Understanding Pollenosis

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Highlights / Hoogtepunte

- About 6 million South Africans suffer from pollenosis.
- Which plants in South Africa are allergenic and which of them are not?
- Understand pollen the inducers of allergic diseases like hayfever, allergic rhinitis, conjunctivitis and asthma!
- Ongeveer 6 miljoen Suid Afrikaners ly aan hooikoors.
- Watter plante in Suid-Afrika is allergenies en watter is nie?
- Verstaan stuifmeel - die induseerders van allergiese toestande soos hooikoors, voortdurende allergiese rinitis, konjunktiwitis en asma.

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INTRODUCTION

Pollens are important causal agents in sensitising allergic patients and inducing the symptoms of allergic diseases such as hayfever, persistent allergic rhinitis, conjunctivitis and asthma.

HISTORICAL PERSPECTIVE

Prehistoric pollen has been identified in rocks millions of years old. Fifty thousand year old pollen recovered from the gravesites of Neanderthal people in modern day Iraq, indicate that man has been exposed to pollen since he was created. However, it was only in the 17th Century that pollens were first identified under the microscope.

The first European to describe symptoms of seasonal allergy was Leonardo Botallo (1519-1597)[1] who described a constellation of symptoms including headache, sneezing and an itchy nose which he, in fact, termed "nose catarrh".

In 1819 John Bostock, from Liverpool, England, who had suffered from annual recurrent nasal and ocular symptoms since the age of 8 years and asthma like symptoms from the age of 16 years was the first to provide a classical description of hayfever.

It was, however, John Elliotson (1791-1808) who suggested that the hayfever was not caused by hay but by the pollen of plants. Later Blackley[1] invented a clockwork device that exposed sticky plates to pollen for a set time and by attaching his device to kites he could also assess the distribution of the pollen in the air above the ground. He also proved that pollen could induce symptoms of hayfever by inoculating his own conjunctiva and mucus membranes with pollen.

Although pollenosis was rare until the 20th Century it is now recognised as a post industrial revolution epidemic. Serial studies in Switzerland have indicated that, while hayfever was present in 0.26% of the population in 1926, by 1958 it was up to 4.8% and by 1993 up to 13.3%[2]. Similar increases in prevalence have been reported from Scotland, Japan, the USA and also urban and rural gradients worldwide.

ALLERGENIC POLLENS

Although there are 250,000 well described pollen producing plants, less than 100 are significant in terms of pollen allergy. To be allergic, pollen grains must:

a. contain antigens able to elicit a Specific IgE mediated response in atopic subjects,
b. be produced in high quantities,
c. be buoyant and carried for long distances in the air,
d. be produced by plants that grow in abundance.

Pollen grains develop in the anthers (male part of the plant) which are located at the top of the filaments and together these 2 parts are called the "stamen". It is the wind pollinated species which are most relevant from the allergological point of view. Plants which are pollinated by insects (e.g. orchids and roses) are endowed with nectar insects and brightly coloured petals to attract these insects are often large and sticky and thus do not become airborne and do not cause symptoms.

Climatic factors play a very important role in the production and dispersal of pollen. Some pollen producing grasses, such as perennial rye, have a worldwide distribution whereas others are regional. For example, Ragweed is widespread in the Americas, but is not a problem in Africa.

Similarly many of the trees inducing pollenosis in Europe (e.g. Birch, Alder) are not a problem in South Africa. In Japan, Cedar is an important pollen. Although Acacia species occur widely in Africa, the pollen produced by African Acacia species has not been found to be highly allergenic.

The size of the pollen determines whether or not it will produce symptoms

or not. Pollen grains need to be smaller than 50 microns to be carried by the wind.

The main allergy producing pollens are derived from the grasses (Poaceae). In South Africa, weeds are an uncommon cause of allergic symptoms, but in certain areas, trees are fairly important causes of symptoms (e.g. Johannesburg). Pollen grains greater than 10 microns are too large to penetrate the medium size and small airways and thus may cause rhinitis but not asthma. However, larger pollen grains can break up into submicronic particles in rainy and damp conditions following rupture of the granules upon hydration. These small particles typically cause asthma during thunderstorms[3].

Pollen grain allergens may also be transferred by physical contact to other small airborne particles such as diesel exhaust, which penetrate to small airways[4].

The grass family (Poaceae or Graminae) comprises over 600 genera and 10,000 species. Grass pollinates 2-3 weeks earlier at sea level than in mountainous regions. Atmospheric levels of grass pollen peak within 1-2 months of the start of the flowering season. In South Africa the grass pollen flowering seasons are often 8-10 months long.

The most important of the weeds, inducing pollenosis are the Compositae which has over 20,000 species including the Chenopodiaceae and the Urticaceae. Parietaria (Urticaceae) are particularly important in the Mediterranean areas (e.g. in Southern Italy).

POLLEN MONITORING

With the development of volumetric samplers, it has been possible to obtain data on the numbers and levels of pollen grains in the atmosphere worldwide. Usually pollen is collected on a transparent plastic tape, mounted on a drum, and covered with a thin layer of adhesive substance (e.g. Vaseline and Paraffin) about 2mm/hour for 7 days. Pollen is then identified under a light microscope and quantified.

The number of pollen grains counted on each sample is expressed as a daily average in pollen grains per cubic meter of air based on a known rate of airflow through the pollen trap. There are also other types of samplers which could be used for shorter sampling periods (e.g. 1-3 hours) which could be fitted with a series of glass fibre filters of different pore sizes which can fractionate the pollen in size classes.

To determine the allergen concentration in different particle size fractions, immunochemical methods such as IgG subclass RAST inhibition, ELISA, immunoblotting or chemic luminance may be used.

In South Africa pollen monitoring has been conducted in several of the major cities during the past 20 years and recently reviewed[5].

At present active ongoing monitoring of pollen in the South African atmosphere is only being conducted in a handful of localized sites. However, botanical data obtained from the flowering calendars of major grass, weed and tree species are a useful practical guide for patients who suffer from the pollenosis (e.g. hayfever, persistent or intermittent rhinitis, asthma and rhinoconjunctivitis) as to when they are likely to be symptomatic, in the absence of actual day-to-day pollen monitoring data. Pollen calendars for the relevant species are published in the ALLSA Hand Book of Allergy[6]. Usually pollen counts of more than 50 grains per cubic meter indicate significant risk to allergy sufferers, but patient sensitivity is extremely variable and many patients suffer at lower counts. More local studies are needed.

POLLENOSIS IN THE SOUTH AFRICAN CONTEXT

There is a wide biodiversity in climatic conditions and pollenosis in South Africa. It is estimated that about 6 million South Africans suffer from pollenosis. Pollen profiles may be typical of Mediterranean, subtropical, savanna, grassland, semi-desert and arid regions. South Africa is home to 957 (10%) of the known grass species worldwide.

Although the Cape has over 2,622 different species in one of the richest floral kingdoms of the world, the indigenous African flowers (e.g. Fynbos) **(fig 1, 2, 3)** are not allergenic to any degree.

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Figure 1: Cape Pincushion

Figure 2: King Protea Cynaroides

Figure 3: Confetti bus

Figure 4: Kikuyu grass specimen

Pollens causing symptoms in South Africa include indigenous grass pollens such as *Eragrostis*, Buffalo and Kikuyu[7] as well as to Bermuda and Rye grasses, which are well known grass pollens elsewhere.

It is interesting that in rural Africans pollen allergy is extremely rare. However, when rural Africans move to informal settlements in peri urban areas and adopt a more Western Style of living, they rapidly acquire pollen allergies.

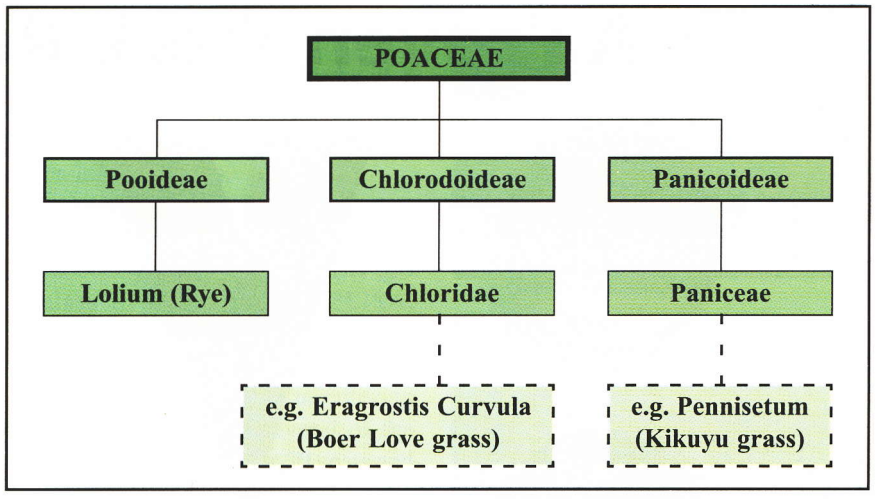
An important effect of cultivation of an African grass on its clinical allergenicity has recently been alluded to[7]. In the rural areas Kikuyu grass grows tall **(fig 5)** and is propagated by rhizomatous propagation. In the urban environment this handy grass is cut regularly for domestic lawns, sports fields or golf courses, particularly in the Gauteng area, and abundant pollen is produced in the mornings.

Figure 5: Tall uncultivated Kikuyu grass (Pennisetum Clandestinum)

Interestingly in the Cape, mainly female Kikuyu strands are found, a reason for less allergenicity of this grass in the Cape when compared to Gauteng and along the East Coast where male plants are abundant. Often male plants are introduced when cultivating large areas (e.g. golf courses) **(fig 6)** leading to more allergenicity than occurs in domestic gardens.

Figure 6: Short, cultivated male Kikuyu grass showing anthers

Table 1



Allergenic grass pollens in South Africa belong to 3 main subfamilies: Pooideae, Chloridoideae and Panicoideae **(Table 1).** Important species for testing for allergenicity include Lolium (Rye), eragrostis (Boer Love Grass), cynodon dactylon (Bermuda), zea mays (Maize), pennisetum (Kikuyu grass) and *stenotaphrum secundatum* (Buffalo grass) **(fig 7).**

Figure 7: Buffalo grass *(stenotaphrum secundatum)*, widespread along the East Coast of Southern Africa

Preliminary studies in the UCT Allergology Unit by Prescott and Potter have shown that grasses such as Kikuyu have both cross reactivity as well as unique IgE binding proteins[7].

Not all abundant pollen producing grasses are highly allergenic. Cadman et al[5] have reported extremely high levels of pollen production by thatch grass (*hyparrhenia hirta*) in the Gauteng area, but his grass pollen appears not to be an important cause of allergy symptoms such as rhinoconjunctivitis or asthma.

An abundant pollen producer which is indeed highly allergenic, is *eragrostis curvula* which is an indigenous African species which has been shown by immuno absorption experiments and RAST inhibition experiments in the Allergology Unit at the University of Cape Town to possess a number of cross reacting elements from the other major allergenic grass pollen producing species in South Africa.

Eighty per cent of pollen allergy sufferers in South Africa are sensitive to Bermuda grass pollens.

Flowers from the Compositae and chrysanthemums induce allergenic symptoms on a more limited scale in South Africa. English plantain does, however, occur quite extensively in the Cape and is an important cause of symptoms. It is, however, unusual for patients to complain of allergy symptoms when viewing the spectacular Namaqualand spring flower displays. These flowers often include succulents but a number of these flowering species belong to the Compositae.

The only true African tree species which appear to be allergenic are the Acacias, but to a very limited extent. In-house studies of allergenicity of Acacia pollen at the University of Cape Town Allergology Unit have identified only weak IgE binding elements in Acacia pollens to date.

The pollenosis from the alien Port Jackson tree imported from Australia **(fig 8)** and the colourful Jacaranda, especially in the Pretoria area, appears to be overestimated. These trees pollinate at the peak of the grass pollen season and it is believed that patients often falsely attribute their symptoms to

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Figure 8: Port Jackson Tree

these pollens as they are the pollens which are "visible". It is, however, the invisible airborne grass pollens which are the more important allergens in most of these cases and this is usually confirmed by specific allergy testing for the grass pollen specific IgE in such patients.

In a recent survey of South African Olympic athletes, it was found that Plane pollen allergy was present in about 15% of the athletes, followed by Oak pollen allergy[8]. Other causes of tree pollenosis in the Gauteng and Mpumalanga areas include the Cypress, Willow, Ulmus and in the Coastal areas of Natal Moracea (Mulberry) species produce the most abundant tree pollen in the spring. Tree pollens usually cause symptoms in well defined peaks between August and November, and symptoms are usually short lived.

Although the reeds (Arundinoideae) are abundant pollen producers and widely distributed in South Africa, their role in the induction of clinical symptoms has not been established.

APPLICATION OF POLLEN DATA IN SOUTH AFRICA

A wealth of information is available on the pollen production of the various grass, tree and weed species in South Africa. Pollen calendars of the allergenic pollens have also been published and are useful guides to patients as to when they can expect symptoms.

Strong allergenicity of indigenous pollens has been confirmed for *Eragrostis*, Kikuyu, Buffalo and weaker allergenicity for Acacia and Themeda species.

Ongoing research is important to identify and characterize the important allergens both for clinical sensitivity testing and for recommending immunotherapy.

Pollen monitoring in the atmosphere has an important role in the care of pollen sensitive patients. In the USA and in Europe pollen seasons are extremely well defined and reproducible, particularly for tree pollens (e.g. Birch), ragweed and panetaria.

In the Southern hemisphere (e.g. RSA, Australia, Argentina) pollen monitoring poses a more difficult challenge as the grass pollen seasons are typically long (8-10 months). In South Africa there are at least 5 distinct biomes and a wide variability in the Burkard spore trap data obtained, even when the sites are in close proximity.

This field needs to be developed and further refined in the future. Until this occurs patients and doctors will continue to rely on pollen calendars obtained from botanists and specific IgE test to guide both pharmacotherapy and immunotherapy in the foreseeable future.❐

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Please refer to the CPD Questionnaire on page 71.

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