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Development of *hymenaea courbaril* l. Var. *Stilbocarpa* seedlings in different fertilizers and substrate composition

Desenvolvimento de mudas de hymenaea courbaril l. Var. Stilbocarpa em diferentes fertilizantes e composição de substrato

Maximiliano Kawahata Pagliarini[1], Regina Maria Monteiro de Castilho[2], Erica Rodrigues Moreira[3], Flávia Aparecida de Carvalho Mariano-Nasser[4], Marlene Cristina Alves[2]

[1]Universidade Federal da Grande Dourados (UFGD), Faculdade de Ciências Agrárias, Rodovia Dourados - Itahum, Km 12 - Unidade II,| CEP: 79804-970, Dourados -MS. E-mail: maxpagliarini@hotmail.com
[2]Universidade Estadual Paulista (UNESP), Ilha Solteira - SP
[3]Universidade Federal de Tocantins, - TO
[4] Universidade Estadual Paulista (UNESP), Botucatu - SP

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Abstract: The objective was to test the development of *Hymenaea courbaril* seedlings in different substrates and different fertilizers. The experiment was conducted at São Paulo State University (UNESP), School of Engineering, Ilha Solteira, Brazil in greenhouse Pad & Fan type. Seedlings were grown in same environment and 20 days after sowing they were transplanted into seedlings black bags (5 litres of volume) with following substrates: S1 = soil + organic compound (1:1) and S2 = soil + cellulose residue (1:1). Fertilizer treatments were: T1 = Control, T2 = Osmocote® (15-09-12), T3 = Osmocote® (14-14-14), T4 = conventional fertilizer (04-30-10). The evaluated traits were: plant height (cm), diameter of plants stems (mm), leaves chlorophyll content (mg 100 cm^{-2}) and dry weight of root and shoot (g). The experimental design was completely randomized in factorial scheme 4 x 2 (substrates x fertilizer) totalling eight treatments and 13 repetitions, one plant per plot. According to all evaluated traits, the most indicated substrate for *Hymenaea courbaril* seedlings development was soil + organic compound using Osmocote® (15-09-12) as fertilizer.

Keywords: Jatobá, Osmocote®, total release fertilizer, organic compound, cellulose residue

Resumo: Objetivou-se avaliar o desenvolvimento de mudas de jatobá em diferentes substratos e diferentes fertilizantes. O experimento foi realizado na Universidade Estadual Paulista (UNESP), Faculdade de Engenharia, Ilha Solteira em casa de vegetação do tipo Pad & Fan. As mudas foram produzidas no mesmo ambiente e aos 20 dias após a semeadura foram transplantadas em sacos plásticos pretos para mudas de 5 litros sendo: S1 = solo + composto orgânico (1:1) e S2 = solo + resíduo de celulose (1:1). Os tratamentos com fertilizantes foram: T1 = Testemunha, T2 = Osmocote® (15-09-12), T3 = Osmocote® (14-14-14), T4 = Adubo de liberação total (04-30-10). As características avaliadas foram: altura das plantas (cm), diâmetro médio do caule das plantas (mm), teor de clorofila das folhas (mg 100 cm^{-2}) e massa seca de raiz e parte aérea (g). O delineamento experimental utilizado foi inteiramente casualizado, em esquema fatorial 4 x 2 (fertilizantes x substratos) totalizando 8 tratamentos e 13 repetições, uma planta por parcela. De acordo com todos os caracteres avaliados o substrato mais indicado para o desenvolvimento de mudas de jatobá foi a mistura de solo + composto orgânico (1:1), utilizando-se Osmocote® (15-09-12) como fertilizante.

Palavras-chave: Jatobá, Osmocote®, adubo de liberação total, composto orgânico, resíduo de celulose

Introduction

With deforestation increase and consequent soil degradation demand for native species has increased considerably. However, advances in degraded areas recovery encounter with small and low seedlings production by low knowledge about germination techniques, dormancy breaking, genetic variability. (Moraes, 1998; Carvalho, 2000).

Hymenaea courbaril belongs to Fabaceae family and has increased its importance as degraded areas recovery and urban landscaping composition (parks and gardens).

Furthermore, for seedling productions, substrates have their worldwide use by providing better physical, chemical and biological development of plants (Kämpf, 2001). These materials are composed of different raw materials and classified according to their source (Abreu, 2002): plant origin (tree fern fiber, sphagnum, moss, peat, coal, coconut fiber and processing of waste as pies, marc and shells); mineral (vermiculite, perlite, granite, limestone, sand, cinasite) and synthetic origin (rock wool, phenolic foam and Styrofoam) (Ferraz et al., 2005).

However, these materials hardly ever have all necessary features to provide good conditions for plants optimal growth and development by themselves (Souza, 1995). In this case, substrate may be formed by mixture of mineral soil and organic matter, either one or several materials.

The ideal substrate for seedlings production is one which has uniformity in its composition, free of pests, pathogens and weeds. These features eliminate need of proceeding disinfection, contributing to reduce plant production costs (Campinhos Júnior and Ikemori, 1983). In addition to this, some physical and chemical characteristics should be regarded as porosity, density, container capacity, electrical conductivity and pH.

The different types of fertilizers also interfere in seedling production system. Slow release fertilizers, for example, in its various formulations, are valuable to seedlings production. The main function for their use is by its gradual nutrients release, depending on substrate temperature which reduces losses by leaching, and keep plant nutrition for a longer period (Serrano et al., 2004). At the same time there is a reduction of hand labour, removing some stages, topdressing, reducing ammonia volatilization and nitrogen loss to environment, reducing substrate salinity avoiding damage to susceptible seeds or seedlings (Sharma, 1979; Bao et al., 2015; Qiao et al., 2016).

Slow release fertilizers have different formulations and granules sizes adapting to individual need. The mechanism is the same, nutrients are encapsulated by special resins and slowly released throughout this resin pores. This release is according to substrate temperature, being higher when it increases coinciding with periods of biggest plant growth. Increasing the concentration of nutrients in roots external environment, they are absorbed by plant by osmosis (Serrano et al., 2010; Tomaszewska, 2002).

Castilho et al. (2009) affirm adoption of slow release fertilizer is the best choice for *Azadirachta indica* seedlings production, as it has shown better development in relation to stem diameter, plant height and chlorophyll content. Vanin et al. (2010) observed higher growth of quince plants when there was fertilization of same controlled release fertilizer instead of N source readily. Dutra et al. (2016) also provided better seedling of *Peltophorum dubium* using slow release fertilizer for plant height, as reported by Rossa et al. (2015) for *Anadenanthera peregrina* and *Schinus terebinthifolius* and Ferrari et al. (2016) for *Tabernaemontana catharinensi.*

Santos et al. (2003) verified coffee seedlings development in bags with slow release fertilizer formulations were superior to conventional fertilization in relation to seedlings height, stem diameter, number of leaves, leaf area and root volume. However, Scivittaro et al. (2003) using soluble and slow release fertilizer in *Poncirus trifoliata seedlings* formation, found both nutrient sources properly have supplied plants requirements nutritional.

Brondani et al. (2008) found fertilization of *Anadenanthera colubrina* seedlings with slow-release fertilizer (14-14-14 Osmocote®) influenced on plant height. The authors found an increment of 16%, for this trait, in relation to control without Osmocote®. Moraes Neto et al. (2003b) also showed an increase in plant height of *Guazuma ulmifolia*, *Peltophorum dubium*, *Eucalyptus grandis*, *Calycophyllum spruceanum* and *Pinus caribeae* var. *caribeae* with Osmocote® use. Besides studied species *Eucalyptus grandis* presented bigger differences in height in relation to all treatments followed by *Calycophyllum spruceanum* and *Pinus caribeae* var. *caribeae.*

In other research, Moraes Neto et al. (2003a) compared different doses of slow release fertilizer levels with conventional fertilizer, they found differences for *Guazuma ulmifolia*, *Croton floribundus* and *Gallesia integrifolia* species which showed strong plant growth when subjected to controlled-release fertilizer. In contrast, Wilsen Neto and Botrel (2009) did not find differences in loblolly pine seedlings height when undergoing treatment with slow release fertilizer in relation to readily soluble.

Therefore, to improve information about seedling production and how to use local material as substrate the aim of this study was to test different fertilizers and substrate composition in *Hymenaea courbaril* seedlings development.

Material and Methods

The experiment was conducted at São Paulo State University (UNESP), School of Engineering, Ilha Solteira, Brazil (lat. 20º25'28 "S, long. 51º21'15" W, 354 m alt.) in a Pad & Fan greenhouse type.

Seedlings were produced in the same place performing the dormancy break by mechanical scarification with sandpaper n° 80 opposite the micropyle + immersion in water for 24 hours (Pagliarini et al., 2016). The same authors also described the species and season in which seed were harvested. After treatment, seeds were placed in 300 mL plastic glasses filled with commercial substrate.

At 20 days after sowing seedlings were transplanted into seedlings black bags (5 litres volume). Soil and organic compounds used were broken and passed on 4 mm sieve, before assembly of the experiment.

Fertilizers used were: T1 = control; T2 = Osmocote® (15-09-12); T3 = Osmocote® (14-14-14); T4 = conventional fertilizer (04-30-10) mixtures in following substrates: S1 = Soil + organic compound (1: 1, v: v) and S2 = Soil + cellulose residue (1: 1, v: v).

Osmocote® is a compound of encapsulated nutrients by a biodegradable organic resin. This set of capsules form uniform grain, easy handling and application of the product. The 15-09-12 formulation has addition of Mg (1%), S (2.3%), B (0.02%), Cu (0.05%), Fe (1%), Mn (0, 06%), Mo (0.02%) and Zn (0.05%). The doses of fertilizers were: Osmocote® 3 g L^{-1} of substrate and conventional fertilizer 6 g L^{-1} as recommended by Castilho et al., (2009).

The soil used was oxisol (Embrapa, 2013) taken from 0 - 20 cm layer at UNESP Experimental Farm located in Selvíria-MS, Brazil; the organic compound was made from *Paspalum notatum* leaves, added cattle manure decomposed for 90 days and the cellulose residue formed by rest of eucalyptus bark of a cellulose and paper industry at municipality of Três Lagoas- MS, Brazil.

The following traits were evaluated: plant height (cm): measure from substrate surface to the apical bud with a graduated scale; stem diameter of plants (mm): measured close to the substrate with a digital caliper; leaf chlorophyll content: measured with chlorophyll meter (Minolta SPAD-5010), whose readings were taken of three sheets: one at the apex, middle and bottom of each plant, obtaining mean values converted to mg 100cm^{-2} by equation proposed by Furlani Junior et al. (1996): $Y = 0.0996X - 0.152$ and root and shoot dry matter: shoots were separated from roots with scissors aid. Both separated parts were placed in labeled paper bags, and placed in an oven with forced air at 65 °C for 72 hours, thereafter weighing to obtain dry matter. For plant height, stem diameter and leaf chlorophyll content evaluations were performed at the day of transplanting, 40, 80, 120, 160 and 200 days after transplanting (DAT). In relation to root and shoot dry matter the evaluation was performed at the end of experimental period (200 DAT).

The experimental design was completely randomized in factorial 4 x 2 scheme (fertilizer x substrates) totalling 8 treatments and 13 repetitions, one plant per plot. Data were subjected to analysis of variance and means were compared by Tukey test at 5% of probability and regression analysis performed by System for Analysis of Variance - SISVAR (Ferreira, 2011).

Results and Discussion

For growth height trait (Table 1) was possible to observe that at substrate S1 (soil + OC) and S2 (soil + RC) in treatment T3 (Osmocote 15-09-12) differentiated statistically compared to other fertilizers and control. Possibly, the best results for treatment T3 was due to presence of micronutrients (Mg, S, B, Cu, Fe, Mn, Mo and Zn) in its formulation.

Comparing each fertilizer and control in each substrate we may noticed T1 (control), T2 (Osmocote 14-14-14) and T3 obtained significant average in relation to substrate S1 in detriment to S2, in addition to it, only T4 (conventional fertilizer 04-30-10) was not statistically different among substrates.

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Table 1. Plant height (cm) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different fertilization and substrates

	Plant height (cm)	
	Substrates	
Fertilizers	S1 (S + OC)	S2 (S + CR)
(T1) Control	20,7 bc A	16,8 c B
(T2) SRF Osmocote (14-14-14)	22,5 b A	20,3 ab B
(T3) SRF Osmocote (15-09-12)	25,7 a A	21,7 a B
(T4) CF (04-30-10)	19,0 c A	18,8 bc A

(SRF = slow release fertilizer, CF = conventional fertilizer, S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same lower-case letter in the column and capital letter on the line do not differ by Tukey test at 5% probability.

Work done with other species corroborate with the results of this work. Castilho et al. (2009) found taller *Azadirachta indica* plants when seedlings were subjected to soil + organic compound fertilized with slow-release fertilizer (15-08-12). Furthermore, Cabreira et al. (2017) working with S*chinus terebinthifolius* also noted the greatest seedlings heights occurred in plants subjected to soil + organic compound with slow-release fertilizer. The reason for this cause might be according to nutrient availability, as slow released fertilizer has provided nutrient in small quantities over a period of time. Therefore, seedlings might use it in different stage of growth.

It was observed in Table 2 *Hymenaea courbaril* plant heights in different substrates during evaluation period and it was noticed statistical difference only from 120 days after transplanting (DAT), in this case at 200 DAT, S1 obtained higher mean and statistical difference to S2.

Table 2. Plant height (cm) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different substrates during evaluation period.

	Plant height (cm)					
	Days after transplanting (DAT)					
Substrates	0	40	80	120	160	200
S1 (S + OC)	16.0 a	17.1 a	20.2 a	23.7 a	27.3 a	30.8 a
S2 (S + CR)	16.6 a	17.6 a	18.4 a	19.8 b	21.3 b	22.9 b

(S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same letter in the column do not differ by Tukey test at 5% probability.

In relation to interaction between substrates and evaluation period for plant height, Figure 1 showed up to 40 DAT both substrates had similar behaviour, however from this evaluation to the end, soil + organic compound was increasing the difference to substrate soil + cellulose residue.

Carvalho Filho et al. (2002) observed in soil + organic compound *Cassia grandis* seedlings obtained greater plant height compared to other substrates, in the same way research conducted by Alves and Passoni (1997) with *Licania tomentosa* seedlings achieved the highest plant height when planted in substrate composed by organic compound and vermicompost. Campos (1986), studying substrate influence in *Caesalpinia peltophoroides* seedlings in early development, concluded plants grew better (greater height and diameter) in soil and soil + cattle manure substrate at a ratio of 1: 1 for volume, which means organic compound might influence on plant growth for many species including *Hymenaea courbaril*.

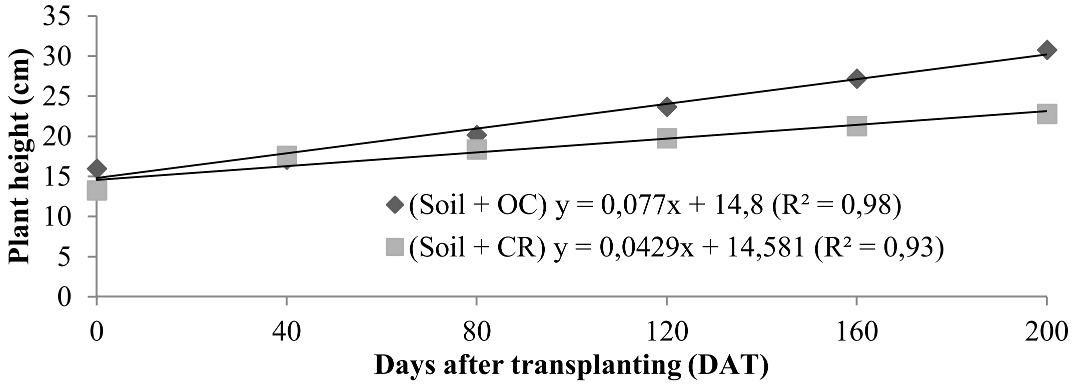

Figure 1. Plant height (cm) of *Hymenaea courbaril* L. var. *Stilbocarpa* seedlings in different substrates during evaluation period. (OC = organic compound and CR = cellulose residue).

According to each evaluation for plant height it was possible to report at the day of transplantation and 80 DAT there was no statistical difference between means in any treatment. At 40, 120 and 160 DAT was noted T2 and T3 have not differed statistically between them and T3 has differed statistically among T1 and T4. At 200 DAT, T3 presented the highest height means differing from other treatments (Table 3).

Table 3. Plant height (cm) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different fertilizers during evaluation period.

	Plant height (cm)					
	Days after transplanting (DAT)					
Fertilizers	0	40	80	120	160	200
(T1) Control	12.4 a	15.0 b	17.3 a	20.3 b	22.5 b	24.8 b
(T2) SRF Osmocote (14-14-14)	16.5 a	18.4 ab	20.7 a	22.5 ab	24.2 ab	26.0 b
(T3) SRF Osmocote (15-09-12)	14.2 a	19.7 a	21.6 a	25.1 a	28.8 a	32.5 a
(T4) CF (04-30-10)	14.7 a	16.3 ab	17.6 a	19.2 b	21.6 b	24.0 b

(SRF = slow release fertilizer, CF = conventional fertilizer. Means followed by the same letter in the column do not differ by Tukey test at 5% probability.

For interaction between fertilizer and evaluation period for plant height it was observed up to 80 DAT means increased gradually and closely and at the end, T3 obtained the biggest mean of plant height (Figure 2).

Brondani et al. (2008) found *Anadenanthera colubrina* seedlings submitted to slow-release fertilizer influenced on plant height. Although, in other working conditions, Moraes Neto et al. (2003b) also showed increase plant height in *Guazuma ulmifolia*, *Peltophorum dubium*, *Eucalyptus grandis*, *Calycophyllum spruceanum* and *Pinus caribeae* var. *caribeae* with Osmocote®, which occurred in present work.

In another study, Moraes Neto et al. (2003a) comparing different doses of slow-release fertilizers, conventional fertilizer and slow-release fertilizer with regular coverage in *Guazuma ulmifolia*, *Croton floribundus* and *Gallesia integrifolia* species showed the biggest plants growth when submitted to slow-release fertilizer, as Dutra et al. (2016) also found same result to *Peltophorum dubium.* This behaviour might be attributed to more constant nutrients availability, providing more egalitarian development for seedlings over the time.

However, Wilsen Neto and Botrel (2009) found no differences in height of loblolly pine (*Pinus taeda*) seedlings when planted with slow-release fertilizer in relation to readily soluble, opposite found at current work.

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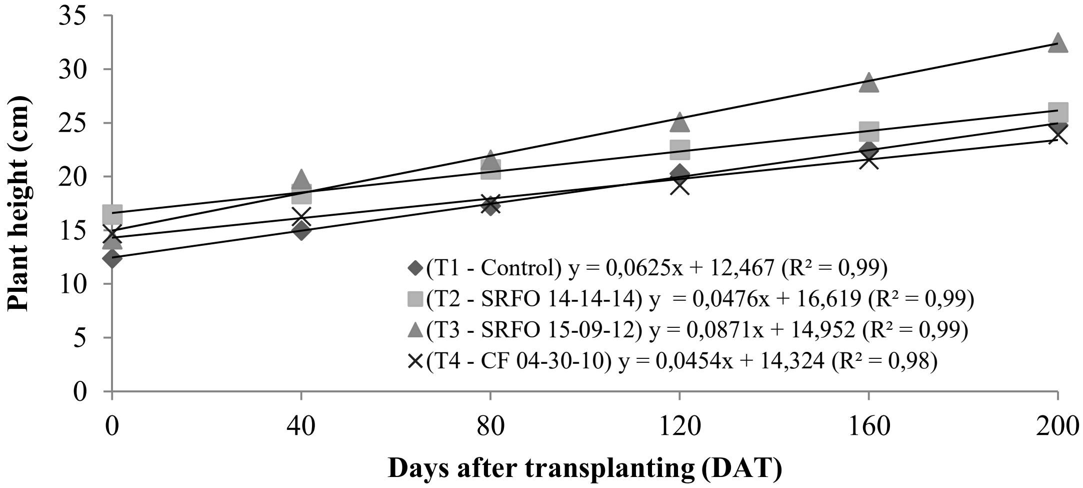

Figure 2. Plant height (cm) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different fertilizers for the evaluation period (SRFO = slow release fertilizer Osmocote® and FC = conventional fertilizer)

For stem diameter in substrate S1, treatments T1, T2 and T3 have not differed among themselves and between T1 and T4. Comparing each fertilizer and control in each substrate, it was noticed in S1 substrate treatments T1, T2 and T3 obtained averages numerically superior to substrate S2, however, only T1 and T3 were statistically different for two substrates (Table 4).

Analysing Tables 1 and 4 in conjunction, it was reported most plant height on substrate S1 corresponds to T3, which also had the largest stem diameter, however, in substrate S2 the biggest height corresponds to T3, but its diameter stem was the lowest, and it could be harmful to nursery as it can cause plant tipping, as possibly a smaller diameter might interfere in support structure unsuited to its size.

Table 4. Stem diameter (mm) of *Hymenaea courbaril* L. var. *Stilbocarpa*) in different substrates and fertilization.

	Stem diameter (mm)					
	Substrates					
Fertilizers	S1 (S + OC)			S2 (S + CR)		
(T1) Control	3.90	ab	A	3.60	a	B
(T2) SRF Osmocote (14-14-14)	3.97	a	A	3.88	a	A
(T3) SRF Osmocote (15-09-12)	4.04	a	A	3.64	a	B
(T4) CF (04-30-10)	3.54	b	A	3.81	a	A

(SRF = slow release fertilizer, CF = conventional fertilizer, S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same lower case letter in the column and capital letter on the line do not differ by Tukey test at 5% probability.

Cunha et al. (2005) observed *Tabebuia impetiginosa* seedlings had higher stem diameter when planted in substrate with soil and organic compound, similar to this work. In addition to this, Siqueira et al. (2018) also found higher stem diameter at *Lafoensia glyptocarpa* seedlings using organic matter as substrate.

Lower stem diameter is harmful for plant to remain standing in field in its initial adaptation phase, causing seedling tipping and losing its silvicultural value and subsequently death. For a seedling production program, it is considered low value those seedlings with smaller diameter and bigger height in detriment of larger diameter and smaller height. Thus, the diameter could be considered the best trait for assessing seedlings quality (Cunha et al., 2005).

In relation to *Hymenaea courbaril* leaves chlorophyll content, Table 5 showed analysis result of different fertilization treatments and control in each substrate. In substrate S1 all treatments differed statistically among themselves, and in this case T3 presented the best means followed by T2, T4 and T1. In substrate S2, treatments T2, T3 and T4 did not differ among themselves, but all of them differed of T1.

Observing jointly Tables 1 and 5 it was possible to report in substrate S1 the biggest plant height corresponding to the highest content of chlorophyll, therefore, chlorophyll content possibly taked greater photosynthetic rate, increasing the amount of photosynthetic components enabling further growth (Taiz and Zeiger, 2004).

Table 5. Chlorophyll leaves content (mg 100 cm^{-2}) of *Hymenaea courbaril* L. var. *Stilbocarpa* seedlings in different fertilization and substrates.

	Chlorophyll content (mg 100 cm^{-2})	
	Substrates	
Fertilizers	S1 (S + OC)	S2 (S + CR)
(T1) Control	1.69 d A	1.59 b A
(T2) SRF Osmocote (14-14-14)	2.48 b A	2.30 a A
(T3) SRF Osmocote (15-09-12)	3.10 a A	2.22 a B
(T4) CF (04-30-10)	2.16 c A	2.23 a A

(SRF = slow release fertilizer, CF = conventional fertilizer, S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same lower-case letter in the column and capital letter on the line do not differ by Tukey test at 5% probability.

During the evaluated period means of *Hymenaea courbaril* leaves chlorophyll content presented significant difference only at 80, 160 and 200 DAT and S1 highlighted in relation to substrate S2 (Table 6).

Table 6. Chlorophyll leaves content (mg 100 cm^{-2}) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different substrates during evaluation period.

	Chlorophyll content (mg 100 cm^{-2})					
	Days after transplanting (DAT)					
Substrates	0	40	80	120	160	200
S1 (S + OC)	1.76 a	2.05 a	2.40 a	2.37 a	2.59 a	2.83 a
S2 (S + CR)	1.94 a	1.98 a	1.89 b	2.27 a	2.23 b	2.18 b

(S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same letter in the column do not differ by Tukey test at 5% probability.

Figure 3 showed regression analysis of *Hymenaea courbaril* L. var. *Stilbocarpa* leaves chlorophyll content in different substrates in relation to evaluation period, and for both analysed substrates tendency was cubic. In this case all evaluations substrate formed by soil + organic compound obtained the highest average.

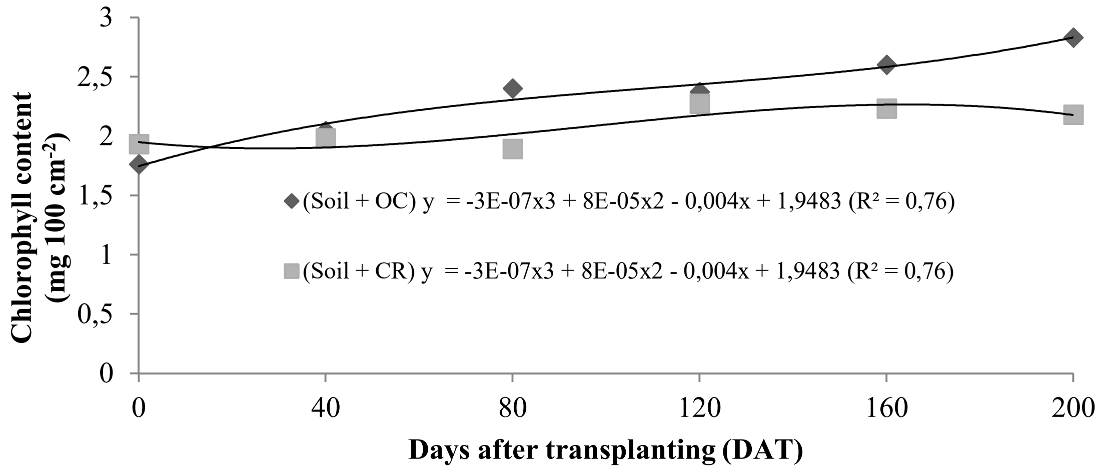

Figure 3. Chlorophyll leaves content (mg 100 cm^{-2}) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different substrates during evaluation period (OC = organic compound and CR = pulp residue).

In each evaluated day for *Hymenaea courbaril leaves* chlorophyll content it was observed there was statistical difference after 40 DAT, and in this assessment was noted T3 differed from T1. After 80 DAT, T3 and T4 did not differ between themselves, even between T1 and T2. At 160 and 200 DAT, T2 and T3 did not differ among themselves, however, differed from T1 and T4 (Table 7).

Table 7. Chlorophyll leaves content (mg 100 cm^{-2}) of *Hymenaea courbaril* L. var. *Stilbocarpa* in different fertilizers during evaluation period.

	Chlorophyll content (mg 100 cm^{-2})					
	Days after transplanting (DAT)					
Fertilizers	0	40	80	120	160	200
(T1) Control	1.61 a	1.58 c	1.56 b	1.63 c	1.64 c	1.65 c
(T2) SRF Osmocote (14-14-14)	1.88 a	1.91 bc	1.89 b	2.62 a	2.91 a	2.89 a
(T3) SRF Osmocote (15-09-12)	2.01 a	2.39 a	2.67 a	2.88 ab	2.85 a	3.19 a
(T4) CF (04-30-10)	1.81 a	2.17 ab	2.49 a	2.15 b	2.27 b	2.31 b

(SRF = slow release fertilizer, CF = conventional fertilizer. Means followed by the same letter in the column do not differ by Tukey test at 5% probability.

The behaviour of T1 and T4 at the end of 200 DAT was lower comparing to T2 and T3 chlorophyll content. This result might be explained by the fact that these treatments have a lower amount of Nitrogen, compared to two treatments with slow-release fertilizer. The N is part of the chlorophyll molecule, thus correlating it to leaves chlorophyll content (Taiz & Zeiger, 2004). The higher chlorophyll content in treatment T3 might also be due to Mg presence at fertilizer formulation, as this micronutrient compose chlorophyll molecule (Taiz and Zeiger, 2004).

For shoot and root dry mass (Table 8) in substrate S1 only T3 was statistically different in shoot dry mass in relation to all other treatments. However, there was no statistical difference between treatments in relation to substrate S2. Analysing each fertilization treatment and control in each substrate noted for all treatments, S1 obtained higher shoot and root dry mass.

Table 8. Shoot and root dry mass (g plant^{-1}) of *Hymenaea courbaril* L. var. *Stilbocarpa* seedlings in different substrates and fertilizers 200 DAT

	Dry mass (g plant^{-1})			
	Shoot		Root	
Fertilizers	S1 (S + OC)	S2 (S + CR)	S1 (S + OC)	S2 (S + CR)
(T1) Control	3.88 b A	0.63 a B	3.02 ab A	0.51 a B
(T2) SRF Osmocote (14-14-14)	4.70 b A	1.60 a B	3.17 ab A	0.98 a B
(T3) SRF Osmocote (15-09-12)	9.23 a A	0.80 a B	3.81 ab A	0.34 a B
(T4) CF (04-30-10)	3.84 b A	1.32 a B	1.95 b A	0.49 a B

(SRF = slow release fertilizer, CF = conventional fertilizer, S = soil, OC = organic compound and CR = cellulose residue). Means followed by the same lower-case letter in the column and capital letter on the line do not differ by Tukey test at 5% probability.

Carvalho Filho et al. (2003) found no significant differences for shoot and root dry mass of *Hymenaea courbaril* when seedlings were submitted to substrate made of soil and organic compound compared to other substrates, similar to results found by Caldeira et al. (2008) with *Schinus terebinthifolius.* Authors reported lower root dry mass when submitted seedlings to substrate formed with soil and organic compound, opposite results to those found in this study.

Conclusions

According to all evaluated traits the most suitable substrate for *Hymenaea courbaril* seedlings development was the mixture of soil + organic compound (1: 1) using Osmocote® (15-09-12) as fertilizer.

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