POLLEN ALLERGY AND ITS MANAGEMENT: AN ACCOUNT OF COMMON ALLERGENIC PLANTS FROM SOUTHERN INDIA - A REVIEW

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ABSTRACT
The incidence of respiratory allergy is increasing all over the world with India being no exception. The air we breathe today is intoxicated with chemical pollutants and also loaded with bio pollutants. Pollen is well studied as allergens among all other aeroallergens. Pollen allergy is one of the most widespread diseases among urban populations. Hence it is necessity to know various pollen allergens, plants producing allergic pollen, and also the seasonal periodicity of pollen. This review article aims to evaluate the published literature for understanding the different aspects of pollinosis, to list out various plants responsible for pollen allergy from South Indian cities, and to develop prominent guidelines for allergy management. A total of 29 species of pollen types were documented. Of the total, 25 species belong to dicotyledons and 4 species belong to monocotyledons. A majority of the pollen that cause allergy are from trees. In conclusion, the present work elaborates on the impact of pollinosis, factors triggering pollinosis in urban areas, the measures to be taken to avoid allergic symptoms, and healthy practices that can be followed to treat pollinosis.
Key Words: Southern India, Pollinosis, Aeroallergens

INTRODUCTION
India is a climatically diverse country and possesses great variety of flora owing to different geographical and edaphic factors (Singh & Pawan Kumar, 2002). As described by the Botanical Survey of India, the country stands tenth in the world and fourth in Asia in plant diversity with 47,000 species. This diverse vegetation attributes discrete pollen concentration in the atmosphere. Apart from this, different plant species have been introduced in towns and cities as part of various afforestation practices. Such unscientific urban planning activities have led to various allergic diseases.

Pollen as Allergens
Pollen grains caught the attention of scientists in the 18th century, when J. Koelreuter reported the dispersal of pollen by wind (Singh & Dahiya, 2008). Several scientists in the 19th century devised equipment to examine airborne biological particles. Aerobiological monitoring became standardized during the 20th century owing to the increased prevalence of respiratory diseases (Gill et al., 2017). Modern advances in the molecular analysis could improve the information for allergy sufferers and healthcare professionals (Smith et al., 2014). At present, various aerobiological surveys reveal that pollen grains from plants are among the most important allergens loaded in the air and the major source of morbidity among sensitive individuals (Singh & Dahiya, 2008). During flowering seasons, pollen concentration increases in the air and as people breathe in these pollen, their body’s immune system gets triggered to release antibodies and attack the allergens. Among all the allergic reactions, pollinosis is the most common type of allergic response in humans, wherein histamines are released in the blood which leads to symptoms like itchiness, watery eyes, sneezing, runny nose, itchy sinuses or throat, ear congestion and postnasal drainage.
by the production of high amounts of mostly anemophilous pollen and these are grouped as (i) Trees (Pinales, Rosales, Myrtales, Arecales, Salicales, Junglandales, FAGales, Scrophulariales) (ii) Weeds (Asteraceae, Chenopodiaceae and Urticaceae) and (iii) Grasses (Poideae, Bambusioideae, Arundinoideae, Chloridoideae) (Michael et. al., 2010).

Factors triggering pollen allergy in Urban Areas
The extensive pollen allergenicity in urban areas is due to low species diversity at planting, the overabundance of given species, the choice of dioecious species, wide-spreading nature of invasive species and the interaction between pollen and air pollutants (Paloma & Manuel, 2011). Meteorological parameters like air temperature, wind, sunlight, and rainfall together with carbon dioxide are crucial in suspension, transportation, and spread of pollen grains. An increase in temperature and humidity results in ‘allergen load’ in the air mass. Hence, a review has been made to study various aspects of the most commonly occurring allergy, allergic rhinitis (Pollinosis), in the urban areas of Southern India, particularly with reference to its aetiology. The specific objective of the review is to go for a compilation of useful guidelines, which can be followed for effective allergy management.

MATERIALS AND METHODS
A detailed review of literature on pollen allergy was undertaken. An assessment of data on various aerobiological surveys and pollen calendars in Southern India was carried out. The taxa were identified with the help of floras. The All India Co-ordinated Project (AICP) on “Aeroallergens and Human Health” has been referred, which provided inputs for the evaluation of facts and to derive valuable conclusions. The guidelines are proposed after compilation of available data. The photographs of the species are also provided.

RESULTS AND DISCUSSION
The pollen morphology of 29 plant species has been identified and studied. The allergic pollen types include 10 species of herbs, 3 species of shrubs and 16 species of trees. 24 species belong to dicots and 4 species to monocots and 1 Gymnosperm species. Majority of the pollinosis associated pollen are from the family Fabaceae, with 5 species, followed by 4 species of Asteraceae and Mimosaceae each. Of the total dicots, 6 species belong to Polyetela, 3 to Gamopetela and 4 to Monochlamydae. The pollen characteristics and seasonality of the species identified are enumerated. A list of important allergenic plants from Southern India is provided in Table 1. The photographs of the species are provided in Plate I. Various guidelines for allergy management are also listed.

Enumeration:

1. *Acacia arabica* (Lam.) Willd. (Plate Ia) Pollen grains in polyad, polar outline circular, equatorial outline elliptic, surface foveolate. Fl.: spring season
2. *Ageratum conyzoides* L. (Plate Ib) Pollen grain in monad; polar outline triangular obtuse convex, prolate spheroidal; radial symmetry; tricolporate; sculpturing spinulate, densely and faintly distributed; spine blunt at tip. Fl.: August - February
3. *Ailanthus excelsa* Roxb. (Plate Ic) Pollen grain oblate spheroidal, amb sub-triangular, 3-zonocolporate, angulaperturate, Lalongate, exine finely reticulate. Fl.: February - June
4. *Albizia lebbeck* (L.) Benth. (Plate Id) Pollen grains clustered in spherical polyads, heteropolar, outline quadrangular in polar view, 3-zonocolporate, exine-psilate, perforate, foveolate. Fl.: March - May
5. *Amaranthus spinos* L. (Plate Ie) Pollen grain spherical, aperture-dicolpate and monolete, microrugulate and psilate ornamentation. Fl.: December - April
6. *Artemisia sieversiana* (Ehrh.) Willd. (Plate If) Pollen grain oblate spheroidal, exine somewhat echinate, spines minute and rudimentary. Fl.: August - October
7. *Brassica nigra* L. (Plate Ig) Pollen grain oblate or suboblate, tricolpate, exine surface reticulate, endexine warty, regular-heterobronchate pattern. Fl.: June - August
8. *Cassia fistula* L. (Plate Ih) Pollen grain oblate spherical, amb circular, 3-zonocolporate, circulaperturate, Os Lalongate, exine punctitegillate. Fl.: May - June/July
9. *Casuarina equisetifolia* L. (Plate II) Pollen grain oblate spheroidal, amb triangular with slightly convex sides, 3-zonoporate, occasionally 4-zonoporate, exine psilate. Fl.: February - June
10. *Cedrus deodora* (Roxb.) G. Don (Plate Ij) Pollen grain diploxylonoid type, bisaccate, reticulate pattern. Fl.: September - October
11. *Chenopodium album* L. (Plate Ii) Pollen grain isopolar, radially symmetrical, peripolyporate, spherical and 3-12 conical tuberculate on pore of pollen surface, exine perforate. Fl.: February - April
12. *Delonix regia* (Boj. ex Hook.) Raf. (Plate II) Pollen grain oblate, spheroidal, amb circular to
Table 1. List of plants causing Pollinosis

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Binomial</th>
<th>Common Name</th>
<th>Family</th>
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<tbody>
<tr>
<td>DICOTS</td>
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</tr>
<tr>
<td>a.</td>
<td>Acacia arabica (Lam.) Willd.</td>
<td>Indian gum Arabic tree</td>
<td>Mimosaceae</td>
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<tr>
<td>b.</td>
<td>Ageratum conyzoides L.</td>
<td>Billy goat weed</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>c.</td>
<td>Ailanthus excelsa Roxb.</td>
<td>Indian tree of heaven</td>
<td>Simaroubaceae</td>
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<tr>
<td>d.</td>
<td>Albizia lebbeck (L.) Benth.</td>
<td>Woman’s tongue tree</td>
<td>Mimosaceae</td>
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<tr>
<td>e.</td>
<td>Amaranthus spinosus L.</td>
<td>Mexican poppy</td>
<td>Amaranthaceae</td>
</tr>
<tr>
<td>f.</td>
<td>Artemisia sieversiana (Ehrh.) Willd.</td>
<td>Sieversian worm wood</td>
<td>Asteraceae</td>
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<tr>
<td>g.</td>
<td>Brassica nigra L.</td>
<td>Black mustard</td>
<td>Brassicaceae</td>
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<td>h.</td>
<td>Cassia fistula L.</td>
<td>Golden shower tree</td>
<td>Caesalpiniaceae</td>
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<tr>
<td>i.</td>
<td>Casuarina equisetifolia L.</td>
<td>Beefwood tree</td>
<td>Casuarinaceae</td>
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<td>j.</td>
<td>Cedrus deodora (Roxb.) G. Don</td>
<td>Deodar cedar</td>
<td>Pinaceae</td>
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<tr>
<td>k.</td>
<td>Chenopodium album L.</td>
<td>Goosefoot</td>
<td>Amaranthaceae</td>
</tr>
<tr>
<td>l.</td>
<td>Delonix regia (Boj. ex Hook.) Raf.</td>
<td>Royal poinciana</td>
<td>Caesalpiniaceae</td>
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<tr>
<td>m.</td>
<td>Eucalyptus globulus Labill.</td>
<td>Blue gum tree</td>
<td>Myrtaceae</td>
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<td>n.</td>
<td>Gynandropsis gynandra (L.) Briq.</td>
<td>Spider flower</td>
<td>Cleomaceae</td>
</tr>
<tr>
<td>o.</td>
<td>Holoptelea integrifolia (Roxb.) Planch.</td>
<td>Indian elm</td>
<td>Ulmaceae</td>
</tr>
<tr>
<td>p.</td>
<td>Marchamia lutea (Benth.) K. Schum.</td>
<td>Nile tulip tree</td>
<td>Bignoniacese</td>
</tr>
<tr>
<td>q.</td>
<td>Mallotus philippensis (Lam.) Muell.-Arg.</td>
<td>Kamala tree</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>r.</td>
<td>Mimosa pudica L.</td>
<td>Sensitive plant</td>
<td>Mimosaceae</td>
</tr>
<tr>
<td>s.</td>
<td>Parthenium hysterophorus L.</td>
<td>Congress grass</td>
<td>Asteraceae</td>
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<tr>
<td>t.</td>
<td>Peltophorum pterocarpum (DC.) K. Heyne</td>
<td>Copper pod tree</td>
<td>Caesalpiniaceae</td>
</tr>
<tr>
<td>u.</td>
<td>Prospis juliflora (Sw.) DC.</td>
<td>Mesquite</td>
<td>Mimosaceae</td>
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<tr>
<td>v.</td>
<td>Ricinus communis L.</td>
<td>Castor</td>
<td>Euphorbiaceae</td>
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<tr>
<td>w.</td>
<td>Salvadoria persica L.</td>
<td>Tooth brush tree</td>
<td>Salvadoraceae</td>
</tr>
<tr>
<td>x.</td>
<td>Syzygium caryophyllatum (L.) Alston</td>
<td>South Indian plum</td>
<td>Myrtaceae</td>
</tr>
<tr>
<td>y.</td>
<td>Tridax procumbens L.</td>
<td>Coat buttons</td>
<td>Asteraceae</td>
</tr>
</tbody>
</table>

MONOCOTS

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Binomial</th>
<th>Common Name</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cocos nucifera L.</td>
<td>Coconut tree</td>
<td>Arecaceae</td>
</tr>
<tr>
<td>2.</td>
<td>Pennisetum pedicellatum Trin.</td>
<td>Desho grass</td>
<td>Poaceae</td>
</tr>
<tr>
<td>3.</td>
<td>Phoenix dactylifera L.</td>
<td>Date palm</td>
<td>Arecaceae</td>
</tr>
<tr>
<td>4.</td>
<td>Sorghum vulgare Pers.</td>
<td>Indian millet</td>
<td>Poaceae</td>
</tr>
</tbody>
</table>

13. Eucalyptus globulus Labill. (Plate Im)
Pollen grain triangular, radially symmetrical, isopolar, polporate, angulaperturate, 3-parasynapcorporate, with a distinctive slightly arcurate apocolpical field with broken edges, exine regulate. Fl.: April - July

14. Gynandropsis gynandra (L.) Briq. (Plate In)
Pollen grain in monad, spherical/oval, yellow, prolate, tricolpate, reticulate. Fl.: March - April

15. Holoptelea integrifolia (Roxb.) Planch. (Plate Io)
Pollen grain suboblate, amb circular, 4-5 zonoporate, circulaperturate, exine coarsely granular. Fl.: February - March
16. Marchamia lutea (Benth.) K. Schum. (Plate Ip)
Pollen grain 3-4 colpate, isopolar, radiosymmetric, prolate, circular with intruded colpi, exine reticulate. Fl.: February - April
17. Mallotus philippensis (Lam.) Muell.-Arg. (Plate Iq)
Pollen grain tricolporate, oblate sphaerooidal, 3-colporate & 3-zonocolporate, tectum verrucate. Fl.: October - November
18. Mimosa pudica L. (Plate lr)
Pollen grain in tetrad, spheroidal, polar outline circular, equatorial outline quadrangular, obtuse plane, tetrapantporate; sculpturing psilate. Fl.: August - January
19. Parthenium hysterophorus L. (Plate Is)
Pollen grain circular, radially symmetrical, isopolar, trizonocolporate, non-lacuriate and echinate. Fl.: May - March
20. Peltophorum pterocarpum (DC.) Backer. ex Heyne (Plate It)
Pollen grain in monad, polar outline circular, equatorial outline elliptic, isopolar, radial symmetry, tri-colporate; sculpturing reticulate. Fl.: January - May
21. Prosopis juliflora (Sw.) DC. (Plate Iu)
Pollen grain in monad; spherical or triangular in shape, radially symmetrical, subisopolar, with zonocolporate aperture, exine punctuated, scabriculate. Fl.: March - May
22. Ricinus communis L. (Plate Iv)
Pollen grain in monad, spheroidal, colporate, isopolar, prolate, aperture sunken, tricolporate, ornamentation-microreticulate, microgemmate. Fl.: February - June
23. Salvadora persica L. (Plate Iw)
Pollen grains prolate, tricolpate, colpus tending deeply sunken forming elongated fold or sutures, foveate, shallow and deep pits with wavy ridges, thick sexine. Fl.: March - April
24. Syzygium caryophyllatum (L.) Alston (Plate Ix)
Pollen grains are suboblate, isopolar, radially symmetrical, 3-(para)syncolporate, and weakly scabrate. Fl.: March - April
25. Tridax procumbens L. (Plate Iy)
Pollen grain in monad; polar and equatorial outline circular, prolater spheroidal; radial symmetry; tricolporate; sculpturing spinulate, densely distributed; spine narrowly triangular and pointed at tip. Fl.: Throughout the year.
26. Cocos nucifera L. (Plate I 1)
Pollen grain in monad; oblate spheroidal, hetropolar bilateral symmetry, monosulcate; sculpturing microreticulate. Fl.: Throughout the year.
27. Pennisetum pedicellatum (L.) Schult. (Plate I 2)
Pollen grain in monad, polar and equatorial outline circular, bilateral symmetry, heteropolar, monoporate, sculpturing psilate. Fl.: February - June
28. Phoenix dactylifera L. (Plate I 3)
Pollen grains elliptic and boat-shaped with one deep germinal furrow, ends of the grain smooth, rough exine showing tectate-perforate pattern, irregular and semicircular lumina. Fl.: February - May
29. Sorghum vulgare Pers. (Plate I 4)
Pollen grain spherical, operculate-annulate pore, brevicerebro ornate exine pattern. Fl.: kharif and rabi season.

Ensuing from the data on allergenic plants, following guidelines are proposed for allergy management:

- The knowledge of diurnal, seasonal and annual fluctuations in airborne pollen in any geographical area is essential for effective diagnosis and treatment of pollen allergy, as the flowering seasons of allergenic plants span over the whole year, starting from early spring (trees), going over summer (grasses) to late autumn (weeds).
- In case of any visible allergic symptoms, it is important to consult allergists and immunologists to determine which type of pollen a person is sensitive to. This helps them to decide on medications and the best time to avoid outdoors.
- If cold symptoms prevail for more than 10 days, it is considered as an allergy.
- Pollen allergen data to be made public to facilitate patients to adapt their daily outdoor activities concerning the pollen peaks and off-peaks.
- Doctors should be circulated with periodic inputs on pollen watch from researchers and scientists.
- Certain preventive measures to be adopted are: keeping windows closed when pollen counts are high, using special HEPA filters in central air conditioning vents helps to filter out pollen from the air system, changing clothes each time after coming inside from the outdoors can limit pollen exposure, taking bath or shower each night before going to bed to rid the skin and hair of pollen built up, washing bed covers in hot, soapy water at least once per week, drying clothes in closed spaces.
- Useful home remedies to fight a pollen allergy include: drinking herbal tea infused with Ginkgo, milk thistle, red clover, stinging nettles.
- Avoid intake of milk, milk-based products.
- Other allergen avoidance methods include wearing sunglasses, using air-conditioners, where possible, and installing a car pollen filter.

CONCLUSION

A review of important plants responsible for producing allergenic pollen will help us in a preliminary screening of
the selected plant species before planting them for various purposes as it is not possible to get rid of plants that are already there and they cannot be removed completely. Of the total number of species studied many are introduced species. In urban cities most of the species are cultivated as avenues. It is hereby recommended to consider cultivation of native species in order to develop Green Park in urban areas which in turn reduce the menace of invasive species. Furthermore, the proposed guidelines for the management of pollinosis and other common allergic reactions will guide us in combating the effects of the disease and make us aware of being more vigilant.

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DISCLOSURE STATEMENT

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