The ecology and tree species of urban green areas within the municipality of Campestre, Minas Gerais

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Abstract

Urban green areas produce benefits such as reduced air pollution, climate mitigation, reduced wind action, less noise pollution, shelter for fauna, and increased water uptake from the soil as well as increased water infiltration to the soil. This work carried out a floristic survey related to its diverse and characterized habit and dispersion, and also related to the origin of the species existing in four public squares within the municipality of Campestre, Minas Gerais. Thus, the floristic and ecological aspects of trees and shrubs were surveyed in four urban green areas of the municipality. All arboreal and shrubby individuals were marked and identified. Each identified species was classified according to habit, dispersion, and origin. In total, 313 tree individuals, shrubs, and palm trees were registered and distributed among 73 species, (62 genera and 30 botanical families). When considering all squares, Shannon's diversity was 3.72, and Pielou's evenness coefficient was 0.87. Lower values of diversity and evenness were observed for each public square. There was greater richness and number of individuals of native species compared to exotic ones. The yellow ipe (*Handroanthus serratifolius*) was the only species present in all studied squares. Sassafras (*Ocotea odorifera*) and pau-brasil (*Paubrasilia echinata*) are endangered species and underrepresented. The most represented forms of dispersion were zoochory and anemochory.

Keywords: Urban afforestation. Urban Ecology. Landscaping. Ornamental plants. Floristics.

Introduction

Urban afforestation is a science, sometimes treated as an art that works with the management of trees and the physiological-social-economic aesthetic aspects, aiming at the well-being of the urban population. Thus, improving the quality of life (ELIAS, 2020).

In a global context with the industrial revolution of the 18th century, we can say that accelerated and disorderly urban growth began, and it led to the recognition of the importance of green spaces and the good use of public space for the quality of life of the urban population. The landmark for urban afforestation was the urban reform of Paris in the 19th century which served as an example for other cities in the world on how to carry out urban intervention and afforestation planning (ARAÚJO, 2020).

Today, however, cities still have few green spaces. In Brazil, the urban population of approximately 180 million added to the disorderly growth caused by the rural exodus in the 50s/60s and continued in the following decades, transforming cities into large concrete blocks, with a loss of quality of life arising from environmental degradation of its public spaces. Therefore, promoting adequate socio-environmental management and sustainable development of urban spaces has become an urgent challenge in Brazil (BORGES *et al.*, 2020).

According to Buckeridge (2015), existing trees in urban green areas can reduce the incidence of light on the ground by up to 90 %. It can regulate the flow of water between soil and atmosphere via transpiration together with the evaporation of water from free surfaces. It can also form atmospheric moisture fluxes in which

water vapor moves from one region to another improving the microclimate, and consequently providing better environmental conditions for the population.

Environmental quality in urban areas is connected to the quality of life, since it is impossible to promote improvements in one without the other also improving. The concern with people's contact with green areas in cities has gained strength from the concept of sustainability which goes beyond the economic aspect, prioritizing the rational use of natural resources and the ways to restore them (when possible). The green theme and its recomposition appear in the Urban Land Parceling Laws, which provide for a green space area in the urban perimeter, but are often confused with the creation of gardens or free areas. Some master plans reach environmental protection areas, but there are not guarantees of the creation of green areas (ROCHA, 2019).

Urban areas including buildings that keep their landscape and ecological resources preserved offer a place for recreation and social interaction, as they are normally spaces belonging to the public authorities with unrestricted access for the population where individual or group activities can be carried out. As a leisure area, they offer opportunities for physical and mental well-being in addition to carrying out civic activities by adding better conditions of functionality, health, and sociability to the urban environment (MENEZES, 2019).

According to Vidal *et al.* (2020), people who have accessibility and proximity to green spaces and contact with nature have improved mental health (reduction of stress and symptoms of depression, improved mood etc.) when compared to groups not exposed to these areas when the space is built in a satisfactory manner allowing the performance of various activities. Such floristic survey could be carried out related to its diversity and characterization regarding the habit, dispersion, and origin of the species existing in four public squares in the city of Campestre, Minas Gerais, providing information that can support proper management of these urban green areas in the region.

Material and methods

Studied area

The municipality of Campestre is located in the south of Minas Gerais, at latitude 21º42'40" S and longitude 46º14'47" W (FIGURE 1), and altitude ranging from 1,076 m to 1,300 m. It has an area of 578.7 km^2. The region is part of the Semideciduous Seasonal Forest domain within the Atlantic Forest biome (IBGE, 2004). The average annual temperature in the city is 19.1 °C; the maximum monthly average temperature is 21.4 °C; the minimum monthly average temperature is 15.9 °C; and the average annual rainfall is 1,730 mm (CLIMATE-DATA.ORG, 2018).

The study was carried out in four Urban Green Areas (Plazas/Public Squares) of the city, namely: Praça Delfim Moreira (21º42'39. 4"S/ 46º14'51.47"W; 1,075 m of altitude and 6,200 m^2 of area), Praça Brasil (21º42'42. 4"S/ 46º14'44.27"W; 1,081 m of altitude and 1,600 m^2 of area), Praça Nossa Senhora Aparecida (21º42'51.4"S/46º14'27.17"W; 1,112 m of altitude and 1,100 m^2 of area) and, lastly, Praça Ana Simão Zenum (21º42'48. 91"S/ 46º14'26.19"W; 1,113 m of altitude and 980 m^2 of area). According to what is seen in FIGURE 1. All public squares are located within downtown neighborhoods and are used by the community as leisure spaces.

Floristic survey and ecological information on species

All arboreal and shrubby individuals were marked and identified. The APG IV (2016) plant

classification system was adopted. Taxonomic identification, specialized literature, and online consultations on herbaria were used. The botanical synonyms were updated according to the Flora do Brasil 2020´s website from Rio de Janeiro Botanical Garden (FLORA DO BRASIL 2020, 2021).

In order to analyze the diversity of the urban green areas studied, the Shannon Diversity Index (H') (BROWER; ZAR, 1984) and the Pielou Equability Coefficient (J) (PIELOU, 1975) were calculated for each area, which measure the observed diversity proportion in relation to the maximum diversity expected.

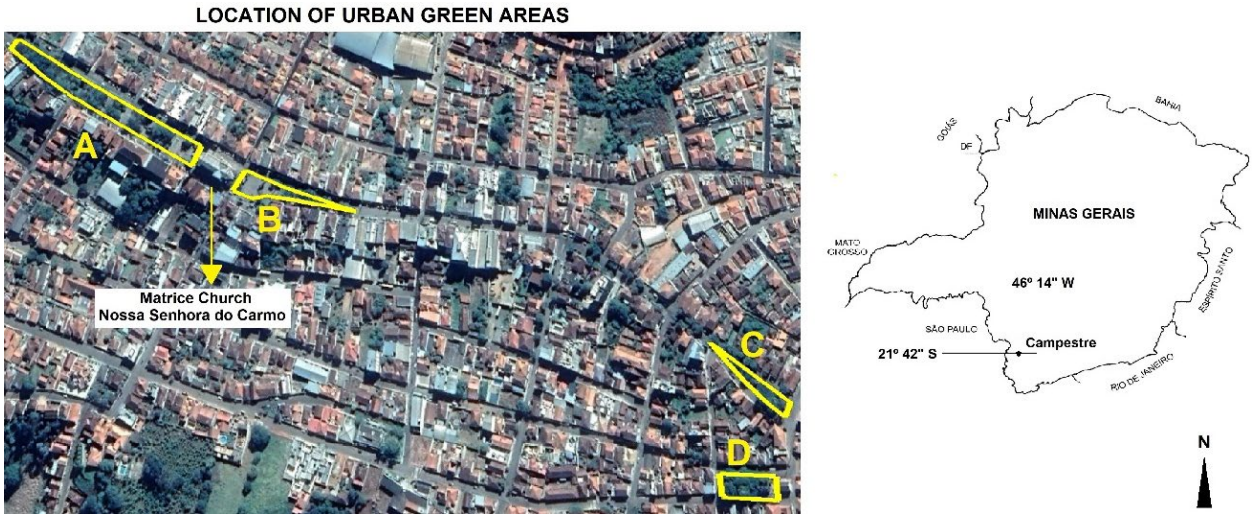
The species were classified according to i) development; ii) dispersion syndrome and iii) origin. Therefore, specialized literature was used such as the website Flora do Brasil 2020 (2021), Lorenzi (2002 a, b), and observation of reproductive structures (fruits and seeds) presented in the individuals and sampled during the study. The types of trees, shrub, and palm development recorded in Vidal and Vidal (2000) were considered.

In regards to dispersion syndromes, the types described by Vidal and Vidal (2000) are: anemochory (dispersion by the wind), autochory (dispersion by the explosive dehiscence of the fruit), barochory (dispersion by the force that gravity exerts on the fruit or seed) and zoochory (dispersion by animals) were considered.

Results and discussion

In total, 313 individual trees, shrubs, and palm trees were registered, distributed in 73 species, 62 genera, and 30 botanical families (TABLE 1). Five species belong to the Gymnospermae group: ciprestes (*Chamaecyparis lawsoniana*, *C. pisifera*, *Cupressus sempervirens*), sagu-de-jardim (*Cycas revoluta*) and pinheiro-budista (*Podocarpus macrophyllus*).

Figure 1. Location of urban green areas in the municipality of Campestre, southern Minas Gerais.



Abreviations: **A**. Praça Delfim Moreira; **B**. Praça Brasil; **C**. Praça Ana Simão Zenum and **D**. Praça Nossa Senhora Aparecida. (Plazas and Squares)

Source: Prepared by the authors using images from Google Earth and Google Maps from June 2017.

Table 1. List of species and botanical families containing ecological information (development, dispersion and origin) of the species sampled in the Urban Green Areas (Public squares) in the municipality of Campestre, Minas Gerais

FAMILY / Specie	**Popular Name**	**Des**	**Disp**	**Origin**	**Public Squares**			
ANACARDIACEAE					**1**	**2**	**3**	**4**
Astronium fraxinifolium Schot	gonçaleiro	Arv	Ane	Brazil	1	2		
Lithraea molleoides (Vell.) Engl.	aroeira-branca	Arv	Zoo	Brazil				1
Mangifera indica L.	mangueira	Arv	Zoo	Asia	2			
Schinus molle L.	chorão	Arv	Zoo	Brazil	12	1		
Tapirira guianensis Aubl.	pau-pombo	Arv	Zoo	Brazil				1
ANNONACEAE								
Annona cacans Warm.	araticum-cagão	Arv	Baro / Zoo	Brazil		1		
APOCYNACEAE								
Nerium oleander L.	espirradeira	Arb	Ane	Mediterranean	6			
ARALIACEAE								
Didymopanax morototoni (Aubl.) Decne. & Planch.	morototó	Arv	Zoo	Brazil	2			
ARECACEAE								
Archontophoenix cunninghamiana (H.Wendl.) H.Wendl. & Drude	drude	Pal	Zoo	Australia	8	1		
Dypsis decaryi (Jum.) Beentje & J. Dransf.	palmeira triangular	Pal	Zoo	Africa and Madagascar	2			
Dypsis lutescens (H.Wendl.) Beentje & J.Dransf.	areca-bambu	Pal	Ane	Madagascar	13	1		
Roystonea oleracea (Jacq.) O.F.Cook	palmeira-imperial	Pal	Zoo	Caribbean, Venezuela and Colombia	2	6		
Syagrus romanzoffiana (Cham.) Glassman	jerivá	Pal	Zoo	Brazil	11		5	1
Washingtonia robusta H.Wendl.	washingtônia	Pal	Zoo	USA and Mexico		3		
ASPARAGACEAE								
Dracaena arborea (Willd.) Link	dracena	Arb	Zoo	Africa	4	4		
BIGNONIACEAE								
Handroanthus albus (Cham.) Mattos	ipê-amarelo	Arv	Ane	Brazil		1		
Handroanthus chrysotrichus (Mart. ex DC.) Mattos	ipê-amarelo	Arv	Ane	Brazil	18	3		12
Handroanthus impetiginosus (Mart. ex DC.) Mattos	ipê-rosa	Arv	Ane	Brazil	7			
Handroanthus serratifolius (Vahl) S.Grose	ipê-amarelo	Arv	Ane	Brazil	1	2	2	2
Jacaranda cuspidifolia Mart.	caroba	Arv	Ane	Brazil	3		2	2
Tabebuia roseoalba (Ridl.) Sandwith	ipê-branco	Arv	Ane	Brazil	2			
Tecoma stans (L.) Juss. ex Kunth	ipê-mirim	Arb	Ane	Americas (Brazil except)	1			
Zeyheria tuberculosa (Vell.) Bureau ex Verl.	bolsa-de-pastor	Arv	Ane	Brazil			1	

COMBRETACEAE								
Terminalia catappa L.	amendoeira	Arv	Zoo	Asia	2	4		
CUPRESSACEAE								
Chamaecyparis lawsoniana (A. Murr.) Parl.	cipreste	Arv	Zoo	USA	1			
Chamaecyparis pisifera (Siebold & Zucc.) Endl.	cipreste	Arv	Zoo	Japan	2			
Cupressus sempervirens L.	cipreste	Arv	Zoo	Mediterranean and Asia	1			
CYCADACEAE								
Cycas revoluta Thunb.	sagu-de-jardim	Arb	Zoo	Japan and China	1	2		
ERYTHROXYLACEAE								
Erythroxylum deciduum A.St.-Hil.	cocão	Arv	Zoo	Brazil	2			
EUPHORBIACEAE								
Alchornea triplinervia (Spreng.) Müll.Arg.	tamanqueiro	Arv	Zoo	Brazil	1			
LAURACEAE								
Ocotea odorifera (Vell.) Rohwer	sassafrás	Arv	Zoo	Brazil	1			
LEGUMINOSAE								
Bauhinia variegata L.	pata-de-vaca	Arv	Auto	India	4			
PauBrazilia echinata (Lam.) Gagnon, H.C.Lima & G.P.Lewis	pau-brasil	Arv	Auto	Brazil	1			
Cenostigma pluviosum var. *peltophoroides* (Benth.) Gagnon & G.P.Lewis	sibipiruna	Arv	Auto / Ane	Brazil			14	5
Cassia fistula L.	cássia-imperial	Arv	Ane	India				2
Centrolobium tomentosum Guillem. ex Benth.	araribá	Arv	Ane	Brazil			1	
Delonix regia (Bojer ex Hook.) Raf.	flamboyant	Arv	Auto / Zoo	Madagascar	1			
Inga edulis Mart.	ingá-de-metro	Arv	Zoo	Brazil		1		
Lonchocarpus cultratus (Vell.) A.M.G.Azevedo & H.C.Lima	falso-timbó	Arv	Auto	Brazil	11		1	
Machaerium villosum Vogel	jacarandá-do-campo	Arv	Ane	Brazil	1			
Peltophorum dubium (Spreng.) Taub.	canafístula	Arv	Auto / Ane	Brazil	12		1	
Schizolobium parahyba (Vell.) Blake	guapuruvu	Arv	Auto / Ane	Brazil				1
LYTHRACEAE								
Lagerstroemia speciosa (L.) Pers.	resedá-gigante	Arv	Ane	China / Índia	2	2		
MALVACEAE								
Ceiba speciosa (A.St.-Hil.) Ravenna	paineira-rosa	Arv	Ane	Brazil	1			1
Dombeya wallichii (Lindl.) Baill.	astrapéia	Arv	Ane	Mediterranean	1			
Pachira aquatica Aubl.	castanheira	Arv	Zoo	Guyanas	2			

MELASTOMATACEAE								
Pleroma granulosum (Desr.) D.Don	quaresmeira	Arv	Ane	Brazil	10	3		
MELIACEAE								
Azadirachta indica A.Juss.	neem	Arv	Zoo	Asian	1			
Cedrela fissilis Vell.	cedro	Arv	Ane	Brazil	2			
MORACEAE								
Ficus benjamina L.	figueira-benjamina	Arv	Zoo	India and Philippines		4		
Ficus enormis Mart. ex Miq.	gameleira	Arv	Zoo	Brazil, Paraguay and Argentina	1			
MYRTACEAE								
Callistemon salignus (Sm.) Colv. ex Sweet	escova-de-garrafa	Arv	Ane	Australia and Oceania	4			
Eugenia sp.	-	Arv	Zoo	Brazil		1		
Eugenia sp. 1	-	Arb	Zoo	Brazil			1	10
Eugenia uniflora L.	pitanga	Arv	Zoo	Brazil				2
Melaleuca leucadendra (L.) L.	melaleuca	Arv	Ane	Australia	3			
Myrcia sp.	-	Arb	Zoo	Brazil				1
Myrciaria sp.	-	Arb	Zoo	Brazil	1			
Myrciaria sp. 1	-	Arv	Zoo	Brazil	1			
Psidium guajava L.	goiabeira	Arv	Zoo	South and Central America	1			
Syzygium cumini (L.) Skeels	jamelão	Arv	Zoo	India	1			
Syzygium jambos (L.) Alston	jambo-amarelo	Arv	Zoo	India and Malaysia	1			
OLEACEAE								
Ligustrum lucidum W.T.Aiton	alfeneiro	Arv	Zoo	Asia, China, Japan and Korea	2			1
PITTOSPORACEAE								
Pittosporum undulatum Vent.	pau-incenso	Arv	Zoo	Australia	12		1	1
PODOCARPACEAE								
Podocarpus macrophyllus (Thunb.) Sweet	pinheiro-budista	Arv	Zoo	Japan and China		1		
POLYGONACEAE								
Triplaris gardneriana Wedd.	pau-formiga	Arv	Ane	Brazil	1			
PRIMULACEAE								
Myrsine umbellata Mart.	capororocão	Arv	Zoo	South America	1			
ROSACEAE								
Eriobotrya japonica (Thunb.) Lindl.	nêspera	Arv	Zoo	China and Japan		2		2
RUBIACEAE								
Palicourea rigida Kunth	bate-caixa	Arb	Zoo	Brazil	3			
RUTACEAE								
Citrus sinensis (L.) Osbeck	laranja-doce	Arv	Zoo	Asia and China				1

Zanthoxylum sp.	-	Arv	Zoo	Brazil		1
SALICACEAE						
Casearia sylvestris Sw.	guaçatonga	Arv	Zoo	Brazil	1	
SAPINDACEAE						
Cupania sp.	-	Arv	Zoo	Brazil	1	1
Total of trees per Public Squares	**189**	**45**	**29**	**50**		

Abreviations: Des = Development; Disp = Dispersion; Arv = Arboreal; Arb = Shrub; Pal = Palm tree; Ane = Anemochoric; Auto = Autochoric; Baro = Barochoric; Zoo = Zoochoric; 1 = Delfim Moreira Square; 2 = Praça Brasil; 3 = Praça Nossa Senhora Aparecida and 4 = Praça Ana Simão Zenum.

Source: Prepared by the authors (2021).

Regarding the diversity analysis of afforestation in the studied public squares (TABLE 2), the Shannon diversity (H') was 3.72 and the Pielou evenness (J') was 0.87. Among the squares, the greatest diversity was registered at Praça Delfim Moreira (H'=3.47) and the smallest at Praça Nossa Senhora Aparecida (H'=1.72). The low diversity observed at Praça Nossa Senhora Aparecida is determined by the low richness of species and the concentration of individuals in a single species. In this case, the sibipiruna (*Cenostigma pluviosum* var. *peltophoroides*), which has 14 of the 29 individuals (TABLE 1) at the public square, reduced the observed value of Pielou's evenness (0.75). The greatest diversity was recorded at the public square with the largest area **(**Praça Delfim Moreira) and the least diversity at the smallest public square (Praça Nossa Senhora Aparecida) (TABLE 2), indicating a relationship between square area and species diversity.

Cabral *et al.* (2020), when studying urban afforestation in Diamantina/MG, recorded a Shannon diversity of 3.70, concluding that the city's afforestation has good floristic diversity and a high frequency of native species which are aspects recommended for urban afforestation. In Gurupi/TO, Santos *et al.* (2013) found H' = 2.37 in the city's central public squares, largely due to the high density of a single species. The sibipiruna represented around 40 % of the individuals. This diversity observed in Gurupi/TO is very close to that observed in Praças Brasil and Ana Simão Zanum (TABLE 2). Almeida and Rondon Neto (2010) found low diversity values for urban green areas in northern Mato Grosso, between 1.17 (Carlinda municipality) and 1.76 (Alta Floresta municipality), values close to those observed in the present study at Praça Nossa Senhora Aparecida (TABLE 2).

Table 2. Floristic and diversity indices of Urban Green Areas in the municipality of Campestre, Minas Gerais

Urban Green Areas	A	S	N	H'	J'
Praça Delfim Moreira	5,520	53	189	3.47	0.87
Praça Brasil	1,550	20	45	2.82	0.94
Praça Nossa Senhora Aparecida	975	10	29	1.72	0.75
Praça Ana Simão Zenum	1,255	19	50	2.48	0.84
Total	**-**	**73**	**313**	**3.72**	**0.87**

Abreviations: A = Area in m^2; S = Species richness; N = Number of trees; H' = Shannon's diversity index and J' = Pielou's evenness coefficient.

Source: Prepared by the authors (2021).

Overall, the families with the highest species richness were: Leguminosae and Myrtaceae (11 species each), Bignoniaceae (8), Arecaceae (6), and Anacardiaceae (5), representing 55 % of all sampled richness (TABLE 1). In the study by Eisenlohr *et al.* (2008), held on the Federal University of Viçosa *Campus*, Leguminosae was registered as the family with the greatest specific wealth. According to Azevedo *et al.* (2007), the Leguminosae family is always found in urban afforestation due to its benefits, and the main benefit is the fixation of nitrogen from the air that is assimilated by plants due to the association of these plants with nitrogen-fixing microorganisms. Lombardi and Morais (2003), in a study carried out at the Federal University of Minas Gerais, registered the Bignoniaceae families (13 species) and Myrtaceae (11 species) as the most diverse ones.

At Praça Delfim Moreira (Public Quare 1), 53 species were recorded among trees, shrubs, and palm trees and a total of 189 individuals. The species with the highest number of individuals were: chorão (*Schinus molle*) (12 individuals), palmeira-areca (*Dypsis lutescens*) (13), ipê-amarelo (*Handroanthus chrysotrichus*) (18), cassia-amarela (*Peltophorum dubium*) (12), pau-incenso (*Pittosporum undulatum*) (12) (TABLES 1 and 2).

At Praça Brasil (Public Square 2), 20 species were recorded, totaling 45 individuals (TABLE 1; TABLE 2). The species with the highest number of individuals is the palmeira-imperial (*Roystonea oleracea*) with six. This species had its first individual planted in Brazil by the Prince Regent Dom João VI in 1809, hence the origin of the popular name of palmeira-imperial (imperial palm), being also an icon of the Rio de Janeiro Botanical Garden (NEPOMUCENO, 2008).

At Praça Nossa Senhora Aparecida (Public Square 3), low wealth was registered in relation to other squares, probably due to its reduced dimensions. In this square, 10 species of trees were recorded, totaling 29 individuals (TABLE 1; TABLE 2). The most abundant species is the sibipiruna (*C. pluviosum* var. *peltophoroides*) with 14 individuals. A research carried out in the Cerrado Goiano by Ferreira and Herrman (2016) showed that this species has a huge influence on the surrounding microclimate, as it is a pioneer tree, having a high-density crown, among other characteristics that provide great shading. These characteristics together mitigate environmental variables, providing greater thermal comfort.

At Praça Ana Simão Zenum (Public Square 4), 19 species grouped into 50 individuals were recorded (TABLE 1; TABLE 2). The species with the highest density was ipê-amarelo (*H. chrysotrichus*) (12 individuals). *H. chrysotrichus* is a native plant in Brazil and is related to the logging trade for the production of high-quality furniture and even sports items, and can be found in other parts of the country in different states (ANDRADE, 2015). The other ipê-amarelo (*H. serratifolius*) was the only species present in the four studied urban green areas.

Out of the 73 sampled species, 31 (42 %) are exotic while 42 (58 %) are native. Out of the 313 sampled individuals, 119 (38 %) are from exotic species and the other 194 (62 %) individuals belong to native species (FIGURE 2). The most abundant exotic species (14 individuals each) are the palmeira-areca (*D. lutescens*) and the pau-incenso (*P. undulatum*) while the most abundant native species were the coco-babão (*Syagrus romanzoffiana*) (16 individuals), ipê-amarelo (*H. chrysotrichus*) (33) and sibipiruna (*C. pluviosum* var. *peltophoroides*) (19) (TABLE 1).

In a study carried out by Dantas and Souza (2004) conducted in Campina Grande/PB, more exotic species (51.2 %) were recorded than native (48.8 %) and fewer individuals of native species (32.8 %) than exotic (67.2 %). In the study carried out by Albertin *et al.* (2011) in Nova Esperança/PR, the authors recorded 75 different species in road afforestation and stated

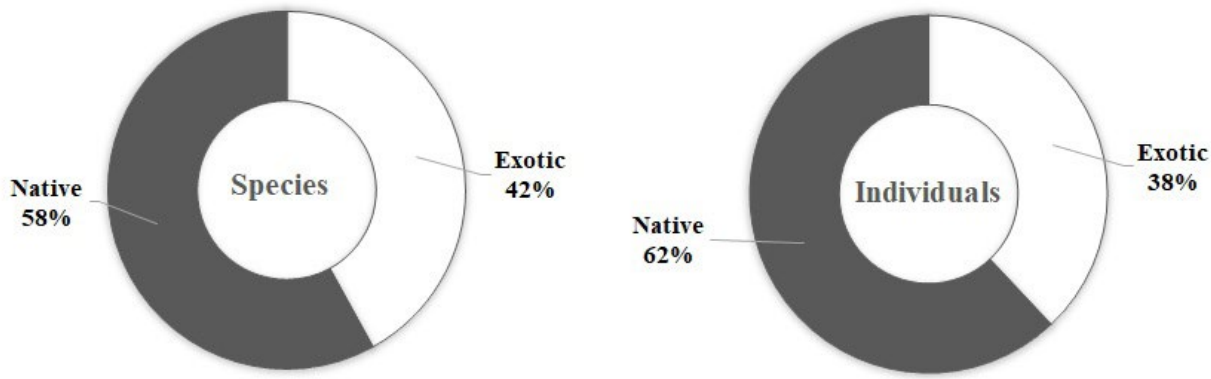
that, when compared to other cities of the same size, the city of Nova Esperança has considerable species richness in its urban green areas. Biondi and Lima Neto (2011) reported that in urban afforestation of most Brazilian cities it was found that exotic species generally represent 70 % of the species used contrary to what is recommended which is preferential planting of native species.

The use of exotic species should be avoided since the biological invasion is considered the second biggest cause of biodiversity loss on the planet making it difficult to recover natural ecosystems, changing ecological cycles, and promoting the local extinction of native species, causing damage to the natural environment, to the economy and to health (RAI; SINGH, 2020). Therefore, native species should be used instead of exotic ones as they adapt very well to local climatic and physical factors bringing benefits to local ecosystems (MATOS; QUEIROZ, 2009). Additionally, Paiva *et al.* (2010) highlighted that the use of native species is recommended to ensure the maintenance of co-evolutionary and genetic ecological relationships between plants and animals. The dispersion of diasporas (pollen, fruits, and seeds) in the urban space, as well as for the conservation of autochthonous genetic material.

As for development, 226 (72 %) individuals are trees, 53 (17 %) are palm trees and 34 (11 %) are shrubs. In the work carried out by Cabreira and Canto-Dorow (2016), at the Federal University of Santa Maria (UFSM) *Campus*, a dominance of tree species (64.1 %) was reported, with shrubs representing 35.9 %. In urban green areas, such as public squares, it is recommended that there is a diversity of plants. However, in beds less than 1.50 m wide, palm trees or even shrubs should be used because of their deep roots and smaller volume. They will rarely cause problems to the physical structures of these spaces, such as sidewalks for example (PIVETTA, 2002).

The species pau-brasil (*P. echinata*) and sassafrás (*Ocotea odorifera*) were recorded with only one individual at Praça Delfim Moreira. Both species are threatened with extinction according to the Official List of Species of the Brazilian Flora Endangered with Extinction (MMA, 2008). Therefore, they must receive care in the maintenance of these individuals, especially when pruning. In addition to recommending the planting of more of these individuals. Species aim at population increase and consequently at the increase in the genetic diversity of the species. Another plant with only one representative was the aroeira-branca (*Lithraea molleoides*), which

Figure 2. Percentage of native and exotic species and individuals of the sampled plants in the Urban Green Areas of the municipality of Campestre, Minas Gerais



Source: Prepared by the authors (2021).

is normally used for landscaping in urban centers and gardens, but its use in urban afforestation requires care as it has substances that can cause severe allergic reactions (LORENZI, 2002a).

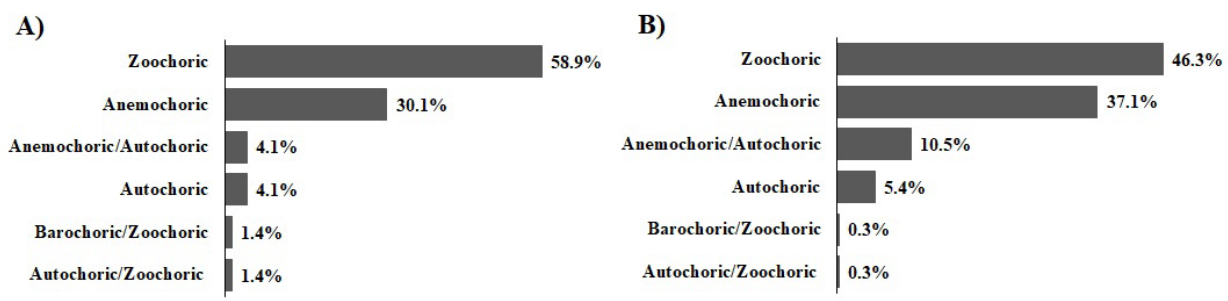
Considering the dispersion syndrome, 43 (58.9 %) species are zoochoric, 22 (30.1 %) are anemochoric, three (4.1 %) are anemochoric/autochoric, three are autochoric, one (1.4 %) is autochoric/zoochoric and one is barochoric/zoochoric (FIGURE 3A). As for the individuals, 145 (46.3 %) are zoochoric species, 116 (37.1 %) are anemochoric, 33 (10.5 %) are anemochoric/autochoric, 17 (5.4 %) are autochoric, one (0.3 %) is autochoric/zoochoric and one, bacic/zoochoric (FIGURE 3B).

When observing the dispersion syndrome distribution among the sampled individuals, each of the studied places had one or two types of predominant dispersion. Praça Delfim Moreira (FIGURE 4A) had a predominance of individuals of zoochoric (44 %) and anemochoric (41 %) species. At Praça Brasil (FIGURE 4B), there was a predominance of zoochoric (67 %) and anemochoric (31 %) dispersion among individuals. Praça Nossa Senhora Aparecida (FIGURE 4C) has a predominance of anemochoric/autochoric dispersion (52 %). At Praça Ana Simão Zenun (FIGURE 4D), it was verified the dominance of zoochory and anemochory (50 % and 38 %, respectively) among its individuals.

Deminicis *et al.* (2009) stated that the dispersal of plants is an important fact in their reproductive cycle and that this dispersal minimizes predation close to adult individuals, thus increasing the chances of new germination and also the colonization of new habitats. According to the authors Oliveira and Moreira (1992), anemochory is usually observed in open regions, and in closed vegetation, zoochory predominates.

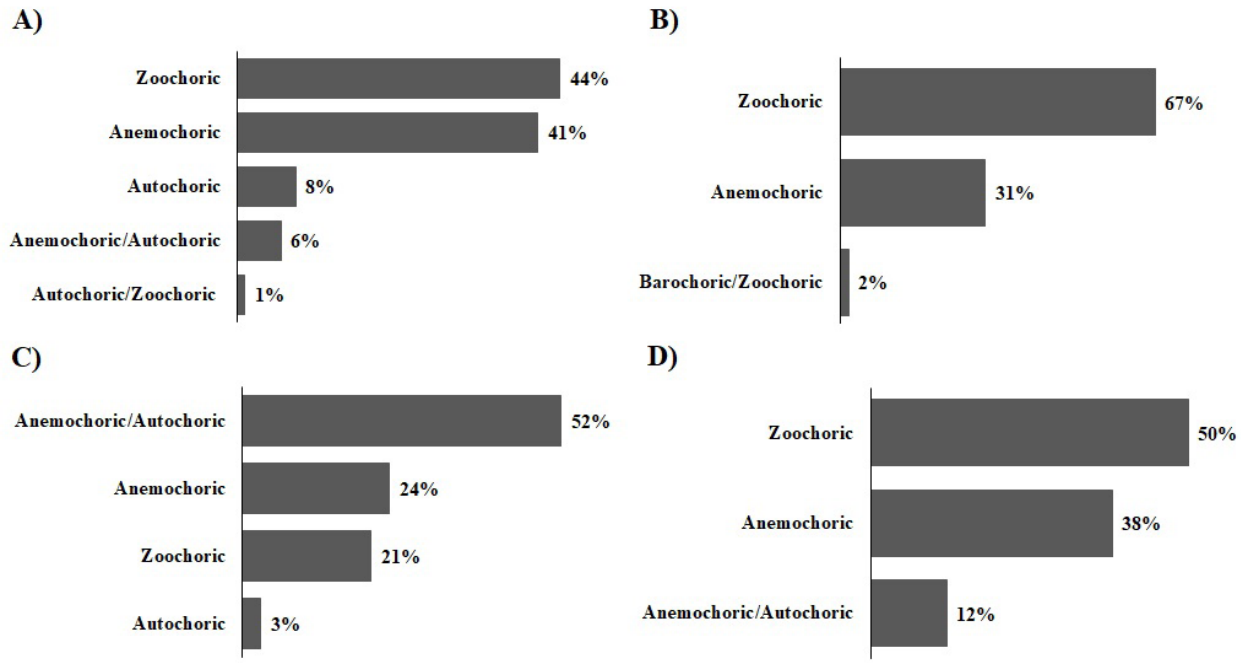
In this study, zoochoric dispersion is recurrent due to the existence of fruit trees, such as manga (*M. indica*), amendoeira (*Terminalia catappa*), laranja-doce (*Citrus sinensis*), goiaba (*Psidium guajava*), nêspera (*Eriobotrya japonica*), the pitanga (*Eugenia uniflora*) and the coco-babão (*S. romanzoffiana*) at these public squares. They represent an important food and shelter resource for urban birds that act as an important disperser of fruits and seeds (BIAGOLINI; LOURENÇO, 2018). Oliveira (2013) reported the importance of animals in the dispersion of fruits and seeds in tropical forests where zoochory is predominant, occurring between 50 % and 75 % of species. Freitas *et al.* (2015) reported important environmental services arising from the mutualistic relationships existing between plants and animals, such as the consumption and dispersal of fruits and seeds that carry out pollination.

Figure 3. Percentage of species (A) and individuals (B) distributed among the types of plant dispersion sampled in urban green areas in the municipality of Campestre, Minas Gerais



Source: Prepared by the authors (2021).

Figure 4. Percentage of individuals by type of dispersion of trees, palm trees and shrubs sampled at Praça Delfim Moreira (A), Praça Brasil (B), Praça Nossa Senhora Aparecida (C) and Praça Ana Simão Zenun (D) in the municipality of Campestre, Minas Gerais



Source: Prepared by the authors (2021).

Although the use of fruit species in urban afforestation is a controversial issue (MATOS; QUEIROZ, 2009), the possibility of offering edible fruits to the local population becomes an element capable of awakening a bond of belonging and care for people with the plants as long as minimal care planning is done. For example, avoiding the use of plants that produce medium and large fruits and that may cause injuries due to falling fruit such as manga (*M. indica*). Distancing these plants from the sidewalks where there is a greater circulation of people as well as fruits with pigments capable of causing stains on clothes and vehicles such as jamelão (*Syzygium cumini*) is advised (PAIVA *et al*., 2010).

Final considerations

High diversity was observed when considering all public squares. Diversity increases with the increase in the public square area.

Native species have greater richness and number of individuals compared to exotic ones.

Zoochory and anemochory were the predominant dispersion syndromes.

It is recommended that other trees of endangered species be introduced in other urban green areas of the municipality and that new individuals of different native species are planted at the public squares Brasil, Ana Simão Zenum, and Nossa Senhora Aparecida to increase the diversity of species.

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