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Scientific Article

Ornamental use of plants from the Restinga

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Abstract

Upstate Rio de Janeiro restingas remain an open field for research on both richness and conservation of species. However, once vegetation there lies in privileged coastal areas, it is constantly threatened by real estate and industrial speculation. The beauty of its flora calls attention and arises the desire to take some local species to urban areas. Thus, the objective of this work is to identify species of plants from the restinga ecosystem which could be suitable for pot planting for landscaping use. Thirty different species were planted in pots containing soil, sand and manure as substrate and maintained for a period of one year. Along this time, variables such as plant height, number of leaves and diameter of the stem base were obtained. It was possible to identify the characteristics of each plant in relation to its adaptation to the potting environment, as well as to obtain information that might help choose species to properly fit the desired purpose of use.

Keywords: adaptation; native ecosystem; domestic cultivation; potting.

Resumo

Uso ornamental de plantas de restinga

As restingas do norte fluminense permanecem como um campo aberto para as pesquisas tanto sobre a riqueza quanto a conservação de espécies. Entretanto, sua vegetação, por estar localizada em áreas privilegiadas do litoral, está constantemente ameaçada pela especulação imobiliária e industrial. A beleza de sua flora chama atenção para a possibilidade de trazer para a área urbana as espécies que ali se encontram. Dessa forma, o objetivo do trabalho foi identificar espécies vegetais do ecossistema de restinga que sejam adequadas ao plantio em vasos para uso no paisagismo. Trinta diferentes espécies foram plantadas em vasos contendo substrato de terra, areia e esterco e mantidas por um período de um ano, no qual foram obtidas as variáveis de altura de planta, número de folhas e diâmetro da base do caule. Foi possível identificar as características de cada planta com relação à adaptação ao ambiente de vaso, bem como obter informações que auxiliam na escolha das espécies em função da finalidade para as quais possam ser utilizadas.

Palavras-chave: adaptação; ecossistema nativo; cultivo doméstico; plantio em vasos.

Introduction

The ecosystems studied here are all in the coastal area of an administrative region in Rio de Janeiro State that comprises several municipalities. This region is known as “Região Norte-Fluminense”, where “Norte” stands for “North(ern)” and “Fluminense” is the gentilic for Rio de Janeiro State. We chose to use the expression “upstate Rio” in this paper for practical purposes. Thus, upstate Rio restinga ecosystem has been a stage where multiple initiatives, from degradation to conservation, have taken place. All of its landscape exhibits outstanding beauty, a peculiar ecological value, and its diversity houses a flora that is particular and priceless, however endangered (Pezarino, 2008).

Undeniable degradation has been caused by real estate development activities in Brazilian coast restingas, including those in upstate Rio. Such degradation has arisen interest for landscaping use of potentially ornamental plant species also as a complementary means of preserving such endangered flora (Freire et al., 2015). Besides, those plants, due to intrinsic characteristics such as their colors, textures, structure, shape, phenological aspects, etc, and to extrinsic characteristics, such as the way they move in the wind, the shade they produce and project, and the harmonious composition they form with the neighboring vegetation do provoke notable stimuli (Alencar and Cardoso, 2015).

Vegetable communities with peculiar composition, physiognomy and structure have been observed in upstate Rio. It was also observed that they were different from

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communities from other restingas in Rio de Janeiro State, and display important vegetable remnants from the original natural coverage of the Paraíba do Sul once extensive restinga (Bidegain et al., 2008).

Ornamental use of native plants eliminates biological contamination risks regarding moving plants away from their original cultivation area. Cultivating such plants in legalized ferneries or greenhouses will reduce the pressure for collecting them in nature. When it concerns the ornamental use of rare or threatened species of plants, issues such as collecting pressure, genetic diversity and variety selection must be considered (Barroso et al., 2007).

Urban characteristics such as soil's low permeability and high compaction, low water retention, temperature variation – and relatively extreme temperatures in some places –, pollutants concentration, and limited physical space impose difficulties for the development of plants outside their natural habitat (Vieira Neto and Reis, 2012).

Some native plants, particularly those from a restinga area, are used to countless adverse conditions such as a poorly fertile soil, elevated salinity, low rainfall rates, excessive wind (Magnano et al, 2011), and high luminosity. These conditions make these plants exhibit some rusticity that people associate with the possibility of developing them in urban environments "without much care", or with some potential to adapt if properly managed (Heiden et al., 2006).

However, criteria for choosing plants to be used in urban areas should not be limited to aesthetic functions or microclimate regulation: the mitigation of environmental impacts, formation of ecological corridors and reassurance of natural biomes, by the use of well adapted native species, are some of the contemporary criteria applied to the construction and rehabilitation of urban spaces (Lima and Machado, 2003).

Then, it was in this context, taking advantage of the rich upstate Rio restinga environment, that this paper was developed aiming to identify vegetal species, within such ecosystem, that might be adequate for urban landscaping purposes as well as to obtain information about their growth and development in vases, thus contributing for the appreciation (Freire and Mussi-Dias, 2016) and conservation (Stumpf et al., 2009) of biodiversity.

Material and Methods

All vegetal species from the restinga were produced by Porto do Açu fernery, São João da Barra municipality, RJ (Porto do Açu, 2017). Specimens were randomly chosen according to availability among the species produced then (Figure 1A). Plants seedlings were all in casts; they have been cultivated for seven months, and their heights ranged from 10 to 20 cm (Figure 1B). Tropical climate prevails in the region, with moderate rainfall regime: major precipitation occur in the beginning and in the middle of the year; air humidity is elevated, with annual average above 75% and annual average temperature around 25 ºC: ranging from 16 and 32 ºC.

Thirty different species were selected. They were transplanted into vases with 10 L substrate capacity, which were prepared with vegetable soil, sand, and tanned bovine manure in a 2:2:1 proportion, respectively.

Later, all plants were transplanted into bigger vases, with 20 L capacity, and containing the same substrate (Figure 1C-G). In this phase, the vases were kept for eight months (from November to June) outdoors, in total sun exposure.

Coverage NPK fertilizer (10-10-10) was performed after each transplantation: 30g/vase, and watering was performed every other three days with 1 L per vase. In rainy days no watering was done.

Measurements of plants heights and stem base diameter, as well as the number of leaves, were monitored along 12 months and such data was used for correlation and plant development analyses.

Results and Discussion

After a two-month adaptation period, the plants were displayed in an exhibition - called "Restinga em Jardineiras" ["Restinga in Containers"] – that was presented during the "II Seminário de Pesquisa e Desenvolvimento dos Institutos Superiores de Ensino do CENSA – ISECENSA" ["II CENSA – ISECENSA Superior Institutes Research and Development Seminar"], which aimed to foster the cultivation of restinga species outside their natural environment, and to help publicize and arise concern about the importance, value and beauty of such biome as a representative of our natural inheritance (Freire et al, 2017).

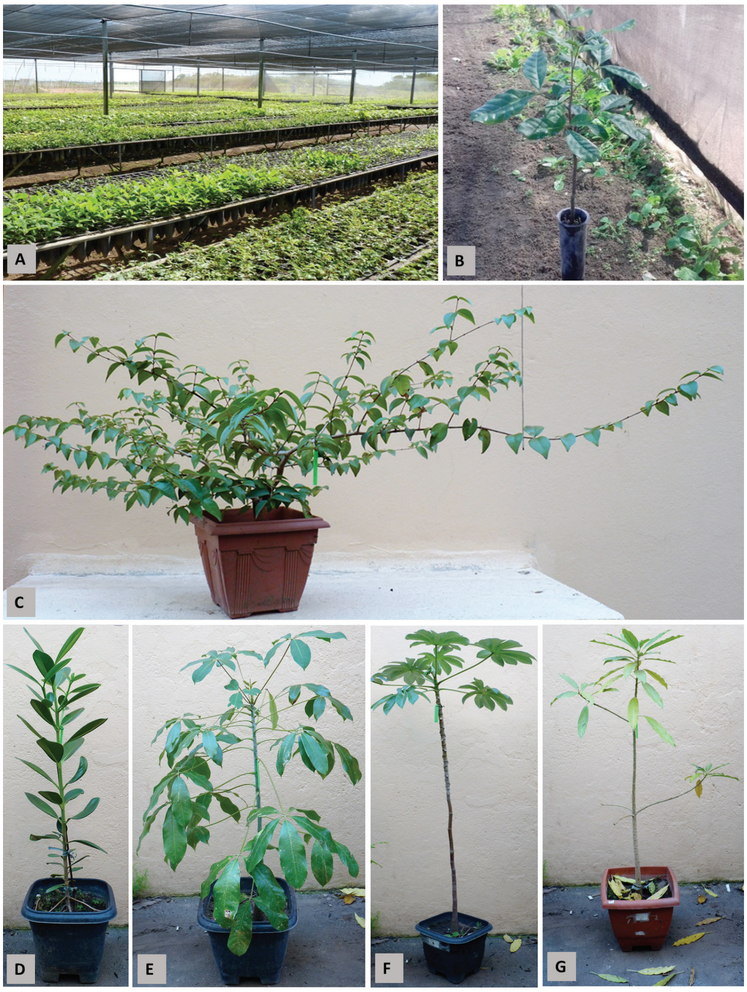

Figure 1. Production of restinga plants species seedlings and use as ornamental plants. (A) restinga seedlings fernery of Prumo Logística, Porto do Açu (São João da Barra municipality, RJ); (B) *Cupania emarginata* (fruto-de-guaxo) seedling cast after seven months; (D) *Clusia hilariana* (abaneiro); (E) *Pseudobombax grandiflorum* (paina); (F) *Cecropia pachystachya* (embaúba); and G) *Sapium glandulosum* (burra-leiteira).

Twenty four restinga vegetal species, cultivated in vases, are presented in Table 1. All plants survived past the period of time between transplantation from casts into ornamental vases.

The fact that the plants roots were submitted to a confined environment for a one year period did not, apparently, impose any restrictions in their development – note that plants lacked neither watering or organic and mineral nutrition, nor had difficulties in climate adaptation (Puchalski and Kämpf, 2000).

When Pearson Correlation Coefficient was used to compare relations between growth in height and number of leaves (Table 1), it was possible to verify that 18 among the 22 plants analyzed exhibited a good to great coefficient, only one displayed a regular coefficient, and three of them showed low correlations. These results suggest that, during the twelve month growth period, the plants adapted to management, and redeveloped their root systems for an adequate absorption of nutrients and water, what enabled plant growth and development of leaves.

In the gurirí palm (*Allagoptera arenaria* (Gomes) Kuntze) case, the low and negative coefficient was due to the naturally very slow development of the species and to the lack of new leaves growth, besides the loss of old ones. Regarding the low coefficient attributed to the jenipapinho (*Tocoyena bullata* (Vell.) Mart.), it was assumed to derive from mechanical damage – loss of leaves – suffered by the plant in the last months of assessment.

Regardless whatever coefficient between plants final height and maximum number of leaves produced, all studied species exhibited fine adaptation to the substrate used (Table 1). It confirms the assumption that coastal areas native plants need less intensive care, water and fertilizers, once they are more naturally adapted to adverse conditions (Loges et al., 2013).

Table 1. One year follow up of restinga plants species for adaptability to ornamental potting purposes

Species	Commom name	Family	Phytofisionomy	Maximum height	Number leaf maximum	Pearson's Correlation (r)
Allagoptera arenaria	coco-gurirí	Arecaceae	II, IV, VI	26	6	-0.40 [i]
Annona glabra	mololo	Anonnacaea	V	144	195	0.87 *
Bactris setosa	coco-tucum	Arecaceae	V	50	8	0.81 *
Cecropia pachystachya	embaúba	Urticaceae	V	124	9	0.28 [i]
Chrysobalanus icaco	abajurú	Chrysobalanaceae	IV	70	209	0.97 **
Clusia hilariana	abaneiro	Clusiaceae	III, IV, VI	90	41	0.99 **
Coccoloba alnifolia	bolo	Polygonaceae	III, VI	132	20	0.94 **
Condalia buxifolia	quixaba	Rhamnaceae	III	56	242	0.98 **
Cordia taguahyensis	muchila	Boraginaceae	II, V	80	145	0.90 **
Cupania emarginata	fruta-de-guaxo	Sapindaceae	IV	28	47	0.88 *
Cynophalla flexuosa	juramento	Capparaceae	II, IV, VI	37	94	0.92 **
Eugenia astringens	apertão	Myrtaceae	II, VI	50	79	0.84 *
Eugenia dichroma	pitanga-lagarto	Myrtaceae	III	54	71	0.94 **
Eugenia uniflora	pitanga	Myrtaceae	II, III, VI	42	473	0.96 **
Jacquinia armillaris	pimenta-da-praia	Primulaceae	II	52	85	0.92 **
Maytenus obtusifolia	papagaio	Celastraceae	II, III, VI	130	135	0.93 **
Myrsine umbellata	capororoca-folha-larga	Primulaceae	II, III, VI	57	20	0.95 **
Pouteria psammophila	aguapeba	Sapotaceae	IV, V	45	34	0.86 *
Pseudobombax grandiflorum	paina	Malvaceae	II, VI	105	90	0.89 *
Sapium glandulosum	burra-leiteira	Euphorbiaceae	V	103	110	0.78 [r]
Schinus terebinthifolius	aroeira	Anacardiaceae	II, III, IV, V	134	274	0.96 **
Scutia arenicola	quixabinha	Rhamnaceae	II, III, VI	82	80	0.94 **
Tocoyena bullata	jenipabinho	Rubiaceae	III, VI	108	65	0.42 [i]
Tocoyena sellowiana	jenipabinho-do-brejo	Rubiaceae	V	135	237	0.98 **

** great; * good; [r] reasonable and, [i] improper correlation, according to Pearson's Correlation Coefficient (Milone, 2004)
I= Grass-like Beach Vegetation; II= Shrubby Beach Vegetation; III= Clusia Vegetation; IV= Restinga Forest Vegetation; V= Open Floodable Shrubby Vegetation; VI= Open Non-floodable Shrubby Vegetation according to the phytophysiognomy proposed by Assumpção e Nascimento (2000), Santos et al., (2009) and Monteiro et al., (2014).

Some vegetal species had always displayed height growth superior to leaf production. Such bush-arboreal structured species presented themselves as ornamental plants differentiated by a high stalk and a small number of leaves, just like the embaúba (*Cecropia pachystachya* Trécul) (Figure 1F and Figure 2) and the abainero (*Clusia hilariana* Schltdl.) (Figure 1D and Figure 3). This characteristic favors the appreciation of the plant specially in areas where it is planted in a vase. That also happens out there in the restinga, as well as in more densely covered areas, although other species growing in the vicinity will end up closing the canopy (Marques and Oliveira, 2004).

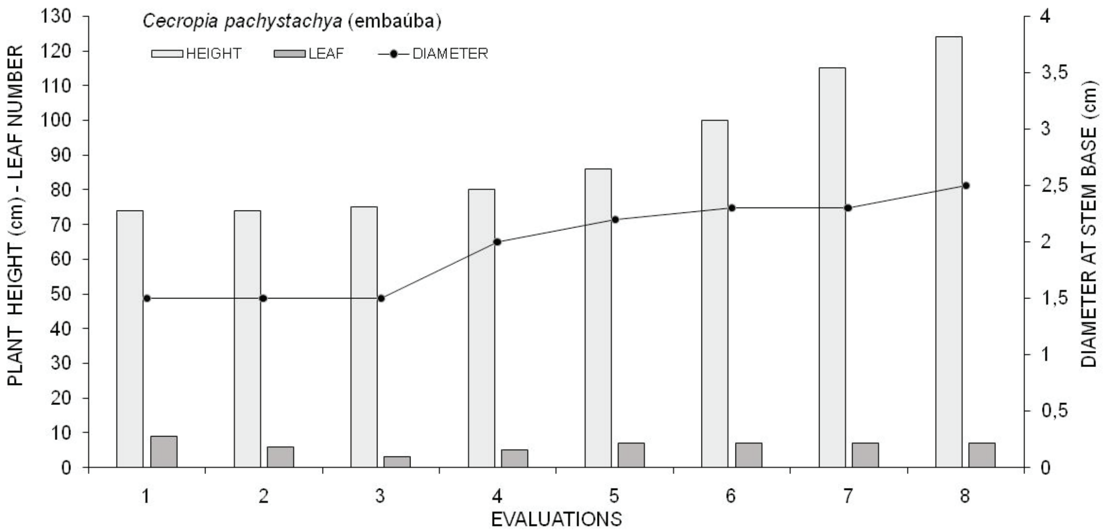

Figure 2. Growth, leaf number and stem base diameter assessments of *Cecropia pachystachya* (embaúba), representative of the Open Floodable Shrubby Vegetation in restinga.

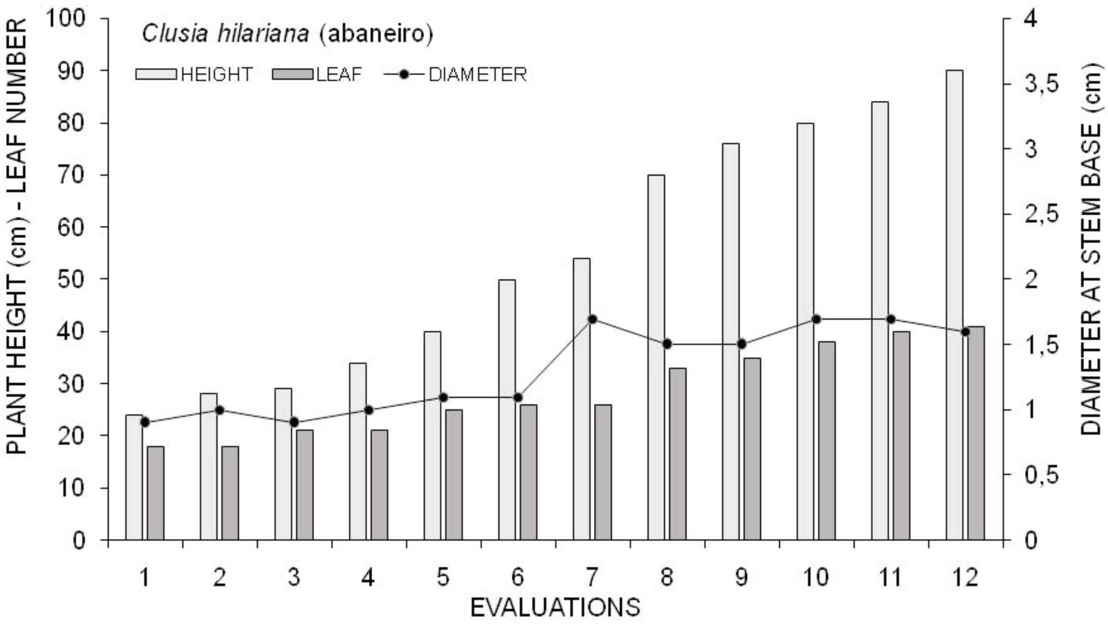

Figure 3. *Clusia hilariana* (abaneiro) evaluations, representative of Clusia vegetation in restingas, throughout one year planted in a vase.

Among the assessed species, the following exhibited a greater production of leaves in relation to height growth throughout the one year evaluation period: *Chrysobalanus icaco* L., *Condalia buxifolia* Reissek, *Cordia taguahyensis* Vell., *Cynophalla flexuosa* (L.) J.Presl, *Eugenia astringens* Cambess., *Jacquinia armillaris* Jacq., *Maytenus obtusifolia* Mart., *Scutia arenicola* (Casar.) Reissek and *Tocoyena sellowiana* (Cham. & Schltdl.) K.Schum. All these species displayed characteristics of stability when transplanted. We did not observe any periods of adaptation – those in which species demand time to recover and entirely reestablish their photosynthetic activities. Most of the times, a progressive and vigorous production of leaves, accompanied by a slower stalk growth, were observed. The final product was constituted by well adapted plants with fresh and flourishing leaves. Once plants from different life forms tend to exhibit distinct phenological patterns (Marques et al. 2004), it is likely that species from the sub-wood do not overlap their phenology among themselves, let alone to resemble the canopy patterns (Marques and Oliveira, 2004).

Other species, such as *Annona glabra* L., *Cupania emarginata* Cambess., *Eugenia dichroma* O. Berg and *Schinus terebinthifolius* Raddi, exhibited a greater height growth than production of leaves in the initial months – which coincided with Brazilian winter months: from June to September. Later on, the number of leaves increased and surpassed the above mentioned growth. Such outcome can be found in the majority of typical ornamental species, whose root systems take a while to recover (from transplantation) while the plants use some time to adapt to the new environment. Only after the plant has absorbed enough water and nutrients associated to local photosynthetic conditions, any outstanding increase in the plants' foliage volume can be observed. At this time, the plant displays force and establishes its canopy.

For the pitangueira [Surinam cherry] species, a slow height growth, which is typically found in species from the Myrtaceae family, was observed. Nevertheless, the number of leaves produced by the plant progressively increased as the branches grew longer (Figure 1C and Figure 4).

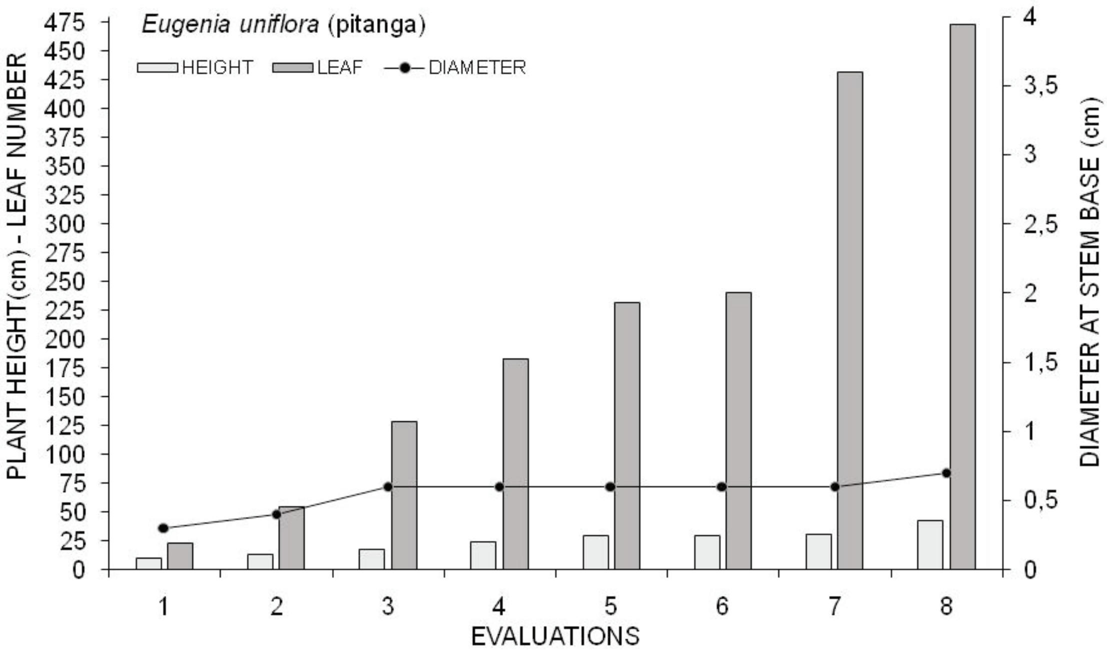

Figure 4. *Eugenia uniflora* (pitangueira) evaluations, representative of Shrubby Beach Vegetation in restinga, throughout 12 months.

Regarding the *Sapium glandulosum* (L.) Morong (burra-leiteira) species, the height growth was more pronounced than the production of leaves in the first months (Figure 1G and Figure 5). However, the number of leaves surpassed the height in the fourth month after transplantation and continued so till the seventh month. From then on, the plant stopped growing in height and progressively started to loose leaves. Such behavior indicated that the plant could not adapt to the vase: it seems that its root system growth came to a halt. Therefore, the plant was not able to produce new roots and leaves, the stalk could not grow anymore, the existent leaves started turning yellow and dry, the plant weakened and eventually died.

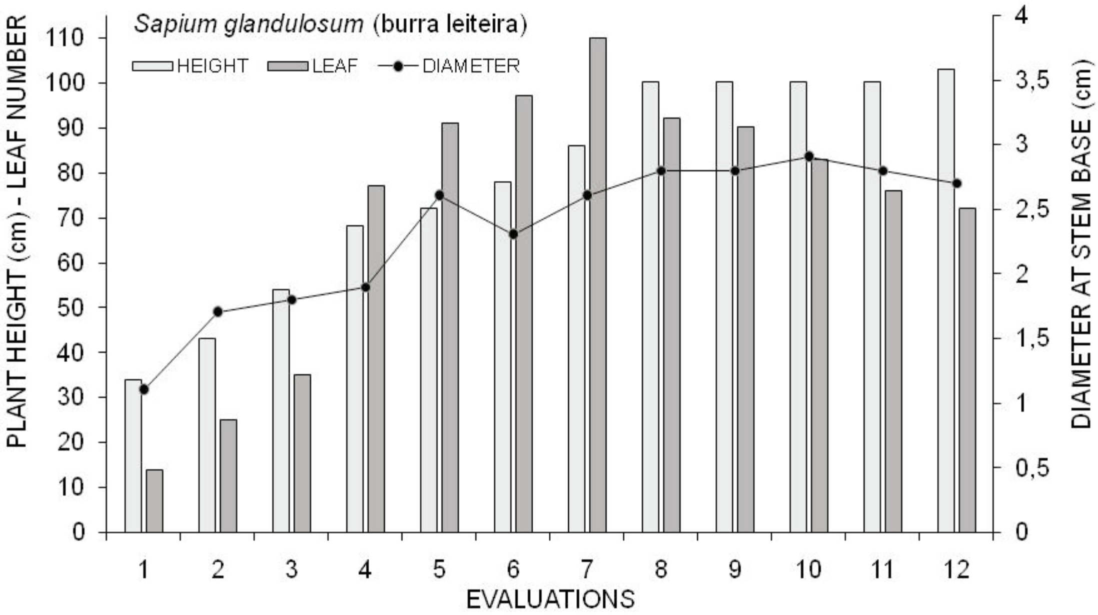

Figure 5. Development assessments of *Sapium glandulosum* (burra leiteira) throughout 12 months planted in vase.

Similar behavior was also observed for the *Pseudobombax grandiflorum* (Cav.) A. Robyns (paina) species, though in a less harmful progression (Figure 1E and Figure 6).

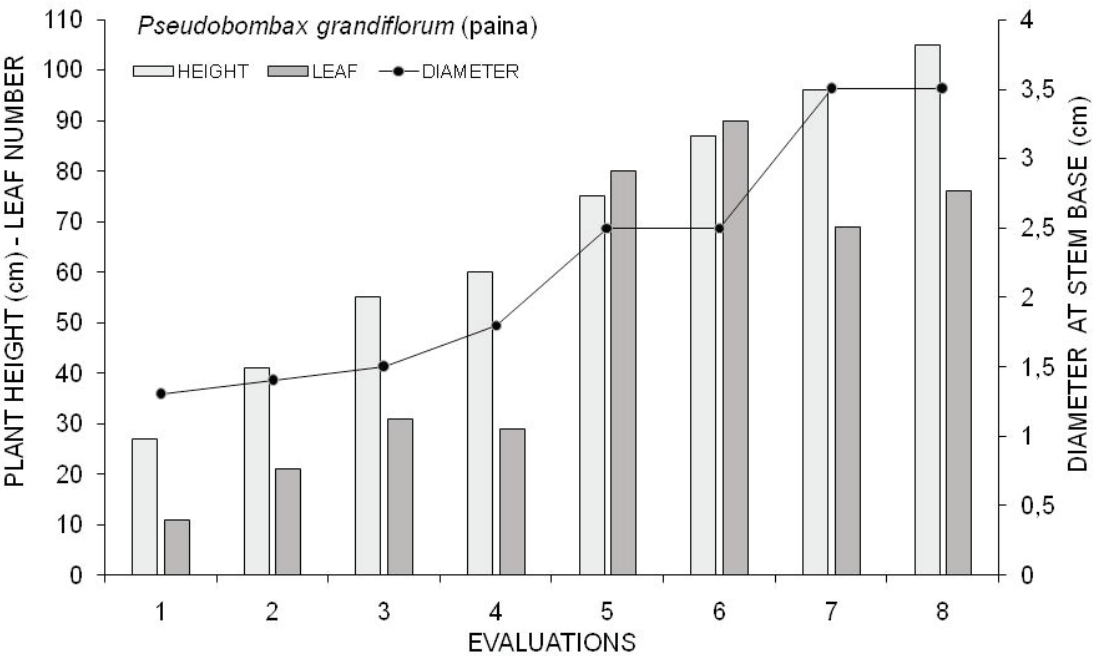

Figure 6. Monitoring of *Pseudobombax grandiflorum* (paina) development, representative of Clusia Vegetation in restinga, throughout one year of the experiment.

The alternative use of larger vases is suggested as a solution for keeping plants in good development conditions in such potting environment. Vases capable of containing larger amounts of substrate will provide larger areas and better conditions for a proper root growth (Lourenço Júnior et al., 2007).

Two other species did not succeed in developing well in vases along the one year period of the study: the tucum palm and the gurirí palm, both from the Aracaceae family. As far as the tucum palm is concerned, the biggest problem was the presence of thorns throughout the whole plant, even in the leaves' surfaces (Figure 7A). That disqualifies the species for domestic ornamental use in vases. Regarding the Guriri palm (Figure 7B), the plant did not produce new leaves, exhibiting slow development. Here, once the plant did not have any apparent stalk, it became difficult to estimate either its height growth or its growth in base diameter. An alternative to standardize collection of data variables to assess height growth could be selecting a certain leaf, in a certain position and plant development stage, and perform periodic measurements and development stage assessment as a follow up procedure (Menezes and Araujo, 2000). Other species that also displayed thorns along its stems was the *Condalia buxifolia* (quixaba) (Figure 7C).

Figure 7. Restinga plants grown in pots for growth evaluation and use for ambient ornamentation. A) *Bactris setosa* (coco-tucum) displaying thorns including on leaf surface; B) *Allagoptera arenaria* (coco-gurirí) absence of aerial stalk; and C) *Condalia buxifolia* (quixaba): exhibiting stem thorns.

Regarding the stalk base diameter variable, no outstanding thickness changes were observed throughout the first cultivation year. Although a slight final diameter increase had been noticed, the stalks did not present any symptoms of cracks, and they were neither darker nor dry. According to this variable, the plants could have been kept in their vases for an even longer period – until they exhibited any signs that transplantation was required. Stalk base diameter decrease was observed in some species in subsequent assessments. This finding tends to be common in certain plant development stages, being followed by a posterior return of width growth. It is due to possible variations in water influx and drainage. According to Pimentel (2004), hydrical stress can affect these forces by its effects on photosynthesis, water and nutrients translocation, and general plant metabolism.

Due to the characteristics and adaptability of the plants studied here, we suggest the use of these species in landscaping. Besides, we remark that such use will help preserve the local flora and reinforce regional identities – standing as a counterpoint to the indiscriminate use of alien species: what causes standardization of landscapes. When Beckmann-Cavalcante et al. (2017) studied species from the Caatinga flora, they suggested their use as a cut flowers resource by reaffirming that such biome, for its peculiar vegetation, possessed a great diversity of vegetal species whose use had not yet been explored.

Prospection of new ornamental plants based on native species can be exemplified through the use or a restinga species called *Chamaecrista ensiformis* (Vell.) H.S. Irwin & Barneby, registered for ornamental purposes in a private lot in Recreio dos Bandeirantes neighborhood, Rio de Janeiro (Zamith and Scarano, 2004), while *Ipomoea brasiliensis* (L.) Sweet, *Clusia* spp. and *Coccoloba uvifera* (L.) L. constitute species also identified for landscaping purposes in Brazilian Northeastern coast (Loges et al., 2013). Species such as gurirí palm (*A. arenaria*), ingá mirim (*Inga laurina* (Sw.) Willd.), amarelinha da praia (*Stigmaphyllon paralias* A. Juss.), and bolo (*C. alnifolia*), among others, are being used for rehabilitation of the beach vegetation in Ipanema, Leblon and in the Parque Natural Municipal da Prainha [“Prainha Municipal Natural Park”], in Rio de Janeiro (Instituto-e, 2018).

Thus, studies that help selecting plants which are representatives of threatened ecosystems become rich and important for the rescue of species with multiple possible uses (Chamas and Matthes, 2000). Besides, their insertion in ornamental cultivation helps arise consciousness in preservation, once it increases their visibility and economic importance.

Conclusions

Most of the restinga plants used in this work have adapted well to potting cultivation, exhibiting progressive and vigorous production of leaves, followed by a little slower stalk growth. The final product we obtained were well adapted plants with fresh and flourishing foliage. For fast growing species or those classified as having a shrubby or an arboreal types, the use of vases with capacity for 20 L of substrate or more becomes an essential condition for them to preserve proper growth and development - as well as receiving adequate maintenance and suffering no water restriction. The species *Chrysobalanus icaco*, *Condalia buxifolia*, *Cordia taguahyensis*, *Cynophalla flexuosa*, *Eugenia astringens*, *Jacquinia armillaris*, *Maytenus obtusifolia*, *Scutia arenicola*, *Tocoyena sellowiana*, *Annona glabra*, *Cupania emarginata*, *Eugenia dichroma*, *Schinus terebinthifolius* and *Eugenia uniflora*, which are native from the Mata Atlântica/Restinga Biome, and are found in Rio de Janeiro state southeastern region, exhibit aesthetic elements and vase development both suitable for landscaping use.

Author Contribution

MGMF[0000-0003-1189-4380] and VM-D[0000-0003-1023-1980]: worked together in all research steps, such as choosing species, planting and managing plants, data collection, analysis and interpretation, and preparation and review of the manuscript.

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