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Nitrogen fertilization in the production of seedlings of *Talisia esculenta* (A. St. Hil) Radlk

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Key words:
'pitombeira'
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ABSTRACT

'Pitombeira' does not have organized cultivation, thus requiring information related to the production of seedlings, particularly in relation to chemical fertilizer. In this context, an experiment was conducted in order to define the best dose of nitrogen (N), using urea as N source, to be applied in 'pitombeira' seedlings. The experimental design was complete randomized blocks with four replicates and ten plants per plot, testing five N doses (0, 400, 800, 1.600 and 3.200 mg dm^{-3}). Data were submitted to analysis of variance and regression. The non-destructive measurements (number of leaves, stem diameter, shoot length and the ratio between shoot length and stem diameter) were evaluated at 30, 60, 90 and 120 days after transplanting (DAT). In addition, shoot, root and total dry matter and Dickson quality index were determined at 120 DAT. Nitrogen fertilizations, from the dose of 500 mg N dm^{-3} as top-dressing, were those that led to the most vigorous 'pitombeira' plants, while plants developed with dose above 1.600 mg of N dm^{-3} showed a reduction in their vigor.

Palavras-chave:
pitombeira
propagação
ureia

Adubação nitrogenada na produção de mudas de *Talisia esculenta* (A. St. Hil) Radlk

RESUMO

A pitombeira possui exploração extrativista, sendo uma cultura carente em informações relacionadas à produção principalmente quanto à relação à adubação química. Neste sentido foi conduzido um trabalho com o objetivo de testar a melhor dose de nitrogênio, tendo como fonte a ureia a ser aplicada em mudas de pitombeira. O delineamento experimental utilizado foi o de blocos completos ao acaso com quatro repetições e dez plantas por parcela sendo testadas cinco doses nitrogênio (0; 400; 800; 1.600 e 3.200 mg dm^{-3}). Os dados foram submetidos à análise de variância e regressão. As mensurações não destrutivas (número de folhas, diâmetro do colo, comprimento da parte aérea e a relação entre o comprimento da parte aérea e o diâmetro do colo) foram avaliadas aos 30, 60, 90 e 120 dias após o transplantio; já a massa seca da parte aérea, das raízes e total e o índice de qualidade de Dickson foram determinados aos 120 dias. As adubações nitrogenadas foram, a partir da dose de 500 mg N dm^{-3} em cobertura, as que proporcionaram formação das mudas de pitombeira mais vigorosas enquanto as plantas desenvolvidas com dose acima de 1.600 mg de N dm^{-3} apresentaram redução no seu vigor.

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Introduction

Popularly known as 'pitombeira', *Talisia esculenta* (A. St. Hil) Radlk is native to Brazil and has highly appreciated edible fruits, which are commercialized in open markets (Lorenzi, 2008). The species has great ecological (Vieira & Gusmão, 2008) and economic importance and, in the season period, constitutes a significant source of income for small producers (Alves et al., 2009).

Pitombeira is exploited through extractivism or in domestic orchards without using technology, requiring information related to the main agronomic techniques, notably in the production of seedlings (Mendonça et al., 2012). For having great potential in family farming, it is notorious the need to obtain information regarding its production, especially related to mineral nutrition.

Nitrogen (N) is one of the most required nutrients in seedling production. It is characterized as one of the main limiting factors for plant growth and development (Meneghin et al., 2008). Its deficiency can compromise the processes of plant growth and reproduction (Cazetta et al., 2007), while its adequate supply is essential for the formation of vegetative structures (leaves, stem and roots), flowering and fruit filling (Taiz & Zeiger, 2009).

Results of studies conducted with various species show responses related to N application for the growth of seedlings in containers (Prado & Vale, 2008; Souza et al., 2009; Leite et al., 2010; Menegazzo et al., 2011; Smarsi et al., 2011; Pereira et al., 2011).

Regarding fertilization, there are difficulties in the recommendation of specific fertilization for 'pitombeira'. Because of the few studies, this research was conducted to test the best N dose, using urea as N source, to be applied as top-dressing in the initial development of 'pitombeira' seedlings in nursery.

Material and Methods

The experiment was conducted from March to July 2014, in the seedling production nursery, covered with shade screen (50%), of the Federal Rural University of the Semi-Arid Region (UFERSA), situated in the municipality of Mossoró-RN (5° 11' S, 37° 20' W, with altitude of 18 m, mean annual rainfall of 673.9 mm, with hot and dry climate).

The experimental design was randomized complete blocks, with five treatments and five replicates, and each experimental unit was composed of ten evaluation plants. The treatments consisted of N doses (0; 400; 800; 1600; 3200 mg dm^{-3}), in the form of urea (45% N).

The utilized seeds came from a plant located in the urban area of Mossoró and were depulped, washed in running water, subsequently dried in the shade for 24 h and sown on polystyrene trays with 128 cells, filled with coconut fiber substrate.

At 30 days after sowing (DAS), 'pitombeira' seedlings were transplanted to 1.5-L black polyethylene bags, filled with 75% of soil and 25% of aged cattle manure, in volume basis. The results of the mixture were: pH (water) = 7.60; Na^+ = 2.29 $cmol_c$ dm^{-3}; Al^{3+} = 0.00; K^+ = 1.49 $cmol_c$ dm^{-3}; Ca^{2+} = 3.30 $cmol_c$ dm^{-3}; Mg^{2+} = 2.00 $cmol_c$ dm^{-3}; Sum of Bases = 9.08 $cmol_c$ dm^{-3}; P = 23.51 mg kg^{-1}; Cu = 0.40 mg kg^{-1}; Zn = 7.40 mg kg^{-1}; Fe = 76.00 mg kg^{-1}; Mn = 22.40 mg kg^{-1}; C = 3,32; OM = 5.73 g kg^{-1} [measured by the Soil Fertility Laboratory of UFERSA, following the methodology of EMBRAPA (2009)].

Top-dressing N fertilizations started 30 days after transplanting (DAT) and the treatments were applied at 14-day intervals. To apply N, the concentrations (0, 400, 800, 1600 and 3200 mg dm^{-3}) were dissolved in 1 L of water and 20 mL were applied per plant, according to each treatment. Irrigations were daily performed, according to the field capacity.

Non-destructive measurements (number of leaves, stem diameter, shoot length and the ratio between shoot length and stem diameter) were evaluated at 30, 60, 90 and 120 DAT.

Shoot, root and total dry matters were determined at 120 DAT, after drying in forced-air oven at temperature of 65.0 ± 1.0 °C until constant weight, with subsequent weighing on analytical scale with precision of 0.001 g and results expressed in g $plant^{-1}$. The ratio between shoot dry matter and root dry matter, as well as the ratio between shoot length and shoot dry matter were obtained by dividing their dry matters. Dickson quality index (DQI) was measured using the formula DQI = [total dry matter/(SH/SD + SDM/RDM)], where SH/SD is the ratio between shoot height and stem diameter and SDM/RDM is the ratio between shoot dry matter and root dry matter, according to the methodology proposed by Dickson et al. (1960). The data were subjected to analysis of variance (ANOVA) and, when significant, the treatments were subjected to polynomial regression analysis ($p < 0.05$). The statistical analyses were performed using the programs Sisvar (Ferreira, 2011) and Table Curve® (Jandel Scientific, 1991).

Results and Discussion

Regarding the non-destructive variables, the number of leaves and shoot length suffered a significant effect of the application of N doses along the days after transplanting (DAT), while stem diameter suffered significant effect only of the DAT. For the ratio between shoot length and stem diameter, there was no effect of N fertilization or DAT, showing a mean value of 5.10 ± 0.16 cm mm^{-1}.

For destructive variables, N fertilization caused significant effect on root length, shoot dry matter and total dry matter. For root dry matter, shoot dry matter/root dry matter ratio, shoot length/shoot dry matter ratio and Dickson quality index, there was no effect of N fertilization as top-dressing, showing mean values of 0.67 and 1.95 g $plant^{-1}$, 13.65 cm and 0.28, respectively.

At 30 DAT, the stem diameter of 'pitombeira' plants was equal to 2.9 mm; in the next evaluations, the cumulative increments were 2.8% at 60 days, 8.0% at 90 days and 12.2% at 120 DAT, with estimated value of 3.4 mm. In the last period, its increment in diameter was the highest one of the entire period, corresponding to 7.0%, as illustrated in Figure 1.

The selection of plants with greater stem diameter may lead to more productive plants, because of the high genetic

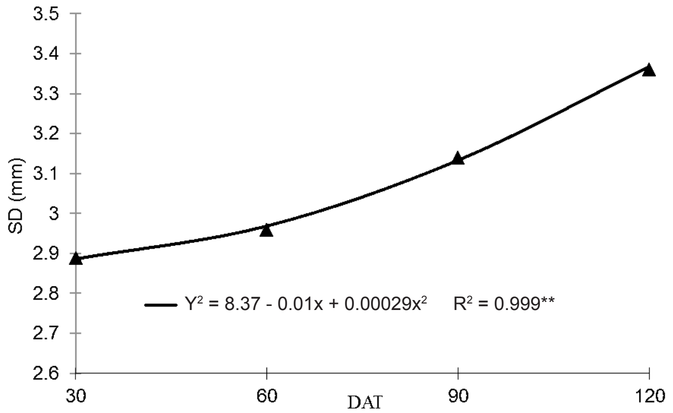

Figure 1. Stem diameter (SD) in the initial development of 'pitombeira' as a function of days after transplanting (DAT)

correlation between these characteristics (Silva et al., 2007). High value of stem diameter is a characteristic considered as desirable, for favoring the execution of management and cultivation practices (Biscaro et al., 2008).

For number of leaves and shoot length, there was significant effect only of the treatments at 120 DAT. The maximum value for number of leaves (6 leaves plant^{-1}) was estimated at the N dose of 948 mg dm^{-3} as top-dressing in the substrate, which represents an increment of 32% of this variable in relation to the control (Figure 2A). The results of the present study were different from those found by Menegazzo et al. (2011), who observed that, as the N fertilization levels increase, the production of papaya seedlings and the number of leaves (NL) also increase. It is interesting to highlight that, in the cultivation of 'pitombeira' seedlings, there was expressive leaf abscission in the lower branches. This may have been due to the excess of shading on these leaves, which was even more aggravated with the excess of N fertilization, possibly caused by a nutritional imbalance of the plant.

For shoot length, the maximum estimated value of 21 cm occurred with the N application of 400 mg dm^{-3} in the substrate, promoting an increment of 20% in relation to the absence of N fertilization (Figure 2B). This growth of seedlings was superior to those found by Pereira et al. (2011), who evaluated N sources and doses also in the production of 'pitombeira' seedlings and found maximum value for this variable (17.8 cm) with the application of 295.6 mg dm^{-3} of N in the form of ammonium sulfate. When urea was used, the maximum estimated shoot length was 17.7 cm, at N dose of 250.8 mg dm^{-3}. Results similar to those of the present study were observed by Mendonça et al. (2009), who observed that papaya seedlings showed maximum shoot length at the dose of 1,411 mg of N dm^{-3}.

According to Figure 3, root length increased up to the N dose of 1975 mg dm^{-3}, with maximum value of 30 cm, which represented an increment of 26% in relation to the absence of N application. Similar responses were observed by Pereira et al. (2011), who evaluated the root length of 'pitombeira' seedlings and found maximum estimated value of 27.9 cm, at the N dose of 1720.5 mg dm^{-3}.

According to Figure 4, shoot dry matter reached maximum estimated value (1.5 g plant^{-1}) at the maximum estimated N dose of 504 mg dm^{-3}. This dose led to increment of 16% in weight, compared with the control. These results are similar to those reported by Pereira et al. (2011), who found highest shoot dry matter of 'pitombeira' rootstocks of 2.1 g, applying 613.6 mg dm^{-3} of N. Doses above 504 mg dm^{-3} led to reduction in 'pitombeira' dry matter, possibly being characterized as N overdose, which favors a nutritional imbalance in the plants, or probably caused by the decrease in substrate pH, affected by a possible release of H+ produced during the nitrification of the applied product, as reported by Decarlos Neto et al. (2002).

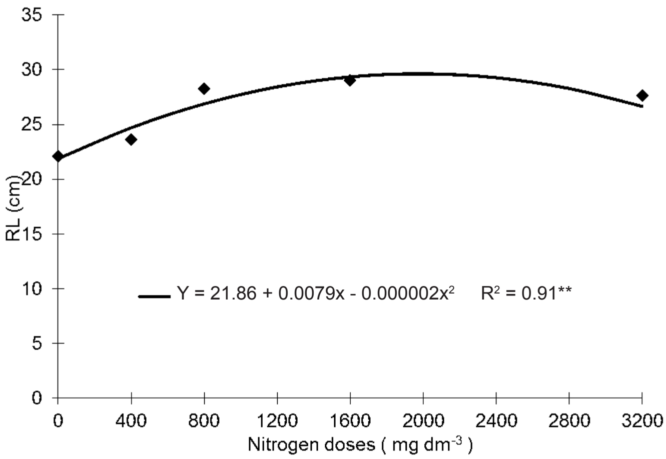

Figure 3. Root length (RL) in the initial development of 'pitombeira' under nitrogen doses as top-dressing

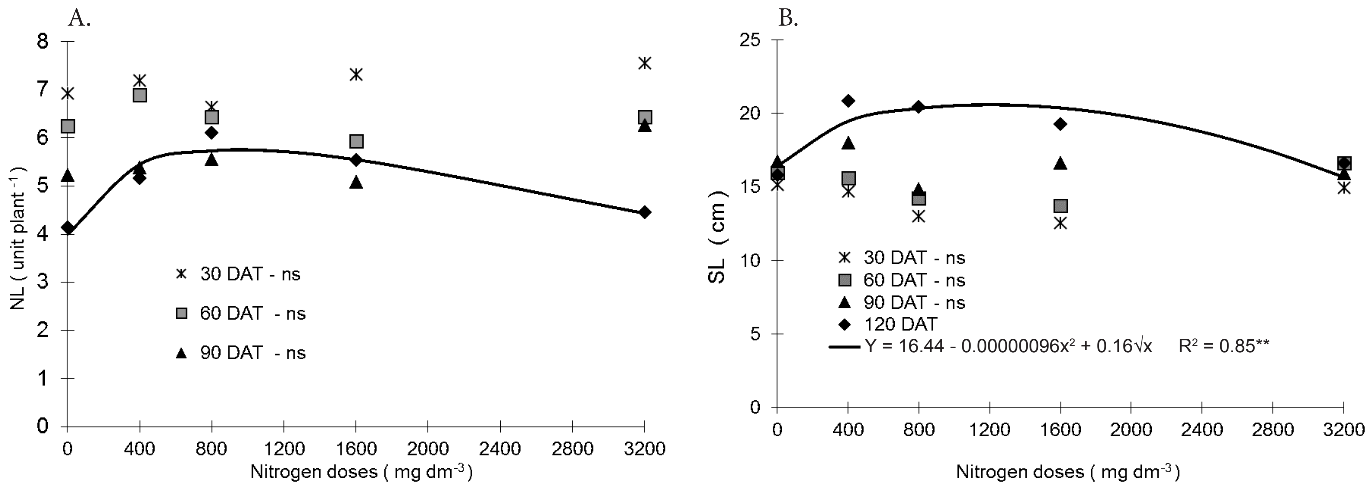

Figure 2. Number of leaves (NL) (A) and shoot length (SL) (B) in the initial development of 'pitombeira' as a function of days after transplanting (DAT) and nitrogen doses as top-dressing

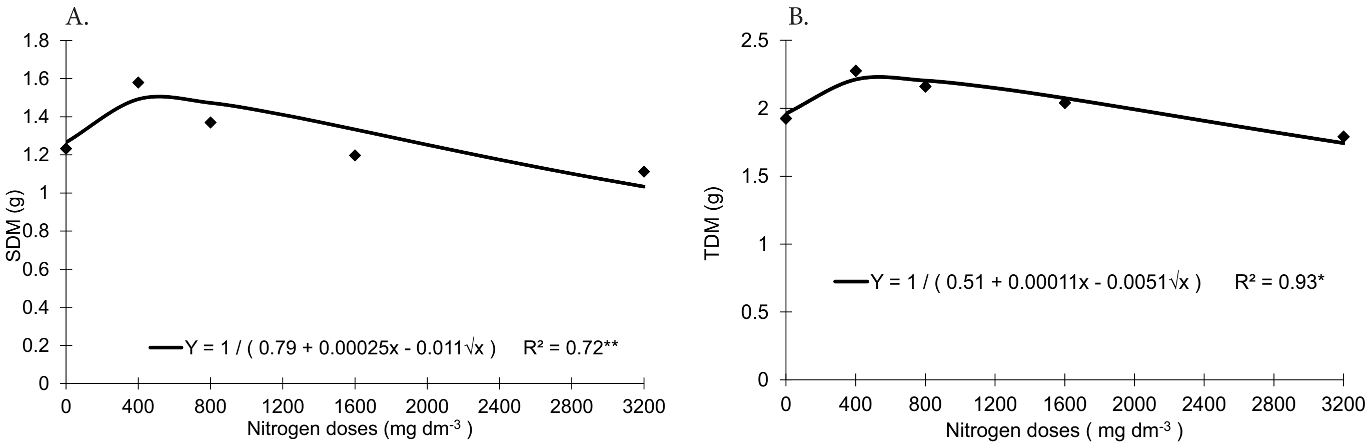

Figure 4. Shoot dry matter (SDM) (A) and total dry matter (TDM) (B) in the initial development of 'pitombeira' under nitrogen doses as top-dressing

Total dry matter showed similar behavior to shoot dry matter, with maximum estimated value of 2.2 g plant^{-1}, observed at N dose of 566 mg dm^{-3} as top-dressing, which represented an increment of 11% in relation to the absence of mineral fertilization (Figure 4B). In general, there was a deleterious effect with the increase in the N doses from 800 mg dm^{-3} on, indicating that higher doses did not reflect in increase of dry matter production. In guava seedlings, Dias et al. (2012) observed that the N dose of 865 mg dm^{-3} led to a maximum value for total dry matter.

It is necessary to establish adequate doses to make the production economically viable and maximize growth, because nutritional imbalances may lead to damages to the seedling, altering its morphology (Mendonça et al., 2012). With the use of mineral N fertilization, it is possible to standardize and improve the initial development of the seedlings and possibly contribute significantly to the initial growth, allowing the commercial propagation of 'pitombeira' plants.

Conclusions

1. 'Pitombeira' seedlings developed with the N dose of 500 mg dm^{-3} resulted in more vigorous plants.

2. Nitrogen fertilization at doses higher than 1,600 mg N dm^{-3} as top-dressing led to a reduction in vigor.

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