# A 12-MONTH AEROBIOLOGICAL SURVEY OF POLLEN IN RIYADH

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أظهرت دراسة على مدى ١٢ شهرا على الأحياء الهوائية المنتشرة في غبار الرياض أن لانتشار غبار الطلع ذروتين، ذروة الربيع في شهر مارس وأبريل ومايو. وذروة الخريف في شهر أكتوبر. تم تسجيل أعداد كبيرة من أجناس النباتات، بما في ذلك كل من الأنواع المحلية والمستجلبة. كانت سحب الغبار تحجب لقاحات النباتات أحيانا أو تتلفها، فتعيق التعرف عليها. أظهر عد غبار الطلع في متر مكعب على مدى ساعة واحدة إبان الذروة وجود ١٣ نوعا في عد واحد على الأقل وأغلب هذه الأنواع تجاوزت في مرات متعددة الحد المتعارف عليه سريريا وهو من ١٠ إلى ٢٠ حبة في كل متر مكعب. كانت الأنواع مرتبة حسب الأكثر شيوعا إلى الأقل تواردا تشمل نباتات رجل الوزة (والتي تشمل شحم العشب)، الحشائش، نباتات لسان الحمل، نبات الشيبة والعنبرية. كانت الحشائش ونباتات رجل الوزة تفرز اللقاحات على مدى ١١ إلى ١٢ شهرا في العام. نعرض الآن تقويما فصليا لغبار الطلع الأصفر النباتي كدليل لمستأرجات محتملة في مختلف الأوقات خلال العام.

A 12-month aerobiological survey of pollen in Riyadh showed a double peak of pollen grains, a spring peak in March, April, and May and an autumn peak in October. A large number of genera were recorded, including both indigenous and imported varieties. Dust clouds at times obscured or damaged pollen grains, hindering recognition. Peak pollen counts per cubic meter in 1 hour showed that 13 genera on at least one occasion and most of these on many occasions exceeded the clinically significant levels of 10 to 20 grains per cubic meter. Genera in order from the most to least common were Chenopodiaceae (which includes the weed fat hen), grasses, plantain, *Artemisia*, and *Ambrosia*. Grasses and Chenopodiaceae released pollen 11 to 12 months of the year. A seasonal pollen calendar is presented as a guide to likely allergens at different times of the year.

Airborne pollen and fungal spores are common triggers of type I IgE-mediated allergic reactions in patients with rhinitis and bronchial asthma. The seasonal appearance of various pollen, such as ragweed and grasses, signals the onset of hay fever or pollinosis seasons. Essential to a diagnosis of pollen or mold-induced nasal or respiratory symptoms is clear information on which pollen or spores are present and at what times of the year.

While allergy skin-testing is widespread as a diagnostic tool in the Kingdom, an accurate chart of the seasonal appearance of pollen and fungi has not been reported for the different regions of Saudi Arabia.[1] To rectify this deficiency, a three-city aerobiological survey has been set up in Riyadh, Jeddah, and Al-Khobar.

This paper presents the results of a full year's survey of pollen in the Riyadh atmosphere delineating the various botanical families likely to contribute to inhalant allergies in the Riyadh region. Aero-allergological information on fungal

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spores has been published as a separate communication.[2]

## Methods

As described in a previous communication,[3] air was sampled on a continuous 24-hour basis with a Burkard 7-day volumetric spore trap mounted on the roof of a two-story building at King Faisal Specialist Hospital and Research Centre (KFSH & RC). At weekly intervals the collecting tape was removed and mounted on microscope slides, and the pollen were identified and counted in bands corresponding to hourly samples throughout the day.

Based on the air intake of the spore trap, a series of quantitative values were calculated for each pollen group including hourly, mean weekly, and mean monthly levels expressed as pollen grains per cubic meter of air sampled.

To aid in the identification of pollen, the study was supported by the collection of over 100 native plant species during their flowering season, and their pollen were mounted and stored as a reference set.

For periods of 3 months or more, a second spore trap was run in conjunction with the first trap, at King Abdulaziz University Hospital (KAUH) in an old, established central area of Riyadh, and later at King Khalid University Hospital (KKUH) in a zone of extensive, but newly planted gardens on the outskirts of the city.

## Results

Figure 1 shows total mean pollen levels recorded as the mean monthly count per cubic meter over the 13-month period from November 1986 through November 1987. Two pollen peaks are clearly defined, the first spring peak in March, April, and May as growth recommences after a short winter, and the second higher autumn peak in October, as the temperature falls from the heights of summer.

Many species contribute to the seasonal peaks, with both grasses and Chenopodiaceae as the largest groups in spring and Chenopodiaceae in autumn. When the maximal peak levels were compared by hour, sharp peaks or pollen clouds were seen with counts up to 10 times higher than

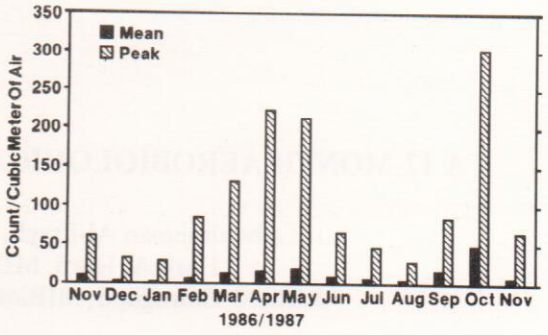


FIGURE 1. Mean and peak pollen levels.

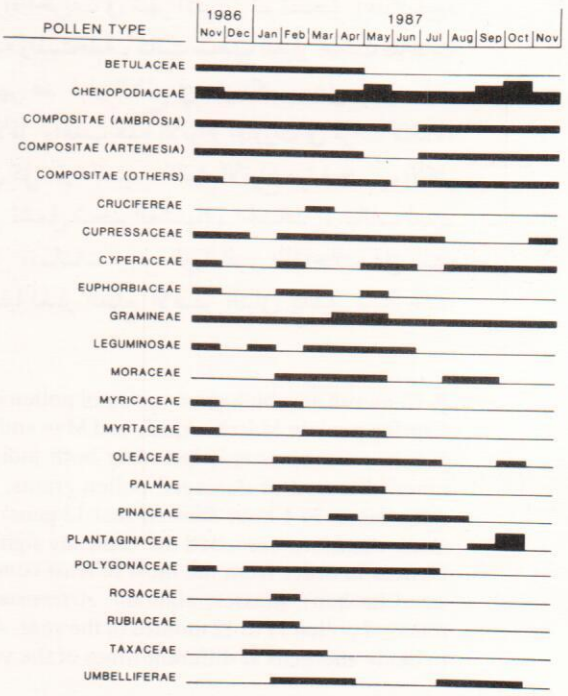


FIGURE 2. Semiquantitative guide to seasonal presence of pollen genera.

the monthly mean. Figure 1 summarizes the maximum peak counts each week showing hourly levels as high as 300 grains per cubic meter. At the time of each peak, however, neither of these two species represented more than 25% of the pollen at that time.

Up to 50% of pollen at any one time could not be identified because the grains were so damaged or obscured by dust impaction. Occasionally, pollen could not be identified, as they did not correspond to any reference material. Assuming that the pollen damage or obscuring was a random event, the identified grains would be present twice as

commonly as recorded. The many other genera contributing pollen are presented with a semiquantitative guide to their pollen season on Figure 2. Each pollen type contains representatives from a number of different species, and some of the common ones are listed in Table 1.

Pollen of one genus was commonly present in trap samples from KFSH & RC and KKUH but to date has not been identified. Further attempts are in progress to label this pollen which is clearly a ubiquitous plant in the region.

Plotting the hourly counts showed the impact of sudden changes in meterological factors such as humidity, wind speed, and direction. From 2 PM to midnight on 24 October 1987, hourly total pollen count averaged 13 grains per cubic meter. After midnight, the hourly count rose to over 100, peaking at 8 AM at 304 grains per cubic meter in 1 hour. In general, peak pollen clouds during autumn occurred in the early morning, usually persisting 5 to 6 hours. In springtime, the peaks, especially grasses, peaked later in the morning. For example, on 25 April 1987, the average total pollen count was 12 grains per cubic meter each hour between midnight and 10 and 11 AM. The spring peak was commonly shown, lasting 2 to 3 hours only.

To assess the relative clinical importance of the different pollen genera, the peak hourly count was recorded during each month and rated on the following scale: 1-15 grains per cubic meter = 1; 16-30 = 2; 31-45 = 3; and above 45 = 4. Adding the counts for the 2 months provided a rough index of maximal pollen levels and their persistence through the year. Table 2 presents these data ranking the pollen from the most to least common and listing the maximal hourly count during the year. While Chenopodiaceae, grasses, plantains, and *Artemisia* were the most common pollens, all 13 groups listed have, at one time during the year, produced hourly pollen counts above 10 grains per cubic meter.

A close examination of the hourly peak throughout the year shows that pollen from the Chenopodiaceae family have exceeded 10 grains per cubic meter in at least 1 hour during every month. Similarly, grasses were persistent throughout the year with a continuous background release failing in only 1 month, January, to achieve a peak of 10 grains per cubic meter. Other genera showed pollen for a few weeks each, such as Palmae, including date palms, whose pollen was present only in March, April, and May.

TABLE 1. *Families of pollen detected on Burkard spore slide and representative species found in the area.*

| Families of pollen detected | Representative species found in the area |
|---|---|
| Compositae | *Ambrosia, Artemisia* |
| Other Compositae | *Launaea capitata, Pulicaria glandulosa* |
| Chenopodiaceae | *Atriplex leucoclada, Hammada elegans* |
| Crucifereae | *Farsetia depressa, Diplotaxis harra* |
| Cupressaceae | *Juniperus procera, Cupressus semipervirens* |
| Cyperaceae | *Cyperus conglomeratus, Cyperus rotundus* |
| Euphorbiaceae | *Ricinus cummunis, Euphorbia retusa* |
| Gramineae | *Cynodon dactylon, Stipagrostis plumosa* |
| Leguminosae | *Acacia gerrardii, Prosopis farcta* |
| Moraceae | *Morus nigra, Ficus carica* |
| Myricacae | *Myrica salicifolia* |
| Myrtaceae | *Myrtus communis, Eucalyptus rostrata* |
| Oleaceae | *Jasminum florbunum, Olea chrysolohylla* |
| Palmae | *Hyphaene thebaica, Phoenix dectylifera* |
| Pinaceae | *Pinus* spp. |
| Plantaginaceae | *Plantago cylindrica, P. ciliata* |
| Polygonaceae | *Rumex vesicarius, Calligonum comosum* |
| Rosaceae | *Amygdalus arabica, Rosa abyssinica* |
| Rubiaceae | *Rubus arabicus* |
| Umbelliferae | *Daucus syrticus, Pimpinella cretica* |

TABLE 2. *Pollen type, frequency, and peak response.*

| Rank order | Pollen | Rate score* | Maximum level per cubic meter | Month of peak |
|---|---|---|---|---|
| 1 | Chenopodiaceae | 36 | 148 | October |
| 2 | Graminae (grasses) | 21 | 52 | May |
| 3 | Plantaginaceae (plantain) | 14 | 81 | October |
| 4 | *Artemisia* | 13 | 24 | November |
| 5 | *Ambrosia* | 11 | 14 | October |
| 6 | Other Compositae | 11 | 14 | May |
| 7 | Cyperaceae | 10 | 129 | May |
| 8 | Oleaceae | 9 | 29 | February |
| 9 | Betulaceae | 8 | 19 | November |
| 10 | Cupressaceae | 8 | 19 | March |
| 11 | Palmae | 5 | 33 | March |
| 12 | Polygonaceae | 5 | 24 | May |
| 13 | Leguminoseae | 5 | 19 | April |

* Rate score calculated on 12-month cumulative scores for each month, maximum grains per cubic meter in 1 hour rated; 1–15 = 1; 16–30 = 2; 31–45 = 3; and > 45 = 4.

*Artemisia* and *Ambrosia* constitute two very allergenic genera, known as mugworts and ragweeds, respectively. Both genera released pollen throughout the year at low levels rising to peaks in autumn when counts frequently exceed 10 grains per cubic meter.

Comparison between readings at the KFSH & RC and the other two sites showed some differences, with values at KAUH generally low and at KKUH comparable with KFSH & RC recordings. Mean monthly total pollen counts per cubic meter for KFSH & RC and KAUH, respectively, in May were 18.8 and 8.5; June, 8.8 and 4.7; July, 6.8 and 3.6; and August, 4.7 and 4.6. The same values for KFSH & RC and KKUH, respectively, were September, 17 and 23.5; October, 50.2 and 44.7; and November, 10.1 and 3.4.

## Discussion

The first comprehensive aerobiological survey of pollen in Saudi Arabia answers a number of questions by identifying the various genera of pollen, defining their seasonal appearance, and measuring their atmospheric concentration.

Clinical experience in recent years clearly emphasizes the real problem of rhinitis and bronchial asthma in the Kingdom; in both conditions inhalant allergic material is a well-recognized trigger. Davies and Smith,[4] studying the relation between pollen counts and severity of hay fever seasons in the United Kingdom, concluded that ambient grass pollen levels of 20 grains or more per cubic meter were associated with overt symptoms in virtually every specific-sensitive subject. Solomon and Mathews[5] placed the relevant level for ragweed pollen at 9 grains per cubic meter.

When the results of the present Riyadh pollen survey are examined in light of the adverse clinical consequences of generic pollen counts per cubic meter of 10 to 20 or above (and ground level readings will be substantially higher than the two-story levels recorded here), then the clinical impact is clear. Thirteen different genera or families produced pollen clouds exceeding 10 grains per cubic meter at least once, but usually on many occasions during the year. Grasses and Chenopodiaceae each achieved clinically significant levels (10 or above) 11 and 12 months of the year, respectively, rising dramatically to their spring and autumn peak of 50 or 100 or more. When these values are adjusted upward by as much as 100% to compensate for the large number of pollen grains counted but not identified, as they were either damaged or obscured by sand, the clinical impact is further emphasized.

Examination of the pollen season for the different genera provides data of clinical value when trying to relate patient symptoms to potential pollen exposure. Palm trees and members of the Cyperaceae family (perennial or annual herbs which grow widely in the Kingdom) exhibit short, sharp seasons. In contrast, grasses, despite the springtime peak, are releasing pollen throughout the year when the high ambient temperature combined with regular irrigation encourage year-round growth.

Of major importance for further study is the contribution of pollen from the genera *Artemisia* and *Ambrosia* with their potent allergenic lineage. Many species of each grow in Saudi Arabia, and as their pollen reaches peaks of 10 to 20 grains per cubic meter during 4 to 5 months of the year, recorded at two stories above the city, then much higher exposure would occur at ground level near these desert plants. No information is available concerning their allergenic cross-reactivity with the traditional ragweed and mugworts of the United States and Europe.

Leguminosae include *Acacia* and *Prosopis*, and both local and imported varieties have been extensively planted in Riyadh. Pollen grains reach levels of 10 or more per cubic meter during the springtime months, and very high levels of exposure would be expected adjacent to these trees.

The double pollen season, spring and autumn, is not unique, having been described in Arizona[6] and India.[7] But it represents a significant contrast to pollen patterns in temperate climates. The only other formal attempt to record pollen quantitatively in the region was reported in 1969 from Kuwait.[8] Davies showed Chenopodiaceae were by far the most common pollen, contributing 66% of total count, while grasses reached only 3% of total pollen, only occasionally reaching levels of 10 grains per cubic meter, a contrast from the picture in Riyadh in 1987. He also identified *Artemisia* and *Prosopis* in low numbers. From the same region, Wilkinson[9] showed a double inhal-

ant allergy season from patient consultations.

The clinical correlation of this study with skin testing allergic patients is almost complete and will be the subject of a separate communication.

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