

SCIENTIFIC ARTICLE

Influence of volume container in the production of rhizomes in *Seemannia* (Gesneriaceae)

Paula Bologna*, Santiago Stancanelli

Abstract

Seemannia Regel belongs to the Gesneriaceae family. It is an herbaceous perennial plant with colorful and brilliant flowers that produces fleshy scaly rhizomes with axillary dormant buds. The objective of this study was to evaluate the effect of the volume of the container in the production and the quality of the rhizomes. Plants of a select hybrid of *Seemannia* were used. Three volume of container were tested: v1 of 1 L, v2 of 1,5 L and v3 of 2 L. Plants were cultivated in the containers following a conventional management. Dry matter, production (number and weight of rhizomes) and quality of the rhizomes were recorded. The rhizomes were classified into four qualities (A, B, C, D) according to the length and width, and the number of the scales. All data was subject to statistical analysis. Dry matter, weight and number of rhizomes increased as the volume of container increased. The v3 container recorded the highest values for these three parameters. Major volume of container, major was the development of vegetative mass and consequently the number and the weight of rhizomes were higher. In regard to the qualities of the rhizomes, v1 and v3 treatments had a better proportion of A rhizomes (the bigger size) compared to v2 treatment. The knowledge of the rhizome quality can be useful to the growers in order to select the best rhizome size for a good production. The v3 treatment recorded the highest number of A rhizomes, that we consider a good quality, because it has the bigger size with more scales and consequently more propagules.

Keywords: *Seemannia*, scales, ornamental, quality, propagules.

Resumo

Influência do volume do recipiente na produção de rizomas em *Seemannia* (Gesneriaceae)

Seemannia Regel pertence à família Gesneriaceae. É uma planta perene herbácea com flores coloridas e brilhantes que produz rizomas escamosas carnudas com gemas dormentes axilares. O objetivo deste estudo foi avaliar o efeito do volume do recipiente na produção e na qualidade dos rizomas. Foram utilizadas plantas de um híbrido selecionado de *Seemannia*. Três volumes de recipientes foram testados: v1 de 1 L, v2 de 1,5 L e v3 de 2 L. As plantas foram cultivadas nos recipientes seguindo o manejo convencional. Foram registrados a massa seca, a produção (número e peso de rizomas) e qualidade dos rizomas. Os rizomas foram classificados em quatro categorias de qualidade (A, B, C, D) de acordo com o comprimento, a largura e o número de escalas. Todos os dados foram analisados estatisticamente. A massa seca, o peso e o número do rizoma aumentaram à medida que o volume do recipiente aumentou. Para o recipiente v3 foram registrados os maiores valores para esses três parâmetros. Quanto maior o volume do recipiente, maior foi o desenvolvimento da massa vegetativa e conseqüentemente, o número e o peso dos rizomas foram maiores. Em relação à qualidade dos rizomas, para os tratamentos v1 e v3 foram registrados o maior número de rizomas A (o tamanho maior) em comparação ao tratamento v2. O conhecimento da qualidade do rizoma pode ser útil para os produtores, a fim de selecionar o melhor tamanho para uma boa produção. O tratamento v3 registrou o maior número de rizomas A, considerado de boa qualidade, pois possui o maior tamanho com mais escamas e portanto com mais propágulos.

Palavras-chave: *Seemannia*, escalas, ornamental, qualidade, propágulos.

Introduction

Seemannia Regel belongs to the Gesneriaceae family, a great taxonomic and biogeographic family (Toursakissian, 1969; Burt and Wiehler, 1995). The genus has been known with the name of *Gloxinia* since both genera have similar morphological characteristics. However, molecular studies

separated *S. sylvatica*, *S. purpurascens*, *S. gymnostoma* and *S. nematanthodes* and place the genus *Seemannia* as a monotypic genus (Roalson et al., 2005; Xifreda and Seo, 2008).

Seemannia is a perennial herbaceous plant with axillary flowers of brightly color. The genus has two endemic species distributed in the subtropical northwestern Argentina, *S.*

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gymnostoma with fuchsia flowers and *S. nematanthodes* with red-orange flowers (Toursakissian, 1969; Xifreda, 1996; Xifreda and Seo, 2008). The species inhabits between 500 and 3000 meters of altitude, in humid and shaded environments at the yungas area (Xifreda, 1996). *Seemannia* is a geophyte and its vegetative propagation is by stolons and rhizomes. Ovoid rhizomes are produced during and after the flowering season, when the vegetative mass die in response to the low temperature of winter. The rhizomes have fleshy imbricate scales leaves, originated at the base of the stem that become into a new propagule with axillary dormant buds (Toursakissian, 1969). In the favorable season the starch accumulated as reserve in the scales of the rhizome, is degraded into sucrose and transported for the next cycle of vegetative growth (Li et al., 2016).

Ornamental geophytes, commonly known as bulbs, corms, tubers, rhizomes, crowns, tuberous roots, and others; comprise an import segment of the world's floriculture industry. The three main markets are in cut flowers, potted plants and in landscaping (Miller, 2017). In the genus *Seemannia* there is a few studies focusing on the pollination biology and the reproduction (Camargo et al., 2011; Cairampoma and Martel, 2012). It is well known the botanical form *Seemannia sylvatica* (Kunth) Hanstein in the ornamental market as "Bolivian sylvatic" (Wiehler, 1976). However, in Argentina there are not ornamental

varieties of *Seemannia* as commercial crop, although it is a highly innovative and promising material for the flower market as an indoor plant. According to that, the Institute of Floriculture of INTA-Castelar (Argentina), has started a breeding programme in *Seemannia* genus using native species of Argentina with the aim to develop a new crop for commercial production (Mata et al., 2009). Therefore, research in the cultivation of rhizome scales has been carried out as preliminary assays (data not shown).

Because the floriculture world market continuously demands new products and the main factor affecting the growth and the yield of the geophytes is the size of their underground organs, the objective of this study was to evaluate the effect of three volume container in the rhizome production of a *Seemannia* hybrid.

Materials and Methods

Plants of a selected hybrid between *S. gymnostoma* and *S. nemathantodes* from the breeding program that the Institute of Floriculture of INTA-Castelar (Argentina) carries out, were used for the assay. The hybrid was selected by its compact phenotype and intense red flowers (Figure 1a). The plants were obtained previously by cultivation of the scales in a breeding chamber with humidity and controlled temperature (22/24 °C day/night temperature, 16 h light cycle) (Figure 1b).



Figure 1. a) *Seemannia* hybrid. b) Sprouted scales grown in chamber. c) Rhizomes of the hybrid.

For the assay, three volume of container was used: 1 L (v1); 1,5 L (v2) and 2 L (v3). The plants were cultivated in the containers with a commercial substrate composed of sphagnum peat, compost of pine bark, perlite, vermiculite and pruning compost (2:2:1:1, pH: 5.58; EC:0,50). The assay was carried out in a shelter with a shade cloth of 50% transmittance (15-25 °C max). The containers were distributed in a randomized design (n=10 replications).

The plants were watered on demand and fertilized with a granular slow-release fertilizer (16N 8P 12K + [2MgO] +ME, 2g per plant). The assay compromised 120 days, started on December and finished on May. At the end of

the assay, the aerial part of the plant (leaves, shoots and flowers) was removed to dry matter. The rhizomes were cleaned and air dried for 48 hours (Figure 1c).

Number and weight of the rhizomes were evaluated per container. The rhizomes were classified into four qualities based on the length and the width. We defined the largest sizes as A and B rhizomes with ≥ 1 cm length (N° scales per rhizome = 25 ± 5); and the smallest sizes as C and D rhizomes with < 1 cm length (N° scales per rhizome = 19 ± 4). The A and B rhizomes differs in width, being A ≥ 0.5 cm and B < 0.5 cm. As well C rhizomes were ≥ 0.5 cm width and D rhizomes < 0.5 cm width (Figure 2).

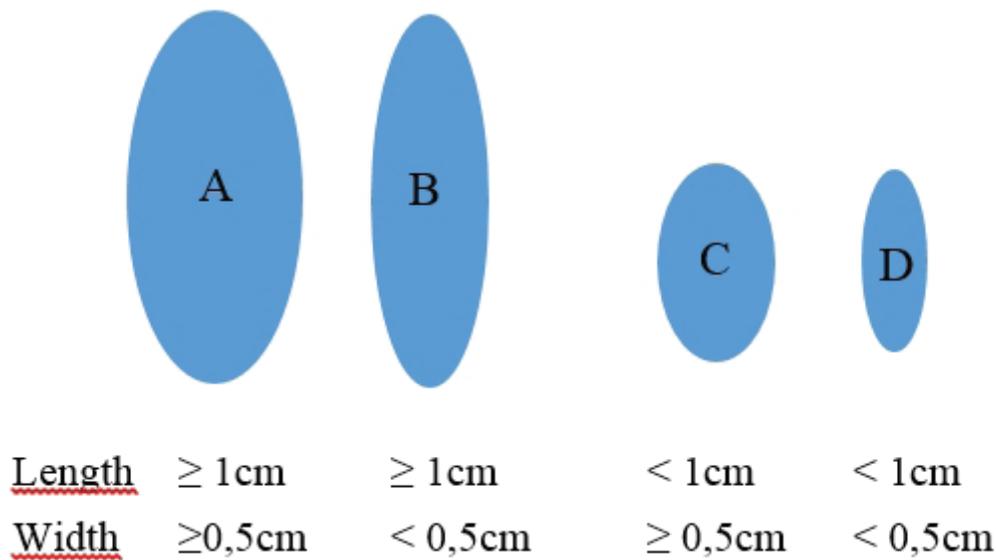


Figure 2. Rhizomes classification of *Seemannia* hybrid based on the length and width.

Data were subjected to analysis of variance (ANOVA) and the means were compared using Tukey test at 5% level of significance. Statistical analyses were performed using the software *Infostat* (Di Rienzo et al., 2014).

Results and Discussion

The aerial dry matter increased significantly as the volume of the container increased (Table 1). We recorded the highest value in v3 (6,11 g) and the lowest value in v1 (3,50 g), with significant difference. These results suggest, that a major of volume of container, major was the capacity to growth and development. We also reported an increase in the average of the weight of the rhizomes. The v3 treatment had a significant higher value (37,90 g) compared to the v1 treatment (17,14 g) (Table 1). Similarly, we recorded this tendency for the

number of the rhizomes. We recorded 72 rhizomes in v1 and 108-116 rhizomes in v2-v3, respectively (Table 1). In summarize, the v3 treatment had the highest values for these three parameters measured. These results can be explained because during the cycle of the plant, the vegetative mass accumulates carbohydrates which allow to the development of the aerial part and the root system. As major vegetative mass, major was the production of the rhizomes with higher values of mass. This effect is also reported in another geophyte cultivated at different transplant tray cell size. Plants of onions produce larger bulbs yields when it cultivated in larger cells trays (Leskovar and Vavrina, 1999). For many perennial plants, the growth of the underground storage organs represents a critical stage in the life-cycle because it affects the production of the propagules (Werger and Huber, 2006; Addai and Scott, 2011; Puntieri et al., 2014).

Table 1. Dry matter, rhizomes fresh weight and number of rhizomes of *Seemannia* hybrid for the three volume of container (v1=1 L; v2=1,5 L; v3 = 2 L) (n=10).

	Aerial dry matter	Rhizome fresh weight	Rhizome
	(g)	(g)	(n°)
v1	3,50 ^a	17,14 ^a	72,0 ^a
v2	4,07 ^a	24,28 ^a	108,5 ^b
v3	6,11 ^b	37,90 ^b	116,2 ^b

Means followed by the same letter in each column are not significant different by Tukey test at $\alpha=0,05$.

Taking into account that, we determinate four qualities of rhizome that represent the variants of the sizes obtained in this assay. We consider the **A** rhizome as a good quality because it represents the widest circumference, which implies more reserves in the scales that would enhance the production of propagules. We recorded a total of 296,7 rhizomes (Table 2). The **A** rhizomes increased as the volume of container increased, being the highest value in v3 treatment with 36,7 rhizomes (Table 2). The **B** rhizomes had the lowest values in all the treatments with no significant difference. The **C** rhizomes presented an intermediate value (14-28 rhizomes) with a significant

difference between v1 and v3 treatment. The **D** rhizomes had the highest values in v2 treatment and the lower value in v1 treatment with significant difference. In summarize, the v3 treatment differed from v1-v2 treatments in the values of **A** rhizomes. In percentage, v1 treatment had 44.1% rhizomes type **D**, and 32% rhizomes type **A** (Figure 3). v2 treatment had with 54% rhizomes type **D** and 23.1% rhizomes type **A**. In v3 we had 41.4% rhizomes type **D**, and 31.6% rhizomes type **A**. In spite of the high values of **D** rhizomes, the smallest size, v1 and v3 treatments also had a better proportion of **A** rhizomes (the bigger size), compared to v2 treatment.

Table 2. Qualities A, B, C and D for the three volume of container (v1=1 L; v2=1,5 L; v3=2 L) (n=10).

	A	B	C	D	TOTAL
v1	23,0 ^a	3,1 ^a	14,1 ^a	31,7 ^a	72
v2	25,1 ^a	2,5 ^a	22,3 ^{ab}	58,6 ^b	108,5
v3	36,7 ^b	3,4 ^a	28,0 ^b	48,1 ^{ab}	116,2
					296,7

Means followed by the same letter in each column are not significant different by Tukey test at $\alpha=0,05$.

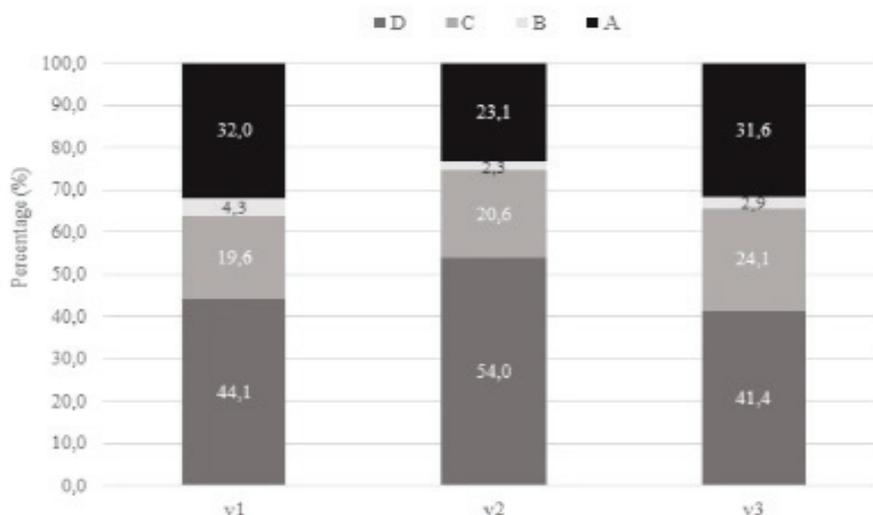


Figure 3. Distribution of rhizome qualities (A, B, C, D) in *Seemannia* hybrid for three volume container (v1= 1 L; v2= 1,5 L; v3= 2 L).

The knowledge of the size and the weight of the rhizome is an important aspect. There is a relationship between the amounts of the stored reserves presents in the tuber, corm, rhizome or bulb at the time of planting. Large bulbs are expected to have higher vegetative growth and development because their reserves in the volume of the scales are relatively higher than in small bulbs (Rees, 1969). Some research has been proven that the weight of bulbs or rhizomes have significantly effects on the growth and in the flowering in *Herbertia lahue* subsp. *lahue*, *Rhodohypoxis baurii* (Baker) Nel, and lachenaria cultivars (Morales et al., 2009; Kapczynska, 2014; Salachna et al., 2015). In hyacinth and lily plants, Addai and Scott (2011) reported that the size of the bulb at planting time influence positively on the vegetative growth. Not only larger rhizomes could be better for the development of the plant but it facilitates the manipulation and the management of the rhizomes in the production chain. Like bulbs, larger sizes of rhizomes could allow a better commercial way for a future import (Miller, 2017). Taking into account this, we consider the A rhizome as a good quality of rhizome, not only because of the size of the rhizome for the management, but also for the production of the propagules. Further research is needed to evaluate the relationship between the size of the underground organs or the qualities of the rhizomes with the vegetative growth, as well as the year-round rhizome production. Although, this information could be useful to the growers to select the right size rhizome for propagation in order to achieve products of good quality.

Conclusions

According to these results, the treatment v3 (2 L) recorded the highest number of A rhizomes (length ≥ 1 cm and width ≥ 0.5 cm), which we consider to be of good quality, because it has the largest size with more scales and therefore with more propagules. The basic knowledge derived from this study provides information on the qualities and the rhizome yield in a *Seemannia* hybrid.

Author Contribution

B.P. 0000-0003-0603-2970: in experimental design, writing, and responsible of the breeding program in *Seemannia* genus at the Floriculture Institute INTA-Argentina. **S.S.:** in management crop, data collection and writing.

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