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RESEARCH ARTICLE

THE USE OF MORPHOLOGICAL PARAMETERS FOR THE ASSESSMENT OF *ACACIA MEARNSII* SEEDLINGS

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ABSTRACT

This study aimed to determine the Dickson's quality index (DQI) and its relationship with morphological variables in *Acacia mearnsii* De Wild seedlings, in the greenhouse. The experiment was conducted in a forestry nursery and a randomized complete block design was used, in which one forest species was evaluated through eleven evaluation periods after emergence, with five repetitions. Height (H), stem diameter (SD), dry leaf matter (DLM), dry stem matter (DSM), dry shoot matter (DSM), dry root matter (DRM), total dry matter (TDM), leaf area (LA) and Dickson's quality index (DQI) were evaluated. DQI was highly correlated with the TDM and DSM. All variables showed significant differences in relation to periods after emergence and a positive systematic change in relation to different DAE was verified. Pearson correlation analysis revealed that all coefficients among the variables studied were significant, and the highest coefficients for H, SD and TDM occurred with DAE. The H and SD are easily measurable variables and plants do not need to be destroyed for analysis, for this reason, they can be used to accurately assess the quality of *Acacia mearnsii* seedlings.

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INTRODUCTION

Acacia mearnsii De Wildbelongs to the Fabaceae family, it is characterized by having rapid growth, and its height can reach 18 m in adulthood (Freddo, 1997). This species is considered appropriate for use in agroforestry systems, commercial reforestation, and is the main source of bark used by the global tannins industry (used in leather tanning). The wood is very dense, and used in the production of pulp and paper, and is resistant to frost (Caron *et al*., 2011). In the state of Rio Grande do Sul State, Brazil, *Acacia mearnsii* is the third most planted species in the area, after species of the genus *Eucalyptus* and *Pinus* (Sanquetta *et al*., 2014). The production of seedlings in forest nurseries is one of the most important steps in the plantation of forest stands, and allows for greater control over the quality of cultivated material. The success of a forest plantation depends on numerous factors such as the quality of seedlings, which can help to increase the productivity of a forest stand. It is necessary to define the various relevant methodologies, containers, substrates, and fertilization techniques related to the production of forest seedlings which show high survival rates and optimal performance in the field (Behling *et al*., 2012). The expansion in demand for forest products has had a direct consequence on the quality and health of native Brazilian forests and resulted in the implementation of much needed reforestation programs. Robust, high productivity species can reduce reforestation time, and in forestry plots, reduce the time required for harvest cycles. In this context, seedlings that have appropriate silvicultural characteristics may present greater resistance to adverse environmental conditions in the field, and less time spent for their complete formation (Cross *et al*., 2004). When the plants are transplanted for field use, criteria based on less ideal parameters are often used which in most cases do not translate to the actual growth or production qualities of plants. These variables show responses in function of species, ecological sites, the cultural practices, transportation, distribution and seedlings planting. Tests can be used in order

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to define the standard and quality of seedlings, add market value to products (Gomes *et al*., 2002). In order to determine the quality of seedlings, we can use both morphological characteristics, which are based on phenotypic aspects for, and physiological characteristics which are defined internally in the plant. The morphological characteristics are most often used in these determinations, because they have a greater acceptance of forest nursery workers;however, definitions that provide improved survival and early growth are needed. Dickson's quality index is mentioned as a promising integrated morphological measure and identified as a good indicator of quality seedlings because of its robustness, and because a distributed balance of dry matter is considered. Morphological parameters are suitable to analyze the seedlings; easy physical application and can be a fast and practical measure for forest species. For this reason, it was used to establish the time necessary for per forming silvicultural activities, which are important to obtain seedlings with better quality (Fonseca *et al*. 2002). In this context, this study aimed to determine the Dickson's quality index and its relationship with the morphological variables in *Acacia mearnsii* seedlings in the greenhouse.

MATERIALS AND METHODS

The experiment was conducted in a greenhouse, at the geographic coordinates 27 ° 23'26" S; 53°25'43" W, 461 m of altitude, in the city of Frederico Westphalen, Rio Grande do Sul, Brazil. According to the Köppen climate classification, the climate is Cfa, i.e., humid subtropical with mean annual temperature of 19.1 ° C, varying with maximum of 38ºC and minimum of 0°C. A randomized complete block design was used, in which one forest species was evaluated in eleven evaluation periods beginning after emergence, with five repetitions. The experimental units had five plants in each evaluation period and used double border. In total to275 plants were evaluated with 25 plants evaluations per period (each 15 days after first emergence). Sowing was performed on March 15, 2010 directly in conical plastic seedling tubes, with a volume of 90 cm^3, these were then packed in plastic trays with a capacity of 96 tubes. The trays were arranged in a stand of 1.3 m from ground level, completed with commercial substrates (Tecnomax®) composed of organic material, and with slow release fertilizer (Basacote®). We placed 6 seeds in each tube. After the seedlings reached 10 days of age, thinning was done in order to eliminate the excess in each container, leaving only what had higher quality and more central. During the experiment, the water regime in the greenhouse included three daily irrigations with spray nozzles. Evaluations were performed every 15 days. The first evaluation was done 30 days after emergence (DAE), and the last evaluation, 180 DAE.

The following variables were evaluated: height (H), stem diameter (SD), dry leaf matter (DLM), dry stem matter (DSM), dry shoot matter (DSM), dry root matter (DRM), total dry matter (TDM), leaf area (LA) and Dickson's quality index (DQI). The H was determined from the level of the substrate until the end of the last leaf, with a graduate rule. The DC was measured at the substrate level, with the aid of digital caliper, with a digital caliper. The processes of dry shoot matter and dry root matter evaluations began with the separation of the shoot and roots of a plant, next material was dried in an oven with forced ventilation at 65 °C until this material reached a constant mass, lastly the weighing of samples was performed with an electronic scale with precision in milligrams. The TDM was obtained by adding the dry shoot matter and dry root matter.

LA was obtained by using a leaf area integrator model LI-3000C. DQI was determined by using the following expression proposed by Dickson *et al*. (1960):

$$DQI=\frac{TDM\ (g)}{\frac{H(cm)}{SD\ (mm)}+\frac{DSM\ (g)}{DRM(g)}}$$

In which DQI =Dickson's quality index; TDM = total dry matter; H = height; DSM = dry shoot matter; SD = stem diameter; DRM = dry root matter.

Data was statistically analyzed using the software "Statistical Analysis System" (SAS, 2003), which was determined the analysis of variance, regression analysis, Pearson correlation analysis and F test at 5% probability error.

RESULTS

Analysis of variance showed a significant difference in height, stem diameter, dry leaf matter, dry stem matter, dry root matter, total dry matter, leaf area and Dickson's quality index in different periods after emergence (30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180 days after emergence) (Table 1). For all variables, there was a positive systematic change in relation to different days after emergence, i.e., in longer periods the highest values were observed. This result was mainly due to the large volume of exploitable substrate (90 cm^3) available for the seedlings in plastic tubes, which promoted the greatest development of roots and, consequently, greater seedling growth (Figure 1). From the Pearson correlation analysis, itcan be observed that all coefficients were presented as significant. The DQI presented, for most variables, lower Pearson correlation coefficients; the DQI correlations were significant when compared to other analyzed correlations (Table 2).

Table 1. Analysis of variance for height (H), stem diameter (SD), dry leaf matter (DLM), dry stem matter (DSM), dry root matter (DRM), total dry matter (TDM), leaf area (LA) and Dickson's quality index (DQI) in different days after emergence (DAE), in *Acacia mearnsii* seedlings

Factors	DF	Mean square							
		H	SD	DLM	DSM	DRM	TDM	LA	DQI
DAE	10	487.71*	4.38*	7.58*	6.96*	6.13*	60.25*	72423.06*	13.04*
Block	4	6.63	0.01	0.07	0.10	0.08	0.22	1868.98	0.27
R^2		0.99	0.98	0.96	0.96	0.94	0.98	0.97	0.90
CV (%)		5.01	4.55	17.14	23.30	23.75	12.14	16.97	31.06

* = significant at the 5% probability of error.

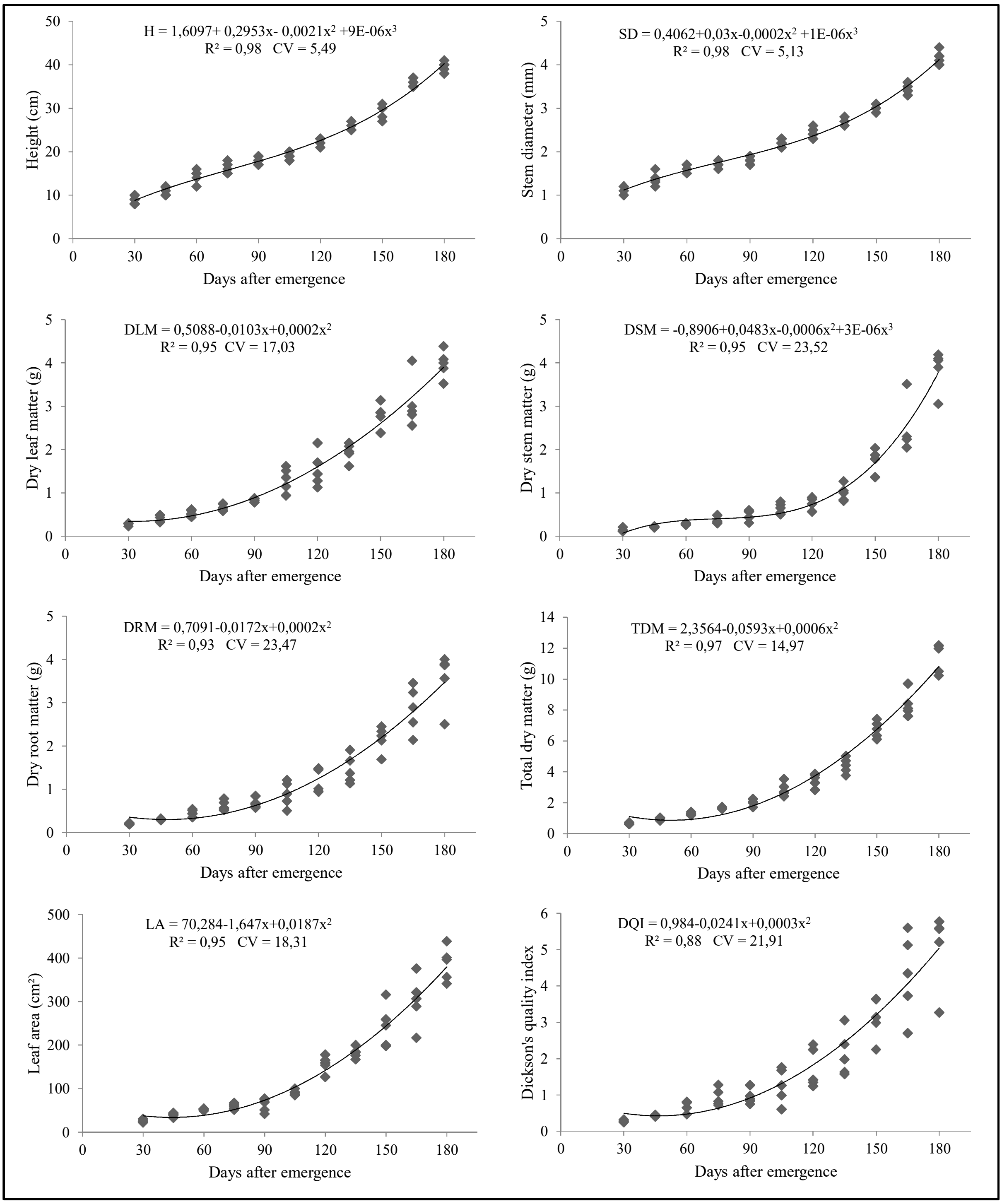

Figure 1. Regression equations for the height, stem diameter, dry leaf matter, dry stem matter, dry root matter, total dry matter, leaf area and Dickson's quality index in different days after emergence, in *Acacia mearnsii* seedlings

Table 2. Pearson correlation coefficient among the variables: days after emergence (DAE), height (H), stem diameter (SD), dry leaf matter (DLM), dry stem matter (DSM), dry root matter (DRM), total dry matter (TDM), leaf area (LA) and Dickson's quality index (DQI) in *Acacia mearnsii* seedlings

	H	SD	DLM	DSM	DRM	TDM	LA	DQI
DAE	0.99	0.99	0.98	0.98	0.97	0.99	0.98	0.96
H		0.98	0.98	0.98	0.96	0.98	0.97	0.95
SD			0.97	0.97	0.97	0.98	0.97	0.95
DLM				0.97	0.95	0.98	0.97	0.93
DSM					0.97	0.98	0.97	0.95
DRM						0.98	0.96	0.97
TDM							0.98	0.97
LA								0.94

* All correlation coefficients were significant at 5% level of probability.

DISCUSSION

H is one of the oldest parameters in the classification and selection of seedlings (Parviainen, 1981), and presents a relatively large contribution which can be indicated as a parameter for evaluating seedlings. Because it is an easily measured variable and not a destructive method it has always been used effectively to estimate the standard quality of seedlings in forests nurseries (Gomes *et al*., 2002). It is also considered one of the most important parameters in estimating growth in the field (Mexal and Lands, 1990; Reis *et al*., 1991), and technically accepted as good measure of performance potential (Mexal and Lands, 1990). DQI is considered as good indicator of quality seedlings, and is used for in a calculation of robustness (H / DC ratio), and in calculating the distributed balance of the biomass (DSM/DRM ratio) (Caldeira *et al*., 2007). The higher DQI, the better the quality of the produced seedlings (Caldeira *et al*., 2012). Literature shows that the DQI may vary depending on the species; the handling of seedlings in the nursery, substrate type and proportion, container volume, and especially ageat which the seedling is evaluated have an impact on DQI (Caaldeira *et al*., 2007; Caldeira *et al*., 2008; Saidelles *et al*., 2009; Trazzi *et al*., 2010; Gomes *et al*., 2013). The results presented in Figure 1 show an increasing trend of DQI over the evaluation period of seedlings in the greenhouse, in plastic tubes of 90 cm^3. Similar results were reported by Malavasi and Malavasi (2006), who found in *trichotoma Cordia* and *Jacaranda micranta* seedlings produced in tubes with volumetric capacity of 120, 180 and 300 cm3, DQI mean values statistically similar, and superior to the seedlings grown in tubes 55 cm^3.Fonseca *et al*. (2002) studying the quality of *Trema micrantha* (L.) Blume seedlings, found that DQI is highly correlated with all morphological plant parameters. Relations between DQI and dry matter are expected, due to the variables used in the calculation expression. According José *et al*. (2005), researching the production *of Schinus terebinthifolius* Raddi seedlings, the growth potential of the root system was significantly correlated with other variables, mainly the SD. For the authors Mexal and Landis (1990); Brisset *et al*. (1991); Cline and Johnson (1991); José *et al*. (2005), the SD was the most correlated trait with other variables. The variables H (0.99), SD (0.99) and TDM (0.99) showed high correlation coefficients with DAE (Table 2). These results may be explained by competition among the seedlings in the trays, which were influenced by the tube size, as they demonstrated a higher standard growth rate. Tree roots are closely associated with the physiological activities in the environment-soil-water-plant complex (Carneiro, 1995); According to Hermann (1964), dry root matter is recognized as one of the best and most important parameters when considering the survival and strength of a seedling. For the same author, in *Pseudotsuga menziesii* seedlings, survival was significantly increased for the traits that had a more developed root system, independent of H. The ratio between dry shoot matter and dry root matter can be considered an efficient and safe index to assess the quality of seedlings (Parviainem, 1981). This ratio was positively verified in Table 2 when analyzing the Pearson correlation coefficient of the dry steam matter (0.97) and dry leaf matter (0.95) with dry root matter. Dry matter production has been considered one of the best parameters to characterize the quality of seedlings. The determination of this variable may not be viablein many forest nurseries because this involve the complete destruction of seedlings and the necessity of weight measurements and a drying oven.

Conclusions

- DQI was highly correlated with the TDM and DSM.
- All variables showed significant differences in relation to the 11 different periods after emergence; positive systematic changes were verified in relation to different DAE.
- Pearson correlation analysis revealed that all coefficients among the studied variable were significant; the largest coefficients were for H, SD and TDM with DAE.
- The H and SD are easily measurable variables and not destructible, for this reason, they can be used to assess the quality of seedlings.

REFERENCES

Behling, A., Caron, B.O., Souza, V.Q. Bamberg, R., Eloy, E. 2012. Acúmulo de radiação solar global para a produção de mudas de eucalipto, *Enciclopédia Biosfera*, 8 (1-8).

Bomfim, A.A., Novaes, A,B., José, A.R.S., Grisi. F.A. 2009. Avaliação morfológica de mudas de madeira-nova (*Pterogyne nitens* tull.) produzidas em tubetes e sacos plásticos e de seu desempenho no campo,Floresta, 39 (33-40).

Brisset, J.C., Barnett, J.P. Landis, T.D. 1991. Container seedlings. In: Duryea, M.L., Dougherty, P.M. (eds.), Forest regeneration manual, Netherlands: Klumer Academic, 1 (117-142).

Caldeira, M.V.W., Delarmelina, W.M., Lübe, S.G., Gomes, D.R., Gonçalves, E.O., Alves, A. F. 2012. Biossólido na composição de substrato para a produção de mudas de *Tectona grandis*, Floresta, 42 (77-84).

Caldeira, M.V.W., Marcolin, M. Moraes, E. ,Schaadt, S.S. 2007. Influência do resíduo da indústria do algodão na formulação de substrato para produção de mudas de *Schinus terebinthifolius* Raddi, *Archontophoenix alexandrae* Wendl. et Drude e *Archontophoenix cunninghamiana* Wendl. Et Drude, Ambiência,3 (1-8).

Caldeira, M.V.W., Rosa, G.N., Fenilli, T.A.B., Harbs, R.M.P. 2008. Composto orgânico na produção de mudas de aroeira-vermelha, Scientia Agraria, 9 (27-33).

Carneiro, J.G.A. 1995. Produção e controle de qualidade de mudas florestais. Curitiba: Campos/UENF. UFPR/FUPEF, 1 (451).

Caron, B.O., Eloy, E., Souza, V.Q., Schmidt, D., Balbinot, R., Behling, A., Monteiro, G.C. 2015. Quantificação da biomassa florestal em plantios de curta rotação com diferentes espaçamentos,Comunicata Scientiae, 6 (106-112).

Cruz, C.A., Paiva, H.N., Gomes, K.C.O., Guerrero, C.R.A. 2004. Efeito de diferentes níveis de saturação por bases no desenvolvimento e qualidade de mudas de ipê-roxo (*Tabebuia impetiginosa* (Mart.) Standley), Scientia Forestalis, 66 (100-107).

Dickson, A., Leaf, A.L., Hosner, J.F. 1960. Quality appraisal of white spruce and white pine seedling stock in nurseries, Forestry Chronicle, 36 (10-13).

Fonseca, E.P., Valeri, S.V., Miglioranza, E., Fonseca, N.A.N., Couto, L. 2002. Padrão de Qualidade de Mudas de *Trema micrantha* (L.) Blume. produzidas sob diferentes períodos de sombreamento, Revista Árvore, 26 (515-523).

Freddo, A. 1997. Elementos minerais em madeiras de eucaliptos e acácia-negra e sua influência na indústria de celulose kraft branqueada.(Dissertação), Universidade Federal de Santa Maria, Santa Maria.

Gomes, D.R., Caldeira, M.V.W., Delarmelina, W.M., Gonçalves, E.O., Trazzi, P.A. 2013. Lodo de esgoto como substrato para a produção de mudas de *Tectona grandis* L., Cerne, 19 (123-131).

Gomes, J.M., Couto, L., Leite, H.G., Xavier, A., Garcia, S.L.R. 2002. Parâmetros morfológicos na avaliação da qualidade de mudas de *Eucalyptus grandis*, Revista Árvore, 26 (655-664).

Hermann, R.K. 1964. Importance of top-root ratios for survival of Douglas-fir seedlings, Tree Planters Notes, 64 (7-11).

Johnson, J.D. and Cline, M.L. Seedling quality of southern pines. In: Duryea, M.L. and Dougherty, P.M. 1991.Forest regeneration manual. Dordrecht Netherlands: Klumer Academic Publishers, 1 (143-162).

Jose, A.C., Davide, A.C., Oliveira, S.L. 2005. Produção de mudas de aroeira (*Schinus terebinthifolius* Raddi) para recuperação de áreas degradadas pela mineração de bauxita, Cerne, 11 (187-196).

Malavasi, U.C. and Malavasi, M.M. 2006. Efeito do volume do tubete no crescimento inicial de plântulas de *Cordia trichotoma* (Vell.) Arrab. ex Steud e *Jacaranda micranta* Cham, Ciência Florestal, 16 (11-16).

Mexal, J.L. and Landis, T.D. 1990. Target seedling concepts: height and diameter. In: Target seedling symposium, meeting of the western forest nursery associations, general technical report Rm-200, Roseburg. Proceedings… (17-35). Fort. Collins: United States Department of Agriculture, Forest Service.

Parviainen, J.V. 1981. Qualidade e avaliação da qualidade de mudas florestais. In: Seminário de sementes e viveiros florestais, Curitiba. Anais do... Curitiba: FUPEF, 1 (59-90).

Reis, M.G.F., Reis, G.G., Regazzi, A.J., Leles, P.S.S. 1991. Crescimento e forma de fuste de mudas de Jacarandá-da-Bahia (*Dalbergia nigra* Fr. Allem.) sob diferentes níveis de sombreamento e tempo de cobertura, Revista Árvore, 15 (23-34).

Saidelles, F.L.F., Caldeira, M.V.W. ,Schirmer, W.N., Sperandio, H.V. 2009. Casca de arroz carbonizada como substrato para produção de mudas de tamboril-da-mata e garapeira, Semina: Ciências Agrárias, 30 (1173-1186).

Sanquetta, C.R., Behling, A., Corte, A.P.D., Simon, A., Pscheidt, H., Ruza, M.S., Mochiutti, S. 2014. Estoques de biomassa e carbono em povoamentos de acácia negra em diferentes idades no Rio Grande do Sul,Scientia Forestalis 42 (361-370).

Sas Learning Edition. 2003. Getting started with the SAS learning edition. Cary (200).

Trazzi, P.A., Caldeira, M.V.W., Colombi, R. Avaliação de mudas de *Tecoma stans* utilizando biossólido e resíduo orgânico, Revista de Agricultura, 85 (218-226).

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