Allergenic Potential of Urban Green Spaces in the City of Corrientes (Argentina)

Potencial alergénico de espacios verdes urbanos en la ciudad de Corrientes (Argentina)

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ABSTRACT

Urban green spaces provide ecosystem services, including well-being, recreation, improved air quality, and thermal regulation. However, certain species can cause adverse effects, such as pollinosis. This study evaluated the allergenic potential of urban green spaces in Corrientes, Argentina, considering species composition and specific botanical parameters. Fifteen censes were carried out in seven green spaces. For each taxon, habit, geographical status, pollen dispersal type, and whether it is a source of allergenic pollen were determined. Shannon diversity and evenness indices, Berger-Parker dominance, and Potential Allergenic Value (PAV) were calculated. A total of 2,251 individuals representing 40 families, 82 genera, and 77 species were recorded. Tree habit (85%), exotic status (66%), and non-allergenic taxa (60.2%) predominated. The indices indicated moderate diversity, with some species more represented than others, and low species dominance. According to the PAV, individuals with high allergenicity occurred in five green spaces, although individuals with null or unknown allergenic potential predominated. The information generated is intended to reevaluate urban flora and guide species selection by adding a criterion to tree planning to minimize the effects of pollinosis on the sensitive population.

Keywords
allergenicity • evenness and dominance • floristic survey • index of diversity • pollinosis • urban flora

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Resumen

Los espacios verdes urbanos ofrecen servicios ecosistémicos, como bienestar, recreación, calidad del aire y regulación térmica. Aunque algunas especies pueden generar efectos adversos, como la polinosis. El objetivo fue evaluar el potencial de alergenicidad de espacios verdes urbanos de Corrientes-Argentina, considerando: composición de especies y parámetros botánicos específicos. Se realizaron 15 censos en siete espacios verdes. Para cada taxón se determinó porte, status geográfico, tipo de dispersión de polen y si es fuente emisora de polen alergénico. Se calcularon índices de diversidad y equitatividad de Shannon, dominancia de Berger-Parker y Valor Potencial Alergénico (VPA). Se registraron 2.251 individuos representando 40 familias, 82 géneros y 77 especies. Predominó el porte arbóreo (85%), el origen exótico (66%) y taxones no alergénicos (60,2%). Los índices indicaron una moderada diversidad, que algunas especies están mejor representadas que otras, y una baja dominancia de especies. Según el VPA, en cinco espacios verdes se encontraron individuos con alta alergenicidad, aunque predominaron individuos con potencial alergénico nulo o desconocido. Con la información generada se pretende revalorizar la flora urbana y orientar la selección de especies, al sumar un criterio en la planificación del arbolado, para minimizar los efectos de la polinosis sobre la población sensible.

Palabras clave

alergenicidad • equitatividad y dominancia • flora urbana • índice de diversidad • polinosis • relevamiento florístico

Introduction

The value of urban green spaces has increased in recent decades because they are considered part of the historical, social, and cultural heritage of a city (Cariñanos *et al.*, 2014; Ortiz & Luna, 2019). These areas also provide multiple ecosystem services, including conserving nature, offering habitat and food for wildlife, increasing biodiversity, while simultaneously benefiting the public by improving well-being, providing recreational spaces, enhancing air quality, and mitigating noise and ambient temperatures (Dobbs *et al.*, 2011; Escobedo *et al.*, 2011; Lafortezza *et al.*, 2009; Maruani & Amit-Cohen, 2007; Sabariego *et al.*, 2021). Urban vegetation can improve the microclimate and mitigate the heat island effect by reducing air temperatures in summer and creating more comfortable environments (Dimoudi & Nikolopoulou, 2003; Lafortezza *et al.*, 2009; Martinez & Coelho-Duarte, 2023). Accordingly, the World Health Organization recommends between 10 and 15 $m^2$of green space per inhabitant in large cities to maintain healthy living conditions (Gaido *et al.*, 2017), ideally with one tree for every three inhabitants to improve air quality (Peñalosa-Londoño *et al.*, 2017).

However, urban green spaces may cause seasonal allergies, affecting sensitive population (Cariñanos *et al.*, 2014; Thompson & Thompson, 2003). Major allergens originate from pollen released by grasses and trees, as well as fungal hyphae, spores, and house dust mites (D´Amato *et al.*, 2007; Esch *et al.*, 2001; Green *et al.*, 2003; Vara *et al.*, 2016). This represents a global health concern, as allergies and respiratory problems are gradually increasing. Pollen allergy affects up to 40% of the population in industrialized countries (D' Amato *et al.*, 2007), and nearly 30% of asymptomatic individuals are sensitized to one or more fungal allergens (Esch *et al.*, 2001). Given this prevalence, identifying the flora that emits pollen and their flowering dynamics is crucial (Abud Sierra & Latorre, 2020; Latorre, 1999; Olabuenaga *et al.*, 2007).

Owing to the impact of flora on public health, its allergenic potential should be considered. Studies in several European cities have produced the first estimates of the potential allergenicity of urban green spaces (Aerts *et al.*, 2021; Camacho *et al.*, 2024; Cariñanos *et al.*, 2014; 2016; García *et al.*, 2022; Lara *et al.*, 2017; Munuera-Gázquez *et al.*, 2017; Sabariego *et al.*, 2021). These assessments consider biological traits of plant species, including pollination strategy, pollination period, and pollen allergenicity. However, studies

in South America remain limited. To date, the Potential Allergenic Value of urban trees has been estimated only in Bogotá (Colombia), Rancagua, and Santiago (Chile) (Escobedo *et al.*, 2023; Flores, 2022; García & Reyes, 2018).

In Argentina, studies on urban vegetation and its relationship with allergies have been conducted in cities with permanent aerobiological sampling, such as San Carlos de Bariloche (Olabuenaga *et al.*, 2007), Mar del Plata (Abud Sierra & Latorre, 2020), La Plata (Nitiu & Mallo, 2002), and Bahía Blanca (Murray *et al.*, 2010). Records of urban allergenic flora are also available for Diamante (Latorre & Sánchez, 2011) and Concepción del Uruguay (Marcó & Pirovani, 2009). Nonetheless, information from northeastern Argentina remains scarce. Preliminary pollen calendars exist for Posadas, Misiones (Paul *et al.*, 1998; 2000) and Corrientes (Cuadrado, 1978; 1979), but none assessed the surrounding urban vegetation.

This study evaluates the allergenic potential of urban green spaces in the city of Corrientes based on plant species composition and species-specific biological parameters.

Materials and Methods

Study Area

The study was conducted in Corrientes, Argentina (27°29'0" S, 58°49'0" W). The city has a subtropical climate without a dry season and a mean annual temperature of 21°C, with maximum temperatures exceeding 40°C. Annual rainfall ranges from 850 to 2000 mm, with an average of 1400 mm (Contreras *et al.*, 2020). Seven downtown green spaces with high socio-cultural activity were selected: Mitre and Camba Cuá Parks, and 25 de Mayo, Torrent, Sargento Cabral, La Cruz, and Libertad Squares (figure 1).

Source/Fuente: IGN, Google Earth.

The reference maps (left) indicate the Corrientes Province and the homonymous Department, respectively. The satellite image (right) corresponds to the downtown area of Corrientes city and the number of green spaces surveyed. 1: Camba Cuá Park. 2: La Cruz Square. 3: Torrent Square. 4: Sargento Cabral Square. 5: Libertad Square. 6: 25 de Mayo Square. 7. Mitre Park.

Los mapas de referencia (izquierda), indican la provincia de Corrientes y el Departamento homónimo, respectivamente. La imagen satelital (derecha) corresponde al microcentro de la ciudad de Corrientes y los números, los espacios verdes censados. 1: Parque Camba Cuá. 2: Plaza La Cruz. 3: Plaza Torrent. 4: Plaza Sargento Cabral. 5: Plaza Libertad. 6: Plaza 25 de Mayo. 7: Parque Mitre.

Figure 1. Geographical location of the urban green spaces surveyed in the city of Corrientes, Argentina.

Figura 1. Ubicación geográfica de los espacios verdes urbanos censados en la ciudad de Corrientes, Argentina.

Floristic Survey and Botanical Parameters

Tree and shrub species were surveyed through 15 censuses conducted between 2023 and 2024. Individuals were identified by direct observation; when this was not possible, specimens were collected and prepared as herbarium vouchers for later identification and deposited in the CTES Herbarium (IBONE, UNNE/CONICET). Taxa were identified using specialized literature (*e.g.*, Bonjour & Martínez-Carretero, 2020; Lozano & Zapater, 2008; Parodi & Dimitri, 1972). Nomenclature was updated using the databases Flora Argentina (IBODA, 2018) and Catálogo de Plantas Vasculares del Conosur (IBODA, 2024) for native species, and Tropicos (MOBOT, 2024) for exotic species. For each taxon, we recorded growth habit (tree or shrub), origin (native or exotic), pollen dispersal type (anemophilous, entomophilous, or ambophilous), and whether the species produces allergenic pollen. Information on pollen allergenicity was obtained from the databases AllergoMe (2024) and The Pollen Library (2024), as well as specialized literature (*e.g.*, Cariñanos *et al.*, 2014; 2016; Cariñanos & Marinangeli, 2021; Hussain *et al.*, 2013; Mandal *et al.*, 2008; Munuera-Gázquez *et al.*, 2017; Paul *et al.*, 2000; Rodríguez & Leal, 2000; Rojo *et al.*, 2017).

Estimation of Diversity, Evenness, and Species Dominance

To evaluate urban tree and subshrub parameters, we calculated the Shannon Diversity Index (H'), Shannon Evenness (E), and Berger-Parker Dominance Index (d).

Shannon Diversity Index (H') was calculated as:

$$H' = \sum[p_i \ln(p_i)]$$

where:
$p_i = n_i/N$
n_i = the number of individuals of species *i*
N = the total number of individuals

H' typically ranges from 1.5 to 3.4, occasionally exceeding 4.5 (Ortiz & Luna, 2019). Higher values indicate greater diversity in the community (Magurran, 1988).

Shannon Evenness Index (E) was calculated as $E = H'/H_{max}$, where $H_{max} = \ln N$, which represents that all species are equally abundant, with N being the total number of individuals (Magurran, 1988). Values range from 0 to 1, with 1 indicating equal abundance of all species.

Berger-Parker Dominance Index (d) was calculated as $d = N_{max}/N$, where N_{max} is the number of individuals of the most abundant species. Values range from 0 to 1, with the highest value indicating dominance by a single species (Magurran, 1988).

Potential Allergenic Values (PAV)

The PAV estimates the allergenic potential of plant species (Cariñanos *et al.*, 2014). It combines three intrinsic parameters:

$$PAV = api \times pei \times pppi$$

where:
api= allergenic potential of the pollen grain
pei = type of pollen emission
pppi = principal pollination period

Parameter values are standardized to facilitate calculation (Cariñanos *et al.*, 2014; 2016; Cariñanos & Marinangeli, 2021). PAV ranges from 0 to 36, classifying species as: None= 0, Low= 1-6, Moderate= 8-12, High= 16-24, or Very High= 27-36. The principal pollination period (pppi) was assigned using Escobedo *et al.* (2023), who observed that high humidity accelerates pollen deposition. Given the humid subtropical climate of the study area (Köppen-Geiger classification; Kottek *et al.*, 2006), a flowering period of less than 6 weeks was assumed for all taxa.

Results

Floristic Survey and Description of Botanical Parameters

A total of 2,251 individuals were recorded, representing 40 botanical families. The most diverse families were Arecaceae (12 spp.), Fabaceae (12 spp.), Moraceae (6 spp.), Myrtaceae (6 spp.), Apocynaceae (5 spp.), and Bignoniaceae (5 spp.). Overall, 82 genera and 77 species were identified, the most abundant being *Handroanthus heptaphyllus* (22.44%), *Tipuana tipu* (9.51%), and *Peltophorum dubium* (8.26%) (figure 2A, page 6; table 1, page 7). Eight individuals remained unidentified due to the absence of reproductive structures or other key features during the surveys.

In terms of habit, 85% of taxa were trees and 15% shrubs (figure 2B, page 6). Also, 34% of species were native to Argentina, and 66% were exotic (figure 2C, page 6). Pollen dispersal types were predominantly entomophilous (85%), followed by anemophilous (8%), and ambophilous (7%) taxa (figure 2D, page 6).

Of the seven urban green spaces, 39.8% of taxa were recorded as producing allergenic pollen, while 60.2% were not (table 2, page 7). More than 50% of species in Libertad and Sargento Cabral Squares, and Camba Cuá Park were allergenic. Torrent Square had an equal proportion of allergenic and non-allergenic species, whereas Mitre Park, La Cruz, and 25 de Mayo Squares contained less than 50% allergenic species.

By combining geographic origin and allergenic status, 30 of the 37 allergenic taxa (81%) were exotic, while 35 of the 61 non-allergenic taxa (57.4%) were exotic (figure 3, page 8).

Estimation of Diversity, Evenness, and Species Dominance

Shannon Diversity (H'), Shannon Evenness (E), and Berger-Parker Specific Dominance (d) values for each urban green space, along with their averages, are presented in table 3 (page 8).

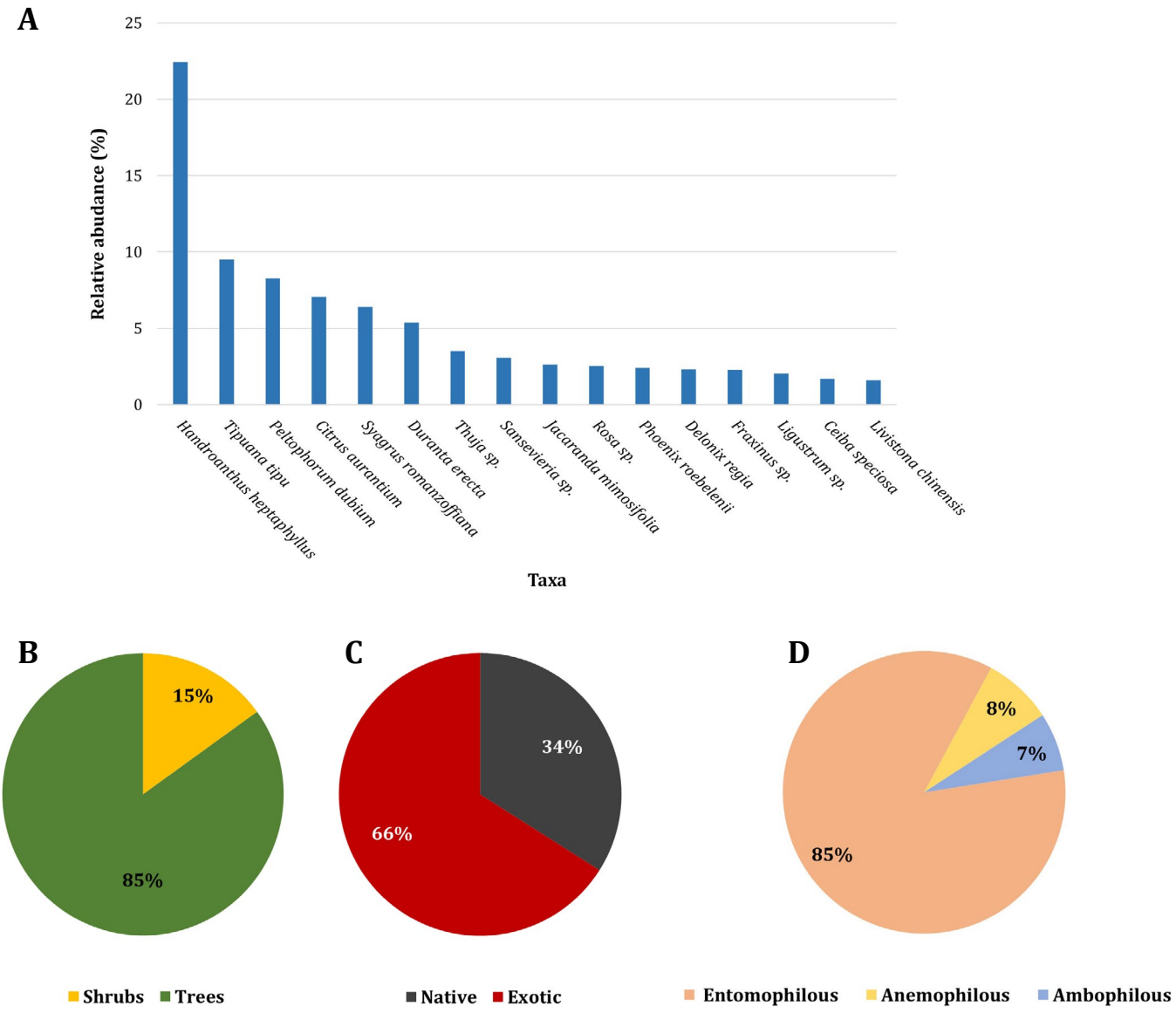
Shannon Diversity (H') ranged from 2.95 in Mitre Park to 2.12 in La Cruz Square. Shannon Evenness (E) was highest in Torrent Square (0.51) and lowest in 25 de Mayo Square (0.39). Berger-Parker Dominance (d) was highest in Torrent and La Cruz Squares (0.37), with *H. heptaphyllus* and *Citrus aurantium* as the most abundant species, respectively. The lowest d value was found in Libertad Square (0.20), where *H. heptaphyllus* was also the dominant species.

Potential Allergenic Values (PAV)

Five of the seven urban green spaces contained taxa with high allergenic potential. Mitre Park had the highest number of allergenic taxa comprising 236 individuals with low, 49 with moderate, and 90 with high allergenic potential (figure 4, page 9). Across all green spaces, roughly 50% of individuals had null or unknown allergenic potential. Individuals with low allergenic potential predominated, but they can still cause allergy symptoms in sensitive populations.

Thuja sp. and *Fraxinus* sp. were both high-PAV taxa occurring in notable numbers in some green spaces. In Mitre Park, *Thuja* sp. accounted for 8.30% and *Fraxinus* sp. for 2.23% of individuals. In Camba Cuá Park, *Fraxinus* sp. was the most frequent taxon with high PAV (6.47%), followed by *Thuja* sp. (0.58%). In Torrent and Libertad Squares, only *Fraxinus* sp. was recorded, with relative abundances of 3.73% and 1.47%, respectively. *Thuja* sp. had the highest PAV in La Cruz Square (1.29%). No high-PAV individuals were recorded in Sargento Cabral and 25 de Mayo Squares (table 4, page 9-10).

Considering all three PAV categories, the most frequent taxa were *Fraxinus* sp. (high PAV); *Livistona chinensis* and *Phoenix roebelenii* (medium PAV); and *Delonix regia*, *Syagrus romanzoffiana*, *Ceiba speciosa*, *Jacaranda mimosifolia*, and *Tipuana tipu* (low PAV) (figure 5, page 11).



A: Genera and species with relative abundance greater than 1%. **B:** Percentage of arboreal and shrubby taxa. **C:** Percentage of taxa according to geographic status. **D:** Percentage of taxa according to type of pollen dispersal.

A: Géneros y especies con abundancia relativa mayor al 1%. **B:** Porcentaje de taxones arbóreos y arbustivos. **C:** Porcentaje de taxones según status geográfico. **D:** Porcentaje de taxones según tipo de dispersión polínica.

Figure 2. Taxa surveyed in the urban green spaces of the city of Corrientes and botanical parameters.

Figura 2. Taxones relevados en los espacios verdes urbanos de la ciudad de Corrientes y parámetros botánicos.

Table 1. Taxa with relative abundance greater than 1% present in the surveyed green spaces.

Tabla 1. Taxones con abundancia relativa mayor al 1% presentes en los espacios verdes relevados.

Family	Taxa	Relative abundance (%)	1	2	3	4	5	6	7
Bignoniaceae	*Handroanthus heptaphyllus* (Vell.) Mattos	22.44	X	X	X	X	X	X	X
Fabaceae	*Tipuana tipu* (Benth.) Kuntze	9.51	X	X		X	X	X	X
	Peltophorum dubium (Spreng.) Taub.	8.26	X	X	X	X	X	X	X
Rutaceae	*Citrus aurantium* L.	7.06	X	X	X		X	X	
Arecaceae	*Syagrus romanzoffiana* (Cham.) Glassman	6.4	X	X	X	X	X	X	X
Verbenaceae	*Duranta erecta* L.	5.38	X	X		X		X	
Cupressaceae	*Thuja* sp.	3.51	X	X			X		
Asparagaceae	*Sansevieria* sp.	3.07	X			X		X	
Bignoniaceae	*Jacaranda mimosifolia* D. Don	2.62	X	X	X		X	X	X
Rosaceae	*Rosa* sp.	2.53		X		X			
Arecaceae	*Phoenix roebelenii* O´ Brien	2.4	X	X	X	X		X	X
Fabaceae	*Delonix regia* (Bojer ex Hook.) Raf.	2.31	X	X	X		X	X	X
Oleaceae	*Fraxinus* sp.	2.27	X	X	X			X	
	Ligustrum sp.	2.04	X	X		X			
Malvaceae	*Ceiba speciosa* (A.St.-Hil.) Ravenna	1.69	X	X	X	X	X	X	X
Arecaceae	*Livistona chinensis* (Jacq.) R. Br. ex Mart.	1.60	X	X	X	X	X	X	X

The presence of the taxon is indicated with an X. Urban green spaces are identified by numbers: 1: Mitre Park. 2: Camba Cuá Park. 3: Libertad Square. 4: 25 de Mayo Square. 5: La Cruz Square. 6: Torrent Square. 7: Sargento Cabral Square.

Se indica con X la presencia del taxón. Los espacios verdes urbanos se identifican con números: 1: Parque Mitre. 2: Parque Camba Cuá. 3: Plaza Libertad. 4: Plaza 25 de Mayo. 5: Plaza La Cruz. 6: Plaza Torrent. 7: Plaza Sargento Cabral.

Table 2. Percentage of allergenic and non-allergenic taxa present in the urban green spaces surveyed.

Tabla 2. Porcentaje de taxones alergénicos y no alergénicos presentes en los espacios verdes urbanos relevados.

	Libertad Square	Cabral Square	Camba Cuá Park	Torrent Square	La Cruz Square	Mitre Park	25 de Mayo Square	All Urban Green Spaces
Allergenic taxa (%)	56.5	53.3	52.2	50	45.5	38.5	31.8	39.8
Non-allergenic taxa (%)	43.5	46.7	47.8	50	54.5	61.5	68.2	60.2

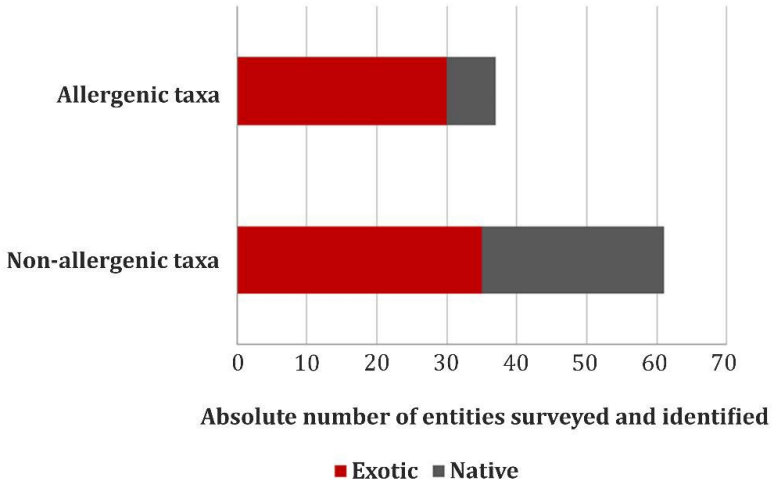


Figure 3. Relationship between the status and the number of allergenic taxa of the urban green spaces surveyed.
Figura 3. Relación entre el *status* y el número de taxones alergénicos de los espacios verdes urbanos relevados.

Table 3. Values of Indexes of Shannon Diversity, Shannon Evenness, and Berger-Parker's Specific Dominance estimated in urban green spaces surveyed.
Tabla 3. Valores de los índices de diversidad de Shannon, equitatividad de Shannon y dominancia específica de Berger-Parker estimados para los espacios verdes urbanos censados.

Indexes	Mitre Park	Camba Cuá Park	Torrent Square	Libertad Square	25 de Mayo Square	Cabral Square	La Cruz Square
Shannon Diversity Index (H')	2.95	2.85	2.58	2.45	2.21	2.19	2.12
Shannon Evenness Index (E)	0.43	0.48	0.51	0.43	0.39	0.49	0.40
Berger-Parker Dominance Index (d)	0.24 (*H. heptaphyllus*)	0.25 (*H. heptaphyllus*)	0.37 (*H. heptaphyllus*)	0.20 (*H. heptaphyllus*)	0.23 (*Tipuana tipu*)	0.26 (*H. heptaphyllus*)	0.37 (*Citrus aurantium*)

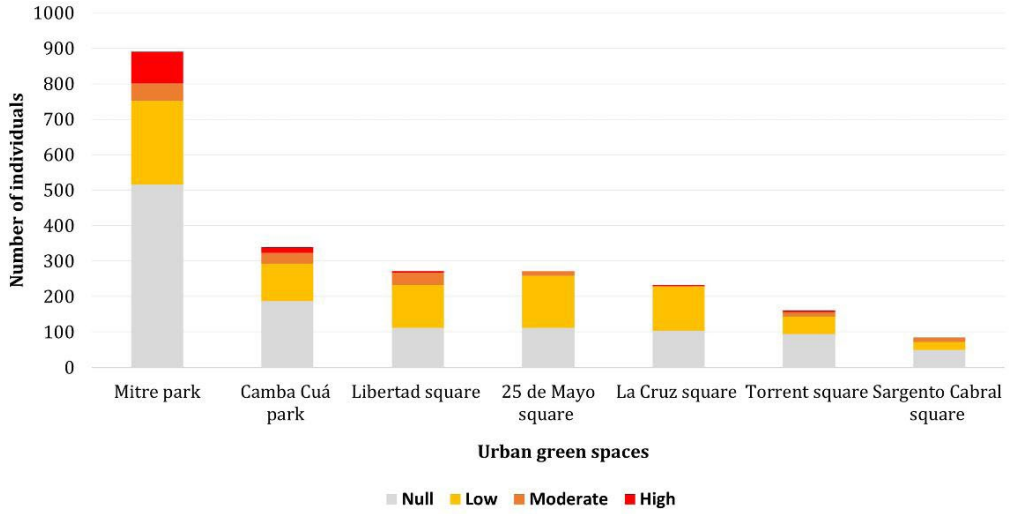


Figure 4. Relationship of total individuals according to PAV category by urban green space surveyed.

Figura 4. Relación de individuos totales según categoría de VPA por espacio verde urbano censado.

Table 4. Allergenic taxa ordered according to PAV category: High (red), Moderate (orange), and Low (yellow).

Tabla 4. Taxones registrados como alergénicos ordenados según la categoría de VPA: Alto (rojo), Moderado (naranja) y Bajo (amarillo).

	Parameters of PAV				Urban green spaces						
	api	pei	pppi	PAV	1	2	3	4	5	6	7
Fraxinus sp.*	3	3	2	18	■	■	■			■	
Liquidambar styraciflua L.*	3	3	2	18	■						
Morus sp.*	3	3	2	18	■	■					
Thuja sp.*	3	3	2	18	■	■			■		
Araucaria bidwillii Hook.*	2	3	2	12		■					
Araucaria heterophylla (Salisb.) Franco*	2	3	2	12		■					
Cecropia pachystachya Trécul	2	3	2	12	■	■				■	
Ligustrum lucidum W.T. Aiton*	3	2	2	12	■	■		■			
Livistona chinensis (Jacq.) R. Br. ex Mart.*	3	2	2	12	■	■	■	■	■	■	■
Phoenix canariensis Wildpret*	3	2	2	12	■		■			■	■

Gray boxes indicate the presence of the taxon in urban green spaces. Exotic taxa are indicated with an asterisk (*). Urban green spaces are numbered: 1: Mitre Park. 2: Camba Cuá Park. 3: Libertad Square. 4: 25 de Mayo Square. 5: La Cruz Square. 6: Torrent Square. 7: Sargento Cabral Square.

Los casilleros en gris indican la presencia del taxón en el espacio verde urbano. Con * (asterisco) se indican los taxones exóticos. Los espacios verdes urbanos se identifican con números: 1: Parque Mitre. 2: Parque Camba Cuá. 3: Plaza Libertad. 4: Plaza 25 de Mayo. 5: Plaza La Cruz. 6: Plaza Torrent. 7: Plaza Sargento Cabral.

Phoenix roebelenii O'Brien*	3	2	2	12							
Phytolacca dioica L.	2	3	2	12							
Pinus sp.*	2	3	2	12							
Bougainvillea glabra Choisy*	1	3	2	6							
Cycas circinalis L.*	2	3	2	6							
Cycas revoluta Thunb.*	2	3	2	6							
Delonix regia (Bojer ex Hook.) Raf.*	3	1	2	6							
Syagrus romanzoffiana (Cham.) Glassman	3	1	2	6							
Washingtonia filifera (Gloner ex Kerch., Burv., Pynaert, Rodigas & Hull) de Bary*	1	3	2	6							
Washingtonia robusta H. Wendl.*	1	3	2	6							
Brachychiton populneus (Schott & Endl.) R. Br.*	2	1	2	4							
Cassia fistula L.*	2	1	2	4							
Ceiba speciosa (A. St.-Hil., A. Juss. & Cambess.) Ravenna	2	1	2	4							
Eucalyptus sp. *	2	1	2	4							
Grevillea robusta A. Cunn. ex R. Br.*	2	1	2	4							
Hibiscus rosa-sinensis L.*	2	1	2	4							
Jacaranda mimosifolia D. Don.	2	1	2	4							
Jasminum mesnyi Hance*	2	1	2	4							
Fargesia sp. *	1	3	1	3							
Citrus aurantium L.*	1	1	2	2							
Lagerstroemia indica L.*	1	1	2	2							
Mangifera indica L.*	1	1	2	2							
Melia azedarach L.*	1	1	2	2							
Rosa sp. *	1	1	2	2							
Roystonea sp. *	1	1	2	2							
Tipuana tipu (Benth.) Kuntze	1	1	2	2							
Pittosporum tobira (Thunb.) W.T. Aiton*	1	1	2	2							

Gray boxes indicate the presence of the taxon in urban green spaces. Exotic taxa are indicated with an asterisk (*). Urban green spaces are numbered: 1: Mitre Park. 2: Camba Cuá Park. 3: Libertad Square. 4: 25 de Mayo Square. 5: La Cruz Square. 6: Torrent Square. 7: Sargento Cabral Square.

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A-B: *Fraxinus* sp. **C-D:** *Livistona chinensis*. **E-F:** *Phoenix roebelenii*. **G-H:** *Delonix regia*. **I-J:** *Syagrus romanzoffiana*. **K-L:** *Ceiba speciosa*. **M-N:** *Jacaranda mimosifolia*. **O-P:** *Tipuana tipu*. **A**, **C**, **E**, **G**, **I**, **K**, **M**, **O:** General view, habit. **B**, **D**, **F**, **H**, **J**, **L**, **N**, **P:** Detail of the inflorescences.

A-B: *Fraxinus* sp. **C-D:** *Livistona chinensis*. **E-F:** *Phoenix roebelenii*. **G-H:** *Delonix regia*. **I-J:** *Syagrus romanzoffiana*. **K-L:** *Ceiba speciosa*. **M-N:** *Jacaranda mimosifolia*. **O-P:** *Tipuana tipu*. **A**, **C**, **E**, **G**, **I**, **K**, **M**, **O:** Aspecto general, porte. **B**, **D**, **F**, **H**, **J**, **L**, **N**, **P:** Detalle de inflorescencias.

Figure 5. Illustrations of most frequent taxa in the green spaces surveyed according to the PAV categories.

Figura 5. Ilustraciones de taxones más frecuentes en espacios verdes censados según categorías de VPA.

Discussion

Species Composition and Ecological Patterns

The floristic survey of tree and shrub species across seven urban green spaces in the microcenter of Corrientes recorded 2,251 individuals, predominantly trees (85%), exotic species (66%), entomophilous species (85.4%), and non-allergenic taxa (60.2%).

The most abundant taxa were *Handroanthus heptaphyllus* (22.44%), *Tipuana tipu* (9.51%), and *Peltophorum dubium* (8.26%), with only *T. tipu* considered allergenic. Similar patterns were reported by Laffont *et al.* (2015), who also identified these species as predominant in Corrientes. In contrast, Luna *et al.* (2023) reported a higher relative abundance of *H. heptaphyllus* (48.51%) in the northern riverside sector.

Studies from other cities in northeastern Argentina also report at least one entomophilous species of Bignoniaceae as dominant. For example, *H. heptaphyllus* was the most abundant species in Resistencia (11.3%; Ortiz & Luna, 2019), whereas *Jacaranda mimosifolia* predominated in Posadas (17.69%; Rodríguez & Dematteis, 1999). In Diamante (Entre Ríos), *Handroanthus impetiginosus* and *Tecoma stans* var. *stans* were also among the most representative taxa (Latorre & Sánchez, 2011).

Increasing species diversity in urban tree assemblages is recommended so that no single species exceeds 15% relative abundance, improving landscape value and reducing pest and disease risks (Ledesma, 2008).

A high diversity of exotic species was recorded in the surveyed urban green areas, consistent with previous studies from the northern Corrientes riverside and other Argentine cities (Luna *et al.*, 2023; Marcó & Pirovani, 2009; Ortiz & Luna, 2019; Rodríguez & Dematteis, 1999; Rodríguez & Leal, 2000; Rodríguez *et al.*, 2015).

Diversity, Dominance, and Spatial Variation

The Shannon Diversity Index across the seven urban green spaces was lower (mean = 2.48) than that reported for squares in the microcenter of Resistencia, Chaco (mean = 3.60; Ortiz & Luna, 2019). However, values for Mitre (2.95) and Camba Cuá (2.85) Parks, and Torrent (2.58) and Libertad (2.45) Squares were higher than those reported for the northern sector of the Corrientes riverside (2.26; Luna *et al.*, 2023), whereas 25 de Mayo (2.21), Sargento Cabral (2.19), and La Cruz (2.12) Squares showed lower values. Overall, these results indicate moderate diversity across the surveyed urban green spaces.

The mean Shannon Evenness Index was 0.45, similar to that reported for the Corrientes riverside (0.32; Luna *et al.*, 2023) but markedly lower than the value reported for urban green spaces in Resistencia (0.77; Ortiz & Luna, 2019). This indicates low species evenness driven by the dominance of a few specific taxa.

Based on the Berger-Parker dominance Index, Libertad Square exhibited the lowest dominance (0.20), with *Handroanthus heptaphyllus* as the most abundant species. Conversely, Torrent and La Cruz Squares showed the highest dominance values (0.37), with *H. heptaphyllus* and *Citrus aurantium* as the respective dominant species. These values are intermediate relative to those reported for the Corrientes riverside (0.48; Luna *et al.*, 2023) and Resistencia (0.19; Ortiz & Luna, 2019), where *H. heptaphyllus* was also the dominant species.

Allergenicity and Implications for Urban Planning

Knowledge of the local allergenic flora is essential for the diagnosis and treatment of pollinosis (Latorre & Sánchez, 2011; Marcó & Pirovani, 2009). In the urban green spaces of Corrientes, 37 taxa with allergenic pollen were recorded, with *Tipuana tipu*, *Citrus aurantium*, and *Syagrus romanzoffiana* among the most representative. This pattern differs from that reported in Concepción del Uruguay (Entre Ríos), where *Fraxinus* sp., *Salix* sp., and *Ligustrum* sp. were the most prevalent allergenic taxa (Marcó & Pirovani, 2009). Similarly, 34 allergenic taxa were identified in Diamante (Entre Ríos), with *Fraxinus americana* L., *F. pennsylvanica* Marshall, and *Platanus acerifolia* (Aiton) Willd as the most abundant (Latorre & Sánchez, 2011).

The Potential Allergenic Value (PAV) serves as a robust metric for estimating allergenic risk in urban green spaces, particularly in cities where aerobiological monitoring is unavailable (Cariñanos *et al.*, 2014). In Corrientes, taxa with high PAV were mainly anemophilous

species, including *Thuja* sp., *Fraxinus* sp., *Morus* sp., and *Liquidambar styraciflua*. Similar patterns have been reported in other studies (Cariñanos *et al.*, 2014; 2016; Cariñanos & Casares-Porcel, 2017; Escobedo *et al.*, 2023; Munuera-Gázquez *et al.*, 2017). For example, in Bogotá, species with high PAV included *Cupressus sempervirens* L., *Thuja* spp., *Alnus acuminata* Kunth, *Schinus molle* L., *Dodonaea viscosa* (L.) Jacq., *Salix humboldtiana* Willd., *Platanus acerifolia*, and *Araucaria excelsa* (Cordero) W.T. Aiton (Escobedo *et al.*, 2023). In Santiago de Chile, the most allergenic species were *Ligustrum lucidum*, *L. sinense* Lour., *Acer negundo* L., *Schinus molle*, and *Fraxinus excelsior* L. (Green *et al.*, 2003). In Argentina, a predominance of exotic anemophilous species such as *Platanus acerifolia* and *Populus* sp. has also been documented in Mujeres Argentinas Park in Buenos Aires (Alcaraz *et al.*, 2023).

To reduce allergenic risk in urban green spaces, previous studies recommend increasing tree diversity and prioritizing species with entomophilous pollination, as well as incorporating dioecious or polygamous-dioecious taxa with pistillate flowers (Alcaraz *et al.*, 2023; Cariñanos *et al.*, 2014). Under this approach, the abundance of allergenic species becomes a key factor, as their impact is determined not only by their presence but also by their relative dominance in the urban tree assemblage (Cariñanos *et al.*, 2014).

Conclusions

This study provides information on the potential allergenicity of urban green spaces in Corrientes and represents the first application of this index in a northeastern province of Argentina. Overall, the seven surveyed green spaces showed low to moderate allergenicity, largely because the most abundant taxa exhibit entomophilous pollination. Among the parks analyzed, Mitre and Camba Cuá showed the highest proportion of taxa with moderate to high allergenicity. The taxa most frequently used as urban trees with allergenic pollen were *Fraxinus* sp. and *Thuja* sp.

Studies are currently underway to analyze the contribution of pollen grains from urban trees to airborne concentrations in Corrientes and to identify the seasonal periods of greatest risk for sensitive individuals. This information will be essential for improving the diagnosis and treatment of pollinosis and for guiding future planting strategies.

Similar research in other cities would generate valuable comparative data and provide a broader framework for species selection based on allergenic risk. Incorporating allergenicity as a criterion in urban forestry planning is therefore essential to minimize the effects of pollinosis in the local environment. Moreover, the use of the Potential Allergenic Value (PAV) as a guiding metric, together with the promotion of entomophilous and dioecious species with pistillate flowers, can significantly reduce allergenic exposure.

Based on the findings of this study, future urban forestry initiatives in Corrientes should prioritize the following strategies:

Broaden species selection by incorporating a greater diversity of native and non-allergenic taxa to enhance ecological compatibility and reduce health risks.

Limit individual species dominance to a maximum of 15% relative abundance, in accordance with best practices for urban biodiversity and pest resilience.

Promote structural and functional diversity in urban tree cover to strengthen ecological resilience and enrich the landscape's aesthetic and cultural value.

Integrate allergenic potential into planting decisions, using tools such as the Potential Allergenic Value (PAV) to guide species selection and foster healthier urban environments.

Finally, a more balanced and health-conscious approach to urban tree management will not only enrich the botanical heritage of the city of Corrientes but also contribute to a safer and more sustainable urban future.

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