Journal of Global Biosciences
ISSN 2320-1355
Volume 7, Number 7, 2018, pp. 5475-5488
Website: www.mutagens.co.in

Research Paper

LIGHT CONDITIONS AND SUBSTRATES IN *Bagassa guianensis* AUBL. SEEDLING PRODUCTION

Luiz Maekawa[1], Maria de Fatima Barbosa Coelho[2] and Oscarlina Lúcia dos Santos Weber[2]

[1]Instituto Federal de Educação, Ciência e Tecnologia de Mato Grosso - Campus Juína (IFMT). Linha J, s/n - CEP: 78320-000 - Juína/MT
[2]Universidade Federal de Mato Grosso (UFMT), Programa de Pós-Graduação em Agricultura Tropical, Av. Fernando Correa da Costa, nº 2367 – CEP 78060-900 – Cuiabá – Mato Grosso, Brasil.

Abstract

Bagassa guianensis Aubl. is a tree of the family Moraceae endemic to the Amazon. The aim of the present study was to verify the best combinations between substrates and light conditions for seedling production in *B. guianensis* nursery. The experimental design was a randomized complete block design in 4 x 7 subdivided plot (4 light conditions and 7 substrate compositions) with 4 replicates of 20 plants. The light conditions were full sun, 30%, 50% and 70% shading and the compositions of the substrates: 1 - Soil; 2 - Soil + limestone "filler" ; 3 - Soil (75% v) + limestone + cattle manure (25% v); 4 - Soil + limestone + phosphate chemical fertilizer; 5 - Soil + limestone + phosphate chemical fertilizer + catle manure (25% v); 6 - Solo + yoorin; 7 - Solo + yoorin + bokashi. Morphophysiological parameters and the Dickson index were used as indicators of seedling quality. The 70% shading should not be used for the production of *B. guianensis* seedlings. The best seedlings for planting *B. guianensis* can be obtained in 180 days in a nursery in full sun and in plastic bags with 25% cattle manure in the substrate.
Key words: Morphophysiological parameters, native forest seedlings, Northwest of Mato Grosso, Dickson index.

INTRODUCTION

The seedlings of native forest species are produced in nurseries with the objective of being used in the recovery of degraded areas, reforestation and environmental solutions [1]. In the production of seedlings of forest species in nurseries in the Northwest Region of Mato Grosso it is common to use sombrite with 50% of light restriction, however the growth responses of the forest species to the different light

conditions often depend on the place that the species occupies in the successional stage. So it is possible that seedlings can be developed in full sun.

The native species of the Amazon need further investigation as unexpected results can be observed, for example, in the study by [2] who evaluated the effect of light on the growth of *Hymenaea parvilora* seedlings, a forest species native to the Amazon Basin, popularly known as jutaí-mirim. According to the authors, the species was able to effectively adjust its physiological behavior, to maximize the acquisition of light, developing both at full sun and at 50 or 70% shading.

In addition to light, substrates for seedling production are important and should be used as an adequate medium to sustain plants and retain sufficient and necessary quantities of water, oxygen and nutrients. The use of organic components for the production of seedlings with the objective of improving the physical, chemical and biological attributes of the substrates is common in forest nurseries [1]. Cattle manure has been successfully used in several compositions and proportions of substrates to produce seedlings [3,4,5].

Bagassa guianensis Aubl. is a tree of the family Moraceae endemic to the Amazon. The species occurs from the Amazon basin to the forests of Guyana, Suriname and French Guiana [6]. The trees reach heights of 35 to 50 meters and more than 190 cm of DAP (diameter at breast height) and in Brazil it occurs in the states of Pará, Amazonas, Maranhão, Amapá, Rondônia, Acre and Northwest of Mato Grosso and is popularly known as amaparirana, amarelão, amarillo, bagaceira, cachaceiro, garrote and tatajuba [7].

The combination of rapid growth, high durability, low drying retraction and low anisotropy in the core of *B. guianensis* makes it suitable for industrial use and is also suitable for growth in clearings of anthropogenic forests and secondary forests, clear advantage for future planting projects [8].

In the northwestern region of Mato Grosso, *B. guianensis* wood is widely used in the construction of fence moirões, palanques, corrals and wooden house foundations. The heart of the *B. guianensis* is resistant to the attack of fungi of white and brown rot. The wood is considered moderately resistant to attack by marine drills and, in contact with the soil, can have a useful life of more than 25 years [7].

The species of the Amazon rainforest *Glicidendron amazonicum, Jacaranda copaia, Diplotropis purpurea* and *Bagassa guianensis,* if well conducted from the seedling stage, can guarantee commercial value for future wood harvesting, in both reduced impact, that is to say, with the removal of only the bole or with the removal of the bole plus the removal of the woody residue with a diameter of more than 10 cm. [9].

Thus, the present study aims to identify the best combinations between substrates and light conditions for the production of seedlings in *Bagassa guianensis* nursery in the Northwest region of Mato Grosso.

MATERIALS AND METHODS

The study was conducted at the Federal Institute of Education, Science and Technology of Mato Grosso (IFMT), located in the Municipality of Juína, Mato Grosso, at the geographical coordinates 11º26'48.9''S and 58º43'22.0''W, with elevation of 311m. According to the classification of Köppen and Geiger, the climate of Juína is Aw, tropical with dry season in the winter. The mean temperature in 2016 was 24.8 °C and the mean annual precipitation in the municipality was 1,850 mm [10].

The ripe fruits with the seeds of *Bagassa guianensis* Aubl. were collected in January 2016 at coordinates 11º26'47.2"S and 058º43'36.2"W and were macerated in water to separate the seeds from the impurities. The seeds were dried, conditioned, identified in bags of kraft paper of 1 kg until the moment of sowing.

The sowing was performed in suspended germinators filled with sawdust sawed in the month of April 2016 and the emergency occurred in 28 days. The *B. guianensis* seedlings with two cotyledon leaves and two true leaves were removed from the germinators and transplanted to the bags on July 20, 2016.

The experimental design was a randomized complete block design in 4 x 7 subdivided plot (4 light conditions and 7 substrate compositions) with 4 replicates of 20 plants. The light conditions were full sun, 30%, 50% and 70% shading, and constituted the plots. The subplots were the following compositions of the substrates: 1 - Surface soil (control); 2 - Soil + filler limestone - PRNT 99.15 - 1g / liter soil; 3 - Soil (75% v) + limestone (1g / liter) + cattle manure (25% v); 4 - Soil + limestone + phosphate chemical fertilizer (0-20-0); 5 - Soil + limestone + phosphate chemical fertilizer

(1g/liter) + cattle manure (25% v); 6 - Soil + yoorin BZ - 1g/liter; 7 - Soil + yoorin BZ + bokashi.

To pack the substrates, bags were used for perforated plastic seedlings with dimensions of 15 x 20 cm and capacity of 1430 cm^3. The irrigation was done with a system of microsprinklers in 2 shifts of 20 minutes (9h/morning and 16h/afternoon) equivalent to the average of 5 mm per day.

At 180 days the evaluation of the seedlings was carried out with the measurement of the diameter of the colon and height, number of leaves, and biomass determination. The plants were washed and dried for 48 hours at 65 ºC in an air circulation drying oven, brand Solab, model SL - 102, at the IFMT. The dry mass of the aerial part and the roots were obtained in an electronic digital scale, brand Edutec, model EJ-320 A to the nearest 0,01g.

The data obtained were used to calculate the relationship between shoot height and shoot diameter (H/D), the relation between aerial shoot height and dry shoot mass (H/MSPA), the ratio (MSPA/MSRA), dry root ratio and dry mass of shoot (MSRA/MSPA), and Dickson quality index (IQD), which is determined by (MST), dry shoot mass (MSPA) and dry mass of roots (MSR) were determined by Equation [11].

$$IQD = \frac{MST(g)}{(\frac{ALT(cm)}{DIAM(cm)}) + (\frac{MSPA(g)}{MSRA(g)})}$$

The obtained data were submitted to analysis of variance and to the F test, and the means were compared by the Scott Knott test at the 5% probability level, using SISVAR software [12].

RESULTS AND DISCUSSION

There was a significant interaction between the substrate compositions and the light conditions for root dry mass, dry shoot mass, total dry mass, leaf number, MSPA/MSRA ratio and MSRA/MSPA ratio in *Bagassa guianensis* seedlings. In light conditions there was no effect on plant height.

Diameter

The *B. guianensis* seedlings showed a larger diameter in the treatments that received 25% bovine manure (S3 and S5) and the 70% restriction of the luminosity reduced the diameter in relation to the other light conditions (Table 1).

Table 1. Diameter, plant height and number of seedling leaves *Bagassa guianensis* Aubl. in different light conditions and substrate composition, at 180 days in nursery. Juína-MT, 2018.

Substrates composition	Light conditions (% de shading)				
	0	30	50	70	Mean A
	Diameter (mm)				
S1.Soil (S)	2,77	2,55	2,47	2,16	2,48 C
S2.S+C	2,88	2,90	2,84	2,38	2,75 C
S3.S+C+E	6,16	6,49	6,09	5,55	6,07 A
S4.S+C+SS	3,27	3,05	2,77	2,46	2,89 C
S5.S+C+SS+E	6,53	6,05	5,98	4,99	5,89 A
S6.S+Y	2,89	3,21	2,95	2,65	2,92 C
S7.S+Y+B	3,30	3,82	3,61	2,50	3,31 B
Mean B	3,63 a	3,64 a	3,48 a	2,99 b	
	Plant Height (cm)				
S1.Soil (S)	15,66	13,08	13,28	13,15	13,76 B
S2.S+C	14,91	20,08	15,75	16,95	16,92 B
S3.S+C+E	42,41	47,50	38,62	50,45	44,75 A
S4.S+C+SS	20,33	19,14	16,39	17,73	18,39 B
S5.S+C+SS+E	41,52	38,16	41,48	39,07	40,05 A
S6.S+Y	16,96	22,29	17,99	21,41	19,66 B
S7.S+Y+B	18,65	23,89	20,76	18,95	20,56 B
Mean B	21,47 a	22,59 a	20,91 a	22,14 a	
	Leaves Number				
S1.Soil (S)	8,19aA	7,97aB	4,82bC	4,35bB	6,33
S2.S+C	8,19aA	7,97aB	4,85bC	4,35bB	6,34
S3.S+C+E	8,72bA	10,94aA	8,91bA	6,63cA	8,80
S4.S+C+SS	7,82aA	8,02aB	4,57bC	4,22bB	6,16
S5.S+C+SS+E	8,57aA	8,10aB	6,85bB	5,19cB	7,17
S6.S+Y	8,45aA	8,29aB	5,69bC	4,41cB	6,71
7.S+Y+B	7,66bA	9,85aA	6,47cB	4,25dB	7,06
Mean B	8,12	8,61	5,85	4,63	

* Equal upper case letters in the column and lowercase in the lines indicate that the means do not differ significantly, according to Scott Knott's test at 5% probability.

** 1.Soil (S) - soil of surface soil (control); 2.S + C - soil + limestone filler Aripuanã PRNT 99,15 (1g / L soil); 3.S + C + E - soil (75% v) + limestone + cattle manure (25% v); 4.S + C + SS - soil + limestone + phosphate chemical fertilizer (0-20-0) 1g / L substrate; 5.S + C + SS + E - soil + limestone + phosphate fertilizer + cattle manure (25% v); 6.S + Y - soil + thermophosphate 1g / L; 7. S + Y + B - soil + Thermophosphate + bokashi.

This result corroborates with that found in other studies regarding the effect of shading on the diameter: [13] verified decrease in the diameter of the seedlings of *Copaifera langsdorffii* Desf. as the shading increased; [14] verified that the shading reflected negatively on the development of the root system and on the diameter of the *Jaracatia spinosa* seedlings; [15] in *Eucalyptus grandis* Hill ex Maiden seedlings observed that the largest stem diameter occurred in full sun when compared to plants under 70% shading.

[16] points out that the greatest growth in terms of diameter is due to the fact that it is a temporary reservoir of assimilates. At the later stage of growth, assimilates can be translocated and allocated in sheets to increase the size of the photosynthetic apparatus. This is directly related to liquid photosynthesis, which depends on the carbohydrates produced and accumulated against the positive balance between crude photosynthesis and respiration, in addition to the adequate hormonal balance. According to [17] the collection diameter is directly related to the survival of the seedlings in the field.

Substrates with cattle manure allow greater aeration and humidity, thus providing superior increase in the collection diameter. Possibly, this is the explanation for the excellent results on substrates S3 and S5 in the present study, which contained 25% bovine manure. In order to obtain seedlings of good quality forest species, it is necessary that the diameter of the colon be proportional to the height of the seedling, considering the positive correlation between diameter and the percentage of seedling survival after field planting [18].

Plant Height

The height of the *B. guianensis* seedlings had similar behavior to the diameter considering the substrates, but there was no significant difference between the averages in relation to the light conditions. Addition of cattle manure to the substrate provided more phosphorus, calcium and organic matter to the seedlings, improving conditions for plant growth (Table 2). This effect of cattle manure on growth also occurred in seedlings of other species such as *Cedrela fissilis, Eucalyptus grandis*, and *Schinus terebinthifolius* [19] and *Peltophorum dubium* [20].

In a study with a cattle manure ratio close to the one used in the present study, the results showed that *Handroanthus heptaphyllus* seedlings produced with 26% to 28% of manure in the substrate had the highest values for diameter and height, would probably be better able to survive and grow in the field after planting [5].

Table 2. Chemical and physical analyzes of the substrates used for seedling production of *Bagassa guianensis* Aubl. in nursery of Juína Campus, IFMT, 2016-2017. Laboratory of EMPAER-MT.

Chemical Analysis	Substrates						
	S1	S2	S3	S4	S5	S6	S7
pH / H2O	5,4	6,5	6,5	6,6	6,5	6,4	6,4
pH / CaCl2	4,5	5,7	5,8	5,8	5,8	5,6	5,6
P mg/dcm³	1,1	0,8	59,3	44,8	104	17,4	17,4
K cmolc/dm³	0,06	0,06	0,12	0,07	0,15	0,07	0,07
Ca + Mg cmolc/dm³	0,70	0,8	1,7	1,1	1,7	0,9	0,9
Ca cmolc/dm³	0,6	0,6	1,4	0,9	1,4	0,7	0,7
Mg cmolc/dm³	0,1	0,2	0,3	0,2	0,3	0,2	0,2
Al cmolc/dm³	0,1	0	0	0	0	0	0
H + Al cmolc/dm³	1,7	1,1	1,5	1,1	2	1,2	1,2
M. O. g/dm³	6,5	6,0	15,5	8,3	17,5	8,8	8,8
Physical Analysis							
Sand g/kg	760,0	765	755	760	775	760	760
Silt g/kg	40,0	35	65	45	50	45	45
Clay g/kg	200,0	200	180	195	175	195	195
S cmolc/dm³	0,74	0,86	1,77	1,12	1,80	0,90	0,90
CTC cmolc/dm³	2,4	1,9	3,2	2,2	3,8	2,1	2,1
V %	33,3	47,8	54,5	55,8	48,5	44,5	44,5
Al Sat %	9,5	0	0	0	0	0	0

* 1.Soil (S) - soil of superficial soil (control); 2.S + C - soil + limestone filler Aripuanã PRNT 99,15 (1g / L soil); 3.S + C + E - soil (75% v) + limestone + cattle manure (25% v); 4.S + C + SS - soil + limestone + phosphate chemical fertilizer (0-20-0) 1g / L substrate; 5.S + C + SS + E - soil + limestone + phosphate fertilizer + cattle manure (25% v); 6.S + Y - soil + thermophosphate 1g / L; 7. S + Y + B - soil + Thermophosphate + bokashi.

Light conditions did not influence the height of *B. guianensis* seedlings. In other studies, it has been found that shading can cause an increase in seedling height. [21] evaluated the growth of *Caesalpinia echinata* Lam. seedlings submitted to five levels of shading (0, 20, 40, 60 and 80%) and observed the highest values for height in plants grown under 20, 40 and 60% shading. [3] observed higher seedling growth of *Erythrina velutina* Willd. in substrates with bovine manure and under shading of 50% in detriment to the seedlings in full sun.

The native species present a great diversity of luminosity responses, mainly on the vegetative development of the aerial part and the survival of the seedlings [22]. Thus, each forest species has its own light requirement for its development, and some seedlings can benefit and develop better in places with high intensity intensity and others in shading, and there are also those species that are intermediate.

The height is a great variable to note characteristics of plant adaptations at low luminosities, since species have different response patterns, according to their adaptive capacity to variations in light intensity [23]. According to [24] *Bagassa guianensis* is a pioneer species, which may explain the plasticity of height response to shading.

Leaves number

Comparing the treatments with the highest number of leaves in relation to the shading, it was verified that the highest values were obtained in the full sun and 30%, followed by 50% shading and lastly by 70% shading, which presented the lowest numbers of leaves (Table 1). The presence of cattle manure in the substrate composition also favored this characteristic.

In other studies, it was verified that the cattle manure in the substrate composition increases the number of leaves, as done by [3] in Mulungú (*Erythrina velutina*) seedlings; [25] in seedlings of Tamboril (*Enterolobium contortisiliquum*); [26] in seedlings of Catingueira (*Caesalpinia pyramidalis*); [27] in seedlings of Mangabeira (*Hancornia speciosa*).

Biomass production

The *B. guianensis* seedlings on the substrates containing bovine manure in the composition (S3 and S5) and in the conditions of more light (0 and 30% of shading) showed higher development expressed by root dry mass, dry shoot mass and dry mass total (Table 3).

Table 3. Dry root mass, dry shoot mass and total dry mass, of *Bagassa guianensis* Aubl.) seedlings in different light conditions and substrates composition at 180 days in nursery. Juína-MT, 2018.

Substrates composition	Light conditions (% de shading)				
	Dry root mass (g)				
	0	30	50	70	Mean A
S1.Soil (S)	14,66 aB	7,65 bD	5,49 bB	3,02 bB	7,70
S2.S+C	13,13 aB	8,86 aD	5,96 bB	4,28 bB	8,05
S3.S+C+E	37,42 aA	38,37 aA	29,09 bA	17,91 cA	30,70
S4.S+C+SS	16,96 aB	13,29 aD	6,11 bB	3,89 bB	10,06
S5.S+C+SS+E	37,37 aA	31,90 aB	23,35 bA	15,42 cA	27,01
S6.S+Y	13,35 aB	11,57 aD	5,65 bB	3,68 bB	8,56
S7. S+Y+B	16,05 aB	19,77 aC	10,02 bB	4,10 cB	12,49
Mean B	19,19	15,90	10,45	6,40	
	Dry shoot mass (g)				
S1.Soil (S)	10,31 aB	6,74 aB	5,51 aB	4,82 aB	6,84
S2.S+C	13,04 aB	8,43 aB	5,48 aB	6,06 aB	8,25
S3.S+C+E	63,51 aA	54,37 aA	43,34 bA	35,59 bA	49,20
S4.S+C+SS	17,32 aB	11,83 aB	6,26 bB	6,16 bB	10,39
S5.S+C+SS+E	64,62 aA	40,75 bA	34,52 bA	30,33 bA	42,55
S6.S+Y	12,69 aB	9,98 aB	7,02 aB	7,62 aB	9,33
S7.S+Y+B	13,31 aB	17,73 aB	11,67 aB	7,74 aB	12,61
Mean B	22,90	16,93	13,33	11,28	
	Total dry mass (g)				
S1.Solo (S)	24,96 aB	14,39 aD	11,00 aC	7,85 aB	14,55
S2.S+C	26,16 aB	17,28 aD	11,44 aC	10,34 aB	16,30
S3.S+C+E	100,92 aA	92,73 aA	72,42 bA	53,50 cA	79,90
S4.S+C+SS	34,28 aB	25,12 aD	12,37 bC	10,05 bB	20,46
S5.S+C+SS+E	101,99 aA	72,65 bB	57,87 cB	45,75 cA	69,57
S6.S+Y	26,04 aB	21,54 aD	12,67 aC	11,30 aB	17,89
S7. S+Y+B	29,36 aB	37,51 aC	21,69 bC	11,85 bB	25,10
Mean B	42,09	32,83	23,78	17,68	

* Equal upper case letters in the column and lowercase in the lines indicate that they do not differ significantly between substrate and shading levels, respectively, according to Scott Knott's test at 5% probability.

** 1.Soil (S) - surface soil (control); 2.S + C - soil + limestone filler Aripuanã PRNT 99,15 (1g / L soil); 3.S + C + E - soil (75% v) + limestone + cattle manure (25% v); 4.S + C + SS - soil + limestone + phosphate chemical fertilizer (0-20-0) 1g / L substrate; 5.S + C + SS + E - soil + limestone + phosphate fertilizer + cattle manure (25% v); 6.S + Y - soil + thermophosphate 1g / L; 7. S + Y + B - soil + Thermophosphate + bokashi.

However, the management of seedlings in full sun should be more researched, since although these conditions provided the greatest biomass gain, there was an expressive mortality rate in *B. guianensis* seedlings conducted in full sun in the nursery (S6: 45%, S7: 31.25%, S2: 28.75%, S4: 23.75%, S5: 11.25%, S1: 10% and S3: 10%).

The occurrence of mortality in the shaded seedlings (30, 50 and 70%) did not exceed 10% of the seedlings, similar to that observed in seedlings in the S3 and S5 substrates, probably due to the greater availability of water caused by the addition of 25 % of manure in subsoil substrate. The use of chemical inputs, such as lime and phosphate fertilizers, caused an increase in the salinity of the substrate, with consequent mortality of the seedlings and the application of Thermophosphate (S6) caused a higher mortality of the species (45%).

[13] tested the production of copaiba (*Copaifera langsdorffii*) seedlings in full sun and 30, 50, 70 and 90% shading and observed that this species presented plasticity in relation to radiation levels. There was no significant difference in dry weight of root, shoot and total, besides the relationship between root dry mass/dry mass of shoot, height/diameter and IQD. The plants presented good growth plasticity at different levels of luminosity, but with better development and quality (IQD) in 50% shading.

[26] studied four substrate compositions, the soil substrate being a control and three mixtures containing different proportions of soil, cattle manure and carbonized rice bark on the germination and growth of monkfish (*Enterolobium contortisiliquum* (Vell.) Morong). The authors, as in the present study, observed the positive influence of cattle manure on the growth of the studied species. The addition of cattle manure in the proportion of 25% increased the organic matter content from 6.5 g/dm^3 (S1) to 15.5 g/dm^3 (S3) and 17.5 g/dm^3 (S5). Probably, the improvement of soil physical structure with the addition of cattle manure, with consequent availability of water, contributed significantly to the increase of MST production of the evaluated species.

Relationship between variables

The relation between the height of the aerial part and the diameter of the collection expresses the equilibrium of growth, relating these two important morphological parameters in only one index, also denominated of robustness quotient, being considered one of the most accurate, since it provides information of how much thin is

the molt and should range from 5.4 to 8.1 [28]. Table 3 shows that the H/DC ratio ranged from 5.04 to 9.06 and was higher in 70% shading (7.53) and in substrates S3, S5 and S6 (7.41, 6.82 and 6.69 respectively).

Table 3. The relationship between height and diameter (H/D), shoot height and dry mass (H/MSPA), root dry mass and shoot dry mass (MSRA/MSPA), dry shoot mass and root dry mass (MSPA/MSRA) and Dickson quality index (IQD) of tatajuba (*Bagassa guianensis* Aubl.) Seedlings under different light conditions and substrate composition at 180 days in nursery. Juína-MT, 2018.

Substrates composition	Light conditions (% de shading)				
	0	30	50	70	Mean A
			H/DC		
S1.Soil (S)	5,65	5,12	5,40	6,02	5,55B
S2.S+C	5,04	6,82	5,40	7,12	6,09B
S3.S+C+E	6,87	7,25	6,45	9,06	7,41A
S4.S+C+SS	6,18	6,29	5,92	7,49	6,38B
S5.S+C+SS+E	6,26	6,28	6,86	7,88	6,82A
S6.S+Y	5,77	6,95	6,07	7,97	6,69A
S7.S+Y+B	5,59	6,29	5,79	7,49	6,29B
Mean B	5,91b	6,43b	5,98b	7,53a	
			H/MSPA		
S1.Subsolo (S)	1,58	1,95	2,44	2,84	2,20A
S2.S+C	1,19	2,42	2,90	2,86	2,34A
S3.S+C+E	0,68	0,89	0,93	1,46	0,99C
S4.S+C+SS	1,27	1,71	2,68	2,95	2,15A
S5.S+C+SS+E	0,65	0,97	1,28	1,31	1,05C
S6.S+Y	1,58	2,22	2,56	2,82	2,29A
S7.S+Y+B	1,43	1,37	1,81	2,47	1,77B
Mean B	1,20c	1,65b	2,09a	2,39a	
			MSRA/MSPA		
S1.Subsolo (S)	1,49aA	1,13bA	1,04bA	0,63cA	1,07
S2.S+C	1,09aB	1,11aA	1,22aA	0,69bA	1,01
S3.S+C+E	0,61aC	0,70aB	0,69aB	0,50aA	0,63
S4.S+C+SS	0,99aB	1,13aA	1,00aA	0,63bA	0,94
S5.S+C+SS+E	0,60aC	0,59aB	0,69aB	0,50aA	0,64
S6.S+Y	1,16aB	1,17aA	0,81bA	0,47cA	0,90
S7. S+Y+B	1,27aA	1,11aA	0,85bA	0,53cA	0,94
Mean B	1,03	1,01	0,90	0,57	
			MSPA/MSRA		
S1.Subsolo (S)	0,70bB	0,89bB	1,03bB	1,58aB	1,05
S2.S+C	0,97bB	1,00bB	0,94bB	1,46aB	1,09
S3.S+C+E	1,68bA	1,41bA	1,48bA	1,99aA	1,64
S4.S+C+SS	1,03bB	0,89bB	1,04bB	1,65aB	1,15
S5.S+C+SS+E	1,71aA	1,28bA	1,50bA	1,99aA	1,62
S6.S+Y	0,90cB	0,89cB	1,26bB	2,14aA	1,30
S7. S+Y+B	0,81cB	0,90cB	1,20bB	1,88aA	1,20
Mean B	1,11	1,04	1,21	1,81	
			IQD		
S1.Subsolo (S)	5,11	3,68	3,08	2,88	3,69 B
S2.S+C	6,20	3,81	3,08	2,91	4,00 B
S3.S+C+E	16,36	14,01	16,81	7.86	13,76 A
S4.S+C+SS	6,89	4,98	3,23	3.08	4,55 B
S5.S+C+SS+E	18,37	12,77	10,08	7.90	12,28 A
S6.S+Y	5,44	4,23	3,38	3.59	4,16 B
S7. S+Y+B	6,02	6,94	5,12	3.47	5,39 B
Mean B	9,20 a	7,20b	6,40b	4,52c	

* Equal upper case letters in the column and lowercase in the lines indicate that they do not differ significantly between substrate and shading levels, respectively, according to Scott Knott's test at 5% probability.

** 1.Soil (S) - surface soil (control); 2.S + C - soil soil + limestone filler Aripuanã PRNT 99,15 (1g / L soil); 3.S + C + E - soil (75% v) + limestone + cattle manure (25% v); 4.S + C + SS - soil + limestone + phosphate chemical fertilizer (0-20-0) 1g / L substrate; 5.S + C + SS + E - soil soil + limestone + phosphate fertilizer + cattle manure (25% v); 6.S + Y - soil soil + thermophosphate 1g / L; 7. S + Y + B - soil earth + Thermophosphate + bokashi.

Regarding the height and dry mass ratio of shoot (H/MSPA), the lowest values occurred in substrates S3 and S5 and in the full sun condition. The lower this relationship, the higher the quality of the seedlings produced, because the lower this index, the more lignified will be the seedling and the greater its survival capacity in the field [18].

The root dry mass and shoot dry mass ratio (MSRA/MSPA) showed no variation between the substrates in the condition of 70% shading with values of 0.47 to 0.69 and in the other light conditions was lower in the substrates S3 and S5.

The presence of a significant difference between the dry matter mass of the aerial part/mass of dry matter of the root indicates that the seedlings did not present the same pattern of dry matter distribution between the two organs, between the different substrates. The MSPA/MSRA ratio was higher at the 70% shading condition for all substrates. The substrates S3 and S5 in this light condition reached the values indicated by [18] that established the value of 2.0 as the best relation between these variables.

It was verified that the values of the IQDs of the *B. guianensis* seedlings in the treatments that were developed in the full sun condition were higher in the T3 substrate (13,76) and T5 (12,28) than in the substrate (Table 3). The lowest IQDs observed were verified under 70% of light restriction and, therefore, *B. guianensis* seedlings should not be produced in this light condition.

The presence of bovine manure in the substrate composition for the growth of plants is responsible for the retention of moisture and supply of part of the nutrients. Traditionally, cattle manure is used as an organic source in the composition of substrates in nurseries for different species.

The seedlings in all light conditions and in all the substrates tested in this study presented quality according to the indication of [18]: IQD must have a minimum value of 0.20. However, the much higher IQD values found in the present study in the full sun condition and in the substrates with manure (S3 and S5) indicated that these are conditions in the nursery to obtain higher quality *B. guianensis* seedlings.

CONCLUSIONS

Quality seedlings of *Bagassa guianensis* can be obtained in 180 days in nursery. The best seedlings are those kept in full sun and in plastic bags with 25% of cattle manure in the

substrate. The 70% shading should not be used for the production of *Bagassa guianensis* seedlings.

ACKNOWLEDGMENTS

Support for this research came from the FASE-Juina and the Universidade Federal de Mato Grosso - UFMT. The second author is grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for Bolsa de Produtividade.

REFERENCES

[1] DELARMELINA, W.M.; CALDEIRA, M.V.W.; FARIA, J.C.T.; GONÇALVES, E.O.; ROCHA, R.L.F. Diferentes substratos para a produção de mudas de *Sesbania virgata*. Floresta e Ambiente, Rio de Janeiro, v. 21, n. 2, p. 224-233, 2014.

[2] SILVA, B. M. S. LIMA, J. D.; DANTAS, V. A. V.; MORAES, W. S.; SABONARO, D. Z. Efeito da luz no crescimento de mudas de *Hymenaea parvifolia* Huber. Revista Árvore, v. 31, n. 06, p. 1019-1026, 2007.

[3] SANTOS, L.W.; COELHO, M.F.B. Sombreamento e substratos na produção de mudas de *Erythrina velutina* Willd. Ciência Florestal, Santa Maria, v. 23, n. 4, p. 571-577, 2013.

[4] ZANATTA, T.P.; CANTARELLI, E.B.; FONTANA, D.; BREZOLIN, P.; TRENTIN, C.; FLORA, D.D.; WERNER, C.J. Análise do desenvolvimento inicial de mudas de *Tabebuia impetiginosa* submetidas a diferentes tipos de substratos. Revista do Instituto Florestal, São Paulo, v. 28, n. 2, p. 103-109, 2016.

[5] LISBOA, A.C.; MELO JÚNIOR, C.J.A.M.; TAVARES, F.P.A.; ALMEIDA, R.B.; MELO, L.A.; MAGISTRALI, I.C. Crescimento e qualidade de mudas de *Handroanthus heptaphyllus* em substrato com esterco bovino Pesquisa Florestal Brasileira, Colombo, v. 38, p. 1-6, 2018.

[6] ROMANIUC NETO, S.; CARAUTA, J.P.P.; VIANNA FILHO, M.D.M.; PEREIRA, R.A.S.; RIBEIRO, J.E.L.S.; MACHADO, A. F. P.; SANTOS, A.; PELISSARI, G.; PEDERNEIRAS, L. C. 2015.

[7] IPT – Instituto de Pesquisas Tecnológicas. Informações sobre madeiras-*Bagassa guianensis*. 2018. Disponível em: <http://www.ipt.br/informacoes_madeiras/50.htm> 29 Jul. 2018.

[8] BOSSU J; BEAUCHÊNE, J; ESTEVEZ Y.; DUPLAIS C.; CLAIR, B. New Insights on Wood Dimensional Stability Influenced by Secondary Metabolites: The Case of a Fast-Growing Tropical Species *Bagassa guianensis* Aubl. PLoS ONE v. 11, n.3, p. 2016.

[9] QUANZ, B.; CARVALHO, J.O.P.; ARAUJO, M.M.; FRANCEZ, L.M.B.; SILVA, U.S.C.; KLEWTON PINHEIRO, K.A.O. Exploração florestal de impacto reduzido não afeta a florística do banco de sementes do solo. Revista de Ciências Agrarias, Manaus, v. 55, n. 3, p. 204-211, 2012.

[10] INMET - Instituto Nacional de Meteorologia. 9º Distrito de Meteorologia, SEOMA, A920 – Juína, MT, 2008. Consulta Genérica: 09/03/2018. Planilha. 2018.

[11] DICKSON, A.; LEAF, A.L.; HOSNER, J. F. Quality appraisal of white spruce and white pine seedling stock in nurseries. Forest Chronicles, Mattawa, v. 36, n. 1, p. 10-13, 1960.

[12] FERREIRA, D.F. Sisvar: a Guide for its Bootstrap procedures in multiple comparisons. *Ciência e agrotecnologia*. Lavras, v.38, n.2, p. 109-112, 2014.

[13] REIS, S.M.; MARIMON-JÚNIOR, B.H.; MORANDI, P.S.; SANTOS, C.O.; OLIVEIRA, B.; MARIMON, B.S. Desenvolvimento inicial e qualidade de mudas de Copaifera langsdorffii Desf. sob diferentes níveis de sombreamento. Ciência Florestal, Santa Maria, v. 26, n. 1, p. 11-20, 2016.

[14] MARANA, J.P.; MIGLIORANZA, E.; FONSECA, E.P. Qualidade de mudas de jaracatiá submetidas a diferentes períodos de sombreamento em viveiro Revista Árvore, Viçosa, v.39, n.2, p.275-282, 2015.

[15] SANTOS, S.M.S.; CUNHA, D.V.P.; SILVA, R.A.; TEIXEIRA, E.C.; CARVALHO, F.D. Avaliação morfofisiológica em mudas de clones de eucalipto em viveiros comerciais na etapa de expedição. Revista Cultivando o Saber, Goiania, v.10, n. 2, p. 238- 250, 2017.

[16] LARCHER, W. Ecofisiologia Vegetal. 3ª ed. Editora RiMa. São Carlos-SP, 2006. 529 p.

[17] SCHEER, M.B.; CARNEIRO, C.; BRESSAN, O.A.; SANTOS, K.G. Composto de lodo de esgoto para produção de mudas de *Anadenanthera colubrina* (Vell.) Brenan. Revista Cerne, Lavras, v. 18, n. 4, p. 613-621, 2012.

[18] GOMES, J.M.; PAIVA, H. N. Viveiros Florestais: propagação sexuada. Viçosa: UFV, 2011. 116 p.

[19] OLIVEIRA, R.B.; SOUZA,J.S.; SOUZA, C.A.M.; SILVA,S.A.; MARTINS FILHO, S. Produção de mudas de essências florestais em diferentes substratos e acompanhamento do desenvolvimento em campo. Ciência e agrotecnologia, Lavras, v. 32, n. 1, p. 122-128, 2008.

[20] SZARESKI, V.J.; SOUZA, V.Q.S.; NARDINO, M.; FERRARI, M.; MARTINI, R.T. Influência de diferentes substratos na produção de *Peltophorum dubium.* Enciclopédia Biosfera, Goiânia, v.11, n. 22, p. 2015-2021, 2015.

[21] AGUIAR, F.F.A.; KANASHIRO, S.; TAVARES, A.R.; NASCIMENTO, T.D.R.; ROCCO, F.M. Crescimento de mudas de pau-brasil (*Caesalpinia echinata* Lam.), submetidas a cinco níveis de sombreamento. Revista Ceres, Viçosa, v. 58, n.6, p. 729-734, 2011.

[22] SCALON, S.P.Q.; ALVARENGA, A.A. Efeito do sombreamento sobre a formação de mudas de pau-pereira (*Platycyamus regnelli* Benth.). Revista Árvore, Viçosa, v.17, n.3, p.265-270, 1993.

[23] MUROYA, K.; VARELA, V.P.; CAMPOS, M.A.A. Análise de crescimento demudas de jacareúba (*Calophyllum angulare* – Guttiferae) cultivadas em condições de viveiro. Acta Amazônica, Manaus, v. 27, n. 3, p.197-212, 1997.

[24] TONINI, H.; OLIVEIRA JUNIOR, M.M.C.; SCHWENGBER, D. Crescimento de espécies nativas da Amazônia submetidas ao plantio no Estado de Roraima. Ciência Florestal, Santa Maria, v. 18, n. 2, p. 151-158, 2008.

[25] ARAUJO, A.P.; PAIVA SOBRINHO, S. Germinação e produção de mudas de tamboril (*Enterolobium contortisiliquum* (Vell.) Morong) em diferentes substratos. Revista Árvore, Viçosa, v.35, n.3, p.581-588. 2011.

[26] DANTAS, B.F.; LOPES, A.P.; SILVA, F.F.S.; BATISTA, P.F.; PIRES, M.M.M.L.; ARAGÃO, C.A. Produção de mudas de catingueira-verdadeira (*Caesalpinia pyramidalis* Tul.) em função de substratos e luminosidades. Científica, Jaboticabal, v. 39, n. 1/2, p. 34-43, 2011.

[27] SILVA, E.A.; MARUYAMA, W.I.; OLIVEIRA, A.C.; BARDIVIESSO, D.M. Efeito de diferentes substratos na produção de mudas de mangabeira (*Hancornia speciosa*). Revista Brasileira de Fruticultura, v. 31, n. 3, p. 925-929, 2009

[28] CARNEIRO, J.G.A. Produção e controle de qualidade de mudas florestais. Curitiba: UFPR/FUPEF, 1995. 451 p.