EFFECT OF DIFFERENT DOSES OF VERMICOMPOST ON THE GROWTH OF *APULEIA LEIOCARPA* (VOG) MACBR. SEEDLINGS

Efeito de diferentes doses de vermicomposto sobre o crescimento de mudas de **Apuleia leiocarpa** *(Vog) Macbr.*

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Abstract

The objective of this study was to determine the best vermicompost dose for seedling production of *Apuleia leiocarpa*. The experiment consisted of five treatments, which were conducted in a greenhouse. The following doses of vermicompost were tested: control (without vermicompost); 10% vermicompost; 20% vermicompost; 30% vermicompost and 40% vermicompost of the total container volume (185 cm^3). The experimental design was entirely randomised. The substratum used was bark of *Pinus* sp., which was triturated and composted. A hundred days after seedling germination, the following variables were analysed: height and diameter growth, above ground dry matter, root dry matter and total dry matter. The 30% vermicompost doses showed to be optimum in growth response and biomass production of *Apuleia leiocarpa* seedlings.
Keywords: *Apuleia leiocarp*; Growth response; Humus; Seedlings; Vermicompost.

Resumo

O objetivo do presente trabalho foi determinar a melhor dosagem de vermicomposto para a produção de mudas de *Apuleia leiocarpa*. O experimento foi constituído por cinco tratamentos, onde foram testadas doses eqüidistantes de vermicomposto, sendo testemunha (sem vermicomposto); 10% de vermicomposto; 20% de vermicomposto; 30% de vermicomposto e 40% de vermicomposto do volume total do tubete (185 cm^3). O substrato utilizado foi casca de *Pinus* sp. triturada e hidratada. O estudo foi conduzido em casa de vegetação climatizada. O delineamento experimental foi inteiramente casualizado. Após 100 dias da semeadura foram analisadas as seguintes variáveis: altura da muda, diâmetro de colo, massa seca da parte aérea, massa seca do sistema radicular e massa seca total. A dosagem de 30% de vermicomposto é a mais indicada para a produção de mudas de grápia de boa qualidade.
Palavras-chave: Apuleia leiocarpa; Resposta de crescimento; Humus; Mudas; Vermicomposto.

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Introduction

Apuleia leiocarpa (grápia) is one of the most common native tree species in the state of Rio Grande do Sul, Brazil. The tree reaches heights ranging from 25 to 30 m and diameters at breast height from 60 to 100 cm. Its straight cylindrical trunk has a thin bark of yellowish colour, which peels off easily (JANKOWSKI et al., 1990). The wood of *Apuleia leiocarpa* is of high quality, very durable and easy to work. Due to its extraordinary characteristics, the species deserves special attention in afforestation activities (REITZ et al., 1988).

However, there is still a lack of knowledge on the propagation of grápia. The technique of producing high quality seedlings and soil requirements in the tree nursery are not yet completely investigated. Vermicompost might be seen as an important option as a substratum for seedling production, both for its economic viability and with respect to nutritional aspects.

Vermicompost is the product of organic matter decomposition by earthworms and its transformation into humus. The humus, using bovine faeces as a basis, is a fine dark granulated powder without smell. The material contains humidified micro-organisms and bacteria that have been recognized as similar to natural antibodies against plant diseases, so leading to healthier plants (ANTONIOLLI et al., 1995).

Vermicompost substratum is of high porosity and drainage, thus facilitating root penetration into the soil (GONÇALVES; POGGIANI, 1996). Other advantages are high water retention and cationic exchange capacity (200-400 milliequivalents).

According to Knäpper (1990), vermicompost humus can be immediately taken up by plants. It is rich in essential macronutrients for plant nutrition, including nitrogen, phosphorous, magnesium, sulphur and potassium, as well as nitrogen-fixing bacteria (MARTINEZ, 1991).

The objective of this study is to analyse the effect of different doses of vermicompost on seedling growth of *Apuleia leiocarpa* and to determine an optimum dose for practical application.

Materials and methods

The experiment was conducted in an air-conditioned greenhouse, with temperatures ranging from 23 to 25 °C, which is located in the Forestry Department of the University of Santa Maria. Santa Maria is located in the Central Depression of the state of Rio Grande do Sul, Brazil, at an altitude of 95 m asl and geographical coordinates of 29°43' S and 53°42' W. The climate in the region is Cfa type, according to the climatic classification of Köppen, with annual mean temperatures of 19 °C and annual precipitation from 1400 to 1800 mm (MORENO, 1961).

The seeds of *Apuleia leiocarpa* used in this study were supplied by the Foundation of Agricultural Research (FEPAGRO) of Rio Grande do Sul. The material underwent a thermal treatment to interrupt dormancy, i.e. the seeds were put into boiling water and quickly moved to cold water, thus causing a thermal shock. Seeds were spread by hand into polypropylene containers with 185 cm^3 of capacity. Each container received three seeds. Fifteen days after germination, only the most vigorous seedlings were retained.

The basis for the substratum was bark of *Pinus* sp., which was triturated and composted. Nutrient analysis of this compost was carried out in the Forest Ecology Laboratory of the University of Santa Maria, following the method of Tedesco et al. (1995) (Table 1).

Table 1 - Total nutrient content of the organic Pine bark.
Tabela 1 – Conteúdo total de nutrientes da casca orgânica de Pinus.

pH	P	K	N	Ca	Mg	Fe	B	S	Mn	Zn
	g.kg^{-1}						mg.L^{-1}			
3,7	0,1	0,4	10,2	1,8	0,6	1,168	10	350	45	49,6

In order to elevate pH to 6,0 300g of $CaCO_3$ and 150g of $MgCO_3$ were added to the substratum. The vermicompost added to the basic bark material was produced from bovine dung by red earthworms from California (*Eisenia fetida*). Chemical analysis of the vermicompost is shown in Table 2 (TEDESCO et al., 1995).

Table 2 - Total nutrient content of the vermicompost.
Tabela 2 – Conteúdo total de nutrientes no vermicomposto.

pH	P	K	N	Ca	Mg	Fe	B	S	Mn	Zn
	$g.kg^{-1}$						$mg.L^{-1}$			
7	2	6	11	5,4	3,4	0,2	27	0,25	824	89

The experimental design was entirely randomised with five treatments and four replications. Thirty plants per treatment were analysed. The treatments were: T1 (control without vermicompost); T2 (10 % vermicompost); T3 (20 % vermicompost); T4 (30 % vermicompost) T5 and (40 % vermicompost of the total container volume of 185 cm^3).

The plants remained 100 days in the greenhouse after sowing. At the end of the observation period, the following parameters were measured: height of the aerial part, stem diameter, above ground dry matter, root dry matter, and total dry matter. For determining dry matter weight, the parts of the seedlings above and below ground were separated. Roots were washed on 0,75 and 0,21 mm wide wire mesh. Then the samples were dried separately in an oven at a temperature of 75°C, until they reached constant weight. Total dry matter was obtained by summing the weights of the above and below ground parts.

To determine the seedlings' growth response to different vermicompost doses, different regression functions were fitted by using the "stepwise" procedure (SAS Institute). The adjusted coefficient of determination (R^2_{adj}) and the standard error (S_{yx}) served as criteria for model selection. The best model found was a third degree polynomial: $\mathbf{y = a_0 + a_1{*}x + a_2{*}x^2 + a_3{*}x^3}$, where y = dependant variable, x = vermicompost doses, and a_0, a_1, a_2, a_3 = coefficients.

Results and discussion

Regression analysis shows that the seedlings of *Apuleia leiocarpa* significantly respond to different doses of vermicompost. Height growth and stem diameter increase with increasing vermicompost dose up to 30 %, while higher doses do not lead to any further responses (Figures 1 and 2). In young plantations, stem diameter is strongly correlated with plant survival rates (SCHUBERT and ADAMS, cited by CARNEIRO, 1983). Furthermore, above ground dry matter, root dry matter and total dry matter decreases at > 30 % vermicompost dose (=61,7 cm_) (Figures 3-5).

Figure 1 - Height growth response in relation to vermicompost dose.
Figura 1 – Resposta do crescimento em altura em função da dose de vermicomposto.

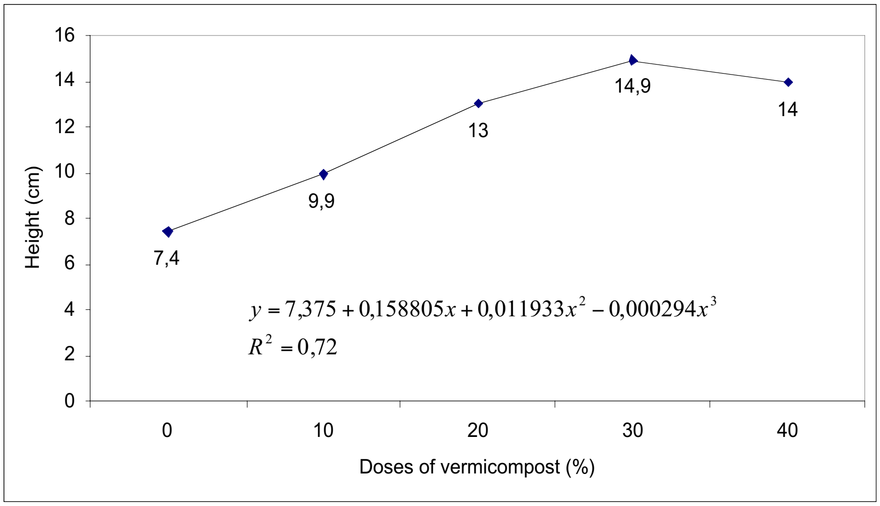
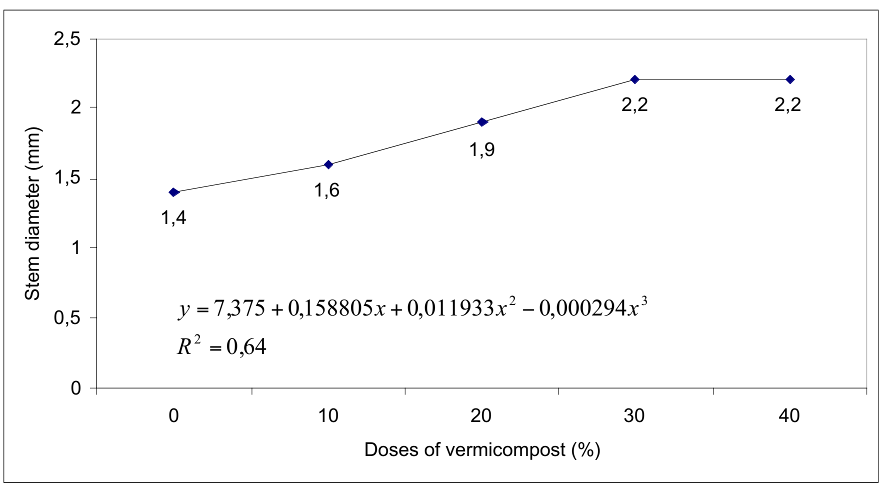
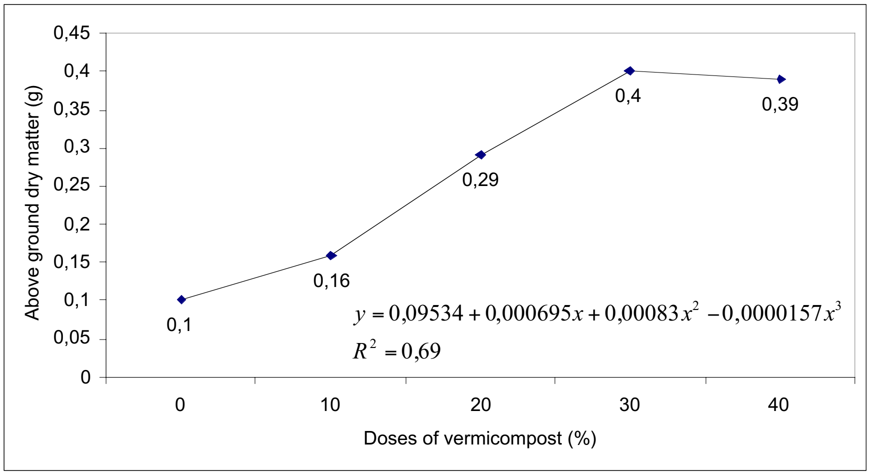


Figure 2 - Stem diameter growth response in relation to vermicompost dose.
Figura 2 - Resposta do crescimento em diâmetro em função da dose de vermicomposto.



A 30 % vermicompost dose shows the best results in terms of height and diameter growth, and biomass production. At that dose, nutrient availability in the substratum is probably optimal, without nutrient lack or excess, which could lead to toxic effects on the seedlings.

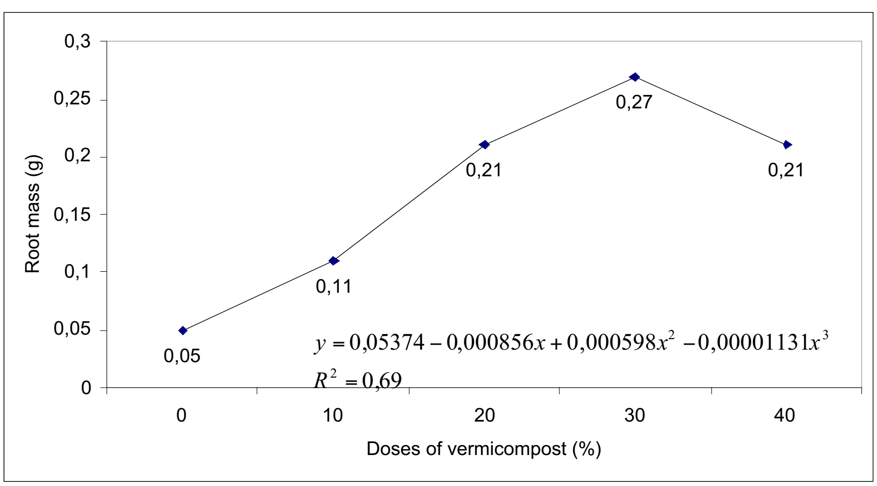
Figure 3 - Above ground dry matter production in relation to vermicompost dose.
Figura 3 - Produção de biomassa aérea em função da dose de vermicomposto.



Gonçalves and Poggiani (1996) state that the success of highly productive plantations is very much related to the efficiency of their respective plant substrates. Germination rates, fixation and root growth, and above ground biomass are strongly correlated with soil characteristics such as soil air, soil drainage and water retention. These parameters in turn are correlated with microporosity and specific surface of the substratum.

In a study with transplanted seedlings of *Cordia trichotoma* using different vermicompost doses, Piroli et al. (1996) found a positive effect of vermicompost doses up to 30 % on stem diameter growth. However, doses above 40 % led to a growth decline, indicating an optimum dose for the application of vermicompost.

Figure 4 - Root mass production in relation to vermicompost dose.
Figura 4 - Produção de massa de raízes em função da dose de vermicomposto.

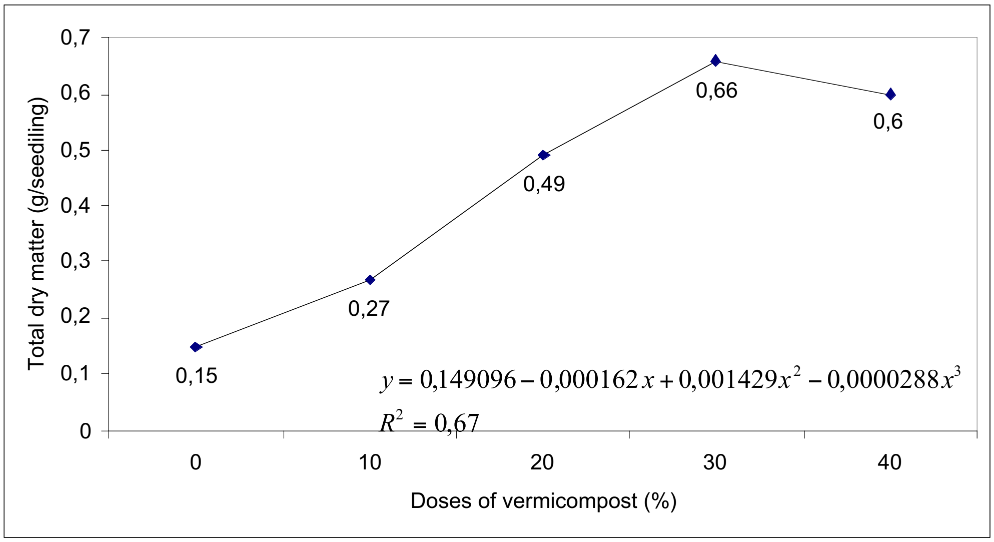


Gomes et al. (1991) found that an 80 % mixture of organic compost with 20 % of hard coal dust resulted in the best root growth of *Eucalyptus grandis*, when compared with other mixtures.

In an investigation with seedlings of *Pinus resinosa* and *Picea glauca*, Phipps (1974) showed that a 1:1 and 3:1 mixture of turf and humus with vermiculite produced seedlings 30 % larger than those produced with other mixtures. Furthermore, higher survival rates were obtained. In a study with oiti (*Licania tomentosa*), Alves; Passioni (1997) proved that height growth in the control treatment without vermicompost was lower than in substrata where vermicompost was added. Even if the whole substratum were substituted by vermicompost, no negative effect on growth could be found. In this case, no phytotoxic effect could be attributed to vermicompost, showing that different species in this development stage require different nutrients.

Figure 5 - Total dry matter production in relation to vermicompost dose.

Figura 5 - Produção de massa seca total em função da dose de vermicomposto.



In a similar study, Tedesco et al. (1995) found that increased doses of vermicompost led to higher above and below ground biomass of *Jacaranda micrantha* Chamisso. No optimum in growth response could be found. Furthermore, increased vermicompost doses tended to reduce the ratio of below to above ground biomass, which is a common strategy in plant response to higher soil fertility (CLARKSON, 1984).

Conclusions

From the results presented it can be concluded that:

1) Vermicompost can be used as a substratum for the production of high quality plants of *Apuleia leiocarpa*;

2) All the analysed variables were influenced by an increasing dose of vermicompost in the basic substratum;

3) The best dose of vermicompost for seedling production of *Apuleia leiocarpa* is 30 %. At higher doses, symptoms of phytotoxicity are to be expected.

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