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Urban afforestation survey in the Labienópolis neighborhood, Garça, São Paulo, Brazil

Talita Carvalho de Souza
Universidade Estadual Paulista "Júlio de Mesquita Filho", Campus Botucatu

Erick Phelipe Amorim
Universidade Federal de São Carlos, Campus de Sorocaba

Osny Tadeu de Aguiar
Instituto de Pesquisas Ambientais

Israel Luiz de Lima
Instituto de Pesquisas Ambientais

Victor Lopes Braccialli
Faculdade de Ensino Superior e Formação Integral

Corresponding author
Eduardo Luiz Longui
Instituto de Pesquisas Ambientais
elongui@sp.gov.br

Abstract: Urban afforestation began around the 15th century in Europe, with "gardened walkways" installation. Over the years, as landscaping techniques have been disseminated and improved, life quality in urban centers has improved. The present study was carried out in the Labienópolis neighborhood in the city of Garça - SP at coordinates 22º 12' South and 49º 35' West., elevation 670m. A total of 1,140 plants were sampled involving trees, shrubs, herbs, palms and lianas belonging to 34 botanical families, 64 species between native and exotic. The species with highest number of planted specimens was *Moquilea tomentosa* (164 plants); *Murraya paniculata* (140); *Pachyra aquatica* (132); *Lagerstroemia indica* (115). On the one hand, the survey allows us to infer that most of species used in the city are exotic, which can compromise the avifauna, as well as the biodiversity of existing native species. On the other hand, there is a clear need for a qualitative study aimed at the planning and management of trees in urban areas.
Keywords: urban centers, exotic species, *Licania tomentosa*, *Pachira aquatica*.

Introduction

The presence of plant elements in urban centers allows deconstruction of artificial aspect of environment and provides an improvement in environment quality such as microclimate alteration, reduction of pollution and aesthetic improvement, in addition to providing food to the local fauna and improvements in the aesthetic aspects of urban centers (Bonametti, 2003; Firmo, 2019).

The use of native species in municipal urban afforestation plans should be prioritized. The municipal public administration in partnership with universities and/or environmental non-governmental organizations can carry out actions that promote the engagement of the local community, as well as projects that stimulate the development of monitoring studies of the effects of the increase of native species in the maintenance of diversity and ecological processes. However, currently, the reality is different, the use of exotic species in the afforestation plans of Brazilian urban spaces is very common, which generates an imbalance, disfavoring the conservation of native species and the maintenance of habitats for wild fauna and ecosystem services (Camaño et al., 2015).

The collection of information about the species present in urban spaces, with the quantification of the number of individuals divided between exotic or native species and the development of studies on the influence of these

individuals in the local environmental dynamics can contribute to a more sustainable planning of new green areas in the municipalities, aiming to guarantee the sovereignty of native species over exotic ones (Messias et al., 2019).

When afforestation is planned, an oriented development is sought in order to avoid future damages to the environment. Planning is one of the ways to obtain qualitative and quantitative knowledge of green areas and street trees, thus avoiding damages that could compromise people's quality of life (Milano, 1987). In this context, the study aimed to carry out a survey of tree species in the Labienópolis neighborhood in Garça, São Paulo.

Materials and Methods

Study area

The survey was carried out in the Labienópolis neighborhood, in the municipality of Garça, in the central-west region of São Paulo, located at the coordinates 22°12' South and 49°35' West, 670 meters above sea level (Figure 1). The climate of the municipality is considered to be subtropical, with an average annual temperature of 28.5°C and an average precipitation of 1274 mm per year, with the soil of the region considered Podzolic Red Yellow. Garça municipality has territorial area of 555,807 km², and estimated population of 44,429 people (Nunes et al., 2013; IBGE, 2021). For the survey to be carried out, a map of the neighborhood provided by the Municipal Secretary of Agriculture and Environment (SAMA, 2014) was used (Figure 2).

Figure 1. Location of the Labienópolis neighborhood (delimited in red), Garça – SP. Source: GOOGLE EARTH, 2021.

Figure 2. Labienópolis neighborhood (delimited in pink), Garça – SP, scale 1: 10,000. Source: SAMA, 2014.

Survey of afforestation

The species survey was carried out between August 11 and 22, 2014. Information on species, location (street) and size were collected in the survey. Size was classified as small (up to 4 m), medium (4 to 12 m) and large (over 12 m) or seeding (diameter at breast height up to 5 cm). To determine the size of the trees, the lighting poles were used as a scale: Up to the limit of the wiring (<4 m); between the wiring boundary and the total height of the lighting pole (4 -12 m); and above the height of the pole (>12 m).

Quantitative analysis was performed by recognizing the plants (popular name, scientific name and botanical family). Next, relative frequency of species was evaluated according to Magurran (2004) based on the formula Fri=(FAi/ΣFA) x 100 where: FRi = frequency of the variable (i); FAi = absolute frequency of the variable (i).

In addition to plant quantification, we used technical and scientific identification through manuals for identification of botanical species, consultation of specialized herbaria and specific literature such as: plant taxonomy system APG III (2009), Brazilian trees (Lorenzi, 2014); exotic trees (Lorenzi et al., 2003); ornamental plants (Souza and Lorenzi, 2008) among others. The habit of the plant, *e.g.* grasses, vines, shrubs, or trees, was also determined. Specimens that were not identified in loco were photographed (Figure 3).

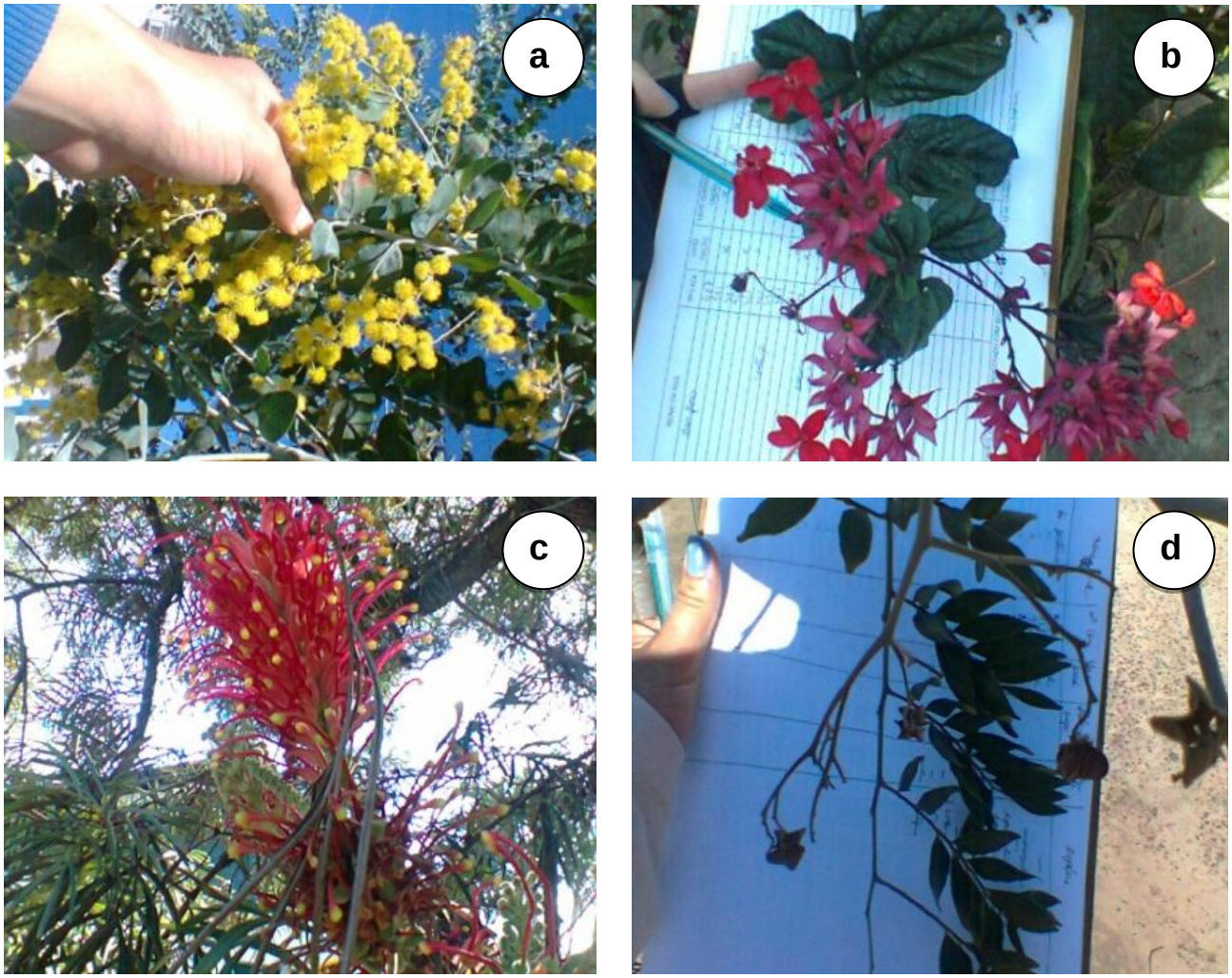

Figure 3. Some species found in Labienópolis neighborhood. a. *Acacia podalyriifolia.* b. *Clerodendrum thomsoniae.* c. *Grevillea banksii*. d. *Dictyoloma vandellianum*.

Results and Discussion

In the survey of Labienópolis neighborhood we found 1,140 plants and numbers of specimens per species were counted (Table 1). The families with the highest relative frequency are: Chrysobalanaceae 14.40%; Lythraceae 13.95%; Rutaceae 13.79%; Malvaceae 11.94% (Figure 4). We detected 64 species, native and exotic, among trees, shrubs, herbs, palms and lianas that are distributed in 34 botanical families (Table 1, Figure 5).

Bignoniaceae and Fabaceae - Caesalpinioideae presented highest diversity of species, six and five species, respectively (Figura 5). The families with highest number of plants were: Chrysobalanaceae (164 plants); Rutaceae (157 plants); Lythraceae (156 plants) and Malvaceae (134 plants).

The species with the highest number of specimens in the neighborhood was *Moquilea tomentosa* (164 plants), followed by *Murraya paniculata* (140 plants). Other expressive species were *Pachira aquatica* (132 plants) and *Largestroemia indica* (115 plants). Among the species, 46 are exotic and 18 are native, that is, they correspond to 71.9% and 28.1%, respectively.

Table 1. Sampled species information, popular names in Brazilian Portuguese, scientific name, habit (grasses, herbs, vines, shrubs, or trees) / native (N) or exotic (E) species, family, and quantity of plants by species.

Popular name	Scientific name	Habit / Native or Exotic	Family	n
Abacateiro	*Persea americana* Mill.	Tree/E	Lauraceae	1
Acácia mimosa	*Acacia podalyriifolia* A. Cunn.ex G. Don	Tree/E	Fabaceae - Mimosoideae	1
Algodão do brejo	*Taliparitipernambucense* (Arruda) Bovini	Shrub/N	Malvaceae	1
Areca bambu	*Dypsis lutescens* (H. Wendl.) Beentje & J. Dransf.	Palm/E	Arecaceae	1
Areca de locuba	*Dypsis madagascariensis* (Becc.)Beentje & J.Dransf.	Palm/E	Arecaceae	3
Aroeira pimenteira	*Schinus terebinthifolius* Raddi	Tree/N	Anacardiaceae	5
Aroeira salsa	*Schinus molle* L.	Tree/N	Anacardiaceae	39
Árvore da felicidade	*Polyscias guilfoylei* (W.Bull.) L.H.Bailey	Shrub/E	Araliaceae	2
Boldo do chile	*Peumus boldus* Mollina	Tree/E	Monimiaceae	1
Buxinho	*Buxus sempervirens* L.	Shrub/E	Buxaceae	1
Calicarpa chinesa	*Callicarpa reevesii* Wall.ex Walp.	Tree/E	Lamiaceae	5
Cássia	*Cassia* spp. L.	Tree/	Fabaceae - Caesalpinoideae	3
Cerejeira	*Prunus campanulata* Maxim.	Tree/E	Rosaceae	3
Chuva de ouro	*Cassia fistula* L.	Tree/E	Fabaceae - Caesalpinoideae	5
Congéia	*Congea tomentosa* Roxb.	Vine/E	Verberanaceae	1
Coração de negro	*Poecilanthe parviflora* Benth.	Tree/N	Fabaceae - Faboideae	44
Crista de galo	*Celosia argentea* L.	Herb/E	Amaranthaceae	1
Dedaleiro	*Lafoensia pacari* A.St.-Hil.	Tree/N	Lythraceae	3
Eritrina verde amarelo	*Erytrina variegata* L.	Tree/E	Fabacea - Faboideae	1
Escova de garrafa	*Callistemon viminalis* (Sol.ex Gaertn.) G. Don	Tree/E	Myrtaceae	6
Espirradeira	*Nerium oleander* L.	Tree/E	Apocynaceae	59
Esponjinha	*Calliandra brevipes* Benth.	Shrub/E	Fabaceae - mimosoideae	1
Falso pau brasil	*Tara spinosa* (Mollina) Britton & Rose	Tree/E	Fabaceae - Caesalpinoideae	1
Figueira benjamina	*Ficus benjamina* L.	Tree/E	Moraceae	14
Flamboyant mirim	*Caesalpinia pulcherrima* (L.) Sw.	Tree/E	Fabaceae - Caesalpinoideae	11
Grevilha	*Grevillea robusta* A.Cunn.ex R.	Tree/E	Proteaceae	16
Grevilha anã	*Grevillea banksii* R. Br.	Shrub/E	Proteaceae	1
Hibisco	*Hibiscus* spp. L.	Shrub/	Malvaceae	3
Ipê amarelo	*Handroanthus serratifolius* (Vahl) S. Grose	Tree/N	Bignoniaceae	30
Ipê branco	*Tabebuia roseoalba* (Ridl.) Sandwith	Tree/N	Bignoniaceae	27
Ipê de jardim	*Tecoma stans* (L.) Juss.ex Kunth	Shrub/E	Bignoniaceae	27
Ipê rosa	*Tabebuia pentaphylla* (Lin.)Hemsl.	Tree/E	Bignoniaceae	8
Ipê roxo	*Handroanthus impetiginosus* (Mart. ex DC.) Mattos	Tree/N	Bignoniaceae	4
Jacarandá	*Jacaranda mimosifolia* D. Don	Tree/E	Bignoniaceae	5
Jerivá	*Syagrus romanzoffiana* (Cham.) Glassman	Palm/N	Arecaceae	13
Lágrima de Cristo	*Clerodendrum thomsoniae* Balf.	Shrub or Vine/E	Laminaceae	1
Leiteiro	*Tabernaemontana hystrix* Steud.	Tree/N	Apocynaceae	5
Ligustro	*Ligustrum lucindum* W.T. Aiton	Tree/E	Oleraceae	5
Magnólia amarela	*Magnolia champaca* (L.) Baill. Ex Pierre	Tree/E	Magnoliaceae	1
Magnólia branca	*Magnolia grandiflora* L.	Tree/E	Magnoliaceae	3
Mangueira	*Mangifera indica* L.	Tree/E	Anacardiaceae	2

to be continue...

Monguba	*Pachira aquatica* Aubl.	Tree/N	Malvaceae	132
Murta	*Murraya paniculata* (L.) Jack	Shrub or Tree/E	Rutaceae	140
Mussaenda rosa	*Mussaenda alicia* Hort.	Shrub/E	Rubiaceae	1
Nêspera	*Eriobotrya japonica* (Thunb.) Lindl.	Tree/E	Rosaceae	1
Neve da montanha	*Euphorbia leucocephala* Lotsy	Shrub/E	Euphorbiaceae	6
Nim	*Azadirachta indica* A.Juss.	Tree/E	Meliaceae	2
Oiti	*Moquilea tomentosa* Benth.	Tree/N	Chrysobalanaceae	164
Palmeira imperial	*Roystonea regia* (Kunth)O.F.Cook	Palm/E	Arecaceae	4
Palmeira triângulo	*Dypsis decaryi (*Jum.) Beetje & J. Dransf.	Palm/E	Arecaceae	4
Pata de vaca	*Bauhinia variegata* L.	Tree/E	Fabaceae - Cercidoideae	25
Pau formiga	*Triplaris americana* L.	Tree/N	Polygonaceae	1
Pingo de ouro	*Duranta erecta* L.	Shrub/E	Verberanaceae	2
Pitangueira	*Eugenia uniflora* L.	Tree/N	Myrtaceae	1
Primavera	*Bougainvillea glabra* Choisy	Tree or Vine/N	Nyctaginaceae	1
Quaresmeira	*Pleroma granulosum* (Desr.) D. Don	Tree/N	Melastomataceae	27
Resedá	*Lagerstroemia indica* L.	Tree/E	Lythraceae	115
Resedá gigante	*Lagerstroemia speciosa* (L.) Pers.	Tree/E	Lythraceae	41
Sete copas	*Terminalia catappa* L.	Tree/E	Combretaceae	10
Sibipiruna	*Cenostigma pluviosum* (DC.) Gagnon & G.P.Lewis	Tree/N	Fabaceae - Caesalpinoideae	38
Sta Bárbara	*Melia azedarach* L.	Tree/E	Meliaceae	14
Tingui preto	*Dictyoloma vandellianum* A. Juss.	Tree/N	Rutaceae	17
Tipuana	*Tipuana tipu* (Benth.) Kuntze	Tree/E	Fabaceae - Faboideae	22
Tuia	*Platycladus orientalis* (L.) Franco	Tree/E	Cupressaceae	3
Unha de gato	*Ficus pumila* L.	Vine/E	Moraceae	1
Uva japonesa	*Hovenia dulcis* Thunb.	Tree/E	Rhamnaceae	1
Desconhecido				3
Total species				64
Total plants				1,140

With similar results to present study regarding the prevalence of exotic species and urban afforestation, we cite the studies by Justino et al. (2018) who found in an urban afforestation survey in the municipality of Santa Gertrudes (State of Paraíba, northeast of Brazil) 87.5% of species are exotic and 12.5% are native, which shows the dominance of exotic species in relation to native species. Also the study of Giacomazzi et al. (2020) in Tietê (State of São Paulo, southeastern Brazil), *Murraya paniculata* and *Lagerstroemia indica* represent 60% (exotic) and 40% (native). Exotic species are individuals that are inserted in environments outside their natural distribution area, being able to adapt to these new environments, generating impacts such as the reduction of richness and diversity, and changes in ecological processes such as nutritional disposition. This behavior is known as biological invasion, considered the second biggest cause of biodiversity loss. Most of exotic species existing in Brazil were introduced for ornamental purposes, without due care to avoid bio invasion (Santos et al., 2018; Rufino et al., 2019).

Moquilea tomentosa (brazilian native tree) represented 78.9% of afforestation in studied neighborhoods in the municipality of Itacoatiara (state of Amazonas, northern Brazil). *Moquilea tomentosa* is the most used species in urban afforestation in Brazil, as it is a fast-growing perennial tree, with a globular, leafy, well-formed, full crown and good adaptability to hot climates. Another widely used species is *Murraya paniculata* (exotic), a large shrub or perennial tree that can reach between 5 and 7 meters, because due to its resistance to adverse soil and climate conditions, it is often used in urban afforestation (Lorenzi et al., 2003; Gomes and Pinto, 2017). Both species with great occurrence in Labienópolis.

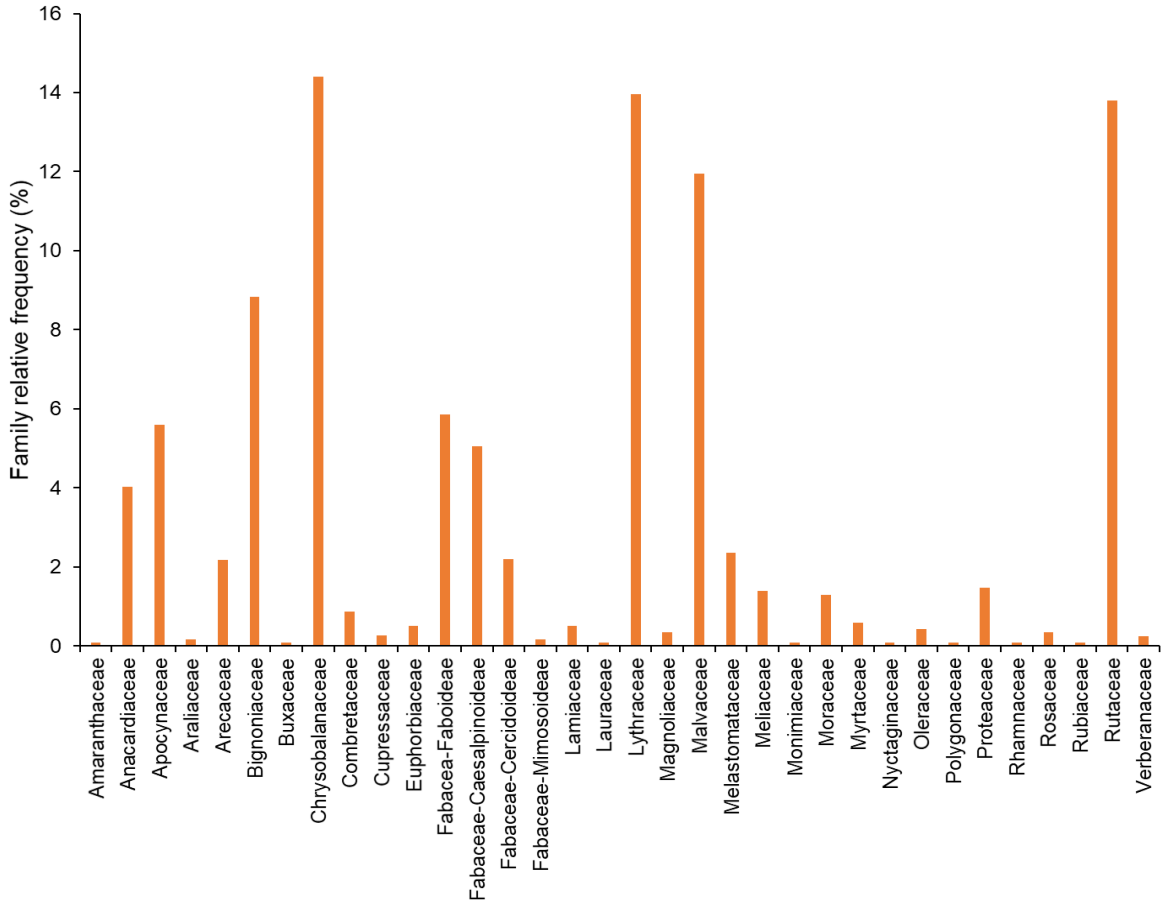

Figure 4. Family relative frequency in the 34 botanical families.

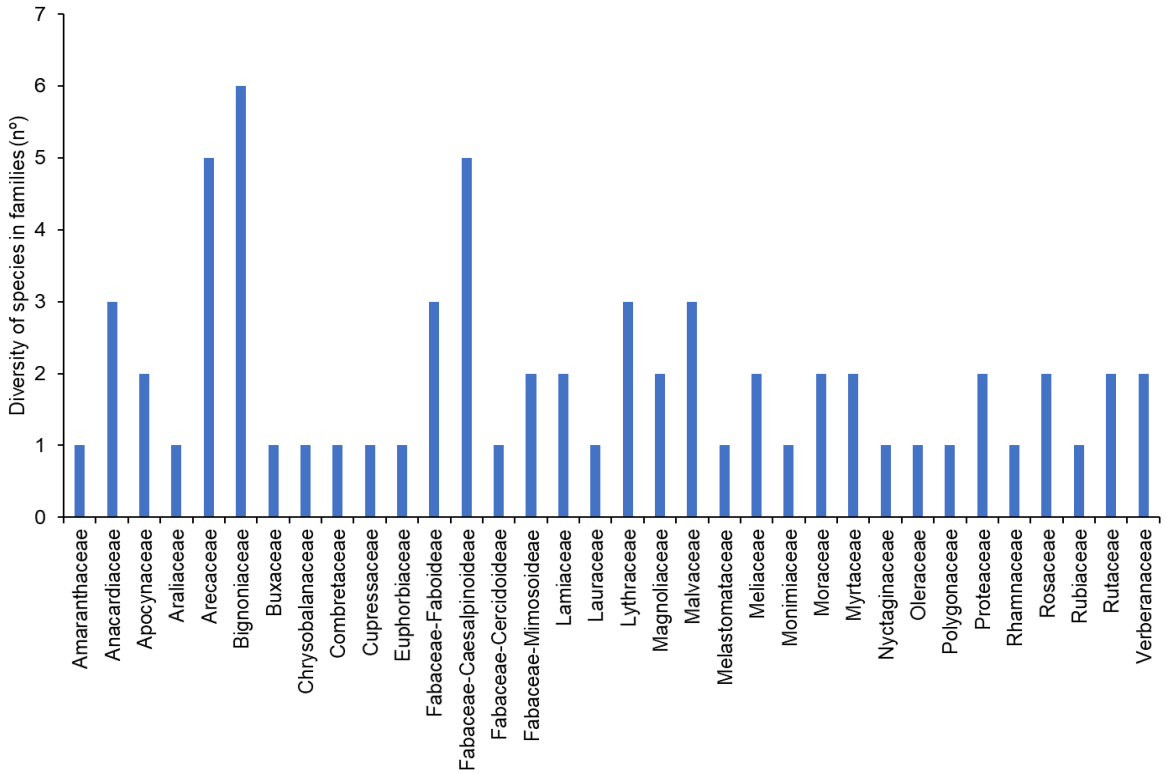

Figure 5. Diversity of species in the 34 botanical families.

In the urban afforestation survey carried out in the Mansour neighborhood in the municipality of Uberlândia (State of Minas Gerais, southeastern Brazil), *Moquilea tomentosa* was the most abundant species, with 430 plants (32.4%), *Pachira aquatica* was another species highlighted in the survey with 84 plants (6.4%) (Silva et al., 2002). This shows a similar pattern among the species highlighted in our study.

When comparing data from Mansour (MG) and Labienópolis (SP) neighborhoods, *Moquilea tomentosa* presented a similar percentage and *Pachira aquatic*a had a greater expression in Labienópolis (24%) than in Mansour neighborhood. This comparison reinforces that *Moquilea tomentosa* rate of use is high in Brazilian urban afforestation.

In the survey carried out in Jardim Morada do Sol, also in the municipality of Garça (SP), Malvaceae family had 319 plants, followed by Rutaceae, with 51 plants and Chrysobalanaceae with 49 plants (Martins et al., 2011). Comparing two neighborhoods in municipality of Garça (Jardim Morada do Sol and Labienópolis), Labienópolis had a greater number of plants from Chrysobalanaceae (115 more plants) and from Rutaceae (106 more plants) than Jardim Morado do Sol. On the other hand, Malvaceae had about 185 more plants in the Jardim Morada do Sol than in Labienópolis. In the survey carried out by Nunes et al. (2013), also in the municipality of Garça (SP) in Ferraropólis neighborhood, the species with the highest number of plants were: *Lagerstroemia indica*, 268 specimens (Fr.17.7%); followed by *Murraya paniulata*, with 201 specimens (Fr.13.3%); *Moquilea tomentosa* 156 specimens (Fr. 10.3%); *Pachira aquatica* 153 (Fr.10.1%); *Nerium oleander* 130 specimens (Fr. 8.6%). This demonstrates that there is a marked presence of species of the same family in the city's neighborhoods.

Conclusions

The Labienópolis neighborhood had more exotic species (71.9%) compared to native species (28.1%). Which is a typical pattern of urban afforestation in many Brazilian municipalities.

The study also shows us how important it is to know the vegetation of the municipalities not only focused on the quantitative aspect, but also aiming at the qualitative aspect and the planning of urban afforestation. Thus, it is possible to merge the exotic species of interest, but we believe that the ideal is to use mostly Brazilian native species, which in addition to aesthetics, can provide adequate food and conditions for native fauna and consequently increase the number and diversity of animals.

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