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ARTICLE

Evaluation of purslane development in different pot sizes

Avaliação do desenvolvimento de beldroega em diferentes tamanhos de vaso

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Abstract: Purslane (*Portulaca oleracea* L.) has potential for ornamental use, in addition to its nutritional, medicinal, phytoremediing and pharmacological properties. To explore the possibilities of using this plant, knowing more efficient cultivation practices are necessary for producers and researchers to obtain quality seedlings. Thus, the objective of this work was to evaluate the growth of P. oleracea in three different pot sizes and substrate volumes. The experiment was carried out in a greenhouse, using small pots (250 g substrate - V1), medium pots (450 g substrate - V2) and large pots containing (850 g substrate - V3) in a completely randomized design in split plots. The results were submitted to analysis of variance and clustering of means using the Scott-Knott test ($p \leq 0.01$). There was a significant interaction for all the variables evaluated, denoting that different pot sizes and substrate volume imply distinct vegetative growth over the weeks of evaluation. Thinking about medicinal and ornamental use and food consumption, the variable of greatest interest is the number of leaves, which showed the same growth in V2 and V3 up to the seventh week of evaluation, both higher than the V1 treatment. Thus, the use of medium pots represents lower expenditure on inputs and the possibility of grouping more pots per m² in a greenhouse, their use in production being converted into economy and sustainability.
Keywords: *Portulaca oleracea*, potted plants, ornamental plant, substrate volume.

Resumo: A beldroega (*Portulaca oleracea* L.) possui potencial para uso ornamental, além de suas propriedades nutricionais, medicinais, fitorremediadoras e farmacológicas. Para exploração das possibilidades de uso desta planta, conhecer práticas de cultivo mais eficientes são necessárias para que os produtores e pesquisadores obtenham mudas de qualidade. Assim, o objetivo deste trabalho foi avaliar o crescimento de *P. oleracea* em três diferentes tamanhos de vasos e volumes de substrato. O experimento foi conduzido em casa de vegetação, utilizando vasos pequenos (250 g de substrato - V1), vasos médios (450 g de substrato - V2) e vasos grandes contendo (850 g de substrato - V3) em delineamento inteiramente casualizado em parcelas subdivididas. Os resultados foram submetidos à análise de variância e agrupamento de médias pelo teste de Scott-Knott ($p \leq 0,01$). Houve interação significativa para todas as variáveis avaliadas, denotando que diferentes tamanhos do vaso e volume de substrato implicam em crescimento vegetativo distinto ao longo das semanas de avaliação. Pensando no uso medicinal, ornamental e consumo alimentício, a variável de maior interesse é o número de folhas, que apresentou o mesmo crescimento em V2 e V3 até a sétima semana de avaliação, ambos superiores ao tratamento V1. Sendo assim, a utilização dos vasos médios representa menor gasto com insumos e possibilidade de agrupar mais vasos por m² em casa de vegetação, seu emprego na produção sendo convertido em economia e sustentabilidade.
Palavras chaves: *Portulaca oleracea,* volume de substrato, planta ornamental, plantas envasadas.

Introduction

Portulaca oleracea, commonly known as purslane, is distributed worldwide, especially in tropical and subtropical regions (Li et al., 2024a), considered an underutilized plant with great functional plurality, and can be used as ornamental, food, nutraceutical, pharmacological, and for phytoremediation purposes (Barroso et al., 2024).

Purslane has been used as a traditional medicinal herb in indigenous tribes in almost all continents being important in indigenous health and folk medicine (Li et al., 2024b). In addition, *P. oleracea* has several proven pharmacological activities, highlighting its antioxidant activity (Baradaran Rahimi et al., 2019; Desta et al., 2020; Fernández-Poyatos et al., 2021), anti-inflammatory (Baradaran RahimI et al., 2019; Khazidair et al., 2021; Song et al., 2022), antimicrobial (Tleubayeva et al., 2021), and immunomodulatory (Alfwuaires et al., 2021; Khazidair et al., 2021).

It is also an edible plant, widely used in Mediterranean countries, Africa, Europe, Asia, and Australia, with a mild acid or sour flavor. It can be consumed as salad, flour, soup, or stew (Nemzer et al., 2020). Purslane has been identified as having the highest amount of omega-3 fatty acids (Srivastava et al., 2023), then any green leafy vegetable (Nemzer et al., 2020).

Its phytoremediation potential is capable of removing heavy metals from the soil (Subpiramaniyam, 2021; Thalassinos et al., 2023) and other toxic substances present in water (Janbazi et al., 2024). Recent studies are promising, but they still need to be intensified, and this is true for all areas in which purslane can be explored.

Given this infinity of possibilities, it is essential that healthy seedlings be produced both for research purposes and for consumption. Rocha et al. (2009) point out that the definition of the size of the container for the production of seedlings is an important aspect, as it has an influence on several characteristics, from the growth of the roots to the formation of the aerial part of the plant. In addition, the use of different sizes implies different amount of substrate being used, as well as the different volumes of water in the irrigation. This control is essential for the healthy development of plants and to avoid wasting water (Rheinheimer et al., 2024).

Despite the easy propagation of the species, knowing more efficient cultivation practices are necessary for producers and researchers to obtain healthy seedlings. Then, the present work aims to evaluate the growth of *P. oleracea* in three different pot sizes and substrate volumes.

Material and Methods

The present work was conducted in a greenhouse. The evaluated seedlings were produced by vegetative propagation, using cuttings of approximately 10 cm in length. The plant material used in the propagation came from the accession PO8 (*Portulaca oleracea)* belonging to the Vegetable Germplasm Bank of the CCA-UFPB.

Throughout the experiment, manual irrigation was adopted with 150 mL of water daily in the afternoon. Once week irrigation was replaced by fertigation with nutrient solution composed of soluble fertilizer, iron chelate and calcium nitrate.

The commercial substrate was autoclaved to eliminate possible unwanted plants or pathogens. It was moistened to field capacity and used to fill the different pot sizes. The transplanting of the cuttings was carried out one day after the autoclaving and wetting process.

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The experimental design was entirely randomized in split plots, the whole plot factor was three pot sizes and seven weeks as subplot factor. The experiment was conducted with five replications. The treatments consisted of different pot sizes and amount of substrate, small pots (V1) containing 250 g of substrate, medium pots (V2) containing 450 g of substrate, and large pots (V3) containing 850 g of substrate.

The morphoagronomic variables analyzed were plant height (PH), canopy width (CW) and number of leaves (NL). Plant height and canopy width were measured with a ruler. The number of leaves was visually counted along the entire length of the plant, considering all leaves. Data were collected once a week for eight weeks. The variables were analyzed as a percentage of weekly growth, in relation to the data from the first week of evaluation. Data were subjected to analysis of variance (ANOVA) using the F test, and means were grouped according to the Scott-Knott test ($p \leq 0.01$)

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Results

The interaction between treatments and days was highly significant ($p \leq 0.01$) for all evaluated variables, denoting that different pot sizes and substrate volume imply distinct vegetative growth along the weeks of evaluation.

Plant height showed significant differences among treatments from the third week of evaluation. The medium (V2) and large (V3) pots did not differ from each other, but both presented significant differences to the small ones (V1) (Table 1).

Over the weeks, medium and large pots showed statistically significant growth for plant height (Table 1). On the other hand, the seedlings in small pots did not show significant growth over the weeks (Fig. 1; Table 1)

Table 1. Average growth percentages of plant height (PH), canopy width (CW) and leaves number (LF) of *Portulaca oleracea* seedlings, as a function of different pot sizes and weeks.

Variables	Pot sizes	Weekly growth (%)						
		1	2	3	4	5	6	7
PH	V1	5.36 Aa	11.01 Aa	15.23 Ab	19.77 Ab	30.19 Ab	48.28 Ab	65.64 Ab
	V2	5.94 Ca	26.50 Ca	80.76 Ba	142.15 Ba	204.88 Aa	257.19 Aa	296.70 Aa
	V3	7.00 Da	45.24 Da	114.43 Ca	149.84 Ba	194.64 Ba	226.37 Aa	264.83 Aa
CW	V1	9.32 Aa	20.87 Ab	28.95 Ab	46.67 Ac	65.21 Ac	113.23 Ac	154.24 Ac
	V2	6.20 Ca	21.59 Cb	89.67 Cb	148.32 Cb	251.19 Bb	318.28 Bb	473.40 Ab
	V3	12.13 Da	129.01 Da	280.00 Ca	365.27 Ba	424.69 Ba	529.31 Aa	610.86 Aa
LN	V1	17.16 Ba	87.43 Ba	132.90 Ba	158.96 Ba	173.30 Bb	351.36 Ab	455.61 Ac
	V2	34.26 Ba	66.68 Ba	168.92 Ba	284.28 Ba	757.35 Aa	909.87 Aa	1035.77 Ab
	V3	15.40 Da	127.41 Da	314.26 Ca	428.59 Ca	621.02 Ca	1120.24Ba	1626.85 Aa

Means followed by the same lowercase letters (vertically) and uppercase letters (horizontally) do not differ by Scott-Knott criteria (0.01). V1 - Small pot (250 g of substrate); V2 - Medium pot, (450 g of substrate), and V3 - Large pot (850 g of substrate).

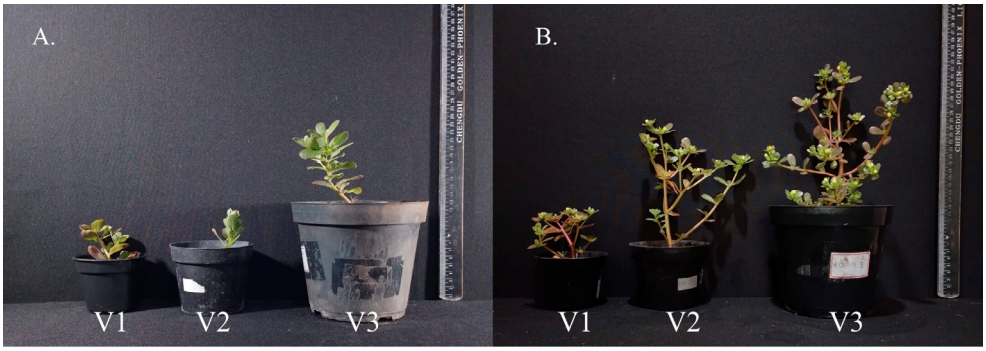

Fig. 1. Growth of *Portulaca oleracea* in different pot sizes. (A) Plants on first week of evaluation; (B) plants on eighth week of evaluation. V1 - Small pot (250 g of substrate); V2 - Medium pot (450 g of substrate), and V3 - Large pot (850 g of substrate).

Large pot allowed the continuous plants growth from the second week of evaluation and so on, showing superior performance compared to medium and small pots. Considering the canopy growth within each week the large pots also showed better results (Table 1).

There were significant differences among treatments to leaves number only from the fifth week. The medium and large pots allowed better growth than the small ones (Table 1).

Discussion

The results showed superiority of medium and large pots for the development of *P. oleracea* plants. Seedlings grown in small pots did not developed well for the evaluated traits over the weeks. It is possible that the plant root system growing in the small vases was restricted due to limited space (Rheinheimer et al, 2024). De Medeiros et al. (2021), found similar results working with ornamental sunflower production. Those authors showed plants produced in larger pots were bigger and stood out in relation to those produced in small pots.

The reduction in pot volume decrease the volume of available space for root growth, reflecting in the reduction of shoot growth. It can also diminish the availability of chemical compounds necessary for plant growth and development (de Moura Guerra et al., 2021).

Souza et al. (2024) highlights the importance of canopy width plant yield since this species is an unconventional food. Larger canopy also implies in greater coverage of the pot, giving the market product to be more attractive to consumers. Some works highlighted the potential of purslane to be used at commercial level to fulfill the sustainable development goal such as zero hunger and good health, since it is abundant and nutritionally rich underutilized crop (Srivastava et al. 2023; Uddin et al. 2014).

Barroso et al. (2024) showed that the Agriculture (23.44%) and Plant Science (22.88%) sector were the ones that published the largest number of articles on *Portulaca* in the last thirteen years. This shows a trend in future research with this edible plant in this sector.

Thinking about medicinal use and food consumption, the variable of greatest interest is the number of leaves, which showed better performance in medium and large pot sizes. Naeem et al. (2022), working with different accessions of Purslane found a range from 121 to 217 leaves per plant, using pots (depth x diameter = 22.5 x 16.5). Purslane growth in small pots (6.5 cm^2) produce averaged 41 leaves (Proctor et al., 2025). In this study, Purslane growing in small pots produces 106.6 leaves/plant. On the other hand, large pots (depth x diameter = 13.0 x 15.5 x 13) reach the average of 378.25 leaves/plant (data not shown). This result demonstrates the possibility to produce Purslane in greenhouse to be consumed both as medicine and vegetable.

Conclusions

The use of medium and large pots in the production of *P. oleracea* is appropriate. Using medium pots allows producing more pots per m² in a greenhouse, reducing production costs. This way this species can be produced into an economy and sustainable way.

The Non-Conventional Edible Plants (NCEPs) has been investigated intensively in order to contribute to agriculture and national development in a sustainable way in the future. The results of this research provide new insights over greenhouse cultivation of Purslane.

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Author Contribution

ERR: Conceptualization; Formal Analysis; Supervision; Methodology. **MMR**: Conceptualization; Project Administration. **NBSF**: Data Curation; Investigation; Writing – Original Draft; Writing – Review & Editing. **NSP**: Data Curation; Writing – Original Draft. **MGS**: Investigation; Review & Editing. **TAM**: Review & Editing.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

Data will be made available upon request to the authors.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that the use of AI and AI-assisted technologies was not applied in the writing process.

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