formation of commercial reforestation or for conservation purposes generates more and more the need for seedlings production of these species and success depends on the prior knowledge of their developmental characteristics (Cunha *et al*., 2005). The procedures and technical recommendations for the production of quality seedlings are scarce and restricted to those that present greater economic interest.

Light availability and substrate volume are some of the factors that influence the development of nursery seedlings. The different degrees of luminosity cause morphological and physiological changes in the plant and the degree of adaptation depends on the particular characteristics of each species in interaction with its environment (Scalon *et al*., 2003). Artificial shading through the use of "sombrite" type screens is one of the methods used to study the luminous needs of different species under nursery conditions, since it is a practice capable of isolating and quantifying the effect of light intensity and providing the plots experimental conditions of illumination, when compared to studies under natural conditions (Rêgo & Possamai, 2006).

Researches on the growth of tree seedlings native to Brazil under different light conditions have been performed by some authors. *Hymenaea parvifolia* seedlings showed higher dry mass production under 50% shading (Silva *et al*., 2007), while *Caesalpinia pyramidalis* seedlings were not affected by light (Dantas *et al*., 2009). Other studies indicate that the decrease in the volume of the substrate causes a restriction of root system growth, resulting in lower plant height, as observed for *Eucalyptus grandis* (Gomes *et al*., 2003) and *Peltophorum dubium* (Brachtvogel & Malavasi, 2010).

Considering the importance of *Ficus gomelleira* in the northern region of Brazil for the recovery of areas and wood production, the present study was conducted with the objective of verifying the development of seedlings at different levels of shading and volume of the recipient.

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MATERIALS AND METHODS

The experiment was carried out in the nursery of the Federal Institute of Mato Grosso (IFMT), located in the Municipality of Juína - Mato Grosso State, Brazil (11º26'54.5 "S and 58º43'21,3"W). According to Köppen and Geiger the climate classification of the experiment site is Aw. The mean temperature in 2016 and 2017 was 24.8 °C and the mean annual precipitation in the two years was 1170 mm (data provided by the Weather Station of National Institute of Meteorology – INMET).

Ficus gomelleira fruits were collected in March 2016 at coordinates 11º26'58.8"S and 58º43'40.1"W and taken to nursery covered with low density polyethylene film at IFMT where they were kept on a plastic tray for 20 days for drying. The nuts were stored in a 1 kg kraft paper bag and stored on shelves at room temperature in the Juína Campus warehouse until the time of sowing.

Seeding was carried out at the beginning of May 2016 in wooden boxes filled with sawdust and kept in the nursery. The irrigation was done daily and the seedlings with two final leaves were transplanted to tubes and trays filled with commercial substrate Plantmax Florestal on July 23, 2016.

The experimental design was completely randomized in the 4x4 factorial scheme (4 levels of shading, 70%, 50%, 30% and 0% and 4 volumes of substrates, 50cm^3, 110 cm^3, 290 cm^3 and 400 cm^3) with 20 plants per plot. All plants were fertilized monthly with MAP fertilizer (mono-ammonium phosphate) in the dilution of 20 grams of MAP in a 10-liter irrigator distributed in 196 tubes or cells. Irrigation was sprayed daily.

The characteristics evaluated at 180 days after transplant were plant height (measuring the distance between the neck and the apex of the shoot), diameter (measured at the base of the seedling), number of leaves, root dry mass, mass dry matter of the aerial part, dry mass of the total plant. For the determination of dry mass of the seedlings, eight plants per plot were removed and taken to the Solab dryer model SL - 102 with air circulation for 48 hours at a temperature of 65 ºC. The dry mass was obtained in an electronic digital scale, Edutec brand, model EJ-320 A to the nearest 0,01g. The Dickson Quality Index (DQI) was determined as a function of total dry mass (TDM), plant height (PH), lap diameter (DIAM), aerial part dry mass (APDM) and root dry mass (RDM), by means of the formula (DICKSON et al., 1960):

$$DQI = \frac{TDM(g)}{\frac{PH(cm)}{DIAM(mm)} + \frac{APDM(g)}{RDM(g)}}$$

Statistical analyses were performed by the computer program System for Analysis of Variance - SISVAR. The means were compared by the Scott Knott Test at 5% probability.

RESULTS AND DISCUSSION

The analysis of variance was significant for shade, recipient volume, and interaction between these for all characteristics evaluated, except for the number of leaves (Table 1).

Table 1: Summary of variance analysis for root dry mass (RDM), aerial part dry mass (APDM), total dry matter (TDM), diameter (D), plant height (H), number of leaves (NF) and Dickson Quality Index (DQI) of *Ficus gomelleira* seedlings at different levels of shading and container volume, Juína-MT, Brazil, 2018.

Source of Variation	GL	Mean Square						
		RDM	APDM	TDM	D	A	NF	DQI
Shading	3	924.48**	94.68**	483.18**	1.99**	49696.38**	2.46**	0.20**
Recipient volume	3	3549.13**	1074.80**	8370.29**	23.18**	66157.64**	6.04**	7.46**
Shading x r. volume	9	179.64**	30.82*	110.28*	0.34**	3296.48**	0.27^{ns}	0.17**
Error	48	21.33	13.99	45.73	0.08	847.48	0.15	0.05
CV (%)		20.34	36.99	20.61	8.15	20.54	10.66	16.66

(**) significant by the F test at the 1% probability level; (*) significant by the F test at the 5% probability level; (n.) is not significant; CV = coefficient of variation.

The averages for the characteristics evaluated in *Ficus gomelleira* seedlings are shown in Table 2.

Table 2: Root dry mass, aerial part dry mass, total dry mass, diameter, plant height, leaf number, and Dickson Quality Index (DQI) of *Ficus gomelleira* Kunth. submitted to different levels of shading and recipient volume, Juína-MT, Brazil, 2018.

shading (%)	recipient volume (cm^3)				
	root dry mass (g)				
	50	110	290	400	mean A
0	5.68 aC	17.60 aB	46.18 aA	51.83 aA	30.32 a
30	8.79 aB	13.79 aB	43.87 aA	42.66 bA	27.27 a
50	9.38 aB	13.28 aB	27.06 bA	29.48 cA	19.80 b
70	4.93 aB	6.62 cB	18.46 cA	23.72 cA	13.43 c
mean B	7.19 C	12.82 B	33.89 A	36.92 A	
	Aerial part dry mass (g)				
0	1.64 aB	3.79 aB	10.21 aA	11.45 bA	6.77 b
30	2.51 aC	4.42 aC	13.45 aB	20.15 aA	10.13 a
50	2.55 aC	4.98 aC	12.48 aB	24.19 aA	11.05 a
70	2.66 aC	5.85 aC	16.09 aB	25.41 aA	12.50 a

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mean B	2.34 C	4.76 C	13.06 B	20.30 A	
	total dry mass (g)				
0	7.31 aC	21.39 aB	56.39 aA	63.28 aA	37.09 a
30	11.29 aB	18.21 aB	57.32 aA	62.80 aA	37.41 a
50	11.93 aC	18.26 aC	39.53 bB	53.67 bA	30.85 b
70	7.59 aC	12.47 aC	34.55 bB	49.13 bA	25.93 c
mean B	9.53 D	17.58 C	46.95 B	57.22 A	
	diameter (mm)				
0	2.09 bD	2.69 aC	3.63 cB	4.06 cA	3.12 c
30	2.29 bD	2.78 aC	4.63 aB	5.09 bA	3.69 b
50	2.57 aC	2.94 aC	4.07 bB	5.10 bA	3.67 b
70	2.58 aD	3.02 aC	4.52 aB	5.72 aA	3.96 a
mean B	2.38 C	2.85 C	4.21 B	4.99 A	
	plant height (mm)				
0	47.23 bB	73.10 bB	108.53 cA	117.58 cA	86.61 c
30	65.28 bB	85.00 bB	156.93 bA	182.39 bA	122.40 b
50	68.49 bC	94.11 bC	174.72 bB	220.34 bA	139.41 b
70	103.11 aC	170.97 aB	281.92 aA	318.19 aA	218.55 a
mean B	71.03 D	105.79 C	180.52 B	209.62 A	
	leaf number				
0	2.56 bB	3.13 aA	3.69 bA	3.25 bA	3.16 c
30	2.69 bC	3.53 aB	4.25 aA	4.29 aA	3.69 b
50	3.13 aC	3.35 aC	4.16 aA	4.79 aA	3.85 b
70	3.38 aB	3.81 aB	4.47 aA	4.66 aA	4.08 a
mean B	2.94 C	3.46 B	4.14 A	4.25 A	
	DQI				
0	0.62 aC	1.01 Ba	2.11 aA	2.43 aA	1.54 a
30	0.68 aB	0.92 aB	2.03 aA	2.25aA	1.47 a
50	0.72 aC	0.95 aC	1.40 bB	2.08aA	1.29 b
70	0.82 aC	1.13 aC	1.50 bB	2.02 aA	1.37 b
mean B	0.71 D	1.00 C	1.76 B	2.20 A	

* Equal lowercase letters in the column and upper case in the rows indicate absence of significant difference between recipient volume and shading levels, respectively, according to Scott Knott's 5% probability test.

It is verified that the largest volume of the recipient (400 cm^3) provided the highest values for all characteristics evaluated, as was also verified in *Bauhinia forficata* Link. (Viana *et al*. 2008).

Substrate volumes 290 and 400 cm^3 combined with 0 and 30% shading provided the highest values of root dry mass, total dry mass and IQD. Possibly the largest space for root development combined with monthly fertilization, and therefore nutritional supplementation, was responsible for this result. While the contribution of the greater luminous intensity to the increment of the dry mass of the roots can be explained by Silva *et al*. (2007), that is, plants under greater light intensity have a greater accumulation of dry mass in the root allowing a greater absorption of

ISSN: 2455-6939

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water and nutrients, a strategy that would guarantee to the plant the ability to withstand higher rates of photosynthesis and transpiration in more enlightened environments.

The forest species in Brazil have been studied in different volumes of recipients (Farias Júnior *et al*., 2007; Pereira *et al*., 2010; Coêlho *et al*., 2013). Thus, seedlings of *Pterogyne nitens* Tull. (Bomfim *et al*., 2009), *Hymenaea courbaril* L. (Caixeta *et al*., 2013) and *Caesalpinia peltophoroides* Benth. (Pinto *et al*., 2017) had better development in container with higher volumetric capacity of substrate.

The highest dry mass values of the aerial part were obtained with recipient volume of 400 cm^3 and in shading condition and the largest diameter and height of the plant in 70% of shading. In a study with *Erythrina velutina*, it was verified that the plant height presents an inversely proportional behavior to the levels of luminosity received by the plants, since the rapid development obtained by the shaded seedlings is due to the search for luminosity by the less favored plants and this is common in areas where there is competitiveness among species (Melo & Cunha, 2008). In a study with another species of the Brazilian forest formations, *Tabebuia heptaphyilla* plants grown in an environment with 50% of luminosity greater growth in height than those cultivated in full sunlight (Siebeneichlen *et al*., 2008).

The highest average number of leaves of *Ficus gomelleira* seedlings occurred under shading conditions and in containers with a higher volume of substrate (290 and 400 cm^3). The DQI was higher than the minimum value of 0.20, recommended by Hunt (1990). This index is a good indicator of the quality of the seedlings, since it takes into account the robustness and the balance of the biomass distribution of the seedlings, considering several parameters considered important and the higher the value, the better the quality standard of the seedlings. changes (Gomes & Paiva, 2004).

Thus, considering the DQI, total dry mass and root dry mass, which ensures better performance in the field, the highest quality seedlings in the present study were those produced in full sun and in the 290 or 400 cm^3 recipients. However, to save on substrate acquisition, it would be best to use 290 cm^3 container.

CONCLUSION

The *Ficus gomelleira* seedlings can be produced in 180 days in nurseries without shading. Better quality seedlings can be obtained with the use of 290 or 400 cm^3 recipients. But considering the economy in substrates are indicated 290 cm^3 containers.

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