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O volume do recipiente influencia na qualidade de mudas de ora-pro-nóbis?

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RESUMO: O objetivo deste trabalho foi avaliar a qualidade de mudas de ora-pro-nóbis produzidas em recipientes de diferentes volumes. O experimento foi realizado na horta experimental da Universidade Federal do Acre, durante os meses de outubro a novembro de 2023. O delineamento experimental foi inteiramente casualizado, com quatro tratamentos e dez repetições. Os tratamentos foram os volumes de recipiente, sendo: 50 cm3, 100 cm3, 150 cm3 e 200 cm3, disponíveis no comércio. A produção das mudas foi realizada utilizando-se estacas seccionadas de matrizes adultas, padronizadas em diâmetro e comprimento, acondicionadas nos recipientes com substrato comercial. Aos 30 dias, foram avaliados nas mudas: altura total, diâmetro do coleto, comprimento foliar, largura foliar, número total de brotações, número total de folhas, número total de raízes, massa fresca da parte aérea, massa fresca das raízes, massa seca da parte aérea, massa seca das raízes, massa fresca total, massa seca total e calculou-se o Índice de Qualidade Dickson. Houve efeito significativo do volume dos recipientes ($p<0,05$) para todas as variáveis avaliadas, exceto diâmetro do coleto. Mudas de ora-pro-nóbis produzidas em recipientes de 200 cm³ apresentam qualidade superior. Recipientes com volumes de 50 cm³, 100cm3 e 150 cm3 reduzem as características biométricas das mudas.
Palavras-chave: *Pereskia aculeata* Mill.), produção de mudas, plantas alimentícias não convencionais.

Does the volume of the container influence the quality of ora-pro-nóbis seedlings?

ABSTRACT: The objective of this work was to evaluate the quality of ora-pro-nóbis seedlings produced in containers of different volumes. The experiment was carried out in the experimental garden of the Federal University of Acre, during the months of October to November 2023. The experimental design was completely randomized, with four treatments and ten replications. The treatments were container volumes, being: 50 cm3, 100 cm3, 150 cm3 and 200 cm3, available commercially. The production of seedlings was carried out using sectioned cuttings from adult matrices, standardized in diameter and length, placed in containers with commercial substrate. At 30 days, the following were evaluated in the seedlings: total height, stem diameter, leaf length, leaf width, total number of shoots, total number of leaves, total number of roots, fresh mass of the aerial part, fresh mass of the roots, dry mass of the aerial part, dry mass of the roots, total fresh mass, total dry mass and the Dickson Quality Index was calculated. There was a significant effect of container volume ($p<0.05$) for all variables evaluated, except duct diameter. Ora-pro-nóbis seedlings produced in 200 cm³ containers are of superior quality. Containers with volumes of 50 cm³, 100cm3 and 150 cm3 reduce the biometric characteristics of the seedlings.
Keywords: *Pereskia aculeata* Mill.), seedling production, unconventional food plants.

INTRODUÇÃO

Vegetables play an important role in the human diet, providing nutritional, health and well-being benefits. They are sources of minerals, vitamins, antioxidants, fiber and bioactive compounds that contribute to food security. More than half of the vegetables in Brazil are produced and sold by small farmers, from family farming, who are responsible for strengthening the local economy. This makes it possible to generate local jobs, due to the demand for labor in the production stages (Marouelli, W. A.; Braga, 2016; De Lima Proença et al., 2018).

Vegetable production is dynamic and presents challenges, depending on the region, levels of technology, productivity and investment, being a crucial component in the vegetable production chain, directly influencing the success of cultivation. Among which we can find unconventional food plants (PANCs), which are easy to propagate, but are little known and used. Some PANCs have high nutritional and economic value, but are restricted to certain locations and have limited distribution, being more used for nutrition and culture of traditional populations (Biondo, et al., 2018; De Lima Proença, et al., 2018).

In agriculture, plant quality and growth parameters play a crucial role in determining vegetable yield. Thus, studies seek methods that provide higher quality plant seedling growth. To

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obtain quality seedlings, it is essential to provide quality propagation material, substrate, irrigation and adequate management, seeking to obtain seedlings with uniform growth and early development. The choice of substrate significantly impacts the seedling propagation phase, as well as the propagation environment, such as greenhouses, which are more suitable for seedling production (De Almeida, et al., 2017; Melo et al., 2018).

In the context of vegetative propagation, appropriate container selection can positively impact the efficiency of the process, reflected in subsequent phases of the cultivation cycle. The use of containers in the production of seedlings has been an alternative used in several crops, with seedlings being able to be produced in different types and sizes of containers, playing a significant role in the initial establishment of plants, influencing factors such as roots development, leaf growth and general quality. of the seedlings (Borba, 2023).

The use of containers provides savings on substrates in seedling production, in addition to protecting them from mechanical damage and dehydration. Containers facilitate handling and transportation, can be reused, resulting in cost savings, and can maximize survival rates and initial growth. The most suitable ones for seedling production vary according to the species and the desired quality of the seedling (De Oliveira, et al., 2020).

Among non-conventional food plants, Ora-pro-Nóbis (*Pereskia aculeata* Mill.) stands out, a plant widely used in human nutrition and traditional medicine, considered a PANC. It has high nutritional content, including minerals, proteins and dietary fiber. consumed in various forms, such as juice, stews and as flour in pasta and pastries. Research has shown that ora-pro-nóbis contains bioactive compounds, such as phenolics, flavonoids and antioxidants, useful in the food and pharmaceutical industries (Kinnup; Lorenzi, 2014, Santos, et al., 2022).

The choice of container, in terms of volume, can directly affect the space available for root development, nutrient absorption and substrate aeration, crucial aspects for the initial success of the seedling. Thus, the objective of this work was to evaluate the quality of ora-pro-nóbis (*Pereskia aculeata* Mill.) seedlings produced in containers of different volumes.

MATERIAL AND METHODS

The experiment was installed and conducted under greenhouse conditions in the vegetable garden of the Federal University of Acre - UFAC, located in the municipality of Rio Branco, Acre, at coordinates (9º57'34” S, 67º52'13" W, 143 m altitude), during the months of October to November 2023. The region's climate is hot and humid, type Am, according to the Köppen classification, with average temperatures of 27.4 °C and relative humidity of 90.8% and precipitation of 1560 mm during the experiment (Inmet, 2023).

The experimental design used was completely randomized (DIC), with four treatments and 10 replications. The treatments were four container volumes, namely: 50 cm3, 100 cm3, 150 cm3 and 200 cm3, with one seedling per container. To fill the containers, commercial mecplant® substrate was used, obtained from a local agricultural store. The containers used were disposable polystyrene plastic cups, easily available on the market.

Figure 1: organization of the experiment, with emphasis on treatments (A) and the special distribution of containers (B) and (C).

The cuttings were obtained from the sectioning of herbaceous plant material from adult ora-pro-nóbis (Pereskia aculeata Mill.) matrices, which came from organic cultivation. The cuttings were selected with approximately 10 cm in length and 4 mm in diameter, all with the presence of two nodes and four germinative buds.

The selected cuttings were placed in the determined treatment containers in a vertical position, one cutting per container, filled with commercial substrate. The seedlings were placed on benches and kept in a greenhouse for 30 days, with daily irrigation as needed. The cultivation greenhouse had the following characteristics: 30 meters long and 14 meters wide, 3 meters high, with closed sides and covered with 100 µm thick transparent polyethylene film.

The chemical and physical attributes of the commercial substrate presented in the experiment setup. Chemicals: pH = 5.6; P = 2.09 $mg.L^{-1}$; K = 112.0 $mg.L^{-1}$; Ca = 122.0 $mg.L^{-1}$; Mg = 44.8 $mg.L^{-1}$; S = 134.0 $mg.L^{-1}$; B = 0.08 $mg.L^{-1}$; Cu = 0 $mg.L^{-1}$; Fe = 0 $mg.L^{-1}$; Mn = 0.60 $mg.L^{-1}$; Na = 37.0 $mg.L^{-1}$ and

Physical: D.a = 269.0 $Kg.m^{-3}$; C.R.A = 249.36%; C.E = 0.639 $Milli.Scm^{-1}$.

After 30 days of cultivation and complete formation of seedlings, the following were evaluated: total height, stem diameter, leaf length, leaf width, total number of shoots, total number of leaves, total number of roots, fresh mass of the aerial part, mass fresh root mass, aerial part dry mass, root dry mass, total fresh mass, total dry mass and the Dickson Quality Index (DQI) was calculated.

Seven plants per treatment were evaluated. The seedlings were removed from the cultivation containers with substrate adhered to their roots, so that the root system was not damaged. The root system was separated from the aerial part, the roots were washed until the adhering soil was removed. Excess water from the roots was removed with the help of paper towels and the evaluations were then carried out.

The evaluation of the total height of the seedlings was carried out using a ruler graduated in cm. The stem diameter, root length, leaf width and length were obtained with the aid of a caliper graduated in mm. The total number of shoots and total number of leaves

was determined by counting. The fresh masses of the aerial part and roots were measured by weighing on a digital scale with an accuracy of 0.05 g. The collected material was then dried in a forced air circulation oven at 65°C for 48 hours, until they reached a constant mass.

To check the quality of the seedlings, the Dickson Quality Index (DQI) was calculated, following the methodology of Dickson et al., (1960), considering the following formula:

$$\mathrm{DQI} = \frac{\mathrm{TDM}}{\left(\frac{\mathrm{TH}}{\mathrm{CD}}\right) + \left(\frac{\mathrm{DMS}}{\mathrm{RDM}}\right)}$$

On what: DQI: Dickson quality index; TDM: Total dry mass (g); TH: Total height (cm); CD: Collection diameter (mm); DMS: Dry mass of the shoot (g); RDM: Root dry mass (g).

The collected data were subjected to verification of discrepant data using the Grubbs test, normality of errors using the Shapiro-Wilk test and homogeneity of variances using the Cochran test. Subsequently, the F test was applied to perform analysis of variance, and when statistical significance was verified, the means were compared to 5% probability using the Tukey test. Statistical analyzes were performed using the open-source program R.

RESULTS AND DISCUSSION

The volume of the container was statistically significant by the F test ($p<0.05$) for the variables: total height, leaf length, leaf width, total number of leaves, root length, fresh mass of the aerial part, fresh mass of the roots, aerial part dry mass, root dry mass, total fresh mass, total dry mass and Dickson Quality Index, in seedlings formed from *P. aculeata*.

The experimental coefficients of variation (CVs) mostly presented average values (between 10 and 20%), according to the classification of Pimentel-Gomes and Garcia (2002), indicating good experimental precision.

The container volume of 200 cm3 presented the best results for all variables analyzed, highlighting the dry mass of the aerial part (0.73 g) and total dry mass (0.82 g), statistically different from all other treatments by the Tukey test at 5% significance (Tables 1 and 2).

Table 1. Fresh mass of shoots (FMS), dry mass of shoots (DMS), fresh mass of roots (FMR), dry mass of roots (DMR), total fresh mass (TFM) and total dry mass (TDM) in ora-pro-nóbis (*Pereskia aculeata*) seedlings produced in different volumes of containers.

Volume (cm^{-3})	FMS	DMS	FMR	DMR	TFM	TDM
		------------------------------------ (g) ------------------------------------				
50	3,39 b	0,57 c	0,15 c	0,06 b	3,54	0,63 d
100	3,89 ab	0,59 c	0,23 bc	0,08 a	4,12	0,67 cd
150	5,27 a	0,66 b	0,26 ab	0,08 a	5,53	0,74 b
200	5,31 a	0,73 a	0,37 a	0,09 a	5,68	0,82 a
CV (%)	16,85	15,86	19,24	11,17	14,78	9,18

Seabra Júnior, Gadun and Cardoso (2004), working with expanded polystyrene trays, tested two volumes of substrates (34.6 and 121.2 cm3) on Japanese cucumber seedlings. According to the authors, seedlings produced in containers with greater substrate support capacity show greater growth and development, with greater production of total phytomass.

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Similar results were also observed by Echer et al. (2007), in work aiming to evaluate the effect of two cell sizes for the production of beet seedlings in expanded polystyrene trays. The authors observed that trays with a larger volume of substrate (128 cells and 32 cm3) presented superior performance for the MSPA and MST variables when compared to those with a smaller volume (200 cells and 16 cm3), in line with the results obtained in this work. These values are due to the greater availability of growth factors, such as water, nutrients, physical space and light, present in containers with a larger volume of substrate.

Costa et al. (2011), using trays with different cell volumes to form eggplant seedlings, observed superiority of the tray with 72 cells (121.2 cm3) in relation to the tray with 128 cells (34.6 cm3), except for the height ratio and neck diameter in the agricultural greenhouse. According to the authors, the larger volume of the container, by providing more space for the roots and a greater quantity of nutrients, led to better development of the eggplant seedlings.

Souza et al. (2018) observed better expression of sweet potato genotypes in disposable cups with a volume of 200 cm3, when compared to trays (128 cells and 40 cm3) and polystyrene tubes (115 cm3), for the variables NF, MSF, MSPA and MSR. According to these researchers, as the volume of the container increased, the genotypes were able to present more satisfactory results in relation to seedling production.

The container volume of 50 cm3 presented the worst results for all variables studied. The lowest values were observed for the variables CF, NTF, MFR and MSR, when this treatment was shown to be statistically different from all the others using the Tukey test at 5% (Tables 1 and 2). These results were similar to those observed by Silva, Souza and Silva (2022) in sweet pepper seedlings grown in 50 cm3 containers. The reduced size and biometric characteristics make the production of seedlings in this type of container unfeasible, according to the authors.

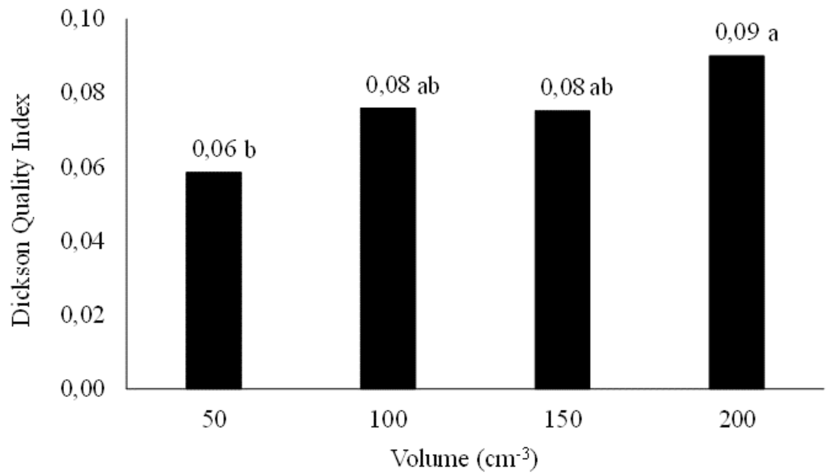
Table 2. Total height (TH), stem diameter (SD), leaf length (LL), leaf width (LW) total number of shoots (TNS), total number of leaves (TNL), root length (RL) , in ora-pro-nóbis (*Pereskia aculeata*) seedlings produced in different volumes of containers.

Volume (cm^{-3})	TH	SD	LL	LW	TNS	TNL	RL
	-- cm --	--------------- mm ---------------			----- unit -----		-- mm --
50	7,16 b	5,68 a	14,46 c	10,93 b	5,22 c	1,78 a	4,86 b
100	8,46 ab	5,82 a	16,23 b	13,08 a	7,87 b	1,75 a	6,90 ab
150	9,26 ab	5,81 a	16,72 ab	13,13 a	9,25 ab	2,00 a	8,71 a
200	10,74 a	5,46 a	17,68 a	13,14 a	10,06 a	2,25 a	8,68 a
CV (%)	17,73	16,88	15,39	10,08	12,69	23,33	14,18

The low results for this treatment are probably related to the smaller volume of substrate present in the container, limiting the availability of nutrients and space for plant root development (Cerqueira et al., 2015).

The Dickson quality index (DQI) is a good indicator for evaluating the quality of seedlings, as it uses both the height/diameter relationship and the balance between biomass, roots and aerial parts of the plants (Pimentel et al., 2021; Silva et al., 2023). This index can be understood as follows: the higher the IQD value, the better the results regarding seedling quality (Cerqueira et al., 2015).

The volume of 200 cm3 was statistically equal to those of 150 and 100 cm3, however, higher than the volume of 50 cm3 (Figure 1).



*Averages followed by the same letter do not differ (p>0.05) from each other using the Tukey test

Figura 1. Dickson Quality Index in ora-pro-nóbis seedlings produced in different container volumes

These results were similar to those obtained by Mello, Trevisan and Steiner (2016), who, testing the effects of different types of containers on the quality of cucumber seedlings, obtained IQDs of 0.12 and 0.10 for plastic cups measuring 180 cm3 and 120 cm3 tubes, statistically equal, respectively. The other treatments, trays of 30 and 60 cm3, were inferior to those previously mentioned. According to the authors, the absorption of water and nutrients can be affected by the restriction of root growth, with the volume of substrate determined by the capacity of the container constituting an important factor for the growth and development of seedlings.

CONCLUSIONS

Ora-pro-nóbis seedlings produced in 200 cm³ containers are of superior quality.

Containers with volumes of 50 cm³, 100cm3 and 150 cm3 reduce the biometric characteristics of the seedlings.

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