# ROAD TREE POLLEN GRAIN CONTENTS AND EFFECT ON THE IMMUNE SYSTEM

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**Abstract.** Seven road trees, four deciduous and three evergreens, commonly planted in Alexandria streets, have been chosen to investigate their pollen protein contents and some element compositions as an allergy inducing particles. The chosen trees are *Bauhinia variegate, Casia javanieca, Parkinsonia aculeate, Peltophorum roxburghii, Delonix regii, Croton cotinifolia,* and *Jacaranda mimosifolia.* The pollen grains have been gathered during the period of July till November 2019, acetolyzed and described, meanwhile non-acetolyzed pollen grains have been sputtered on Aluminum stubs and coated with Gold for SEM examination and photographs. Pollen grains have been smeared onto glass slides, stained and photographed for protein contents evaluations. Mineral contents have been estimated using X-ray analyses. The results have been discussed according to their stimulation to the immune system causing symptoms of allergy. The amount of both mineral and protein contents depends on pollen-specific characteristics such as their density, dispersion, and profusion. The results obtained indicated that many factors inducing allergic diseases and affect the immune system as environmental conditions include climate change, temperature, humidity, air pollution and loss of biodiversity. This stimulant beside the exposure to submicronic particles may be causes the stimulation of the immune system and result in suffering diseases and breath difficulty and asthmatic conditions.
**Keywords**: *allergy, immunology, pollen grains, road trees*

## Introduction

WHO (2014) reported that air pollution causes 3.7 million premature deaths worldwide per year. Indeed, air pollution, specifically smaller PM, is the leading environmental cause of mortality. Meanwhile, Bowler (2020), Khadka (2020) and Dušička et al. (2013) linked between air pollution and the increased number of Covid-19 death risk. Air pollution may be according to both biotic and a biotic factors. From the biotic factors are the pollen grains, which are the male gametes in both Gymnosperms and Angiosperms, are considered from the most important outdoor sources of allergens especially those released from anemophilous plants, including trees, grasses, and weeds. In Mediterranean countries, governments planted many types of road trees for ornamentation and sheltering from exposed sun rays besides decreasing the hot feelings in summer. Pollen grains released by these trees constitute one of the most important causes of pollinosis (Liccardi et al., 1996). Exposure to these pollen grains led to a variety of allergic symptoms ranging from seasonal rhino conjunctivitis to severe asthma in susceptible individuals (Florido et al., 1999). Bousquet et al. (2008) reported that different types of pollen grains stimulate the production of IgE which is the allergens indicator. Vieira (2003) noted to the annual periodicity of pollinosis as an important feature with symptoms usually occurring at the same time of the year, during pollination time. Actually Pollen allergens are water-soluble proteins, or glycolproteins, sometimes starch and fats, which make them capable of evoking an IgE antibody-mediated allergic reaction in seconds to sensitive peoples. Stewart et al. (2014) recognized 15 distinct groups of proteins with diverse biochemical properties as allergens in taxa of subfamily Pooideae, family Poaceae. While Roschmann et al. (2012) clarified the allergens by being proteins capable of citing powerful T helper lymphocyte type 2 (Th2) responses, resulting in immunoglobulin (Ig)E antibody production.

Dhyani et al. (2006) as well as Mandal et al. (2011) recognized that trees belonging to orders Fabales, Fagales, Lamiales, Proteales, and Pinales are recognized as the most potent allergen sources. They recognized both *Prosopsis juliflora* and *Peltophorum pterocarpum* trees as the source of the important allergen. Whereas Asturias et al. (2005) found that date palms produce clinically relevant pollen allergens. Taia (2020) found that allergy is not restricted to certain trees, shrubs, or herbs, but it depends on the number of pollen grains released in the air and several environmental and climatic factors. This work provides the pollen characteristics and their quantitative protein contents and some important mineral contents of seven common tree species growing in Alexandria streets, Egypt. Alexandria city, which lies in the Mediterranean coastal region of Egypt, has its own weather with high humidity in summer and rainfall in winter (*Figure 1*). The chosen trees are commonly planted in the streets everywhere in Alexandria, and their flowers are flourished in the summer from July till November. This weather hydrates the pollen grain easily to excrete their allergens substances stimulating the human immune system causing severe symptoms to allergic people. This work will help in aeropalynological, immunological, and horticultural studies and identification of allergenically significant road trees pollen grains.

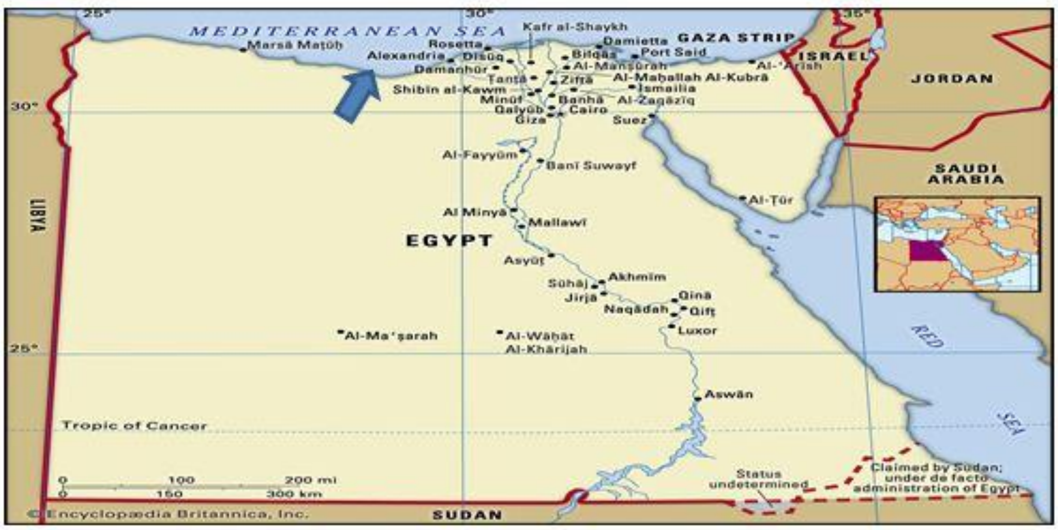



***Figure 1.*** *The study area of Alexandria.*

## *Mechanisms underlying allegy response*

The term “allergy” was coined in 1906 by Clemens von Pirquet, an Austrian scientist, to draw attention to the unusual propensity of some persons to develop reactivity symptoms of hypersensitivity reactions after exposure to certain substances (Galli et al., 2008). Indeed, allergy is defined as an abnormal adaptive immune response against noninfectious environmental compounds, i.e., allergens, including noninfectious components of some infectious organisms.

When allergens crosslink the performed immunoglobulin E (IgE) bound to the high-affinity receptor FcεRI on mast cells, the allergic reaction occurs. Mast cells are immune cells derived from hematopoietic precursors and mature in tissue microenvironments. Not only are mast cells crucial for the development of allergic reactions, but also function as sensors of psychological and environmental stress (Theoharides et al., 2019). Besides binding to FcεRI, IgE mediates biological functions by binding to CD23 and other receptors in mast cells and other hematopoietic cells. The most important role of IgE, however, lies in its potential to promote the release of biologically active mediators in an antigen-specific manner by sensitizing mast cells. Mast cells are, together with dendritic cells, among the very first cells of the immune system to interact with allergens and other compounds from the environment. More precisely, upon activation, mast cells synthesize and release chemokines, lipid mediators, and additional cytokines such as IL-4 and IL-13 to perpetuate the TH2 response. The differentiation of naïve allergen-specific T cells into TH2 cells is favored by an early burst of IL-4 presence. IL-4 seems to be derived from a specialized subset of T cells. The allergen-specific TH2 cells produce IL-4 and IL-13 that act on allergen-specific B-cells to produce IgE. The IgE, produced in response to the specific allergen, binds to the high-affinity receptor for IgE on the abovementioned mast cells, activated eosinophils, and basophils. These cells can amplify the production of IgE since they produce IL-4 and CD40 ligands upon their activation.

Basophils have similar features to mast cells, including the expression of FcεR1, secretion of TH2 cytokines, and release of histamine after activation. However, basophils have a different lineage and other unique features. The most significant feature of basophils is the rapid and powerful expression of IL-4 and IL-13. Eosinophils, on the other hand, are granulocytes that express an array of cell surface molecules including immunoglobulin receptors, cytokine receptors, chemokines, and other receptors (Stone et al., 2010).

Activation of T-cells involves dendritic cells, discovered in 1973. In fact, dendritic cells are the most significant antigen-presenting cells to activate naïve T-cells, which makes them the key player in the immune system. As Humenuik et al. (2017) explain, Dendritic cells help cross the bridge between innate and adaptive immunity. Two major populations of dendritic cells are present in human lungs: myeloid and plasmacytoid dendritic cells, respectively. During allergen challenges, the body recruits dendritic cells to airway tissues. Jahnsen et al. (2001) found an allergen challenge induced a significant increase in CD1c1HLA-DR1 dendritic cell numbers. The dendritic cells form a solid network of allergen sampling throughout the epithelia in the respiratory tract including the nose, nasopharynx, airways, bronchi, bronchioles, and alveolar interstitium. Antigen or allergen uptake by dendritic cells involves three mechanisms of action such as macropinocytosis, phagocytosis, and receptor-mediated endocytosis.

In the case of pollen allergy, the TH2-biased immune system reacts to pollen-derived allergens. The allergic reaction to pollen grains develops in the same manner as other allergic responses, and it includes two phases. The first phase, early response, depends on IgE receptors binding, which leads to activation of mast cells and basophils. The second phase, the late response, involves the engagement of adhesive molecules, eosinophils, lymphocytes and their products, and neuropeptides (Cichocka-Jarosz et al., 1997).

Hosoki et al. (2015) uncovered a mechanism crucial for developing an allergy to pollen grain and forming allergic asthma or seasonal nasal allergies. Exposure of airways to pollens rapidly induces recruitment of neutrophils, a type of white blood cells that move quickly to an affected site and induce inflammation. The recruitment of neutrophils facilitates allergic sensitization. A potential mechanism of action through which this happens is an induction of a state of sustained oxidative stress in the airways. Oxidative stress occurs due to repeated recruitment of activated ROS-generating neutrophils. Chronic oxidative stress can alter the function of dendritic cells, worsen allergic asthma, and modify the balance of TH1 and TH2. Additionally, neutrophils have other effects that modulate allergic inflammation. These cells can promote extracellular infection clearance in the regulation of innate and adaptive immunity responses. Neutrophils could contribute to allergic sensitization and inflammation by inducing pro-inflammatory cytokines, increasing microvascular permeability, but further evidence is necessary to uncover the complete mechanism of action through which neutrophils may act on immune response after exposure to pollen grain.

Csillag et al. (2010) also pointed to the role of oxidative stress and allergy to pollen. Exposure to pollen grains induces oxidative stress that activates dendritic cells. Oxidative stress activates the NF-κB and MAPK signaling pathways responsible for transcriptional activation of pro-inflammatory cytokine and chemokine genes in macrophages and dendritic cells. Deficiency in antioxidant defense mechanisms could elevate the susceptibility to pollen-derived ROS or other factors that contribute to allergic sensitization. The impact of oxidative stress induced by pollen grain on dendritic cells has a dual-action. Besides activating the production of pro-inflammatory cytokine from dendritic cells linked to local innate immunity, oxidative stress is also an adjuvant factor in the adaptive immunity initiation against pollen allergens.

## Materials and Methods

Collected flowers and flower buds of seven road trees, four deciduous, and three evergreens have been subjected in this study during July-October 2019 (summer and beginning of autumn). This collection is from perennial trees, commonly planted in Alexandria streets, with the name of *Bauhinia variegate*, *Casia javanica, Parkinsonia aculeate*, *Peltophorum roxburghii*, *Delonix regii*, *Croton cotinifolia*, and *Jacaranda mimosifolia*. The trees were photographed as shown in *Figure 2a*, the plants are identified with the aid of Heneidy (2010)**.** The anthers are carefully removed from the flowers immediately after gathering by the aid of stereomicroscope and the pollen grains were sputtered on glass slides with a thin film of egg albumin. The slides were directly stained with bromophenol blue for 2 min., washed in tap water, cleared in xylol, mounted in Canada balsam, then covered for examination by Olympus light microscope and selected species with the different protein concentrations photographed (Mazia et al., 1953). For SEM examinations, non-acetolyzed pollens were sputtered onto Aluminum stubs, coated with gold, and examined and photographed using JEOL JSL IT 200 SEM allocated at Faculty of Science, Alexandria University at 15 Kev. For mineral contents, pollen grain pellets have been made of the studied species and subjected to X-ray analysis under 20 kv, using JEOL JSL IT 200 SEM. Acetolyzed pollen grains were examined by Olympus light microscope for measurements; at least 30 pollen/ taxa were subjected in this study. The terminology used here is according to Erdtman (1966).

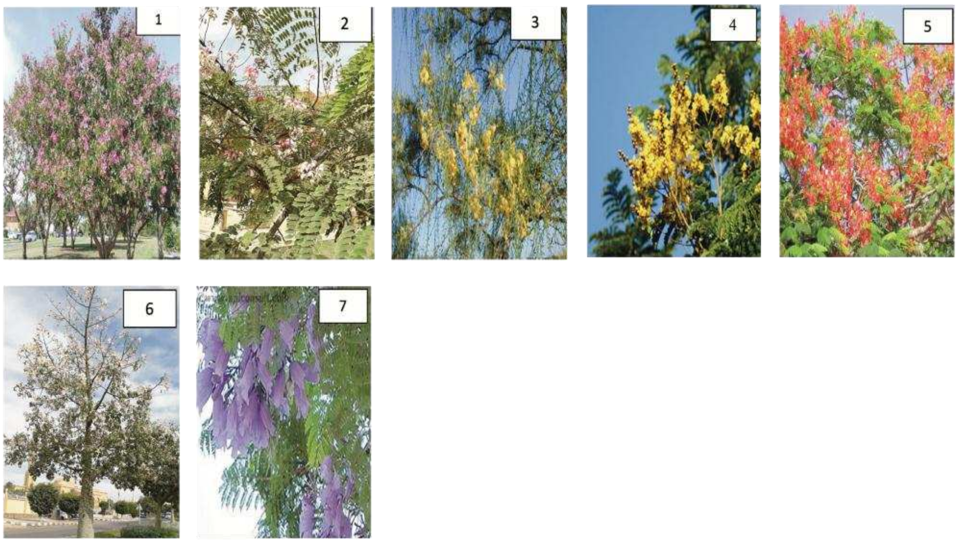



***Figure 2a.*** *The photograph of trees.*

## Results and Discussion

Description of the pollen grains and their protein contents are summarized in *Table 1* and *Figure 2b*, while the mineral contents are listed in *Table 2*. Full pollen morphology descriptions are given below.

***Table 1.*** *Summary of the different features within the studied taxa.*

| Taxa | Family | Status | Pollen characteristic | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Polarity | Size | P/E | Shape | Exine Orn | Protein |
| B. variegata | Caesalpinaceae | Eg. | Iso | L. | 0.9 | Ob-Sp | Striate | M. |
| C. javanica | | D. | Iso | M. | 1.2 | S.Pr. | Reticulate | V.H. |
| P. aculeata | | Eg. | Iso | S. | 1.3 | Pr. | Reticulate | V.H. |
| P. roxburghii | | D. | Iso | L. | 1.3 | Pr. | Reticulate | V.H. |
| D. regia | | Eg. | Iso | S. | 1.25 | S.Pr. | Reticulate, Rugulate | L. |
| C. cotinifolia | Euphorbiaceae | D. | Iso | M. | 1.3 | Prolate | Reticulate | V.H. |
| J. minosifolia | Bignoniaceae | D. | Het. | M. | 1.3 | Pr. | Psilate, Faintly | M. |

**Notes: Eg.=Ever green; D.=Deciduous; Iso=Isopolar; Het.=Heteropoal; L.=Large ≥ 50µm; M.=Moderate from 25-48 µm; S.=Small ≤25 µm; Ob-Sp=Oblate Spheroidal; S.Pr.=Subprolate; Pr.=Prolate; Orn=Ornamentation; M.=Moderate; H.=High; V.H.=Very high.*

***Table 2.*** *Summary of the investigated minerals within the studied taxa shown by X-ray analyses.*

| Taxa | The Mass of investigated Elements | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | N | O | Na | Mg | Al | Si | P | S | Cl | K | Ca | Fe | Cu | Zn |
| B. variegata | 58.84± 0.19 | 2.22± 0.21 | 36.62± 0.39 | 0.06± 0.02 | 0.14± 0.02 | 0.05± 0.01 | 0.05± 0.0 | 0.28± 0.02 | 0.17± 0.01 | 0.0 | 0.80± 0.03 | 0.33± 0.02 | 0.04± 0.02 | 0.28± 0.04 | 0.13± 0.04 |
| C. javanica | 62.85± 0.23 | 0.0 | 34.34± 0.45 | 0.11± 0.03 | 0.0 | 0.08± 0.02 | 0.0 | 0.48± 0.03 | 0.22± 0.02 | 0.05± 0.01 | 0.70± 0.0 | 0.38± 0.03 | 0.12± 0.03 | 0.39± 0.06 | 0.39± 0.06 |
| P. aculeata | 60.16± 0.20 | 2.11± 0.22 | 0.08± 0.39 | 0.08± 0.02 | 0.05± 0.02 | 0.20± 0.02 | 0.19± 0.02 | 0.22± 0.02 | 14± 0.01 | 0.13± 0.01 | 65± 0.03 | 0.28± 0.02 | 0.04± 0.02 | 0.26± 0.05 | 0.25± 0.05 |
| P. roxburghii | 59.59± 0.28 | 11.97± 0.15 | 24.77± 0.49 | 0.07± 0.03 | 0.03± 0.02 | 0.11± 0.02 | 0.42± 0.03 | 0.03± 0.02 | 0.0 | 1.99± 0.06 | 0.02± 0.02 | 0.22± 0.03 | 0.06± 0.02 | 0.48± 0.07 | 0.24± 0.07 |
| D. regia | 60.16± 0.20 | 2.11± 0.22 | 35.26± 0.39 | 0.08± 0.02 | 0.05± 0.02 | 0.20± 0.02 | 0.19± 0.02 | 0.22± 0.02 | 14± 0.01 | 0.13± 0.01 | 65± 0.03 | 0.28± 0.02 | 0.04± 0.02 | 0.26± 0.05 | 0.25± 0.05 |
| C. cotinifolia | 60.86± 0.24 | 2.75± 0.28 | 33.03± 0.46 | 0.03± 0.03 | 0.37± 0.03 | 0.02± 0.02 | 0.06± 0.02 | 0.66± 0.03 | 0.25± 0.02 | 0.36± 0.03 | 0.65± 0.04 | 0.41± 0.03 | 0.03± 0.02 | 0.27± 0.05 | 26± 0.06 |
| J. mimosifolia | 57.86± 0.30 | 2.28± 0.33 | 35.97± 0.60 | 35.97± 0.60 | 0.20± 0.03 | 0.06± 0.03 | 0.11± 0.03 | 0.61± 0.04 | 0.38± 0.03 | 0.02± 0.02 | 1.29± 0.07 | 0.45± 0.05 | 0.0 | 0.49± 0.09 | 0.06± 0.07 |

*Notes: C=Carbon; N=Nitrogen; O=Oxygen; Na=Sodium; Mg=Magnesium; Al=Aluminium; Si=Silicon; P=Phosphorus; S=Sulphur; Cl=Chlorine; K=Potassium; Ca=Calcium; Fe=Iron; Cu=Copper; Zn=Zinc.*

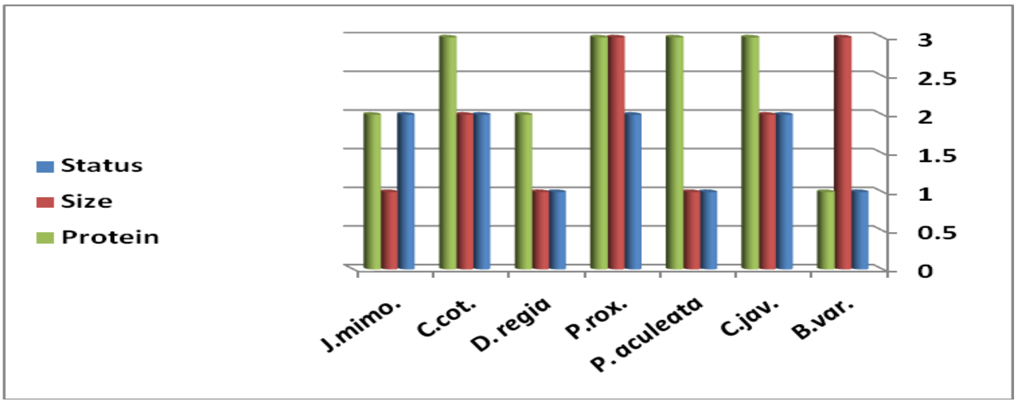



***Figure 2b.*** *Pollen grain size (1=small, 2=moderate, 3=large) and their protein contents (1=low, 2=moderate, 3=very high), and the status of the tree (1=evergreen, 2= deciduous).*

## *Pollen morphology*

### *Bauhinia variegata L.*

*Bauhinia variegata* L. with Family Caesalpinaceae, evergreen tree (*Figure 3*) consists of symmetric, isopolar P/E ratio: 0.9**,** polar axis P 54.2(56.8.15) 62.5µm and equatorial diameter 55.3(59.12) 64.2µm; oblate spheroidal, sometimes subprolate, tricolporate, colpi, length 38.2(39.4) 41.54µmand breadth 5.9(7.4) 8.45µm, with granulate colpus membrane; ora protruding lalongate; mesocolpium 12.6(13.44) 17.7 µm; apocolpium 14.0(16.47) 18.5µm; exine 1.00(1.9) 2.5µm thick; as well as sexineas thick as tectum striate. The protein contents are moderate as indicated by the degree of stain (*Figure 4*).

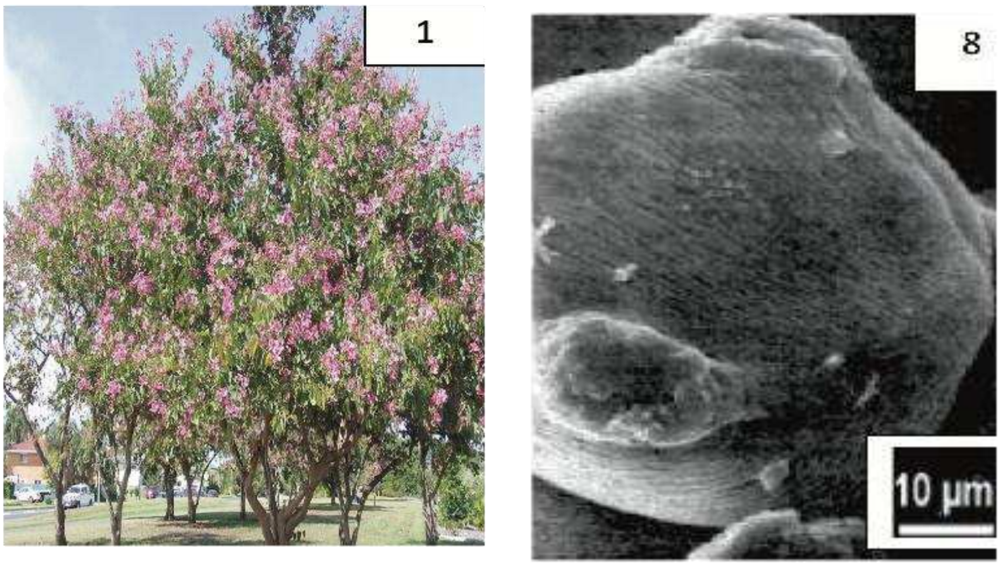



***Figure 3.*** *Bauhinia variegata L. for (1) external shape, and (8) SEM photograph.*

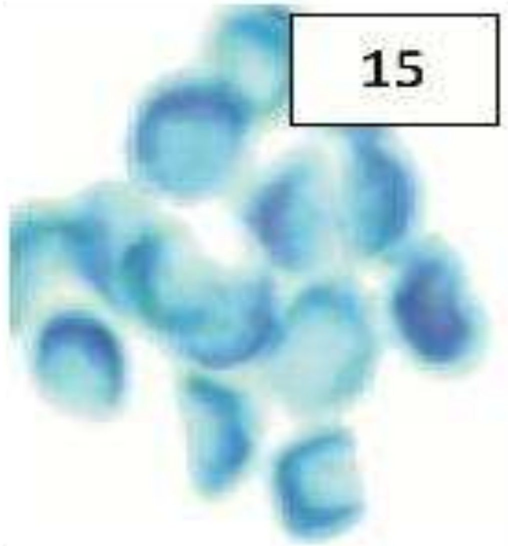



***Figure 4.*** *The protein intensity for Bauhinia variegata L.*

### *Cassia javanica L.*

*Cassia javanica* L. with Family Caesalpinaceae, desciduous tree (*Figure 5*) consists of symmetric, isopolar P/E ratio: 1.2, polar axis P 27.8(32.15) 37.2µm and equatorial diameter E 21.7(24.9) 28.2 µm; subprolate to prolate, tricolporate; colpi length 16.2(15.2) 18.3µm with lolongateora; mesocolpium 9.8(10.44) 14.7 µm; apocolpium 10.19(11.75) 14.8µm; exine 1.0(1.8) 2.0µm thick; sexineas thick as nexine; and exine widely reticulate with granulate endexine. The protein contents are very high as indicated by the degree of stain (*Figure 6*).

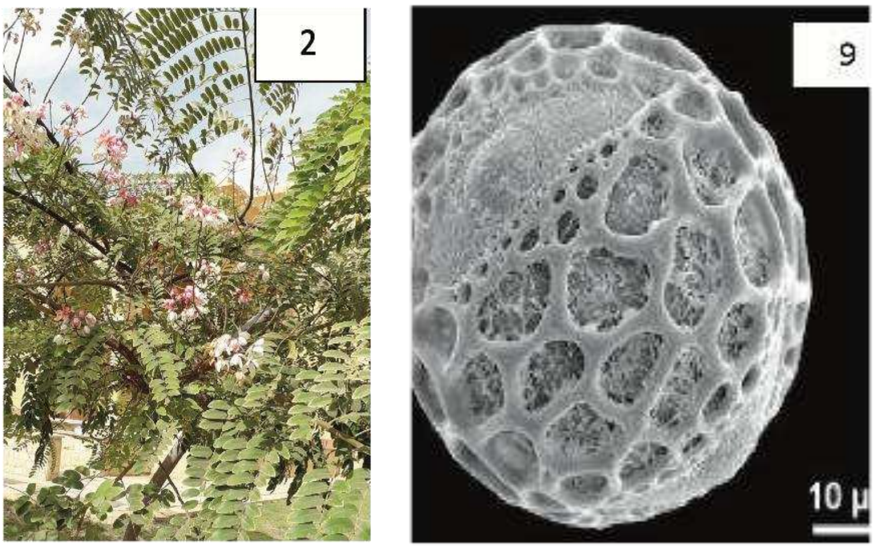



***Figure 5.*** *Cassia javanica L. for (2) external shape, and (9) SEM photograph.*

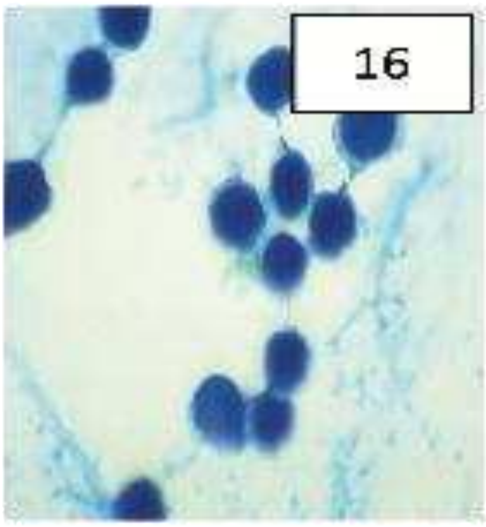



***Figure 6.*** *The protein intensity for Cassia javanica L.*

### *Parkinsonia aculeate L.*

*Parkinsonia aculeate* L. with Family Caesalpinaceae, evergreen tree (*Figure 7*) are characterized with symmetric, isopolar P/E ratio: 1.3**,** polar axis P 19.2(20.15) 22.5µm and equatorial diameter E 14.05(15.9) 18.2µm; Prolate, tricolporate, colpi, length 15.9(19.2) 20.54µmand breadth 6.4(7.45) 9.25µm, oralalongate; mesocolpium 12.6(13.44) 14.7 µm; apocolpium 14.59(16.47) 19.5µm; exine 1.00(1.9) 2.5µm thick; and sexine thicker than nexine with tectum reticulate. The protein contents are very high as indicated by the degree of stain (*Figure 8*).

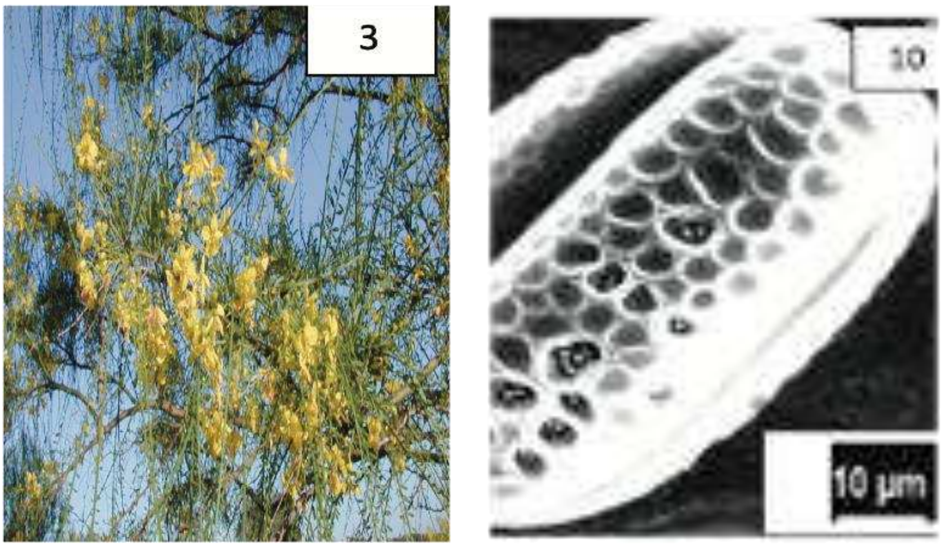



***Figure 7.*** *Parkinsonia aculeate L.for (3) external shape, and (10) SEM photograph.*

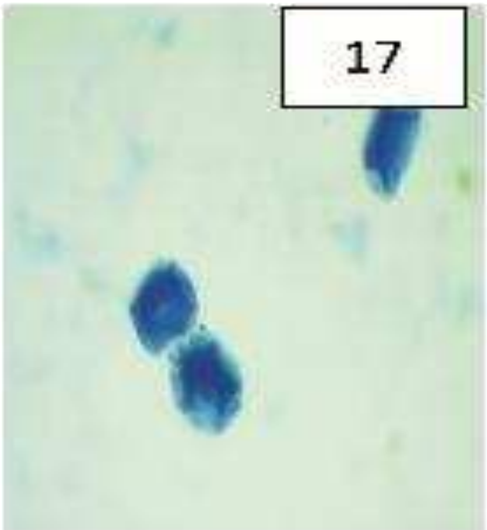



***Figure 8.*** *The protein intensity for Parkinsonia aculeate L.*

### *Peltophorum roxburghii*

*Peltophorum roxburghii* (G.Don) Degener with Family Caesalpinaceae, deciduous tree (*Figure 9*) are characterized with symmetric, isopolar P/E ratio: 1.3, polar axis P 48.8(57.79) 65.2µm and equatorial diameter E. 39.5(47.2) 59.7µm; prolate to prolate, tricolporate, colpi length 7.6(12.85) 15.8µm and breadth 5.8(7.65) 11.75µm; mesocolpium 24.2(33.36) 44.2µm; apocolpium 37.9(52.9) 56.2µm; exine 2.0(2.5) 3.0µm thick; and sexine thicker than nexine with tectum coarsely reticulate. The protein contents are very high as indicated by the degree of stain (*Figure 10*).

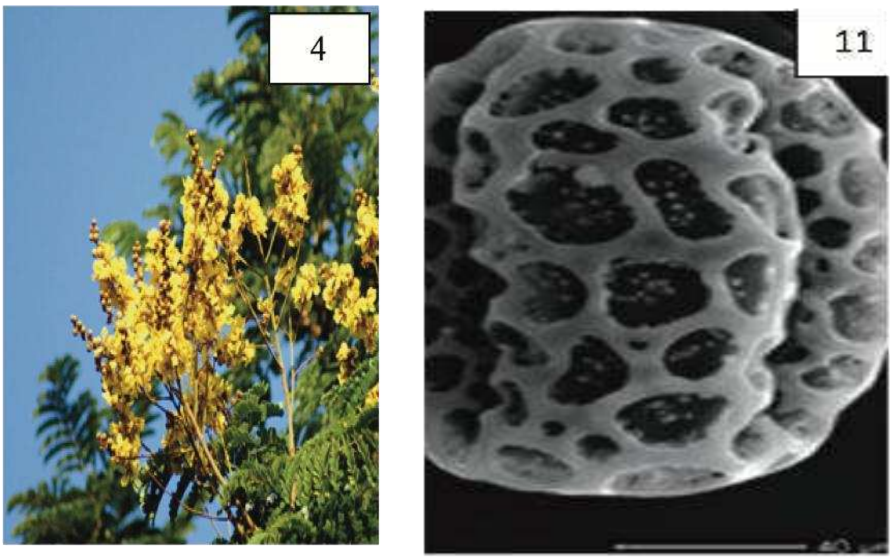



***Figure 9.*** *Peltophorum roxburghii for (4) external shape, and (11) SEM photograph.*

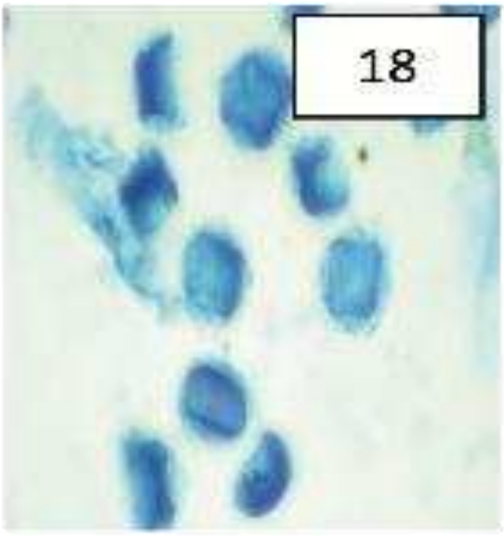



***Figure 10.*** *The protein intensity for peltophorum roxburghii.*

### *Delonix regia*

*Delonix regia* (Bojer) Rafin with Family Caesalpinaceae, evergreen tree (*Figure 11*) are having symmetric, isopolar P/E ratio: 1.25, polar axis P 16.8(19.95) 21µm and equatorial diameter 12.6(15.75) 16.8 µm; sub-prolate, tricolporate, triangular,colpi length 6.3(9.45) 10.5µm and breadth 2.1(4.935) 6.3 µm, oralalongate; mesocolpium 12.6(16.38) 18.9 µm; apocolpium 14.7(17.85) 18.9 µm; exine 1.8(2.0) 2.3 µm; as well as sexine thicker than nexine with tectum reticulate-rugulate. The protein contents are low as indicated by the degree of stain (*Figure 12*).

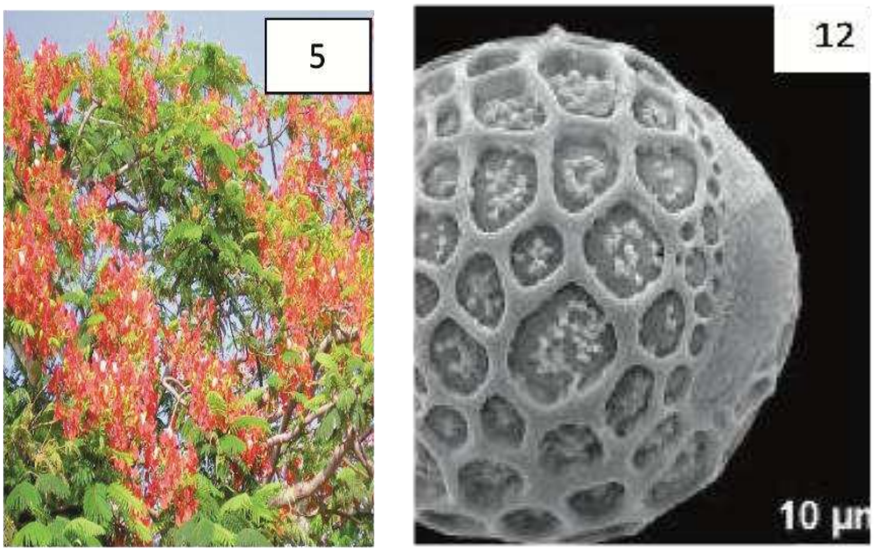
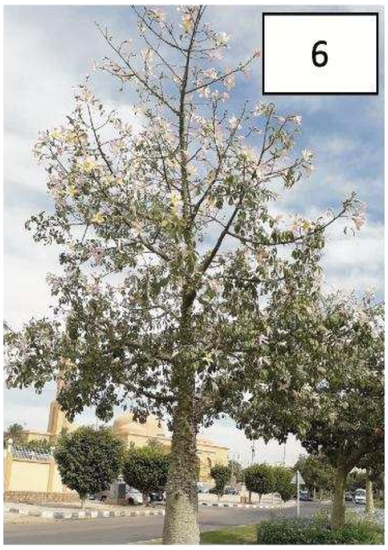



***Figure 11.*** *Delonix regia for (5) external shape, and (12) SEM photograph.*


***Figure 12.*** *The protein intensity for delonix regia.*

### *Croton cotinifolia L.*

*Croton cotinifolia* L. with Family Euphorbiaceae, deciduous tree (*Figure 13*) are having the symmetric, isopolar P/E ratio: 1.3, Polar axis P 38.4(41.95) 46.8 µm and equatorial diameter 22.6(27.75) 31.8 µm; prolate, tricolporate, colpi length 19.3(27.45) 31.5µm and breadth 1.8(2.9) 3.3 µm, ora very small, lalongate; mesocolpium 14.3(16.38) 18.5µm; apocolpium 15.7(17.85) 19.2µm; exine 1.8(2.0) 2.3 µm; and sexine as thick asnexine with tectum reticulate. The protein contents are very high as indicated by the degree of stain (*Figure 14*).



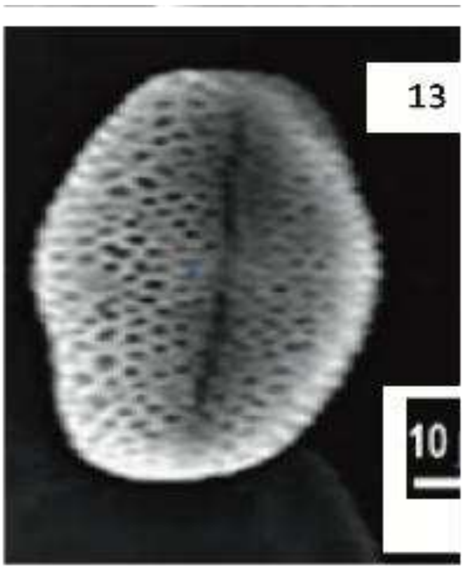




***Figure 13.*** *Croton cotinifolia L. for (6) external shape, and (13) SEM photograph.*


***Figure 14.*** *The protein intensity for croton cotinifolia L.*

### *Jaccaranda mimosifolia D.Don*

*Jaccaranda mimosifolia* D.Don with Family Bignoniaceae deciduous tree (*Figure 15*) consists of symmetric, heteropolar P/E ratio: 1.3, polar axis P 38.2(41.8) 46.7µm and equatorial diameter 25.8(32.3) 39.75 µm; prolate, tricolporate, the colpi syncolpate at one pole, colpi length 25.8(28.3) 32.5 µm and breadth 3.2(4.5) 6.7 µm, ora small and plugged lolongate; exine 2,0(3.5) 3.8 µm; sexine thicker than nexine, tectatepsilate, or faintly punctuate. The protein contents are moderate, as indicated by the degree of stain (*Figure 16*).

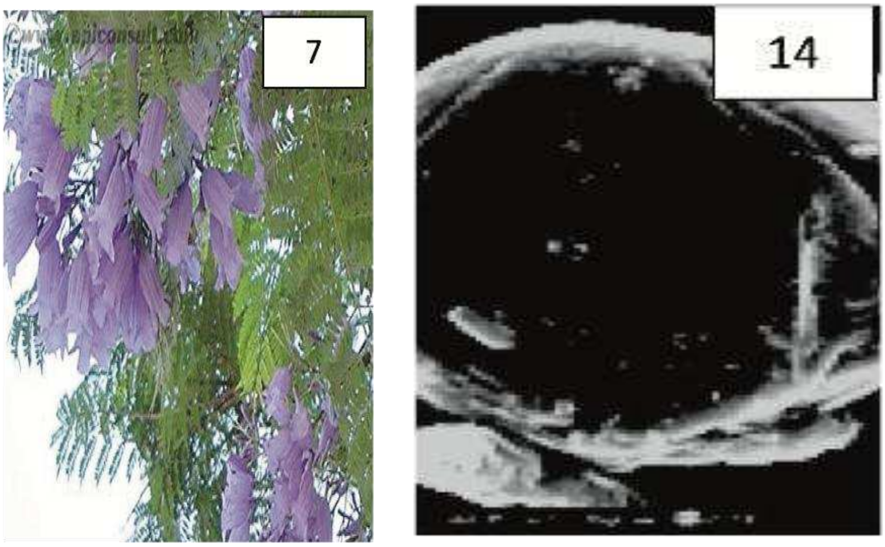



***Figure 15.*** *Jaccaranda mimosifolia for (6) external shape, and (13) SEM photograph.*

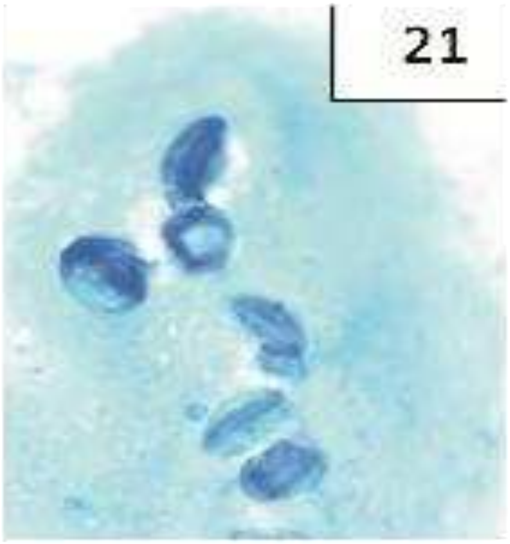



***Figure 16.*** *The protein intensity for Jaccaranda mimosifolia.*

The study of Pollen allergens becomes from the recent points of research now a day. These allergens arise from the process of pollination happened in wind pollinated trees, shrubs and herbs, especially grasses. The amount of these allergens depends on pollen-specific characteristics such as their density, dispersion, and profusion. Dhyani et al. (2006) found that the proteins found on the surface of the pollen grains of *Prosopis juliflora* trees can induce allergy. At the same time, Mandal et al. (2011) found that the use of the pollen grains of one of the wide trees in India, *Peltophorum pterocarpum*, can be of Clinical and immune-biochemical characterization. Accordingly, the street trees can be one of the reasons causing pollinosis and meanwhile can be used in immunotherapy. D'amato and Spieksma (1991) indicated that many factors inducing allergic diseases, such as climate change, temperature, humidity, and loss of biodiversity. These stimulants, besides air pollution and exposure to submicronic particles, may be causes of allergy. Nowaday, Bowler (2020) and Khadka (2020) linked air pollution and the increased number of Covid-19 death risk. Meanwhile, Taia (2020) found that the type of road trees is not the cause of pollinosis alone, but there are many factors in combination with the dispersed pollen grains that are all together reasons for allergy. In this work, seven widely planted road trees are chosen to investigate their pollen grains allergic stimulations. The external morphology, protein contents as well as mineral contents have been estimated.

The results showed that both *Parkensonia aculeate* and *Delonix regia* have small pollen grains than the other trees. The size of the pollen grains is considered an important character in inducing allergy. Small pollen grains are easily dispersed by air and inhaled (D'amato and Spieksma, 1991). Eder et al. (2006) pointed to exposure to allergens as being a key factor besides the environmental determinants of asthma, which include air pollution. The most effective reasons for pollinosis is the exposure to submicronic particles and the role of the pollen grains is to stimulate the allergens present in their cytoplasm, such as starch, proteins, ubish bodies and polysaccharides. These organic substances are specific to each plant species to recognize the stigma specific to this species. The results obtained revealed that all the studied trees have high Carbon and Oxygen contents, which is due to the high contents of Carbohydrates. Meanwhile, the Nitrogen content is low due to the decrease in Proteins. The rest of the elements are considerably low, and this is can be due to the difference in their physiological activity. Traverse (2007) advised to use of medical methods to alleviate pollinosis, assumes the elative predictability of spores/pollen in the air in a given area at a given time. Okubo (2009) mentioned that it is necessary to handle the anti-allergic agent to focus on the patient's symptoms. In addition, QOL improves well by antigen removal, immunotherapy, treating the operation, and combining. Terada et al. (2020) found that intralymphatic immunotherapy (ILIT) for allergic patients require only a few intralymphatic injections of the allergen.

Worth mentioning is the fact pollens contain aqueous pollen extract proteins, proteases, NADPH oxidases, and lipids that stimulate innate immunity responses. These responses recruit the abovementioned neutrophils and modulate functions of the dendritic cells, but also induce TH2 polarization, and promote allergic inflammation (Hosoki et al., 2015). Gilles et al. (2009) found pollen allergens do not act on their own. Pollen-associated lipid mediators (PALMs) may propagate the overall TH2 favoring micro milieu in tissue exposed to pollen, independently of pollen allergens. PALMs may activate eosinophils and provide signals for dendritic cells to mature and acquire migratory phenotypes. In other words, PALMs could have a role in the immune system’s response to pollen grains, besides pollen allergens only.

## Conclusion

From this study, we can conclude that the most effective trees causing allergy are those having smaller pollen grains with the excess of starch, polysaccharides ( as indicated by Carbon and Oxygen contents), and release more proteins on their surfaces. From the studied trees, *Delonix regia* and *Parkensonia arculeata* are the most responsible ones.

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## Conflict of interest

The author confirm that there are no conflict of interest involve with any parties in this research study.

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