

Airborne pollen sampling on the Caribbean Island of Trinidad and Tobago, WI

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Received: 29 December 2014 / Accepted: 1 June 2015
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Abstract Probable associations which exist between airborne pollen and respiratory diseases remain under-appreciated, particularly within the Caribbean region, due to limited research. In an effort to better appreciate these relationships, further investigation into local airborne pollen on a sustained long-term basis is required. As a first step, using a 7-day-recording volumetric spore trap, air sampling was carried out in the St. Augustine area on the Caribbean Island of Trinidad to expand the limited data presently available to allergists on local pollen varieties. This sampling was a component of broader research on the association between airborne pollen, Saharan Dust, and pediatric asthma. During the 2-year sampling period, several varieties of pollen were found and classified and are presented in this article. The photographic pollen image compilation created can be used as a baseline to further investigate the aerospora in Trinidad which can address the current lack of documented records of local airborne pollen, thereby improving local scientific knowledge in this area.

Keywords Pollen · Airborne pollen · Pediatric asthma · Trinidad and Tobago · Caribbean

1 Introduction

The onset of respiratory ailments can be stimulated by a wide variety of factors, one of which is the biological material, pollen. This has been demonstrated by various studies internationally which have suggested that increased pollen counts in the atmosphere aggravate and exacerbate those with respiratory diseases (D'Amato et al. 2000; Martin et al. 2002; Kadocsa and Juhasz 2002; Brunereef and Holgate 2002; Singh et al. 2002). According to Singh et al. (2002), pollen contains many proteins, but only a few of these have the ability to interact with the human immune system to cause allergic symptoms. Several studies have also explicitly demonstrated associations between allergenic airborne pollen and cases of pollinosis (hay fever) and asthma, as a result of airborne pollen from several species of weeds, grasses, trees, and field crops in the breathable atmosphere (Brunereef and Holgate 2002; Singh et al. 2002; Burt and Sharma 2002). This association between atmospheric pollen and allergenic disease has stimulated the formation of international agencies which focus on measuring and forecasting pollen counts on a daily basis with the intention of allowing the national population to be better informed so as to prevent the onset of respiratory ailments. As a result of the monitoring of airborne pollen, it has been found that pollen allergy seems to be typically a seasonal disease, often dependent on the flowering season of plants to which individuals are pollen sensitive (Kadocsa and Juhasz 2002). This type of

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monitoring is not observed within the Caribbean region or at a national level.

From a Latin-American and the Caribbean perspective, a few studies to identify airborne pollen and expand the sparse data available to allergists have been undertaken in Columbia, as well as in Caracas, Venezuela, which is close to Trinidad and Tobago. Hurtado and Riegler-Goihman (1984) reported that the diagnosis and treatment of many allergic respiratory conditions in Caracas were based on skin and laboratory tests from temperate countries, which reflects the lack of information on airborne pollen not only in Venezuela, but in the rest of tropical America.

This is consistent with the approach to the diagnosis and treatment of many allergic respiratory conditions in Trinidad and Tobago as little information on local varieties of pollen is currently available to medical practitioners. This showcases the need to expand the local pollen data set to allow for more accurate diagnosis of allergic respiratory illnesses.

Given the vast local flora in terms of species, much of which is to still be classified, collecting and identifying local pollen species is quite a daunting undertaking. To date, there has been no continuous long-term monitoring of pollen in the atmosphere in Trinidad and Tobago. As a result, there is little or no documented information about airborne pollen, local or exotic for the country, with specific regard to the types of pollen, and their relative abundance, both of which require some level of investigation at a local level. In addition, there is limited information on local flowering patterns in relation to pollen dispersal, and further research is required to determine the flowering pattern exhibited by plants in Trinidad and Tobago. This sampling of airborne pollen which was a component of a broader research study on the association between airborne pollen, Saharan dust, and pediatric asthma presented a good opportunity, as a first step, to contribute to information on airborne pollen found in St. Augustine, Trinidad, and assemble a photographic reference file of airborne pollen on which further studies of local pollen could be based.

2 Method

The study was conducted on the tropical Island of Trinidad which is situated at the southern end of the Caribbean chain approximately 11 km from Venezuela.

Pollen samples were collected during the period March 2006 to November 2007, 24 h a day, 7 days a week, at the University of the West Indies Campus (UWI) in St Augustine Trinidad, using a “Burkard 7-day-recording volumetric spore sampler” with a sample flow rate of 10 l/min (Burkard Manufacturing Co., Rickmansworth Hertfordshire, England).

The sample period incorporated the wet and dry seasons on the island. The dry season was recorded as January–May and the wet season as June–December, which are the periods used by the Meteorological Services Division in Trinidad and Tobago. The sampler was placed at the top of the Life Sciences Department at the University of the West Indies, St. Augustine, approximately 60 ft above ground level, in an area that was not shadowed by vegetation or buildings to prevent obstruction of the air stream. The site locations and orientation of sampling equipment complied with standard requirements and protocols (Ogden et al. 1974; Rogers and Muilenberg 2000).

A trial of the various adhesives which were recommended for hot climates was conducted. Based on this, silicone grease was found to be the most effective adhesive for trapping pollen and was, therefore, selected as the adhesive to be used in this study (Galán and Domínguez-Vilches 1997). Calberla's stain was used to recognize pollen grains as this stain is specific for staining pollen exine (Ogden et al. 1974). Pollen grains were analyzed using a twelve-transverse counting method, and pollen concentrations were recorded as pollen grains/cubic meter of air sampled per day (Rogers and Muilenberg 2000). Pollen identification was done using various pollen atlases. Photographs of the pollen were taken with a light microscope using $\times 40$ objective lens. As a first approximation, the pollen grains were categorized by the most obvious morphological features (Ogden et al. 1974). Further identification was done using illustrations and reference texts (Colinvaux et al. 1999; Jelks 2001). The identification of the pollen grains included size of grain (P/E) μm , shape, and surface morphology.

3 Results and discussion

The results show that within the sample area, airborne pollen is present in the ambient environment during all months of the year and that there are variations by month in the atmospheric concentrations of pollen.

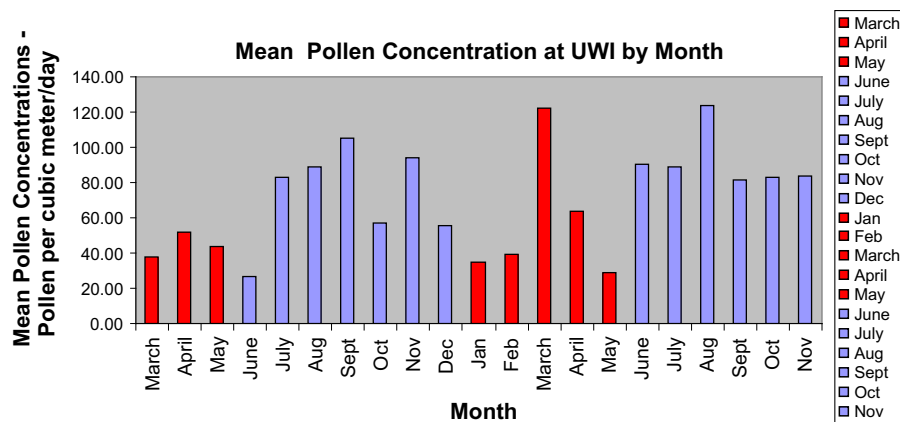


Fig. 1 Mean pollen concentration at the University of the West Indies (UWI) by month (red—dry season; blue—wet season)

This is consistent with studies by Arobba et al. (2000) and Kadocska and Juhasz (2002) who also identified various pollen types in airborne samples throughout the year. Increases in the volume of pollen sampled at UWI during certain months of the wet season were observed, specifically in the months of July, August, September, October, and November in 2006, and in the months of May, June, July, August, September, and November in 2007. This is consistent with research by Blades et al. (2001) which noted work in Barbados identifying pollen peaks in the latter half of the year, in particular September to October, as well as, work in Venezuela which found peaks in pollen in November (Hurtado and Riegles-Goihman 1984). Kadocska and Juhasz (2002) also noted in their study in South Hungary that the flowering period for certain species of weeds is August—September. The peak in pollen at UWI suggests that some flowering activity may be occurring locally during this latter period of the year. There is limited information on local flowering patterns in relation to pollen dispersal, and further research is required to determine the flowering pattern exhibited by plants in Trinidad.

The wet season in Trinidad showed higher pollen concentrations than the dry season, with the exception of March 2007, which was a month of high pollen concentration during the dry season. In the dry season, a mean pollen concentration of 53 pollen per cubic meter/day was observed, and in the wet season, a mean pollen concentration of 82 pollen per cubic meter/day was observed. Given the nature of the wider research, pollen counts were conducted for all the pollen grains observed in the sample and not counted separately by

various pollen types. Figure 1 illustrates the mean pollen concentration at the UWI site by month. The finding that high concentrations of pollen were observed in the wetter periods of the year is consistent with previous regional research in Barbados (Blades et al. 2001) and Venezuela (Hurtado and Riegles-Goihman 1984), which shows that pollen concentration increases in the months of September and November, which are traditionally wet season months in these areas.

Pollen belonging to the families Pinaceae, Poaceae, Asteraceae, Fabaceae, Leguminosae, and Urticaceae was observed through preliminary identification (Colinvaux et al. 1999; Jelks 2001). *Cecropia*, of the Urticaceae family, was found throughout the sample period and in high abundance in months with high pollen counts, which is consistent with previous work in Caracas Venezuela, which noted that *Cecropia* pollen was the most abundant grain throughout the sample year, and the numbers of pollen grains recorded of this suspected allergen were well above those deemed necessary for human sensitization (Hurtado and Alson 1995).

As no compilation of pollen images exists for Trinidad, the opportunity was used to attempt to create a compilation of images of pollen grains observed on the samples. Table 1 shows photographs and descriptions of a sample of pollen recorded at the UWI sampling site.

From the results, and given the rich and vast variety of tropical flora found on the island, it may be concluded that only a relatively low portion of the flora contribute to the aerospora. This is supported by

Table 1 Descriptions of a sample of pollen recorded at the University of the West Indies Trinidad sample site

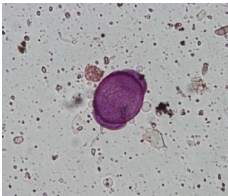
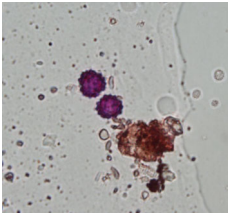
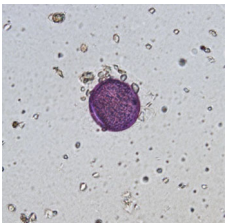
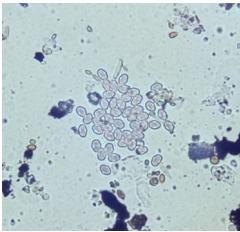
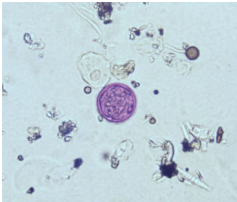
Image	Identification	Number of grains	Size of grain (P/E) μm	Shape	Surface morphology
	Pinus	Monad	40/62.5	Vesiculate	Furrow located at the bottom between bladders
	Asteraceae	Monad	20/20	Spheroidal	Short spines and conical in shape
	Poaceae	Monad	40/40	Spheroidal	Thin exine, granular surface, one pore surrounded by an annulus
	Urticaceae (<i>Cecropia</i>)	Monad	10/5	Ellipsoidal	Two pores protruding, smooth exine
	Picea	Monad	57.5/55	Vesiculate	No constriction at junction between bladder and body of the grain. Bladders mounted closer to furrow at bottom
	Poaceae	Monad	30/30	Spheroidal	Smooth exine, granular surface, one pore surrounded by annulus

Table 1 continued

Image	Identification	Number of grains	Size of grain (P/E) μm	Shape	Surface morphology
	Podocarpus	Monad	47.5/20	Vesiculate	Bladders attached in same plane as ridges
	Leguminosae	Polyad	125/100	Ellipsoidal	Polyad grain
	Fabaceae (genus Acacia)	Polyad	37.5/32.5	Ellipsoidal	Polyad grain

the finding that only a limited number of species were captured in the sampling study. Though the airborne pollen species appear to be low, the few species that are identified in the sample consist of allergens from other regional studies (Hurtado and Alson 1995). The work in this study highlights the need for a comprehensive pollen survey of the island of Trinidad and Tobago including but not limited to airborne pollen to create a more accurate and complete understanding of the local aerospora, including those that produce airborne pollen which may be possible allergens. It is evident from the relatively small variety of pollen found that any attempt to develop a pollen atlas for Trinidad and Tobago will require intensive ground sampling of flora in conjunction with airborne volumetric sampling.

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