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# ALLERGY and ASTHMA PROCEEDINGS

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Table 1 **Pollen types found in the study area and their monthly concentration (grains/m$^3$ per mo) during 2004**

| Taxa | Month | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Total |
| *Acacia farnesiana* | 0 | 2 | 43 | 20 | 2 | 0 | 5 | 0 | 0 | 0 | 3 | 0 | 0 | 76 |
| *Acalypha* spp | 9 | 2 | 21 | 65 | 28 | 4 | 2 | 32 | 30 | 1 | 0 | 0 | 0 | 192 |
| *Agave* spp | 0 | 2 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| *Alnus glutinosa* | 8 | 17 | 15 | 8 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 24 | 83 |
| *Alternatera* spp | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Amaranthaceae/ Chenopodiaceae | 3 | 17 | 28 | 47 | 212 | 95 | 48 | 122 | 72 | 108 | 33 | 447 | 25 | 1256 |
| *Ambrosia* spp | 5 | 15 | 52 | 17 | 108 | 9 | 49 | 97 | 75 | 127 | 30 | 248 | 77 | 909 |
| *Apiaceae* spp | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| *Argemone mexicana* | 0 | 1 | 5 | 26 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| *Artemisia* spp | 0 | 0 | 1 | 0 | 9 | 0 | 0 | 19 | 0 | 38 | 3 | 0 | 0 | 71 |
| *Aster* spp | 0 | 0 | 6 | 4 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 1 | 0 | 16 |
| *Bauhinia* spp | 0 | 0 | 3 | 3 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| *Bouganvillae* spp | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| *Caesalpinia mexicana* | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| *Callistemon speciosus* | 0 | 0 | 0 | 0 | 66 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 75 |
| *Carya* spp | 0 | 1 | 46 | 66 | 47 | 9 | 1 | 0 | 0 | 29 | 2 | 0 | 0 | 201 |
| *Casuarina equisetifolia* | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 20 | 9 | 1 | 11 | 43 |
| *Celtis* spp | 3 | 39 | 215 | 70 | 109 | 420 | 49 | 203 | 185 | 127 | 19 | 107 | 0 | 1548 |
| *Citrus* spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Compositae | 0 | 0 | 0 | 1 | 24 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 27 |
| *Cupressus* spp | 266 | 273 | 82 | 43 | 2 | 6 | 0 | 0 | 32 | 101 | 42 | 40 | 331 | 1218 |
| *Cyperus rotundifolia* | 0 | 1 | 22 | 21 | 14 | 5 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 66 |
| *Ehretia anacua* | 0 | 0 | 51 | 8 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| *Ephedra* spp | 1 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| *Erythrina* spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 294 | 0 | 295 |
| *Eucalyptus* spp | 1 | 1 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 37 | 2 | 0 | 0 | 46 |
| *Fouquieria splendens* | 0 | 0 | 7 | 1 | 8 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| *Fraxinus* spp | 430 | 5837 | 512 | 237 | 10 | 0 | 2 | 0 | 11 | 37 | 1 | 1 | 35 | 7112 |
| Gramineae/Paoceae | 22 | 29 | 52 | 67 | 120 | 158 | 86 | 116 | 251 | 191 | 64 | 826 | 71 | 2051 |
| *Helianthus annus* | 1 | 1 | 4 | 20 | 44 | 4 | 5 | 1 | 2 | 59 | 28 | 4 | 0 | 172 |
| *Hippeastrum equestre* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Jacaranda mimosifolia* | 0 | 0 | 371 | 137 | 31 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 550 |
| *Junglans* spp | 0 | 2 | 22 | 81 | 29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| *Langerstroemia indica* | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| *Lantana cámara* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Leucaena leucocephala* | 0 | 0 | 42 | 15 | 1 | 9 | 14 | 115 | 0 | 4 | 0 | 0 | 0 | 200 |
| *Leucophyllum frutescens* | 0 | 0 | 2 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| *Ligustrum lucidum* | 2 | 9 | 187 | 150 | 33 | 66 | 18 | 5 | 0 | 18 | 1 | 0 | 1 | 491 |
| *Magnofolia grandiflora* | 0 | 0 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| Malvaceace | 0 | 0 | 0 | 0 | 7 | 8 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 29 |
| *Mimosa malacophylla* | 0 | 0 | 178 | 68 | 44 | 37 | 37 | 63 | 6 | 0 | 11 | 0 | 0 | 445 |
| *Morus* spp | 5 | 1417 | 418 | 155 | 76 | 23 | 23 | 0 | 1 | 0 | 0 | 0 | 0 | 2118 |
| Palmae | 1 | 5 | 8 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 |
| *Parietaria* spp | 25 | 131 | 645 | 126 | 120 | 59 | 97 | 63 | 100 | 53 | 12 | 1 | 6 | 1439 |
| *Parkinsonia aculeata* | 0 | 0 | 8 | 3 | 3 | 16 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 37 |

Table 1 **Continued**

| Taxa | Month | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Total |
| *Parthenium hysteophorus* | 5 | 16 | 80 | 161 | 103 | 187 | 37 | 32 | 0 | 0 | 0 | 0 | 2 | 624 |
| *Persea americana* | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| *Phitecellobium* | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| *Pinus* spp | 2 | 45 | 592 | 182 | 117 | 57 | 43 | 31 | 0 | 10 | 18 | 1 | 3 | 1103 |
| *Platanus occidentalis* | 0 | 211 | 87 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 308 |
| *Populus* spp | 0 | 3 | 18 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| *Prosopis* spp | 0 | 3 | 138 | 89 | 96 | 22 | 2 | 25 | 0 | 0 | 0 | 0 | 0 | 374 |
| *Prunus pérsica* | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| *Pteris longifolia* | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| *Quercus* spp | 1 | 222 | 108 | 69 | 38 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 449 |
| *Rhododendron mucronatum* | 0 | 2 | 2 | 5 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 11 |
| *Ricinus communis* | 14 | 39 | 148 | 119 | 103 | 36 | 23 | 46 | 49 | 87 | 50 | 4 | 67 | 785 |
| Rosaceae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Salix* spp | 0 | 16 | 145 | 226 | 20 | 36 | 29 | 15 | 3 | 3 | 0 | 8 | 0 | 500 |
| *Sapium sebiferum* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 28 | 0 | 0 | 0 | 39 |
| *Schrankia uncinata* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Selaginella* spp | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| *Solanum* spp | 0 | 0 | 1 | 31 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 37 |
| *Tamarix gálica* | 0 | 0 | 0 | 2 | 0 | 21 | 24 | 88 | 28 | 52 | 2 | 0 | 0 | 215 |
| *Tradescantia virginiana* | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 12 | 0 | 0 | 0 | 14 |
| *Vinca rosea* | 0 | 0 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| *Washingtonia filifera* | 0 | 0 | 2 | 37 | 44 | 51 | 14 | 0 | 0 | 0 | 0 | 2 | 0 | 148 |
| *Yucca* spp | 0 | 0 | 0 | 0 | 11 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| *Zea mays* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

grain collection was done according to the recommendations of the Pan-American Aerobiology Association using a Hirst 7-day recording air sampler (Burkard Manufacturing Co., Hertfordshire, U.K.), with an airflow volume of 10 L/minute, installed on the roof of a four-story building of the "Dr. Jose Eleuterio Gonzalez" University Hospital, 12 m off the ground, and located in the western part of the city of Monterrey, Nuevo Leon (altitude, 540 m above sea level; coordinates, north 27°49′ and south 23°11′ north latitude; east 98°26′ and west 101°14′ west longitude).

The particles were trapped on Melinex (Du Pont, USA) transparent polyester film (345 mm with a silicon solution as an adhesive) mounted on a clockwork-driven drum, which contains a sampling plate that moves at 2 mm/hour; this allows hourly calculations of air particles. The collection drum rotates completely during 1 week of sampling. The tape was removed weekly and cut into seven pieces with each piece representing a day of sampling (48 mm of sampling). Afterward, the strips of tape were mounted in layers of glycerin and safranine on a slide. The works by Kremp,[19] Erdman,[20,21] Faegri e Iversen,[22] and Kapp[23] were used to identify pollen. Trained personnel from the School of Biologic Sciences of the Universidad Autónoma de Nuevo Leon counted and identified with a light microscope (40×), with four longitudinal sweeps. A correction factor was applied by multiplying the number of grains observed by 0.54 to obtain the real number of grains per cubic meter of air.

A daily count of the pollen identified was made daily for the 365 days that the study lasted. The average daily count of pollen was obtained by adding the daily pollen count of each month and dividing it by the total number of days corresponding to that month. In this way, the average count of pollen particles per cubic meter per day of sampled air was reported. We also determined the total monthly count of each pollen identified and the pollination period (PP). The beginning of the PP was established when 5% of the total count was reached and lasted until it reached 95% of the total.[24]

Table 1 **Pollen types found in the study area and their monthly concentration (grains/m$^3$ per mo) during 2004**

| Taxa | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acacia farnesiana* | 0 | 2 | 43 | 20 | 2 | 0 | 5 | 0 | 0 | 0 | 3 | 0 | 0 | 76 |
| *Acalypha* spp | 9 | 2 | 21 | 65 | 28 | 4 | 2 | 32 | 30 | 1 | 0 | 0 | 0 | 192 |
| *Agave* spp | 0 | 2 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| *Alnus glutinosa* | 8 | 17 | 15 | 8 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 24 | 83 |
| *Alternatera* spp | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Amaranthaceae/ Chenopodiaceae | 3 | 17 | 28 | 47 | 212 | 95 | 48 | 122 | 72 | 108 | 33 | 447 | 25 | 1256 |
| *Ambrosia* spp | 5 | 15 | 52 | 17 | 108 | 9 | 49 | 97 | 75 | 127 | 30 | 248 | 77 | 909 |
| *Apiaceae* spp | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| *Argemone mexicana* | 0 | 1 | 5 | 26 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| *Artemisia* spp | 0 | 0 | 1 | 0 | 9 | 0 | 0 | 19 | 0 | 38 | 3 | 0 | 0 | 71 |
| *Aster* spp | 0 | 0 | 6 | 4 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 1 | 0 | 16 |
| *Bauhinia* spp | 0 | 0 | 3 | 3 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| *Bouganvillae* spp | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| *Caesalpinia mexicana* | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| *Callistemon speciosus* | 0 | 0 | 0 | 0 | 66 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 75 |
| *Carya* spp | 0 | 1 | 46 | 66 | 47 | 9 | 1 | 0 | 0 | 29 | 2 | 0 | 0 | 201 |
| *Casuarina equisetifolia* | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 20 | 9 | 1 | 11 | 43 |
| *Celtis* spp | 3 | 39 | 215 | 70 | 109 | 420 | 49 | 203 | 185 | 127 | 19 | 107 | 0 | 1548 |
| *Citrus* spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Compositae | 0 | 0 | 0 | 1 | 24 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 27 |
| *Cupressus* spp | 266 | 273 | 82 | 43 | 2 | 6 | 0 | 0 | 32 | 101 | 42 | 40 | 331 | 1218 |
| *Cyperus rotundifolia* | 0 | 1 | 22 | 21 | 14 | 5 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 66 |
| *Ehretia anacua* | 0 | 0 | 51 | 8 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| *Ephedra* spp | 1 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| *Erythrina* spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 294 | 0 | 295 |
| *Eucalyptus* spp | 1 | 1 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 37 | 2 | 0 | 0 | 46 |
| *Fouquieria splendens* | 0 | 0 | 7 | 1 | 8 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| *Fraxinus* spp | 430 | 5837 | 512 | 237 | 10 | 0 | 2 | 0 | 11 | 37 | 1 | 1 | 35 | 7112 |
| Gramineae/Paoceae | 22 | 29 | 52 | 67 | 120 | 158 | 86 | 116 | 251 | 191 | 64 | 826 | 71 | 2051 |
| *Helianthus annus* | 1 | 1 | 4 | 20 | 44 | 4 | 5 | 1 | 2 | 59 | 28 | 4 | 0 | 172 |
| *Hippeastrum equestre* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Jacaranda mimosifolia* | 0 | 0 | 371 | 137 | 31 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 550 |
| *Junglans* spp | 0 | 2 | 22 | 81 | 29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| *Langerstroemia indica* | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| *Lantana cámara* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Leucaena leucocephala* | 0 | 0 | 42 | 15 | 1 | 9 | 14 | 115 | 0 | 4 | 0 | 0 | 0 | 200 |
| *Leucophyllum frutescens* | 0 | 0 | 2 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| *Ligustrum lucidum* | 2 | 9 | 187 | 150 | 33 | 66 | 18 | 5 | 0 | 18 | 1 | 0 | 1 | 491 |
| *Magnofolia grandiflora* | 0 | 0 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| Malvaceace | 0 | 0 | 0 | 0 | 7 | 8 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 29 |
| *Mimosa malacophylla* | 0 | 0 | 178 | 68 | 44 | 37 | 37 | 63 | 6 | 0 | 11 | 0 | 0 | 445 |
| *Morus* spp | 5 | 1417 | 418 | 155 | 76 | 23 | 23 | 0 | 1 | 0 | 0 | 0 | 0 | 2118 |
| Palmae | 1 | 5 | 8 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 |
| *Parietaria* spp | 25 | 131 | 645 | 126 | 120 | 59 | 97 | 63 | 100 | 53 | 12 | 1 | 6 | 1439 |
| *Parkinsonia aculeata* | 0 | 0 | 8 | 3 | 3 | 16 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 37 |

Table 2 **Average pollen count for trees, weeds, and grasses per month, reported in grains/m³ per day from January 2004 to January 2005**

| Month | Trees | Weeds | Grasses | Total | % |
|---|---|---|---|---|---|
| January 2004 | 49.5 | 2.5 | 1.4 | 53.4 | 5.82 |
| February 2004 | 281 | 6.5 | 1.0 | 288.5 | 31.39 |
| March 2004 | 106.2 | 34.1 | 1.6 | 141.9 | 15.45 |
| April 2004 | 59.8 | 18.9 | 2.2 | 80.9 | 8.81 |
| May 2004 | 28.2 | 23.3 | 3.8 | 55.3 | 6.15 |
| June 2004 | 26.1 | 14.7 | 5.2 | 46 | 5.02 |
| July 2004 | 7.4 | 9.7 | 2.7 | 19.8 | 2.19 |
| August 2004 | 15.4 | 16.2 | 3.7 | 35.3 | 3.85 |
| September 2004 | 11.1 | 9.7 | 8.3 | 29.1 | 3.16 |
| October 2004 | 16.2 | 14.6 | 6.2 | 37 | 4.02 |
| November 2004 | 4.8 | 3.9 | 2.1 | 10.8 | 1.18 |
| December 2004 | 14.7 | 22.5 | 26.6 | 63.8 | 6.95 |
| January 2005 | 29.4 | 6.9 | 4.4 | 40.7 | 4.73 |
| Year average (grains/m³ per day)* | 54 | 15 | 6 | 75 | |
| Percentage corresponding to the total pollen count | 72% | 20.3% | 7.7% | | 100 |

**Average number of grains per cubic meter per day.*

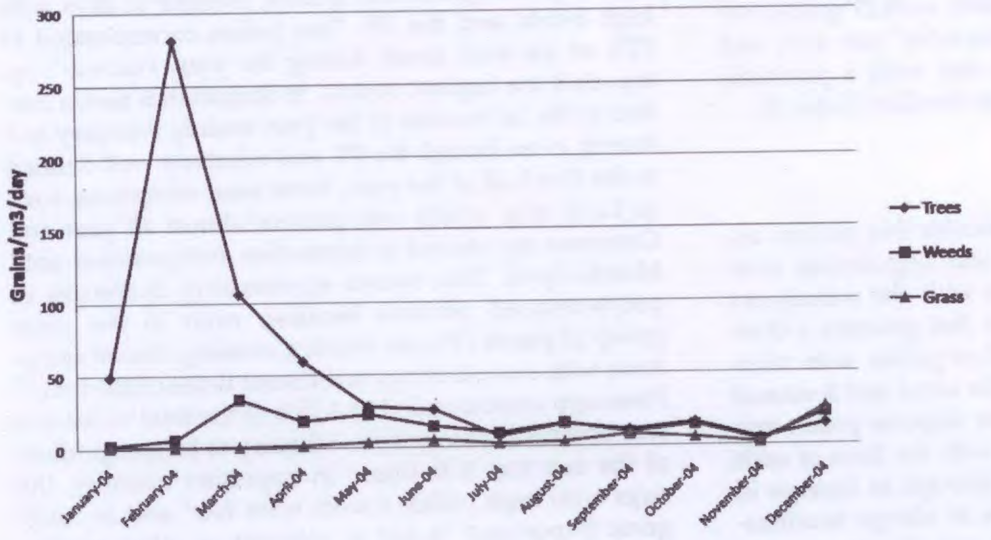


*Figure 1. Pollen count average of trees, weeds, and grasses during study.*

## RESULTS

During the period of study we identified 70 different types of pollen. The total pollen studied was 25,918 grains/m³. In Table 1 the pollen types found are described, as well as the total monthly concentration of pollen per taxa.

The months with the highest pollen concentration were February, with an average of 289 grains/m³ per day, and March with 142 grains/m³ per day. The months of July and November had the lowest concentration with a total of 20 and 11 grains/m³ per day, respectively (Table 2).

Most of the pollen corresponded to trees (72% of the total), followed by weeds (20.3%), and last, by grass pollen (7.7%). Tree pollen count was higher in the first half of the year; the months with the highest concentration were February and March. Weed pollen was higher in March, May, and December. The highest concentration of grass pollen was reported in December (Table 2 and Fig. 1).

Of all the collected pollen in the year, *Fraxinus* spp. was the most important in quantity with a total of 7112 grains/m³. A peak occurred in February with a daily average of 201 grains/m³. This pollen corresponded to 27.5% of the total count of pollen in the year.

The most frequently identified tree pollen was *Fraxinus* spp, with high concentrations in January and April; *Morus* spp, present from February to May, reaching its highest concentration in February; *Celtis* spp, present most of the year (March to December), presented its highest concentration in June; *Cupressus* spp, also present most of the time, mainly from October to April, had its highest concentration in January; and *Pinus* spp, which was present from February to August, had the highest concentration in March. Table 1 corresponds to the average pollen count of grains per cubic meter per month of the main trees identified during the study.

The predominant weed pollen was *Parietaria* spp, present at all times during the year with an average of 4 grains/$m^3$ per day. It predominated from February to May. The highest concentration was reported at 21 grains/$m^3$ per day in March. The pollen of Amaranthaceae/Chenopodiaceae was present all year; mostly in the months of May, June, August, October, and December, its highest concentration was reported in December. The pollen of *Ambrosia* spp. was also present all year, mainly from August to October, December, and January, December being the month with the highest concentration reported at 8 grains/$m^3$ per day. Other weeds identified in smaller quantities were *Helianthus annus*, *Parthenium hysteophorus*, and *Tamarix galica* (Table 1). The PP for grasses was from the middle of April to January; the months with the highest daily average corresponded to December, with 27 grains/$m^3$ per day; September, with 8 grains/$m^3$ per day; and October, with 6 grains/$m^3$ per day with a predominance of the Gramineae/Poaceae families (Table 2).

## DISCUSSION

Aeroallergens are complex molecules that contain antigenic proteins, which activate and degranulate mast cells by specific IgE mechanisms with the subsequent release of inflammatory mediators that generate a characteristic allergic response.[25,26] Most pollen with allergenic potential is transported by the wind and is named anemophilous.[15,27] The species that disperse pollen into the atmosphere usually correlate with the flora of each region but this is not a rule.[5,6,28] Although an increase in pollen levels can cause an increase in allergic sensitization, the level of pollination does not always coincide with the *sensitization* pattern of certain plants in the same season.[4,7] This is an important consideration when prescribing allergen-specific immunotherapy.[29–31]

Not all pollen has the capacity to produce an allergic reaction. This capacity depends on factors such as protein components that constitute the pollen grain, plant distribution, pollen flotation, etc.[32–35]

Some authors believe that the maximum concentration of pollen and its duration is more important than the correlation of symptoms—pollen counts for patients with pollinosis.[36] Because of the characteristics of pollen types, it is not always possible to linearly correlate allergy symptoms (rhinorrhea, sneezing, itching, etc.) and atmospheric pollen counts. The Burge categorization system is an attempt at a clinical approximation for this relationship.[34] Extremely sensitive patient will experience symptoms with levels of pollen between 1 and 15 grains/$m^3$ for trees, 1 and 5 grains/m in grasses, and 1 and 10 grains/$m^3$ in weeds. However most individuals will present symptoms with variable pollen counts (16–90 grains/$m^3$ from trees, 6–20 grains/$m^3$ from grasses, and 11–50 grains/$m^3$ from weeds).[34] For example, Negriti *et al.* reported symptoms in allergic patients to *Parietaria* spp with 10–15 grains/$m^3$ per day at ≥80 grains/$m^3$ per day, almost 90% of the patients presented symptoms.[37] Among weeds, *Parietaria* spp. was common with counts of at least 10 grains/$m^3$ per day for 30 days during the year, but reached counts of 99 grains/$m^3$ per day (March 16, 2004) with a wide PP. Other weeds that had important levels and considerable amounts were Amaranthaceae/Chenopodiaceae (22 days) as well as *Ambrosía* spp. (20 days). *Parietaria* spp. is special in this group because although it is frequent, it is not included in the aeroallergen panel that we use in our center.

Table 3 shows the taxa that had pollen counts equal or higher than those that cause symptoms according to the Burge categorization system, number of days with high levels, and the PP. Tree pollen corresponded to 72% of the total count during the year, *Fraxinus* spp. reported the highest counts, its importance seems limited to the 1st months of the year, mainly February and March, even though the PP was relatively well defined to the first half of the year, there were exceptions, such as *Celtis* spp, which was present almost all year and *Cupressus* spp started in September and persisted until March–April. This causes approaching challenges in polysensitized patients because, even in the same group of plants PPs can overlap, causing clinical symptoms with exacerbations at different times of the year.[38] *Pinus* spp corresponded to 4.25% of the total count and was observed mainly from February to July, regardless of the fact that it is found in important quantity, the days with high pollen counts were few[7] and its allergenic importance is not as relevant as other species, such as *Fraxinus* spp, *Morus* spp, *Cupressus* spp, and *Ricinus communis*.[34]

The interpretation of the results of Gramineae/Poaceae shows a similar risk of causing symptoms such as *Fraxinus* spp. (50 days versus 49 days, respectively). This is not simple in clinical terms because grasses cause symptoms at smaller grain counts and it is easier to find patients with symptoms induced by grasses than trees, with a ratio of 4:1.[39] The largest amount was 420 grains/$m^3$ (December 21, 2004); the PP lasted almost all year (10 months). Patients sensitive to grasses would have more variability in their symptoms during December, because the average was high enough to cause pollinosis (26 grains/$m^3$ per day).[34]

Despite the advantages offered by the Hirst sampler, a defect in our study is the lack of data on the hourly

Table 3 **Relevant plants from an allergenic perspective**

| Taxa | Concentration with Risk of Pollinosis* (days) | Main Pollination Period |
|---|---|---|
| Trees | | |
| *Cupressus* spp | 19 | January–April |
| *Fraxinus* spp | 49 | January–April |
| *Junglans* spp | 3 | March–May |
| *Ligustrum* spp | 4 | March–June |
| *Morus* spp | 30 | February–May |
| *Prosopis* spp | 7 | March–June |
| *Quercus* spp | 7 | February–May |
| *Platanus* spp | 10 | February–March |
| *Pinus* spp | 7 | February–August |
| Weeds | | |
| Amaranthaceae/Chenopodiaceae | 22 | April-December |
| *Ambrosia* spp | 20 | May–December |
| *Helianthus* spp | 7 | May–November |
| *Parietaria* spp | 30 | February–September |
| *Ricinnus* spp | 18 | January–October |
| *Artemisa* spp | 3 | August–October |
| Grasses | | |
| Gramineae/Poaceae | 50 | April–January |

*First column describes relevant taxa, second column describes the number of days with concentrations >15 grains/m$^3$ per day for trees, >10 grains/m$^3$ per day for weeds, and >5 grains/m$^3$ per day for grasses, and the third column describes main pollination period.*

**Clinically relevant according to the Burge categorization system.*

variation of pollen for each taxa, especially those with allergenic importance. Some studies have reported the release of pollen from 8 A.M. to 2 P.M. with a maximum peak between 10 A.M. and 12 P.M.[39]

Factors such as climate change, relative humidity, wind, pollution level, and altitude[1,40] can influence the presence of pollen, *i.e.*, pollen production for *Ambrosia* spp occurs after sunrise (Bianchi 1951 and Ogden 1969) and levels decrease during rainy seasons.[39] Other authors have observed that rain hinders the atmospheric pollen count and the symptomology of affected individuals usually decreases, if patients really have pollinosis.[41]

This study identifies the main pollens in the city of Monterrey and their variation during the year; a better estimate may be obtained averaging pollen data obtained over several years, but, unfortunately, we have only completed 1 year. There is a similar behavior among tree, weed, and grass pollen during the year according to Cueva-Velazquez[14] and Corona,[12] but it is important to point out that these studies were reported >40 years ago. A common phenomenon in our setting is that PPs overlap, and some types of pollen are present practically all year. This behavior of pollen explains why the patient with perennial disease has seasonal exacerbations, because many allergy patients are sensitive to more than one aeroallergen.[42] However, even in urbanized areas there is an overlapping about native species and plants that have been adopted because of gradual urbanization. A report developed in parallel with this study was done in a different location of Monterrey (north area), by the same personnel of the School of Biologic Sciences, and there were some differences in pollen count, *i.e.*, higher levels of *Cupressus* spp. and Amaranthaceae/Chenopodiaceae pollen, than in our study with the other pollen levels almost the same[43]; this correlates that differences in the concentration of pollen in the air depend on the vegetation features in each region and even in different areas of the same city.[13,44] This is important to predict the type of sensitivity that we can expect to find in allergic patients. Also, we can estimate the risk of exacerbation of symptoms in the allergic population if we know the behavior of pollen in each region; *e.g.*, Schmier performed a review summarizing existing asthma-related impact of aeroallergen exposure literature, and despite that little is known about this relationship, there appears to be evidence that weed pollen is associated with asthma exacerbations.[45]

Pollen sampling with different devices is used only as a guide. Some studies with personal sampling devices have shown variability depending on the level where the device is placed (patient level or several meters above the ground).[34] A fact well known is that very sensitive patients can present an allergic response with small doses of pollen,[46] which makes the atmospheric counts and aeroallergen sensitization patterns (several or single allergens) important for the clinician; however, it should always be considered that the patient can be more sensitive than the pollen detector device.[39]

## CONCLUSIONS

Tree pollen represented most of the pollen collected, mainly from the months of January–March, with *Fraxinus* spp having the highest concentration. Weed and grass pollen were perennial presenting some peaks during the year.

PP for trees and grass is similar in other cities, such as Mexico City, Zacatecas, Tamaulipas, Tepic, Veracruz, Toluca, and Guadalajara, from November to May with each geographical area having its own features. For weeds the PP was mainly from June to October, with the higher atmospheric concentration reported at the end of the summer and beginning of autumn. In Monterrey, no well-defined period was observed, because several peaks occurred during the year. Plants such as *Parietaria* spp, *Morus* spp, *Cupressus* spp, and *Ricinus communis* represent recently found allergens in this region relevant for diagnosis and treatment, because allergy to these has been observed. In polysensitized patients a perennial pattern of symptoms is more common with several exacerbations during the year. December, January, February, March, and April were the months with the highest concentration of pollen count. It is important to be aware of this for an appropriate clinical approach of allergic patients.

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