

POLLEN MONITORING IN SOUTH AFRICA

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ABSTRACT

The study of allergenic pollen in South Africa began in 1928, but volumetric spore traps, to identify and count airborne allergenic pollen, only replaced the original gravity samplers in 1968. Hirst-type samplers have been used continuously in the Cape Peninsula since this time and short-term studies have been carried out in most major South African cities and some rural areas since 1987. Thus a broader knowledge of the allergenic pollen and fungal spore profiles is gradually being acquired. This is helpful to allergologists when selecting appropriate skin-prick and RAST testing panels, or immunising grass-sensitive patients, which must be done during the months when airborne grass-pollen levels are low. It is also useful to know the background pollen and fungal spore levels and seasonality when measuring inorganic pollutants for air quality studies. Furthermore, the timing of clinical drug trials is important, as some of these need to be conducted during the season of peak pollen concentration. Selected sampling areas from the Western Cape and Mpumalanga are discussed in terms of their pollen concentrations and fungal spore loads.

INTRODUCTION

Pollen is an important cause of seasonal allergy. Not all pollen taxa are allergenic; symptoms are usually caused by pollen from the anemophilous, or wind-pollinated plant species, rather than the sticky pollen from showy flowers, that use insects, birds or bats as vectors (Fig. 1). Pollens that cause seasonal symptoms are categorised as originating from trees, grasses or weeds. Of these groups, grass is by far the most important pollen allergen found in the sampled areas of South Africa so far. Peak tree pollen concentrations are commonly present from early spring until early summer, followed by the grass season, which varies according to the climate but occurs in early to midsummer. The weed season is less important, as major weed allergens like ragweed are not found in South Africa. Weeds pollinate in late summer and autumn.

Fungal spores, or moulds, are usually sampled concurrently with pollen grains, so that the pollen catch and fungal spore loads as well as their seasonal peaks, are noted for specific areas. In most areas measured, the fungal spore load is highest in spring and autumn, but it is useful to know the seasonal peaks for the allergenic fungi such as *Alternaria*, *Cladosporium* and *Epicoccum*, which have their own signature. In regions where midwinter temperatures drop to low levels, fungal spore levels decline accordingly.



Fig. 1. Insect pollination. *Xylocopa* (carpenter bee) pollinating *Aspalathus* sp.

In order to assess the concentration and seasonality of these airspora, various sampling systems are used. In South Africa, Burkard spore traps, imported from England, are ideal (Fig. 2). They may be run continuously and changed weekly. Pollen and spore counts are taken along representative samples of the prepared cellulose strip to which spores adhere. The counts are standardised, using parameters of the spore trap and the light microscope used for counting the airspora.

There are several reasons for assessing airspora levels. Clinicians treating seasonal allergy should know the pollen/fungal spore profile of the area in which they practise. Immunotherapy to grasses must be carried out when grass pollen levels are at their lowest. Clinical drug trials, designed to test preparations for the treatment of nasal or ocular symptoms, require pollen counts and must be carried out during peak pollinating



Fig. 2. The spore trap at Red Cross Children's Hospital.

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periods. Finally, a background level of aerosols of biological origin is necessary for air quality studies that need to assess inorganic pollutants and their possible role in respiratory disease.

Airspora monitoring has been carried out in and around a few major cities, but there are extensive areas in South Africa where nothing is known about airborne pollen and fungal spores. Airborne allergens vary according to different climate zones and vegetation belts. The range in South Africa is large, varying from the arid Nama Karoo in the west, to the subtropical KwaZulu-Natal in the east. Furthermore, varying weather patterns within these zones may affect the concentrations from year to year and this is reflected in the pollen catch. Therefore, unseasonal rain or severe drought, both of which occur in many regions, can affect the annual pollen and fungal spore levels.

SAMPLING AREAS

Pollinosis in South Africa and the effect of climate on pollen and fungal spores has long been of interest to allergologists. Ordman¹⁻⁵ emphasised this aspect of seasonal allergic rhinitis. He discussed the regional variation and the effect of climate zones on vegetation belts and thus airspora levels, focusing on the Highveld, a summer rainfall area.

Pollen sampling in South Africa has been intermittent in all regions except the Western Cape. Although several local or even national studies have been carried out, many of these are unpublished. Some areas where findings are available are discussed.

Gauteng

The Johannesburg, Pretoria and Vereeniging urban areas were monitored by Cadman and colleagues⁶⁻⁹ as part of a survey from 1987 to 1994. Airspora levels and their seasonality were described.

Johannesburg

Grass was found to be the most important pollen allergen and its peak pollinating season was from October to February, although grasses flowered throughout the year. Tree pollen was predominantly found from alien species, with the exception of *Celtis*. *Cladosporium* was the most important fungal allergen, followed by Basidiospores, *Periconia* and *Aspergillus/Penicillium*.

KwaZulu-Natal

Airspora monitoring in this province has been limited to the ports of Durban^{10,11} and Richards Bay, both of which are situated along the north-eastern coastline of the country, in a subtropical zone.

Durban

Durban enjoys mild winters and a high relative humidity, which favours fungal growth. *Cladosporium* was also the most important fungal allergen in this area, followed by Basidiospores. In this region skin-prick and RAST testing for fungal spores, such as *Alternaria*, *Aspergillus*, *Cladosporium*, *Epicoccum* and *Penicillium* are especially important. Grasses, Moraceae (mulberry tree) and the weed *Cannabis* dominated the pollen catch.

Mpumalanga

A 12-month baseline study to measure airspora at two sites in Secunda, a Lowveld area north-east of Gauteng, was completed at the end of June 2007. The

measurement of pollen and fungal spores formed part of an air quality study, designed to measure pollutants and bio-aerosols in the ambient air at two sites – Langverwacht and Secunda Club. Although these data are currently being analysed, some preliminary observations are worth mentioning.

The pollen rain at both sampling stations was slight and the tree, grass and weed seasons were all short. Tree pollen included Ulmaceae (possibly *Celtis*), Cupressaceae (cypress) and Oleaceae (olive). The tree season occurred in midsummer at both sites, during January. The grass season occurred after the first rains in this summer rainfall area and extended from January to March. The weed season occurred in autumn and included Asteraceae, a large family of daisy-like flowers which includes the indigenous *Cosmos*. Again it is not possible to identify particular species, but as Secunda is close to an area known as 'Cosmos Country', it would be reasonable to expect to find *Cosmos* pollen. This genus however, is insect-pollinated and therefore not trapped far from its source. Despite the fact that it is allergenic, it is not abundant in the air and is not an important allergen in this area. Chenopodiaceae (goosefoot), an allergenic weed, was also recorded from both sampling sites.

The fungal spore load from both sites was very high during spring and summer, peaking at 29 228 spores/m³ at the Secunda Club site. Significant levels were measured at both sites after the first rains. *Alternaria*, *Cladosporium* and *Epicoccum* were the most abundant fungal spores and each taxon showed a definite seasonality, dropping to low levels during the cold winter months.

Western Cape

The Cape Floral Kingdom is the richest known such kingdom in the world with 1 300 species/ 10 000 km.^{2,12} These indigenous trees and flowers are not usually wind pollinated, so the Cape pollen catch is dominated by grasses and alien tree pollen.

Cape Town

The metropolitan area of Cape Town is difficult to monitor because of the variation in climate, topography and even differing weather patterns within a small geographic area. Two of the sampled areas are described: Rondebosch, a suburb close to a mountain range, and Table View, which is on the sea. These areas have been sampled concurrently over a 10-year period. The two suburbs are only 15 km apart, yet their pollen profiles differ significantly. The spore trap at Rondebosch is mounted on the roof of the Red Cross Children's Hospital and the airspora levels have been used for many years in the diagnosis and treatment of children attending the Allergy Clinic. The Table View site on the West Coast was run from 1994 until 2004 by the City of Cape Town, as part of an air quality project.

Grasses. Poaceae (grass) is the major contributor to the pollen catch at both sites, but although these sites are relatively close to each other, the pollen levels and flowering seasons are quite different. The start of the grass season at Table View is always at least 10 days earlier than that of Rondebosch. The start of the grass flowering season in Table View, during this study period, fell between 19 September and 8 October while in Rondebosch it ranged from 8 to 21 October. During October, the peak month, grass levels were six times higher at Table View (Fig. 3). Many grass species found in the Cape have been introduced and naturalised. Grasses frequently seen on Rondebosch Common include; *Poa annua* (winter grass), *Avena barbata* and

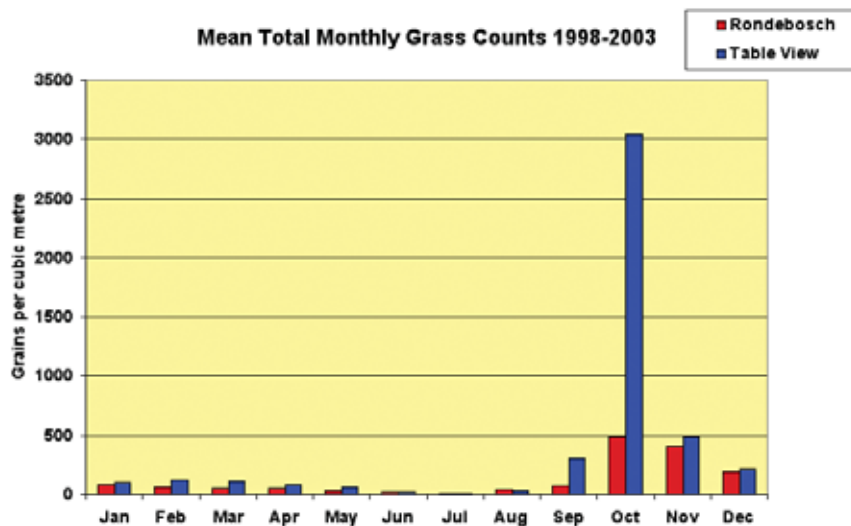


Fig. 3. Mean total grass counts 1998-2003: Total grass concentration (grains per m³) was measured daily and summed over the days of the month. This figure was averaged over 6 years for each month at each site.



Fig. 4. The grass *Briza maxima* (klokkies).

fatua, *Briza maxima* (Fig. 4) and *minor* (quaking grass), *Lagurus ovatus* (bunny tail), *Lolium perenne* and *temulentum* and *Cynodon dactylon* (Bermuda grass), flowering in this order as sunshine hours increase. African grass species are *Pennisetum clandestinum* (kikuyu) and *Stenotaphrum secundatum* (buffalo grass). Most northern hemisphere pasture grasses cross-react. *Cynodon dactylon* (Bermuda grass) is an exception as antibodies to this species do not cross-react with northern pasture grasses and a separate antigen for Bermuda grass should be used when skin-prick or RAST testing.

Trees. Tree pollen levels are four times higher in Rondebosch than in Table View, as the *Platanaceae* (plane tree) pollen levels are higher in Rondebosch. *Cupressaceae* (cypress) (Fig. 5) starts flowering as early as June at both sites, followed by *Quercus robur* (oak), in late July, *Platanus* (plane) in September and *Olea* (olive) in January. There are alien and indigenous species of cypress (*Widdringtonia*) and olive (*Olea europaea subsp. africana*) which undoubtedly contribute. Another indigenous tree, producing allergenic pollen is *Rhus* sp (kareeboom),¹³ which has become popular in public and private gardens. Significant levels for oak have not been recorded in Table View. *Acacia*, which is not wind-pollinated, rarely exceeds the significant threshold. *Pinus* (pine) releases pollen abundantly but is only weakly allergenic. *Podocarpus* (yellowwood) is seen in Rondebosch. The allergenicity of the local yellowwood species has not been assessed, but allergenic species of this genus exist in other countries.¹⁴

Weeds. *Plantaginaceae* (English plantain) (Fig. 6) is the most important weed allergen in Rondebosch, followed by *Chenopodiaceae* (goosefoot), the levels of which are higher in Table View than in Rondebosch. The weed season, in late summer and autumn, is less important in South Africa than elsewhere as *Ambrosia artemisiifolia* (ragweed), a significant weed allergen in North America and parts of Europe, is not present. The indigenous *Restionaceae* (reed) and *Myricaceae* (waxberry) reach significant pollen levels in Table View. *Urtica* sp. (nettle) flowers in spring and early summer at both sites, but reaches significant levels in Rondebosch only.

Fungal spores. *Alternaria*, *Cladosporium* and *Epicoccum* are the most abundant fungal spores trapped in Rondebosch. Allergenic levels of these



Fig. 5. Cypress trees. Indigenous and introduced species are found in South Africa.

spores are also seen in Table View, while *Basidiospores* (mushrooms) are higher in Table View than in Rondebosch in autumn. *Aspergillus* and *Penicillium*, which are indistinguishable under a light microscope, occur at both sites.

DISCUSSION

Grass is the most important pollen allergen in all of the sampled areas discussed here. Although the tree season is short, it should be taken into account when seasonal symptoms are displayed. Fungal spores also need to be considered as some strong seasonal patterns, with significant fungal spore levels, were seen in



Fig. 6. English plantain, *Plantago lanceolata*, a common Cape weed.

Mpumalanga and in the Western Cape. Perennial rhinitis is usually attributed to house-dust mite sensitivity. However, in humid areas like Durban, this could also be caused by sensitivity to fungal spores.

In Europe and North America, pollen levels are predicted, using calculations that incorporate the weather forecast, as well as current and previous pollen counts.¹⁵ In Melbourne Australia, only grass levels are predicted and the predicted and actual values are published.¹⁵ In South Africa, predicted grass levels would be helpful for clinicians treating allergy, by using a pollen-monitoring network. In flat areas like Bloemfontein, one pollen sampler would cover a 50 km radius.

In Cape Town, because of the geographical variation, it would be necessary to operate a local network of sampling stations, using standardised sampling methods and identical samplers. Weather parameters would need to be monitored at each sampling station and the pollen forecast calculated individually. There is only one weather forecast for Cape Town, but it is obvious that different patterns occur, as rainfall figures vary quite widely in different areas. In keeping with other studies, grass flowers earlier in coastal areas than inland.¹⁶

Ideally, pollen samplers could be operated in all the major cities of South Africa, in a collaborative exercise between allergists and the botany or palynology departments of the local universities. In this way, a pollen network for South Africa could be established, similar to those on other continents.¹⁷ This would benefit patients and clinicians alike in the diagnosis and management of seasonal allergic rhinitis and related symptoms.

Declaration of conflict of interest

The author declares no conflict of interest.

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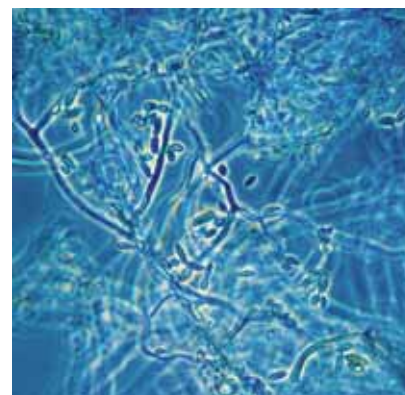
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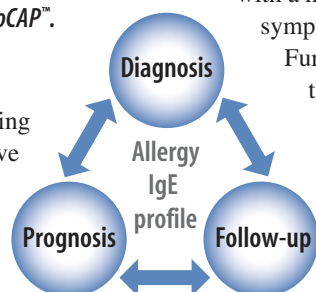
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