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Survey of the Airborne Pollens in Seoul, Korea

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A daily count of air borne pollen was done within the city limits of Seoul, Korea for a period of two years (1984-1985) using Durham's Gravity Sampling Device. Two major pollen seasons, March through May, and the month of September, were easily distinguishable. The concentration of the different types of pollen as well as all of the pollens combined varied similarly both years to a significant degree. The pollen types found in the greatest numbers were Alnus (March), Populus (April), Quercus (April-May), Pinus (May), grasses (September), and weeds (September). The main weed pollens detected in September, sagebrush, ragweed and Japanese hop would also be considered to be important allergenic pollens of respiratory allergy in Korea. The results of the survey are discussed in the light of especially relevant published literature.

Key Words: Airborne pollen; Seoul, Korea; pollen season, trees and weeds

Aerollergens are the most important allergens involved in producing the symptoms of respiratory allergies. There have been several reports on the results of skin tests for inhalant allergens in asthma and allergic rhinitis in Korea (Hong *et al.* 1981; Hong *et al.* 1982; Hwanf *et al.* 1974; Joo 1965; Kang 1973; Kang *et al.* 1984; Kim 1973; Kim 1975; Min 1984; Rhee 1985). Here, as in other countries the most important inhalant allergens are house dust and mites.

In 1982 Hong has suggested that Artemisia might be the most important allergic pollen and that late summer-early autumn could be a hay fever season in Korea. Previously even though the positive skin test results of pollen allergens have since been reported to be about 20-30% in respiratory allergic patients, the existence of a definite hay fever season in Korea had not been specifically confirmed on the evidence of clinical experience alone.

There have been some published reports on pollen counts which have previously been done in Seoul (Joo 1965; Kim 1966; Min 1984).

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Continuous monitoring of the qualitative and quantitative composition of airspora over an extended period is a prerequisite of planning any program aimed at devising an effective and efficient mode of diagnosis and treatment of respiratory allergic disorders in human beings. As such, air surveys for collecting data on pollen have been considered to be an essential aspect of respiratory allergic studies.

Seoul is inhabited by ten million persons. The climate is hot and moist summer and cold and dry in winter with four distinct seasons.

The goals of this study were to work up a listing of the plant species producing airborne pollen at various times during the year and the periods in which their pollens can be detected in the air, to determine the degree of consistency of pattern in consecutive years, and to construct a pollen season chart that would be useful to physicians in the area.

The collecting of data on spores from fungi and lower vascular plants was not included in this count, although many kinds were collected on the sample slides.

MATERIALS AND METHODS

Several field trips were taken to collect voucher specimens. After the specimens had been identified, the slides of them (22) were placed in permanent storage in the Allergy Research Laboratory of the Yonsei University College of Medicine.

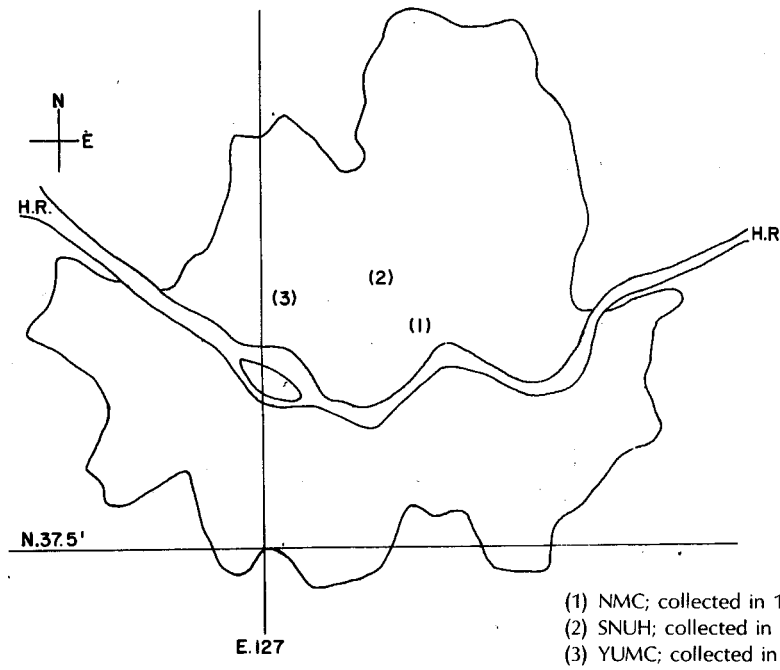

Fig. 1. *Map of Seoul showing pollen collection sites.*

Standard Durham gravity slide samplers (Durham 1952) were placed in two locations: a roof garden 30m from the ground and a place only 1.5 m above the ground at Yonsei University Severance Hospital (Fig. 1).

The microslides, thinly coated with white vaseline, were exposed at each sampling station between the beginning of March and the end of October 1984, and late February and the end of October 1985. Within those 2 periods they were collected daily at about 9:00 AM, stained with Calberla's funchsin (10 ml glycerine, 20 ml 95% ethanol, 30 ml distilled water, and 0.1 gm basic fuchsin), and after a 22 × 60 mm cover slip had been placed over each one, they were all examined quickly under a microscope at magnifications of 100×, 400×, and 1000× for identification and counting.

The incidence was reported as the average number of pollen grains per one sq cm of a slide.

RESULTS

The results of counting the total number of pollen grains of trees, grasses, and weeds per cm^2 are shown in Figure 2. Table 1 shows peak counts of pollens and detected durations in 1984–1985. Tree pollens began to appear the air near the beginning of March and continued to be detected until June. The peak of tree pollen season occurred in the middle of May.

The pollen of various trees appeared, chronologically, in the following order: alder (Alnus spp.), poplar (Populus spp.), willow (Salix spp.), oak (Quercus spp.), maple (Acer spp.), and pine (Pinus spp.). From the early part of March to the early part of April, the tree pollen which was found in the greatest numbers was that of the alder, but the pollen which had the highest count for the month of April as a whole was that of the puplar. The pollen of the willow was detected from the April to early May. For the period from the end of April to the middle of May, the pollens of the oak and maple had the highest count. Pine pollen was detected from the early part of May to the end of June (Fig. 3).

The pollens of the grasses were detected from the late part of April to the middle of October. They were observed to be of several different genera, but it was impossible to identify them, and there was no real

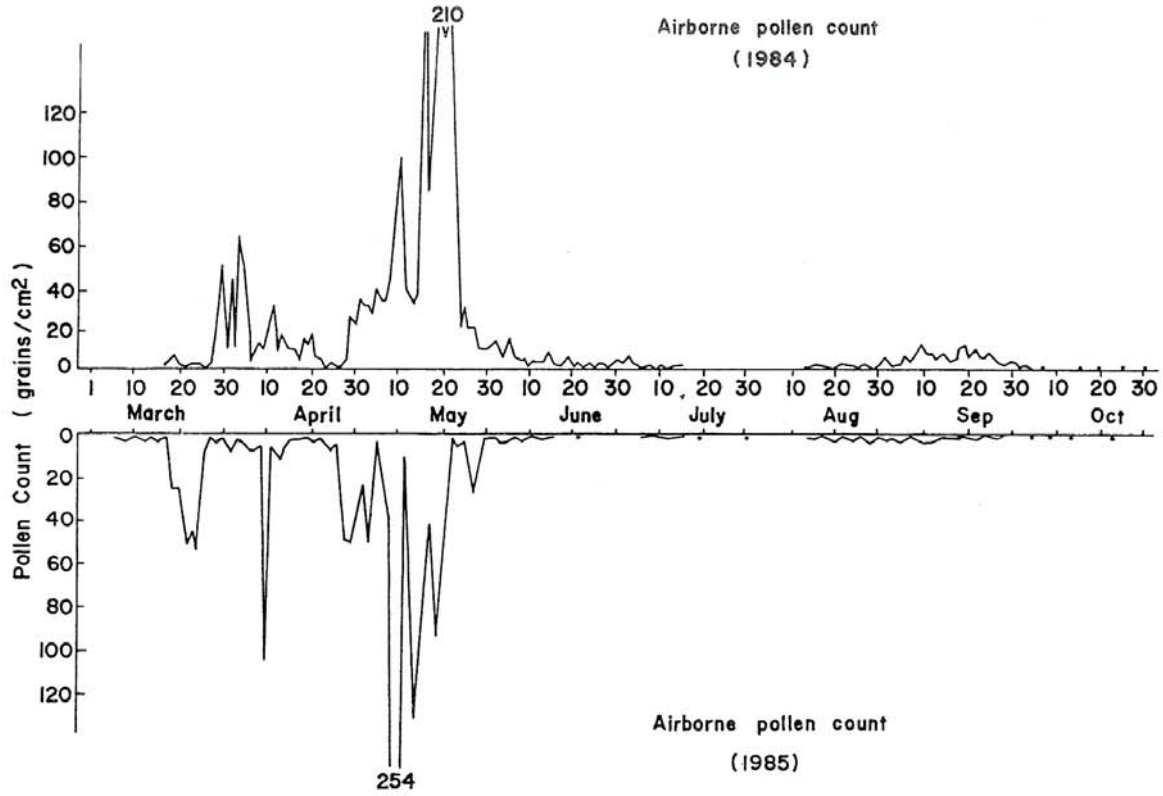

Fig. 2. Airborne pollen count in Seoul during 1984-1985

Table 1. Pollens: Peak Counts and Duratioins Detected

Pollen	Peak Count (Grains/Sq Cm)	First Appeared	Last Detected
Alnus	69	84. 3. 19	84. 4. 10
	66	85. 3. 3	85. 4. 15
Populus	28	84. 4. 6	84. 4. 26
	124	85. 3. 24	85. 4. 26
Salix	13	84. 4. 18	84. 4. 24
	30	85. 4. 13	85. 5. 3
Quercus	24	84. 4. 29	84. 5. 26
	18	85. 4. 28	85. 5. 16
Acer	12	84. 4. 29	84. 5. 13
	11	85. 5. 2	85. 6. 6
Pinus	202	84. 5. 4	84. 6. 16
	238	85. 5. 2	85. 6. 12
Grasses	8	84. 5. 16	84. 10. 20
	5	85. 4. 22	85. 10. 28
Humulus	9	84. 8. 10	84. 10. 16
	3	85. 9. 1	85. 10. 30
Ambrosia	11	84. 9. 1	84. 10. 21
	4	85. 9. 5	85. 10. 4
Artemisia	10	84. 8. 7	84. 10. 22
	4	85. 8. 10	85. 10. 31

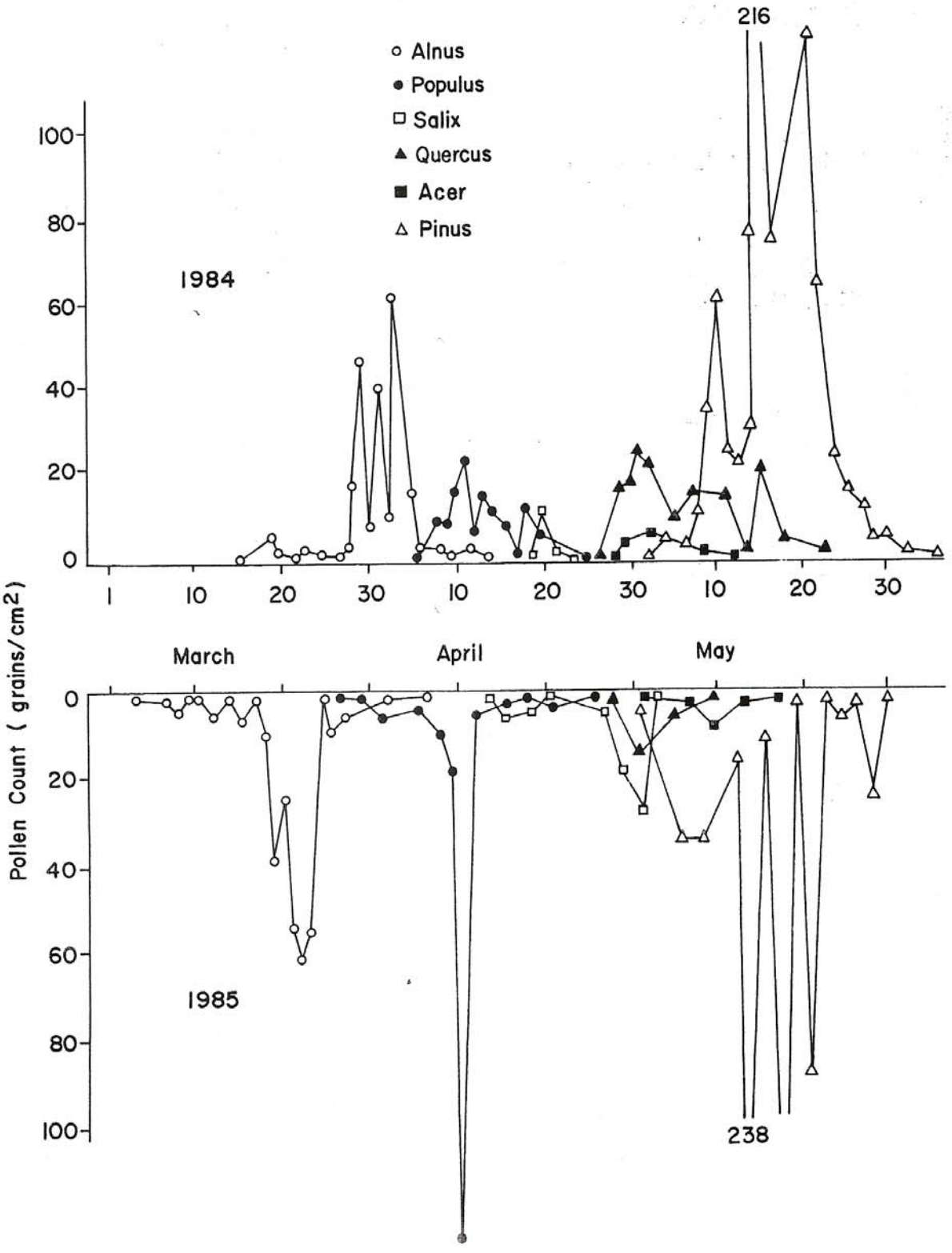

Fig. 3. Monthly distribution of counts of airborne pollen of trees in Seoul during 1984-1985

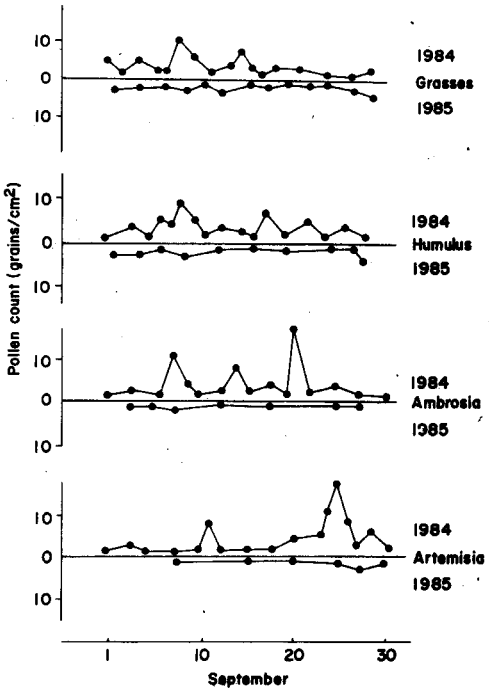

Fig. 4. Pollen count of grasses and weeds in Seoul during September 1984-1985.

peak season for them.

From July to the middle of August, the airborne pollens were nearly absent. It could be suggested that the grass pollens were to a considerable extent, cleared from the air by frequent and heavy rainfall in July, and the season of week pollens had not started.

In the weed group the pollens of ragweed (Ambrosia spp.), sagebrush (Artemisiá spp.), and Japanese hop (Humulus japonicus) were detected continuously from the middle of August to the end of October. Their incidence was similar, and they were all detected in common throughout the month of September (Fig. 4). With above results we could make pollen calender for Seoul (Table 2).

In Table 3 are shown poplar pollen counts at the two different collecting sites. There were much higher counts of poplar pollen at the ground site than at the roof garden site, because the ground sampling station was located near a large popular tree.

DISCUSSION

Plant pollens, which are among the commonest allergens, have been investigated in many countries

Table 2. Pollen Calender for Seoul, 1984, 1985

Pollen	Month								
	2:	3:	4:	5:	6:	7:	8:	9:	10:
Alnus		———							
Populus			———						
Salix				———					
Quercus				———					
Acer				———					
Pinus				———					
Grasses				———	———	———		———	
Humulus								———	
Ambrosia								———	
Artemisia								———	

Table 3. Poplar Pollen Count Done at Two Different Collecting Sites in the Same Area for a Weeks of the 1984 Season

Date	April 1984.	7	8	9	10	11	12	13	14	15	16	17	18	19	20th
Poplar (grains/sq.cm)	Ground	8	21	18	15	39	10	31	193	146	51	13	94	56	7
	Roof	4	11	9	16	25	7	16	12	8	9	2	14	7	3

(Al-Doory *et al.* 1980; Amin *et al.* 1977; Anderson *et al.* 1978; Cua-Lim *et al.* 1978; Grammer *et al.* 1982; Halse 1984; Hendrix *et al.* 1980; Raynor *et al.* 1975; Reiss *et al.* 1976; Singh 1982; Solomon 1984). In Korea there are records of studies related to airborne pollens found in this country (Joo 1965; Kim 1973; Min 1984).

In 1965 Joo had investigated pollinosis and surveyed the air for collecting data on pollen in a different part of Seoul from where we took our samples. She had used Blackely's slide method, and gentian violet as the stain in collecting the pollen grains and concentrated her attention much more closely on tree pollens and less on weeds.

In 1984 Min identified pollen grains collected on glycerine-coated slides by means of a specific gravity collector. In his report mentioned that he had found that there were many pollens of ragweed and sagebrush in the atmosphere in September and concluded that these are probably important allergens each year in that month. This count has supported most of Hong's suggestion, based on clinical observation, that late summer-early autumn pollinosis in Korea is brought on by the presence of sagebrush in the air (Hong *et al.* 1981; 1982). Min did not note pollens of Japanese hop. We found that there were the pollen counts of Japanese hop similar to those of ragweed and sagebrush during weed pollen season.

Japanese hop is a weed native to Korea, as sagebrush is, and different from ragweed which is thought to be a weed imported from America. It may be found growing in vacant lots in urban and uncultivated rural areas. It is known to be an important allergenic pollen in Japan (Saito 1980). Therefore, Japanese hop just as sagebrush and ragweed are, would be considered to be an important allergenic weed in Korea.

The incidence of pollen in the air is affected by rainfall, of course; rain clears pollen from the air very effectively, and this causes a day-to-day variation in the level of airborne pollen. In Seoul, there are frequent rainfall in the spring, and a long and heavy rainfall occurs for nearly a month beginning, more or less, in the early part of July. It results in a variation in the start of the pollen season in the spring and in the time of the disappearance of tree pollen in July. Although, however, typhoons occasionally occur in August or September, the typhoon season seems to have little effect on the number of allergenic pollens in the air.

There are two distinct pollen seasons in Seoul. Trees are the chief pollen contributors in the first of them between early March and June, while weeds are the major pollen producers during the second, the month of September.

The pollen season of 1984 was somewhat delayed because of unusually cool spring weather. In 1985 there were unusually frequent rains, especially during late summer and autumn, correlating with the lower pollen count of grasses and weeds during September (Fig. 2). During September it rained 6 days in 1984 and 15 days in 1985.

Davis in 1969 and Michel *et al.* in 1976 reported that they had found that the airborne pollen concentrations not only revealed seasonal and annual variations according to the atmospheric condition prevailing, but exhibited significant fluctuations from site to site. In our study the much higher densities of popular pollen at the ground station than those at roof garden station can quite probably be attributed to the fact that the collector was neighbor to a big poplar tree. It could be speculated that a specific pollen can act as an important allergenic pollen under certain environmental conditions even though it is found in only scant amount in the air in general.

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