Australian Journal of Basic and Applied Sciences, 10(18) December 2016, Pages: 60-65

AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

Early Development of *Schizolobium amazonicum* Seedlings Under Different Cultivation Conditions

[1]Mauricio Reginaldo Alves dos Santos, [1]Ozelma Alves Marques, [2]Josilene Félix da Rocha, [1]Abadio Hermes Vieira

[1]*Embrapa Rondonia, Box.127. Porto Velho. Brazil. 76815-800.*
[2]*Universidade Federal de Lavras, Box.3037. Lavras. Brazil. 37200-000.*

Address For Correspondence:
Mauricio Reginaldo Alves dos Santos, Embrapa Rondonia, Box. 127. Porto Velho. Brazil.
55-69-32195025; E-mail: mauricio.santos@embrapa.br

ARTICLE INFO

Article history:
Received 19 September 2016
Accepted 10 December 2016
Published 31 December 2016

Keywords:
Caesalpiniaceae, sunlight, substrate, plastic tube.

ABSTRACT

Background: *Schizolobium amazonicum* is an Amazonian tree species useful for reforestation and commercial plantations, which causes the increased demand for uniform and high quality seedlings. It can be used for plantations in degraded areas, reforestation, and to compose agroforest systems due to its fast growth and good performance both in homogeneous formations and in conjunction with other species. Also, the establishment of forest plantations in areas of transition between savannah and forest can be made possible using this species. The study of environmental effects on the production of seedlings is essential for the expansion of the cultivation of this species **Objective:** The objective of this study was to evaluate the early development of *S. amazonicum* seedlings submitted to different conditions of light, substrate and plastic tube volume, aiming at the establishment of methodologies for the production of high quality shoots. **Results:** All treatments resulted in 100% survival of the seedlings. 280 mL plastic tubes resulted in superior values than 175 mL tubes in every studied variable. In a general view, Tropstrato® commercial substrate resulted in more growth than the composite substrate. In relation to light conditions, 50% shading resulted in greater plant growth than full light. There were no interactions among the studied factors. For the early development of *S. amazonicum* seedlings, the use of 280 mL plastic tubes, 50% shading and Tropstrato® commercial substrate is recommended. **Conclusion:** For early development of *S. amazonicum* seedlings, the use of 280 mL plastic tubes, 50% shading and Tropstrato® commercial substrate is recommended.

INTRODUCTION

Schizolobium amazonicum Huber ex Ducke belongs to the botanical family Caesalpiniaceae (Leguminosae: Caesalpinioideae) and is a large tree, occurring naturaly in the Amazon in primary forests and mostly in secondary forests of dry and flooded areas. It is known by the common names; bandarra, parica, guapuruvu-da-Amazonia or pinho-cuiabano (Carvalho, 2005; Marques *et al*., 2004; Lorenzi, 2002).

The species stands out for its rapid growth, straight trunk with branches growing from seven meters height, and also for the remarkable price of its wood in the Brazilian and foreign markets (Costa *et al.*, 1998). Trees from 12 to 15 years old can grow to 30 m tall and 80 cm in diameter (Cordeiro *et al*, 2002; Rondon, 2002).

Its wood is white, soft and light (specific weight of 0.302 $g.cm^{-3}$) and is used in the manufacture of fibers, plywood, high quality laminates, core of panels and doors, toys, heels for shoes, concrete forms, light and heavy crates. It is also promising for the production of cellulose pulp for paper, highlighting its easy bleaching and excellent resistance obtained from the bleached paper (Carvalho, 2007).

To Cite This Article: Mauricio Reginaldo Alves dos Santos, Ozelma Alves Marques, Josilene Félix da Rocha, Abadio Hermes Vieira., Early Development of *Schizolobium amazonicum* Seedlings Under Different Cultivation Conditions. ***Aust. J. Basic & Appl. Sci.**, 10(18): 60-65, 2016*

Regarding its forestry potential, in recent years it has shown feasibility for reforestation in the North and Northeast of Brazil, especially in riparian environments not subject to flood (Vidaurre *et al*., 2012). It can be used for plantations in degraded areas, reforestation, and to compose agroforest systems due to its fast growth and good performance both in homogeneous formations and in conjunction with other species (Cordeiro *et al*., 2002). Also, the establishment of forest plantations in areas of transition between savannah and forest can be made possible using this species (Costa *et al*., 1998).

The species has been recommended for the formation of commercial plantations and, therefore, the demand for uniform and high quality seedlings has increased considerably (Shimizu *et al*., 2011). The study of environmental effects on the production of seedlings is essential for the expansion of the cultivation of this species (Uchida and Campos, 2000). The objective of this study was to evaluate the early development of *S. amazonicum* seedlings submitted to different conditions of light, substrate and plastic tube volume, aiming at the establishment of methodologies for the production of high quality shoots.

MATERIALS AND METHODS

The experiment was carried out under greenhouse conditions at the Degraded Area Recovery Center of the Environmental Police of Rondonia state, in Porto Velho, Brazil. The seeds were submitted to mechanical scarification with pruning shears for breaking the dormancy due to the tegument impermeability and then soaked in water for imbibition for 24 hours. These pre-germinated seeds were submitted to cultivation under full sunlight or 50% shading, 175 or 280 mL plastic tube volumes, filled with Tropstrato® commercial substrate or composite substrate, in a factorial combination of 2 x 2 x 2, totaling 8 treatments with 5 replicates of 25 tubes, each one containing one seed. Tropstrato® is a pine bark-based substrate and expanded vermiculite, enriched with macro and micronutrients, traditionally sold in the Brazilian market as a complete substrate. The composite substrate consists of soil (33.77%), coffee chaff (45.02%), NPK 1:1:1 (0.43%) and chicken manure (20.78%) (w/w). The cultivation was watered three times a day. For 70 days, plant survival, plant height and number of leaves were evaluated. After 70 days, 8 plants from each replicate were collected, washed and separated into aerial and root parts. These parts were separately weighed, dried in an oven at 60°C and then weighed again for determination of the fresh and dry weight of roots and shoots. Treatments were arranged in a randomized block design. Averages were compared by F test by using the Genes statistical program.

RESULTS AND DISCUSSION

All treatments resulted in 100% survival of the seedlings. The comparison among the evaluated variables, at the 70th day of cultivation, in relation to the effects of light, tube volume and substrate are shown respectively in Tables 1, 2 and 3. There were no interactions among the variables; for this reason they were considered individually.

Regarding the effect of light conditions, higher averages for all the variables were observed with 50% shading (Table 1). Only the fresh and dry weight of the roots did not differ in relation to light conditions. This result was not expected, for the species is considered a pioneer and recommended for full sunlight cultivation, due to its tolerance of high intensities of radiation. In Acre state, Oliveira (1994) observed that the species is naturally abundant in forests where there is a high penetration of solar radiation, as in secondary forests, where the species shows dominance in relation to other tree species. It is possible to observe that 50% shading did not cause etiolation in relation to the full sunlight cultivation, for the ratio between the fresh weight and dry weight of the aerial part was exactly the same in both conditions, namely 5.48/1.85 = 2.96; 4.14/1.40 = 2.96. According to Pearcy *et al*. (1996), the excess of solar radiation may cause damage to the plant, affecting the assimilation of CO_2 due to the fotoinhibition. Caron *et al*. (2010) mentioned that the artificial shading may affect positively the growth and quality of the seedling, improving its nutritional and hydric status.

The positive effect of shading on the growth in height was also observed in seedlings of *S. amazonicum* by Rosa *et al*. (2009), who observed that 30% shading is adequate for the early development of the seedlings. Caron *et al*. (2010) observed a positive correlation between aerial part growth and increasing levels of shading in *S. parahyba*. Almeida *et al*. (2004) found a greater height in young plants of *Cryptocaria aschersoniana* cultivated under 50% shading than in those cultivated under full sunlight. This positive correlation was also observed in several forest tree species; *Prunus brasilensis* (Sturion, 1980), *Cordia trichoma, Astronium fraxinifolium* (Jesus *et al*., 1987), *Dinizia excelsa* (Varela and Santos, 1992), *Piptadenia peregrina, Colubrina rufa, Tabebuia serratifolia, Dalbergia nigra* (Reis *et al*., 1994), *Clitoria fairchildiana* (Portela *et al*., 2001).

In general, the shading influence on the accumulation of dry matter is positive, as observed by some studies; *S.amazonicum* (Rosa *et al*., 2009), *Hymeneae stigonocarpa* (Ferreira *et al*., 1977), *Eucalyptus grandis* (Fonseca *et al*., 1979), *Eperua bijuga* (Façanha and Varela, 1987), *Dinizia excelsa* (Varela and Santos, 1992), and *Goupia glabra* (Daniel *et al*., 1994). Contrastingly, Dutra *et al*. (2012) observed a decrease of the dry matter in *Copaifera langsdorffii* in relation to shading, attributing this result to a positive hardening of the shoots under full sunlight.

The lack of difference in the development of the root system of the species in different light conditions can be explained by Silva *et al*. (2007), who mention that a higher solar radiation can cause the development of a root system capable of high absorption of water and nutrients, a strategy that could guarantee survival under elevated rates of photosynthesis and transpiration.

The plastic tubes of 280 mL volume showed significantly higher values than the 175 mL tubes, in relation to all the studied variables (Table 2), probably because the higher volume allowed more absorption, a greater area for the root system to expand and more contact with the substrate. Sturion (1980) observed that the diameter of the stem and the dry mass of roots and aerial part of *S. parahyba* were greater in larger containers. Gomes *et al*. (1990) mentioned that small sized plastic tubes can cause a longer duration for the production of seedlings of forest tree species. However, the same authors highlight that the use of containers larger than the recommended result in unnecessary costs of material resources, as evidenced in *Tabebuia serratifolia, C. langsdorffii* and *P. peregrina.* Reis (2003) tested plastic tubes of 56 and 280 cm^3 and also plastic bags of 330 cm^3 for the production of *S. amazonicum* seedlings and concluded that the larger containers result in higher growth.

In relation to the substrate, in a general view, Tropstrato® resulted in significantly higher values than the observed with the composite substrate (Table 3). These results were expected, since this commercial substrate is characterized by low density, good water retention and balanced chemical composition (Minami and Puchala, 2000). However, there were no significant differences between the two substrates in relation to the fresh and dry weight of the roots, probably because in a poorer substrate the root system develops to explore a greater volume of substrate seeking nutrients (Ferreira *et al*., 1995).

Tropstrato® was used in the cultivation of *Tabebuia aurea* by Pacheco *et al*. (2008), who observed positive effects for length and dry mass of the aerial part. The formation of high quality seedlings of forest tree species is directly related to aeration, drainage, water retention and balanced availability of nutrients of the substrate (Fonseca, 2005). According to Rosa Júnior *et al*. (1998) and Trigueiro (2002), substrates for production of seedlings must retain necessary amounts of water, oxygen and nutrients, and provide compatible pH, absence of chemicals at toxic levels and adequate electrical conductivity. The use of substrates replacing the use of soil in seedling production has provided substantial improvements in their quality, and therefore the commercial substrates are generally considered more efficient than soil for this purpose (Smiderle *et al.,* 2001; Ramos *et al*., 2002).

Conclusions:

For the early development of *S. amazonicum* seedlings the use of 280 mL plastic tubes, 50% shading and Tropstrato® commercial substrate is recommended.

Table 1: Effect of light conditions on the growth of *S. amazonicum* seedlings at the 70th day of cultivation.

Variables	Full sunlight	50% shading	F test
Height (cm)	26.1	29.1	36.73**
Number of leaves	5.1	5.5	13.94**
Fresh weight of aerial part (g)	4.14	5.48	72.63**
Fresh weight of roots (g)	4.10	4.39	1.97ns
Dry weight of aerial part (g)	1.40	1.85	26.89**
Dry weight of roots (g)	0.86	1.04	3.10ns

* significant by F test, p<0.05. ** significant by F test, p<0.01. ns - not significant.

Table 2: Effect of tube volume on the growth of *S. amazonicum* seedlings at the 70th day of cultivation.

Variables	Plastic tube of 175 mL	Plastic tube of 280 mL	F test
Height (cm)	26.1	29.1	36.73**
Number of leaves	5.2	5.6	22.45**
Fresh weight of aerial part (g)	4.02	5.58	101.42**
Fresh weight of roots (g)	3.63	4.86	36.61**
Dry weight of aerial part (g)	1.37	1.89	36.35**
Dry weight	0.84	1.06	4.90*

of roots (g)	

* significant by F test, p<0.05. ** significant by F test, p<0.01. ns - not significant.

Table 3: Effect of type of substrate on the growth of *S. amazonicum* seedlings at the 70th day of cultivation.

Variables	Composite substrate	Commercial substrate	F test
Height (cm)	26.4	28.9	25.51**
Number of leaves	5.3	5.5	13.94**
Fresh weight of aerial part (g)	4.57	5.03	8.83**
Fresh weight of roots (g)	4.30	4.19	0.32ns
Dry weight of aerial part (g)	1.45	1.81	17.03**
Dry weight of roots (g)	0.99	0.90	1.02ns

* significant by F test, p<0.05. ** significant by F test, p<0.01. ns - not significant.

REFERENCES

Balbuena, T.S., C. Santa-Catarina, V. Silveira, M.J. Kato and E.I.S. Floh, 2009. *In vitro* morphogenesis and cell suspension culture establishment in *Piper solmsianum* C. DC. (Piperaceae). Acta Botanica Brasilica, 23(1): 274-281.

Barbosa, M.H.P., J.E.B.P. Pinto, R. Inneco and C.A.B.P. Pinto, 1994. Effect Of Growth regulators and different explants on *in vitro* morphogenesis of *Capsicum annuum* L. Ciência Rural, 24(1): 67-72.

Castro, A.H.F., M.M. Lima, R. Paiva, A.A. Alvarenga and M.O. Sóter, 2008. Curva de crescimento, atividade da fenilalanina amônia-liase e teores de fenóis e taninos totais em calos de *Stryphnodendron adstringens* (Mart.) Coville (Fabaceae-Mimosoideae). Plant Cell Culture and Micropropagation, 4(2): 99-104.

Cerqueira, E.S., J.E.B.P. Pinto, A.R. Morais, N.E.A. Castro, M.G. Cardoso and O.A. Lameira, 2002. Indução de calos em erva-de-touro (*Tridax procumbens* L.) utilizando diferentes reguladores de crescimento e tipos de explantes. Ciência e Agrotecnologia, 26(2): 301-308.

Cordeiro, I.M.C.C., O.A. Lameira, S.T. Ohashi and L.R.S. Reis, 2007. Indução de calos *in vitro* de paricá (*Schizolobium amazonicum* Huber ex Ducke). Plant Cell Culture and Micropropagation, 3(1): 35-40.

Coste, A., L. Vlase, A. Halmagyi, C. Deliu and G. Coldea, 2011. Effects of plant growth regulators and elicitors on production of secondary metabolites in shoot cultures of *Hypericum hirsutum* and *Hypericum maculatum*. Plant Cell, Tissue and Organ Culture, 106(2): 279-288.

Danelutte, A.P., M.B. Constantin, G.E. Delgado, R. Braz-Filho and M.J. Kato, 2005. Divergence of secondary metabolismo in cell suspension cultures and differentiated plants of *Piper cernuum* and *P. crassinervium*. Journal of the Brazilian Chemical Society, 16(6B): 1425-1430.

Devanand, P. and U. Rani, 2011. Insect growth regulatory activity of the crude and purified fractions from *Solanum melongena* L., *Lycopersicum esculentum* Mill. and *Capsicum annuum* L. Journal of Biopesticides, 4(2): 118-130.

Diz, M.S., A.O. Carvalho, S.F.F. Ribeiro, M. Cunha, L. Beltramini, R. Rodrigues, V.V. Nascimento, O.L.T. Machado and V.M. Gomes, 2011. Characterisation, immunolocalisation and antifungal activity of a lipid transfer protein from chili pepper (*Capsicum annuum*) seeds with novel α-amylase inhibitory properties. Physiologia Plantarum, 142(3): 233-246.

Erdogan, P., G. Saltan and B. Sever, 2010. Acaricidal effect of *Capsicum annum* L. extracts on two-spotted spider mite*Tetranychus urticae* Koch (Arachnida: Tetranychidae). Bitki Koruma Bülteni, 50(1): 35-43.

Far, M.M.M.E. and H.A.A. Taie, 2009. Antioxidant activities, total anthocyanins, fhenolics and flavonoids contents of some sweetpotato genotypes under stress of different concentrations of sucrose and sorbitol. Australian Journal of Basic and Applied Sciences, 3(4): 3609-3616.

Feitosa, L.S., A.S. Costa, M.F. Arrigoni-Blank, R. Dibax, M.P. Botânico and A.F. Blank, 2013. Indução e análise histológica de calos em explantes foliares de *Jatropha curcas* L.(Euphorbiaceae). Bioscience Journal, 29(2): 370-377.

Games, P.D., C.R. Koscky-Paier, H.O. Almeida-Souza, M.O. Barbosa, P.W.P. Antunes, L.C. Carrijo, P.R.G. Pereira and M.C. Baracat-Pereira, 2013. *In vitro* anti-bacterial and anti-fungal activities of hydrophilic plant defence compounds obtained from the leaves of bell pepper (*Capsicum annuum* L.). Journal of Horticultural Science and Biotechnology, 88(5): 551-558.

Gomes, F.P., 2009. Curso de Estatística Experimental. Fealq, Piracicaba.

Islek, C., A.S. Ustun, E. Koc, 2014. The effects of cellulase on capsaicin production in freely suspended cells and immobilized cell cultures of *Capsicum annuum* L. Pakistan Journal of Botany, 46(5): 1883-1887.

Kang, S.-M., H.-Y. Jung, Y.-M. Kang, J.-Y. Min, C.S. Karigar, J.-K. Yang, S.-W. Kim, Y.-R. Ha, S.-H. Lee and M.-S. Choi, 2005. Biotransformation and impact of ferulic acid on phenylpropanoid and capsaicin levels in

Capsicum annuum L. cv. P1482 cell suspension cultures. Journal of Agricultural and Food Chemistry, 53(9): 3449-3453.

Kehie, M., S. Kumaria and P. Tandon, 2012. Osmotic stress induced-capsaicin production in suspension cultures of *Capsicum chinense* Jacq. cv. Naga King Chili. Acta Physiologiae Plantarum, 34(5): 2039-2044.

Khan, H.A.A., W. Akram, K. Shehzad and E.A. Shaalan, 2011. First report of field evolved resistance to agrochemicals in dengue mosquito, *Aedes albopictus* (Diptera: Culicidae), from Pakistan. Parasites & Vectors, 146(4): 1-11.

Kintzios, S., J.B. Drossopoulos, E. Shortsianitis and D. Peppes, 2000. Induction of somatic embryogenesis from young, fully expanded leaves of chilli pepper (*Capsicum annuum* L.): effect of leaf position, illumination and explant pretreatment with high cytokinin concentrations. Scientia Horticulturae, 85(1-2): 137-144.

Kittipongpatana, N., P. Maneerat, P. Pattanakitkosol and O.S. Kittipongpatana, 2007. Effect of some factors on the growth of *Capsicum annuum* L. cell suspension culture and biotransformation of hydroquinone to arbutin. CMU Journal of Natural Sciences, 6(2): 207-218.

Koffi-Nevry, R., K.C. Kouassi, Z.Y. Nanga, M. Koussémon and G.Y. Loukou, 2012. Antibacterial activity of two bell pepper extracts: *Capsicum annuum* L. and *Capsicum frutescens*. *Int. J. Food Prop.*, 15(5): 961-971.

MA, C.J., 2008. Cellulase elicitor induced accumulation of capsidiol in *Capsicum annuum* L. suspension cultures. Biotechnology Letters, 30(5): 961-965.

Mendonça, E.G., V.C. Stein, F.P. Balieiro, C.D.F. Lima, B.R. Santos and L.V. Paiva, 2013. Genetic transformation of *Eucaliptus camaldulensis* by agrobalistic method. Revista Árvore, 37(3): 419-429.

Murashige, T. and F. Skoog, 1962. A revised medium for rapid growth and bioassays with tobacco tissue cultures. Physiologiae Plantarum, 15(3): 473-497.

Murthy, H.N., E.-J. Lee and K.-Y. Paek, 2014. Production of secondary metabolites from cell and organ cultures: strategies and approaches for biomass improvement and metabolite accumulation. Plant Cell, Tissue and Organ Culture, 118(1): 1-16.

Nogueira, R.C., R. Paiva, E.C. Lima, G.A. Soares, L.M. Oliveira, B.R. Santos, E.B. Emrich and A.H.F. Castro, 2008. Curva de crescimento e análises bioquímicas de calos de murici-pequeno (*Byrsonima intermedia* A. Juss.). Revista Brasileira de Plantas Medicinais, 10(1): 44-48.

Nuñez-Palenius, H. G. and N. Ochoa-Alejo, 2005. Effect of phenylalanine and phenylpropanoids on the accumulatin of capsaicinoids and lignina in cell cultures of chili pepper (*Capsicum annuum* L.). In Vitro Cellular and Developmental Biology - Plant, 41(6): 801-805.

Oni, M.O., 2011. Evaluation of seed and fruit powders of *Capsicum annuum* and *Capsicum frutescens* for control of *Callosobruchus maculatus* (F.) in stored cowpea and *Sitophilus zeamais* (Motsch) in stored maize. International Journal of Biology, 3(2): 185-188.

Parsaeimehr, A. and B. Mousavi, 2009. Producing friable callus for suspension culture in *Glycyrrhiza glabra*. Advances in Environmental Biology, 3(2): 125-128.

Peixoto, C.P., T. V. Cruz and M.F.S.P. Peixoto, 2011. Análise quantitativa do crescimento de plantas: Conceitos e Prática. Enciclopédia Biosfera, 7(13): 51-76.

Rao, S.R. and G.A. Ravishankar, 2002. Plant cell cultures: chemical factories of secondary metabolites. Biotechnology Advances, 20(2): 101-153.

Santos, M.M.P., O. Vieira-da-Mota, I.J.C. Vieira, R. Braz-Filho, P.S. Gonçalves, E.J. Maria, W.S. Terra, R. Rodrigues, C.L.M. Souza, 2012. Antibacterial activity of *Capsicum annuum* extract and synthetic capsaicinoid derivatives against *Streptococcus mutans*. Journal of Natural Medicines, 66(2): 354-356.

Santos, M.R.A., J.F. Rocha, E.S. Paz, C.V. Smozinski, W.O. Nogueira and M.C.M. Guimarães, 2014. Callus induction in leaf explants of *Cissus verticillata* (L.) Nicolson & C. E. Jarvis. Plant Cell Culture and Micropropagation, 10(2): 41-46.

Santos, M.R.A., M.G.R. Ferreira, M.C.M. Guimarães, R.A. Lima and C.L.L.G. Oliveira, 2014. Callogenesis in leaves of *Kalanchoe pinnata* Lam. by 2,4-D and BA action. Revista Brasileira de Plantas Medicinais, 16(3): 760-764.

Santos, M.R.A., M.G.R. Ferreira, V. Sarubo, 2010. Determination of callus growth curve in Conilon coffee. Revista Caatinga, 23(1): 133-136.

Santos, M.R.A., C.A. Souza, M.C.M. Guimarães, C.V. Smozinski, G.M.O. Magalhães, W.O. Nogueira and E.S. Paz., 2015. Growth pattern of friable callus from *P. Carniconnectivum* leaf explants. Australian Journal of Basic and Applied Sciences, 9(27): 226-231, 2015.

Souza, J.M.M., M.L. Tomaz, S.C.C. Arruda, C.G.B. Demétrio, W.N. Venables and A.P. Martinelli, 2011. Callus sieving is effective in improving synchronization and frequency of somatic embryogenesis in *Citrus sinensis*. Biologia Plantarum, 55(4): 703-307.

Souza, J.M.M., S. Berkov and A.S. Santos, 2014. Improvement of friable callus production of *Boerhaavia paniculata* Rich and the investigation of its lipid profile by GC/MS. Anais da Academia Brasileira de Ciências, 86(3): 1015-1027.

Umamaheswari, A. and V. Lalitha, 2007. *In vitro* effect of various growth hormones in *Capsicum annuum* L. on the callus induction and production of capsaicin. Journal of Plant Sciences, 2(5): 545-551.

Vanisree, M., C.-Y. Lee, S.-F. Lo, S.M. Nalawade, C.Y. Lin, H.-S. Tsay, 2004. Studies on the production of some important secondary metabolites from medicinal plants by plant tissue cultures. Botanical Bulletin of Academia Sinica, 45(1): 1-22.