

Pollen from tree and shrub taxa in the atmosphere of Caxias do Sul (Rio Grande do Sul, Brazil)

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Abstract An aerobiological study has been carried out in the region of Caxias do Sul in southern Brazil. Pollen monitoring was performed from January 1, 2001 through to December 31, 2002. A total of 30,469 pollen grains were collected during this period, and 40 pollen types were identified; of these, 23,389 pollen grains, representing 29 pollen types, originated from tree and shrub taxa. The maximum pollen concentration was registered in August 2001 and October 2002. In the study area, the pollen type *Mimosa scabrella* (18.8%) was much more abundant than all of the pollen types from tree and shrub taxa, such as: Urticaceae (18.4%), Myrtaceae (10.2%), Cupressaceae (7.7%), *Myrsine* (4.8%), *Sorocea* (3.9%), Pinaceae (2.9%), Asteraceae (2.2%) and *Ricinus* (2.1%). These nine pollen types accounted for the largest pollen concentrations of all the tree and shrub taxa. The pollen types *Carya*, Melastomataceae, *Mimosa scabrella*, *Myrsine* and *Sorocea* are reported for the first time in an aerobiological study in Brazil.

Key words Airborne Pollen · Caxias do Sul · Brazil

Introduction

Aerobiological studies in Latin America are scarce, and the majority of those that have been conducted have not used Hirst-type samplers; for example, the investigations carried out in Brazil by Bernd and Oliveira Lima (1951), Salgado Labouriau (1973), Bernd and Lorscheitter (1992), and Hilgert (1998).

Due to climatic conditions, relief aspects and rainfall, Caxias do Sul has three different types of vegetation: mixed shadow forest, savanna and deciduous forest. The mixed shadow forest, known as *Araucaria* forest, forms the most extensive vegetation in the region of study, and in Caxias do Sul it is limited to savanna areas and to deciduous forest at about 400 and 800 m.a.s.l.; *Araucaria angustifolia* is rarely found at altitudes lower than 400 m.a.s.l. However, the most significant aspect of the flora in urban areas is the deterioration of the natural vegetation, which is an important component of ornamental plants.

Southern Brazil has four well-defined seasons, which is characteristic of the bioclimate Tropical Pluvial (Rivas-Martínez, Sánchez Mata, & Costa, 1999); these seasons favor the development of respiratory allergies. As a result, it is important to know the allergenic pollen types and their pollen

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station to assist doctors in identifying pollinosis symptoms. Epidemiological research estimates that 4.8% of the inhabitants of Caxias do Sul suffer from pollinosis (Vieira & Negreiros, 1989).

The objective of this study was to identify and quantify the several pollen types of tree and shrub taxa and their respective seasonal oscillations in abundance in the atmosphere of Caxias do Sul.

Materials and methods

Study area

Caxias do Sul is located in southern Brazil (29°14'S, 51°10'W) in the State of Rio Grande do Sul which has a mean altitude of 760 m.a.s.l. and covers an area of 1657 km² (Fig. 1), with a population of approximately 396,261 inhabitants.

The meteorological parameters during the study period were: a mean temperature of 17.8°C, a maximum temperature of 33°C, a minimum temperature of -2°C, and a rainfall of 2004.2 mm. The mean relative humidity was 75.3%, and the predominant wind direction was southwest (SW) (Fig. 2).

Methods

The pollen monitoring was performed from January 1, 2001 through to December 31, 2002, using a 7-day recording Burkard and Hirst's volumetric method (Hirst, 1952). The sampler was located on the roof of the University Hospital in Caxias do Sul, about 20 m above ground level; the hospital is in an open space with no buildings nearby that might interrupt the current of air.

Pollen counts were analyzed by four longitudinal scans per slide using a 40× lens, according to the method proposed by the Spanish Aerobiological Network (Domínguez Vilches, Galán Soldevilla, Villamandos de la Torre, & Infante García, 1992). The data were expressed as an average of daily pollen concentration per cubic meter of air.

Pollen identifications were based on a reference collection made with fresh or herbarium material from the region as well on specialized reference books (Hyde & Adams, 1958; Barth & Barbosa, 1972; Barth, 1976; Smith, 1984, 1986; Valdés, Diez, & Fernández, 1987; Moore, Webb, & Collinson, 1991; Pire,

Anzótégui, & Cuadrado, 1998; Barth & Pinto da Cruz, 2000).

Results

During the period of this investigation, 30,469 pollen grains of 40 pollen types were identified in the atmosphere of Caxias do Sul. In 2001, 16,221 pollen grains were collected. Among these were 12,200 pollen grains from tree and shrub taxa; these represented 75.34% of the total. In 2002, 14,248 pollen grains were collected, of which 11,166 grains were from tree and shrub taxa, representing 78.42% of the total pollen grains.

Among the 40 pollen types that were identified, 29 were from tree and shrub taxa. Of these, nine pollen types represented 71.1% of the total: Urticaceae (18.8%), *Mimosa scabrella* (18.6%), Myrtaceae (10.1%), Cupressaceae (7.7%), *Myrsine* (4.8%), *Sorocea* (3.9%), Pinaceae (2.9%), Asteraceae (2.2%) and *Ricinus* (2.1%) (Table 1).

The pollen types *Araucaria*, *Ligustrum*, Melastomataceae, Meliaceae, *Carya*, *Acacia*, *Podocarpus*, *Castanea*, *Platanus*, Verbenaceae, *Justicia*, Rutaceae, Solanaceae, Sapindaceae, Lauraceae, Bignoniaceae, Apocynaceae, Ericaceae, Loranthaceae and *Parapiptadenia* represented 5.6% of the total pollen recorded during the study period.

The incidence of pollen grains from tree and shrub taxa remained stable between January and June of both years of the study period. In 2001, the pollen concentrations increased from July onwards, with the peak occurring in August, corresponding to the flowering of *Mimosa scabrella*. Another peak in October corresponded to the flowering of other pollen types, such as Myrtaceae, *Ricinus*, *Ligustrum* and *Sorocea*. In 2002, the pollen concentrations increased again from July onwards, with a peak in August again corresponding to the flowering of *Mimosa scabrella*; however, there were fewer pollen grains than in 2001. The pollen concentration decreased a little in September, then reached its second peak in October, followed by a smaller peak in November that coincided with the flowering period of Urticaceae. The abundance of pollen grains of these taxa decreased in December in both study years (Fig. 3).

The pollen types *Carya*, Melastomataceae, *Mimosa scabrella*, *Myrsine*, and *Sorocea* are listed

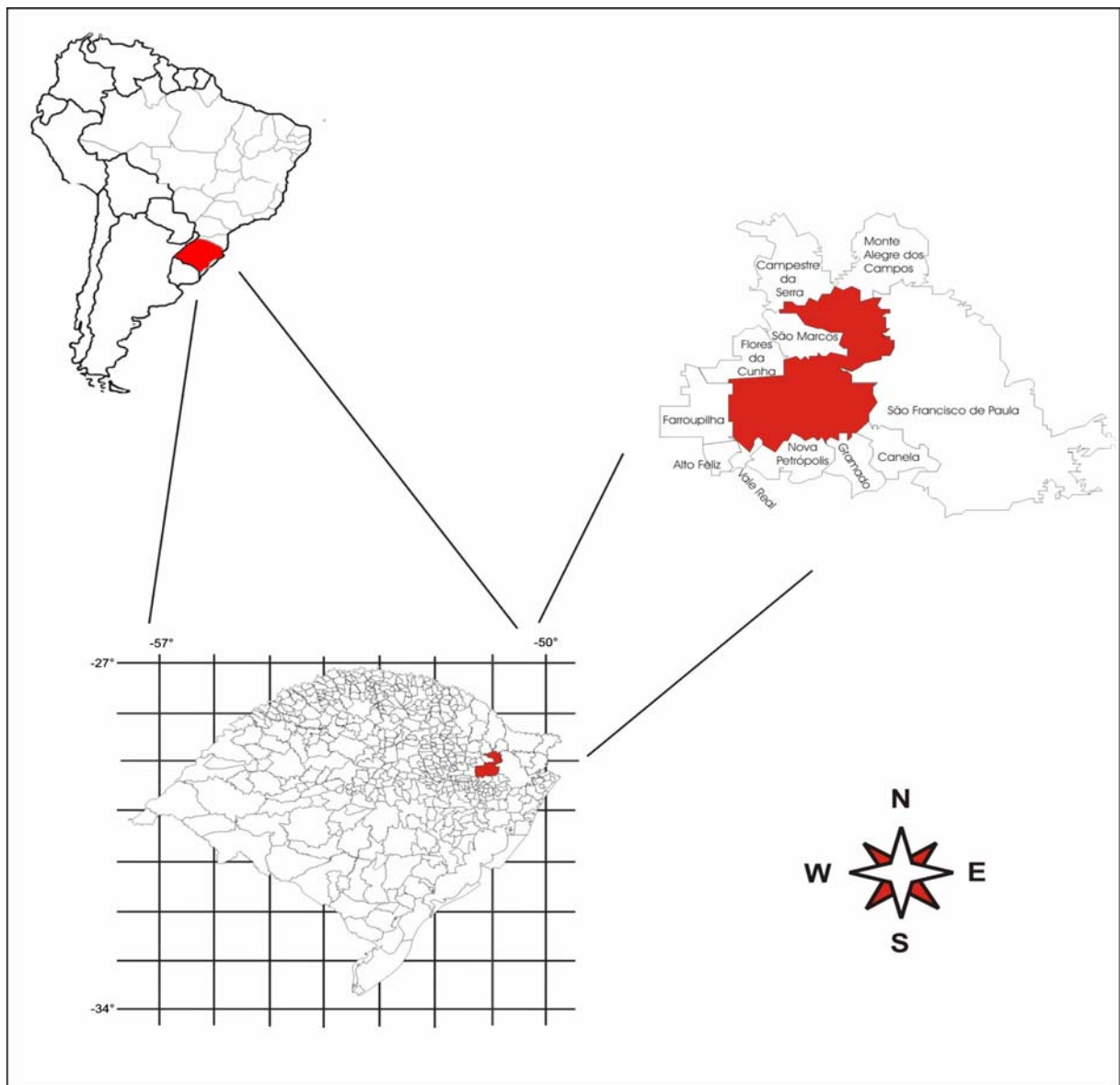


Fig. 1 Location of Caxias do Sul city in South America

separately because they have not been reported in previous aeropalynological studies in Brazil. Their presence in the atmosphere of Caxias do Sul is therefore unique.

Discussion

The results on the abundance, composition and distribution pattern of the pollen population in the atmosphere of Caxias do Sul provided a direct and

encompassing vision of the vegetation in the city and its outskirts.

Hilgert (1998) investigated the pollen types in the atmosphere of Caxias do Sul using a Rotorod sampler, from May to November, and identified a low number of pollen types, seven of which originated from tree and shrub taxa. Among the most abundant were pollen from Cupressaceae and Myrtaceae. The difference between his results and those of the present investigation is probably due to the methodology that was used and the sampling period. In both studies,

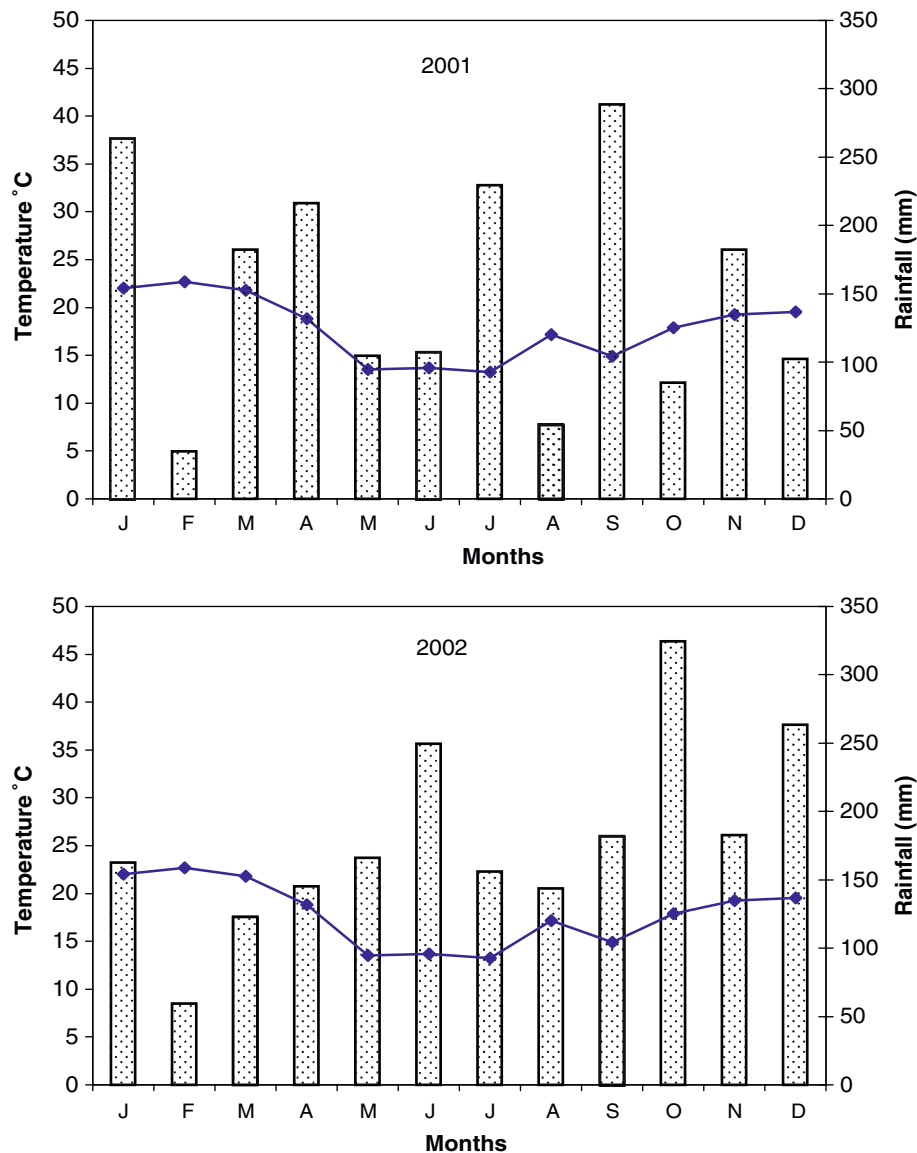


Fig. 2 Average values of monthly mean temperature and total rainfall during the sampling years

tree and shrub taxa were the main taxa, thereby illustrating the abundance of these kinds of plants in the study area.

The highest concentration of pollen from tree and shrub taxa occurred in August 2001. These results are similar to those found in Argentinean cities, such as Buenos Aires (Noetinger, 1993), Posadas (Paul, Fernández, & Huk, 2000), La Plata (Nitiu & Romero, 2001) and Rosario (Gatusso et al., 2003). The most important taxa that bloomed during this period were *Cupressus*, *Fraxinus*, *Platanus* and *Moraceae*. Most

of the airborne pollen from tree and shrub taxa in Caxias do Sul originates from *Mimosa scabrella* as a result of the devastation of *Araucaria* forests. In 2002, precipitation was the highest in August, resulting in *Mimosa scabrella* pollen being deposited; the highest pollen concentrations were registered in October, coinciding with *Urticaceae* blooming, mainly the genus *Urera*.

The Cupressaceae pollen type was an important element in Caxias do Sul during July and August because the species *Cupressus sempervirens*, *C.*

Table 1 Annual and monthly number of grains of pollen of tree and shrub taxa in 2001 and 2002 and the percentage of the annual total pollen collected

Pollen types	Year	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percentage
<i>Acacia</i>	2001	0	0	0	0	0	0	4	11	3	2	2	5	26	0.16
	2002	2	0	0	0	0	0	0	17	17	8	0	1	45	0.31
Apocynaceae	2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	2002	0	0	0	0	0	1	0	0	0	4	0	0	6	0.04
<i>Araucaria</i>	2001	0	0	0	0	0	0	0	0	7	348	6	0	361	2.23
	2002	2	1	0	0	0	0	2	0	1	196	5	0	208	1.46
Asteraceae	2001	8	23	62	46	14	6	9	5	10	70	52	7	313	1.93
	2002	17	44	50	24	6	1	3	3	5	51	118	38	361	2.54
Bignoniaceae	2001	0	0	0	0	0	0	0	0	0	1	1	0	2	0.01
	2002	0	0	0	0	0	0	0	0	2	0	4	0	6	0.04
<i>Carya</i>	2001	0	0	0	0	0	0	0	0	0	17	25	2	44	0.27
	2002	0	0	0	0	0	0	0	0	0	13	45	25	83	0.58
<i>Castanea</i>	2001	0	0	0	0	0	0	0	0	0	5	13	0	18	0.11
	2002	0	0	0	0	0	0	0	0	0	9	43	4	57	0.40
Cupressaceae	2001	3	22	5	12	154	48	542	239	108	49	12	22	1215	7.49
	2002	6	8	9	15	15	43	484	442	97	7	4	3	1132	7.95
Ericaceae	2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	2002	0	0	0	0	0	0	0	0	0	0	1	0	2	0.01
<i>Justicia</i>	2001	0	0	0	0	0	0	0	0	8	1	0	0	9	0.05
	2002	0	0	0	0	0	0	0	4	10	13	0	0	27	0.18
Lauraceae	2001	0	0	0	0	0	0	0	0	0	1	0	0	1	0.006
	2002	0	0	0	0	0	1	0	3	3	0	2	1	11	0.07
<i>Ligustrum</i>	2001	19	4	2	0	0	0	0	0	4	5	1	18	53	0.33
	2002	8	1	12	0	0	0	0	0	12	45	23	27	126	0.89
Loranthaceae	2001	0	1	0	0	0	0	0	0	0	1	0	0	2	0.01
	2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Melastomataceae	2001	2	2	3	4	8	2	0	5	21	3	16	5	70	0.43
	2002	0	0	4	0	0	0	0	1	29	6	25	33	98	0.69
Meliaceae	2001	6	5	2	0	0	0	0	6	20	12	14	9	76	0.46
	2002	10	7	0	0	1	0	0	0	27	2	1	6	54	0.37
<i>Mimosa scabrella</i>	2001	1	35	58	0	1	17	192	3001	311	36	5	0	3656	22.54
	2002	0	6	0	0	0	7	87	1155	711	93	21	8	2087	14.65
<i>Myrsine</i>	2001	8	9	86	470	25	90	130	14	87	3	0	17	937	5.77
	2002	30	15	51	250	32	8	1	33	48	66	0	5	539	3.79
Myrtaceae	2001	99	41	13	13	14	12	24	168	549	637	273	86	1930	11.90
	2002	39	8	6	14	8	2	9	28	192	408	341	135	1190	8.35
<i>Paraphadenia</i>	2001	0	0	0	0	0	0	0	0	0	0	0	1	1	0.006
	2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Pinaceae	2001	0	0	0	0	0	9	138	204	14	24	21	0	410	2.53
	2002	0	0	0	0	0	3	89	209	116	26	17	4	464	3.26

Table 1 continued

Pollen types	Year	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percentage
<i>Platanus</i>	2001	0	0	0	0	0	0	0	0	28	3	0	0	31	0.19
	2002	0	0	0	0	0	0	0	0	32	6	0	0	39	0.27
<i>Podocarpus</i>	2001	0	0	0	0	0	0	0	0	0	17	46	2	64	0.39
	2002	1	0	2	0	0	0	0	0	0	0	41	5	50	0.35
<i>Ricinus</i>	2001	5	9	0	35	4	0	5	3	50	98	42	44	296	1.82
	2002	4	3	0	0	1	0	0	3	120	107	83	24	346	2.42
<i>Rutaceae</i>	2001	0	0	0	0	0	0	14	1	0	0	0	0	15	0.09
	2002	0	0	0	0	0	0	2	5	0	0	0	4	12	0.08
<i>Sapindaceae</i>	2001	1	0	0	0	0	0	1	0	0	4	1	1	7	0.04
	2002	2	0	0	0	0	0	0	0	3	0	0	0	6	0.04
<i>Solanaceae</i>	2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	2002	0	0	0	0	1	0	0	9	0	16	0	0	27	0.18
<i>Sorocea</i>	2001	59	43	8	7	0	10	11	23	32	72	147	165	577	3.56
	2002	52	18	0	0	0	0	0	4	58	17	272	192	613	4.30
<i>Urticaceae</i>	2001	476	164	18	15	4	6	73	61	156	376	558	159	2066	12.73
	2002	64	55	16	0	0	2	0	19	200	1566	1138	494	3554	24.94
<i>Verbenaceae</i>	2001	0	0	7	22	1	0	0	9	0	0	0	3	41	0.25
	2002	7	4	4	0	0	0	0	0	0	10	0	0	25	0.17

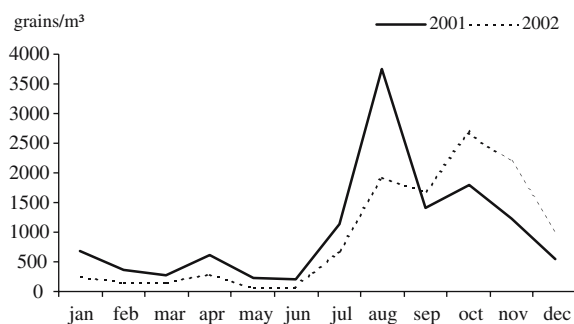


Fig. 3 Monthly pollen concentrations of tree and shrub taxa during the years 2001–2002

lusitanica and *Cryptomeria japonica* are found in abundance in parks and gardens in this city. The registered pollen concentrations were very similar in both years of study. The pollen type Pinaceae also contributed to the winter pollen levels because it represents a large portion of the ornamental vegetation in the city. The occurrence of Cupressaceae and Pinaceae pollen types in the atmosphere during the winter depositions have also been described in other South American cities, such as Mar del Plata (Pérez, 1991; Bianchi, 1994; Latorre & Pérez, 1997), Buenos Aires (Majas & Romero, 1992; Noetinger, 1993; Noetinger & Romero, 1997; Nitiu, Mallo, & Romero, 2003), Caxias do Sul (Hilgert, 1998), Santiago de Chile (Villegas & Nolla, 2001) and Bahía Blanca (Murray, Sonaglioni, & Villamil, 2002).

Other tree and shrub taxa that contributed to the high spring and summer pollen deposition levels were Myrtaceae, *Sorocea*, Asteraceae and *Ricinus*. Pollen of species of Myrtaceae (*Campomanesia aurea*, *C. xantocarpa*, *Eucalyptus camaldulensis*, *Eugenia pluriflora*, *E. uniflora*, *Myrceugenia glaucescens*), which are found in the urban zone near the sampler, was present in significant proportions during the spring. This observation has been made during earlier aeropalynological investigations in Brazilian cities (Bernd & Oliveira Lima, 1951; Oliveira Lima & Greco, 1942; Bernd & Lorscheiter, 1992). We found the Moraceae family to be well represented in the city's pollen spectrum; however, pollen type *Sorocea* has never been mentioned in earlier aerobiological studies in Brazil. Asteraceae pollen was found in the atmosphere almost the entire year, but most of the tree and shrub species present bloom in the spring and summer. The higher quantity of *Ricinus* pollen that occurred in September and October and the number of

collected pollen grains in both years of study are approximate values, although the highest incidence was in 2002. The pollen of Euphorbiaceae family has also been mentioned in other South Americans studies (Bernd & Oliveira Lima, 1951; Noetinger, 1993; Latorre & Pérez, 1997; Paul et al., 2000).

The Myrsinaceae family is well represented in this zone by the genus *Myrsine*. It flowers almost all year-round, with higher pollen concentrations in April. The presence of this pollen type in the autumn has to be considered abnormal and should be studied in depth in future investigations. To date, this pollen type has been described in South America, in Montevideo, only by Tejera and Beri (2002) in a study developed with the Rotorod sampler.

Araucaria angustifolia, a typical tree of the south of Brazil, and *Carya*, an exotic plant found in the outskirts of the sample area, are pollinated in the spring over a very short period and low quantities of pollen were registered. Majas & Romero (1992) and Noetinger (1993), both in Argentina, reported different pollination periods for the genus *Araucaria* because it is related to other species. Similar results on the incidence and monthly pollen concentration of *Carya* have been reported in earlier Argentinean studies (Majas & Romero, 1992; Noetinger, 1993; Latorre & Pérez 1997; Pérez & Páez 1999); to date, none of the Brazilian studies consulted mention this pollen type.

Low pollen concentrations of Melastomataceae, which is an ornamental plant found in the squares and streets of the city, occurred at the end of the winter and spring, that is to say in September, November and December. The only reference found about its incidence in the atmosphere is that of Paul et al. (2000) in an investigation carried out in Posadas (Argentina).

Ligustrum is another taxa, an exotic plant largely found as an ornamental tree in the streets of this city. The concentration of its pollen in the atmosphere was low due to the short dispersal range of the pollen grains once released from the plant (Cariñanos, Alcázar, Galán, & Domínguez, 2002). However, it does causes allergy problems in this city (Vieira & Negreiros, 1989).

In conclusion, due to the high pollen concentrations in the atmosphere of Caxias do Sul from the pollen types *Mimosa scabrella*, Urticaceae (*Urera*), *Sorocea* and *Myrsine*, it would be advisable that

future epidemiological studies in this city use a test of antigen extracts for these taxa because their allergenicity is still unknown.

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