

# A Complete Review Article on Aeroplainology & Pollen Allergy

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## ABSTRACT

Pollen is the microscopic wonder of plant kingdom, and the most vital part in the flowering plants. Pollens have a definite structure with various ornamentation and perform a key role in the reproduction of angiosperms. Palynology includes the morphometric study of the sporoderm of spores & pollen grains. These characters of Palynomorphs are very useful in different branches of science like botany, oceanography, limnology, Pedology, Geology, ecology, Allergology etc. This study reviews pollen Taxonomy and pollen allergy. The overall Process includes collection of information on recent and historical bibliography and personal Surveys from local, National and Regional network. In these, an attempt has been made to review the researches on important pollen allergen prevalent in different region. Although the pollen grains are present throughout the year, but pick pollen season has been observed in March to May & August to October. The situation for biological Particles like pollen have different issues on our health, particularly sometime pollen may cause allergy when allergen come in contact with Cell bound immunoglobulin-E in the tissue of conjunctiva, and nasal mucosa. The tissue release mediators such as histamine or leukotrienes and induce annoying allergic symptoms. This caused Hay fever, rhinitis, asthma, problem of nasal mucosa etc.

*Index Terms:* Pollen, Palynology, Allergy, Immunoglobulin-E, Conjunctiva, Nasal Mucosa, Hay Fever

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## INTRODUCTION

Pollens are the microscopic wonder of the plant kingdom, produced within the anther of the flowering plants. It generally is a mass of microspores or pollen grains with a special structure and function. Pollen grains are developed inside the microsporangium. These are the first cell of the male gametophyte which contains only one haploid nucleus. These are of various shapes- Polyhedral, cubical, trigonal, cylindrical etc. The size of the pollen grains generally varies from 10-200 micrometer. The pollen grains have two walls- outer exine (exine is further differentiated into two regions- outer sexine & inner nexine) & inner intine.

**History of Pollen:** German chemist and botanist Carl Julius Fritzsche observed and depicted these pollen grains from flowering plants using a microscope set at around 500x magnification. In 1830, Joseph Jackson Lister, an English optician, developed a lens that reduced an aberration that had previously plagued people using microscopes: the persistent apparition of a colored edge around an image. Fritzsche used the advantage of these technological improvements to advance studies in pollen morphology

**Formation of Pollen Grains:** Formation of Pollen grains from spore mother cell to reduction division is called microsporogenesis. Sporogenous tissue within the microsporangium divides repeatedly producing spore mother cell. Diploid spore mother cell divides meiotically producing four haploid pollen grains.

**Palynology:** The study of spores and pollen grains, mainly palynomorphs is termed as palynology. This study includes apertures (the germination sites), ornamentation patterns (the sculpturing), manifold variation in exine infrastructure, and pollen or spore dimensions; which are especially useful when evaluated systematically in conjunction with other features and reflecting the evolutionary or phylogenetic relationships.

**Palynology depends mainly on four characteristics of pollen and spores-**

- (1) Their greater resistance to degradation than most other plant parts, thus facilitating their survival as fossils
  - (2) Their small size, mostly less than 200 microns, so that they are transported and deposited as sedimentary particles
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- (3) Their morphological complexity, so that can be distinguished and characterized
- (4) Their production in enormous numbers.

**History Of Palynology:** In the year 1944 Harold Hyde and David Williams of Cardiff introduced the term palynology, based on the Greek words paluno (to sprinkle) and pale (dust), in the pages of the Pollen Analysis Circular, one of the first journals of pollen analysis. In North America, analysis of pollen was introduced by the Phyllis Draper; the student of the University of Oklahoma, who developed the first pollen diagram that depicted the percentage of several species at different depths using a sample from the Curtis Bo. Today, palynology laboratories often use the same pollen diagram format that Phyllis Draper utilised. The palynology science incorporates the origin of plant species and the environments they are (or were) found in. It's considered an important scientific field.

### BRANCHES OF PALYNOLOGY

The branches of Palynology are:

- 1. Palynotaxonomy:** it includes studies of spore morphology of embryophytic plants and pollen morphology of seed plants.
- 2. Aero palynology:** It includes studies of airospora like fungal spores, pollen grains, bacteria, viruses, insect population etc
- 3. Melissopalynology:** It deals with studies on botanical and geographical origin of honey by subjecting the honey sediments to microscopical analysis for pollen grains contained herein.
- 4. Forensic Palynology:** It is a science deals with application of modern and fossil pollen and spores to solve legal problems.
- 5. Palaeopalynology:** it includes the studies of spore morphology of embryophytic plants, pollen morphology of seed plants and the studies of chitinozoans (animal remains), fungal spores, dinoflagellates, acritarchs and other organisms (except diatoms).
- 6. Copropalynology:** it includes the studies of palynomorphs present in coprolite of animals and this term Copropalynology also includes the pollen analysis of recent excreta
- 7. Entomopalynology:** it includes the studies of pollen grains that are associated with insects.
- 8. Latropalynology:** it includes the studies of pollen morphology of seed plants and spore morphology of embryophytic plants.
- 9. Palynodebris:** it includes the studies of Debris in sediment composed of Fossil pollen and other polynomorphs.

**Palynomorphs:** Any substance or particle which can resist the acidic treatment during the processing is called palynomorph. It ranges from 5 to 500 micrometer in size.

**Allergy & Pollen Allergy:** An allergy is a system response to a distant substance that's not typically harmful to our body. These foreign substances are called allergens. They will include certain foods, pollen, or pet dander. Pollen allergy is an allergic condition affecting the mucous membranes of the nose and also the eyes etc., usually characterized by nasal discharge, nasal congestion, and itchy and watery eyes, itchy nose, inner ears and roof of the mouth, that are caused by a hypersensitivity to airborne pollen, like the pollen of trees, grasses, herbs etc.....

**Types Of Pollen Allergy:** There are many types of pollen allergy. Few common culprits are-

- 1. Birch pollen allergy:** Birch pollen is one in every of the foremost common airborne allergens during the spring because the trees bloom, they release tiny grains of pollen that are scattered by the wind. A single birch can produce up to five million pollen grains, with many travelling distances of up to 100 yards from the parent tree.
- 2. Oak pollen allergy:** Like birch trees, oak trees send pollen into the air during the spring. While oak pollen is taken into account to be mildly allergenic compared to the pollen of other trees, it stays within the air for extended periods of your time. This could cause severe hypersensitivity in some people with pollen allergies.

**3. Grass pollen allergy:** Grass is that the primary trigger of pollen allergies during the summer months. It causes a number of the foremost severe and difficult-to-treat symptoms.

**4. Ragweed pollen allergy:** Ragweed plants are the most culprits of allergies among weed pollens. They're the foremost active between the late spring and fall months. Depending on the placement, however, ragweed may begin spreading its pollen as early because the last week of July and continue into the middle of October. Its wind-driven pollen can travel many miles and survive through a light winter.

**Cause of pollen allergy:**

1. When pollen grains develop within the anther tapetum during pollen wall formation, some protein factors get deposited in the intra-tapetal chamber.

2. Proteins are highly soluble in water, quite liable in nature and get released immediately when they are logged on the stigmatic surface of flower or nasal mucosa or conjunctive of human beings and causes allergy

**Mechanism of pollen allergy:**

It is not the pollen grain or spore itself, but factors (i.e. allergen) located on or within it, that will induce allergic disease. Allergens are principally proteins or glycoproteins (sometimes nucleic acids or polysaccharides may act as allergen) that are capable of eliciting the formation of IgE antibodies through the body's system.

**Sensitization phase-** Hypersensitivity is induced by pollen grains, because pollen makes contact with the upper respiratory tract, the nostrils, rime ores (mouth) and eyes. Following an on the spot contact of pollen with moist eye surface pollen release proteins to induce pollinosis or rhinitis. Pollen grains deposited within the uppermost ciliated portion of the tract, cannot reach to lungs. The nasal cavity filtering them out by inducing a high degree of turbulence within the airflow that is deposited in the trachea and upper bronchi. For more information and understanding. Most pollen grains are swallowed and they become accumulated in stomach. Pollen discharges their proteins while passing through the stomach and a moderate proportion of proteins are introduced into the bloodstream to begin hypersensitivity. Antibodies are produced from different antibody forming cells of lymphoid tissues of allergic individuals in response to first exposure to allergens (proteins) obtained from pollen grains. These Ige antibodies circulate within the serum in the blood stream and it becomes attached to the surface of mast cells or basophilic granulocytes by its foot piece (by Fc region of Ige). About 100,000 Ige molecules may remain sure to the surface of one labrocyte for a period of several weeks. Each Ige molecule has two arms with terminal recognition site for its specific allergen and is in communication with the vegetative cell membrane through the membrane glycoprotein to which it's attached. In human, mast cells are found within the lungs, within the membranes of upper tract, within the skin and within the intestinal tract. Mast cells are rich in granules which contain histamine and a number of other biologically active substances like bradykinin, prostaglandins, etc.

**The effector phase-** Later, when the precise allergens (from similar style of pollen) are again encountered (second exposure), they bind to pairs of adjacent Ige molecules on the somatic cell surface. This binding interaction triggers the rapid release of tissue mediators mainly histamine from granules secreted by the mast cells. This kind I reactions appear very quickly after exposure to an allergen, as a rule within 10-20 minutes, but occasionally within a pair of minutes. Histamines and other chemicals show up the symptoms of allergic diseases (Type I). Histamine effects vessel dilation and increase capillary permeability, ensuingoedema Histamine also contracts the sleek muscles and stimulates the exocrine glands. In the bronchi histamine contracts the graceful muscles, swells the membranes, and produces thick mucus resulting in congestion, making breathing more strenuous. Within the skin, histamine produces wheal and elevated patches with itching and adjoining redness. Symptoms also appear in nose and eyes as sneezing, blocked nose, cold plus reddened, swollen and itching eyes.

**Some important pollen allergy diseases are-**

**Hay fever:** This can be a seasonal kind of allergy. The pollen grains of certain grasses, weeds and trees are the most causes of this kind of allergy, although mold spores may cause the symptoms. Reckoning on where the patients live and also the pollination period of a specific plant, attacks may occur seasonally either in spring, summer, winter or time of year. Various symptoms may occur. The liner of the nose becomes swollen and exudes a runny discharge or clogged nose Spells of sneezing and itchiness of the throat and palate also occur and therefore the eyes may be similarly affected.

**Conjunctivitis:** The people are more likely to suffer from an allergic condition of the eyes as an adult. Allergic conjunctivitis is usually related to coryza. A general complaint is of itchiness of the eyes which are rubbed frequently.

**Asthma:** Asthma could also be allergic or non allergic in origin. In allergic asthma environmental allergens like

pollen grains and spores trigger the disease when inhaled. The patients may suffer from attacks which obstruct the flow of air to the lungs because of the swollen tissue layer and formation of mucous within the airway. Breathing becomes difficult and made breathing becomes necessary. A wheezing sound appears because of the frenzy of air through the narrowed airways. At the identical time, a troublesome cough can develop.

**Symptoms Of Pollen Allergy:** Pollen allergy symptoms most often include-

1. Nasal congestion,
2. Sinus pressure, which may cause facial pain,
3. Runny nose,
4. Itchy, watery eyes,
5. Scratchy throat
6. Cough,
7. Swollen, bluish-colored skin beneath the eyes,
8. decreased sense of taste or smell,
9. Increased asthmatic reactions

### **DIAGNOSIS OF POLLEN ALLERGY:**

Doctor can usually diagnose a pollen allergy. However, they'll refer a patient to an allergist for allergy testing to substantiate the diagnosis. An allergist is someone who focuses on diagnosing and treating allergies. The allergist will first ask the patient about his/her medical records and his/her symptoms, including once they started and the way long they've persisted. Make sure to inform them if the symptoms are always present or reappear or worse at certain times of the year. The allergist will then perform a skin prick test to work out the precise allergen that's causing his/her symptoms. During the procedure, the allergist will prick different areas of the skin and insert a tiny amount of varied varieties of allergens. If the patient is allergic to any of the substances, the patient will develop redness, swelling, and itchiness at the location within 15 to 20 minutes. The patient may also see a raised, round area that appears like hives.

**Treatment of Pollen Allergy:** The best treatment of the pollen allergy is to avoid the allergen and we always know that prevention is better than cure. However, pollen is very difficult to avoid.

**A.** One may be able to minimize one's exposure to pollen by:

1. Staying indoors on dry, windy days.
2. Having others take care of any gardening or yard work during peak seasons
3. Wearing a dust mask when pollen counts are high.
4. Closing doors and windows when pollen counts are high

**B.** There are several over-the-counter (OTC) medications that will help to prevent pollen allergy. These are

1. Antihistamines, such as cetirizine (Zyrtec) or diphenhydramine (Benadryl)
2. Decongestants, such as pseudoephedrine (Sudafed) or oxymetazoline (Afrin nasal spray)
3. Medications that combine an antihistamine and a decongestant, such as Actifed (triprolidine and pseudoephedrine) and Claritin-D (loratadine and pseudoephedrine)

**C.** Allergy shots are also recommended if medications aren't enough to ease the symptoms. Allergy shots are a style of immunotherapy that involves a series of injections of the allergen. The numbers of allergen within the shot gradually increases over time. The shots modify patient's immune system's response to the allergen, helping to scale back the severity of the patient's sensitivity. One may experience complete relief within 1 to 3 years after starting allergy shots

**REMEDIES:** A number of home remedies may also help relieve pollen allergy symptoms.

These include-

1. Using a squeeze bottle or neti pot to flush pollen from the nose
2. Trying herbs and extracts, such as PA-free butterbur or spirulina
3. Removing and washing any clothing that has been worn outside
4. Drying clothes in a dryer rather than outside on a clothing line
5. Using air conditioning in cars and homes
6. Investing in a portable high-efficiency particulate air (HEPA) filter or dehumidifier
7. Vacuuming regularly with a vacuum cleaner that has a HEPA filter.

## LITERATURE REVIEW

### In India

In the year 1982, A JANAKI BAI and C SUBBA REDDI made their research work on airborne pollen grains in Visakhapatnam by combined field and air sampling study. Components of the airborne pollen flora and their relative contribution were beautifully presented on their research work. They also made a pollen productivity chart and the seasonal periodicity in airborne pollen. They also made a bar diagram on effect of urbanization on airborne pollen and clearly distinguished the spring, summer and autumn of temperate zones. They described clinical significance of biopollutants and their allergic response towards human beings and the possible resulting synergistic adverse effects on human health. In the year 1994-1996 (published in 1998), PAMPA CHAKRABORTY, SWATI GUPTA-BHATTACHARYA, CHANCHAL CHAKRABORTY, JOHN LACEY and SUNIRMAL CHANDA made their research work on Airborne allergenic pollen grains on a farm in West Bengal. Their work represented beautifully the Seasonal variation of pollen.

They found 46 kinds of pollen; from which the pollen of **poaceae** took a major portion (more than 18%). They also made Diurnal periodicities and Vertical profile of pollen concentrations and Allergic response to pollen extracts. According to their research- (1) pollen extract of *Saccharum officinarum* followed by *Azadirachta*, *Phoenix*, *Borassus*, *Cyperus*, *Areca*, *Catharanthus*, *Cocos*, *Carica* show strong hypersensitivity and *Justicia*, *Tamarindus* and *Trema* show weak hypersensitivity. And (2) some pollen (*Trema*, *Justicia* etc) was less allergic but few pollen (*Azadirachta*, *Delonix*, *Lantana*, etc.) was highly allergic. In the year 1995-1997 (published in 2004) Dola Boral, Soma Chatterjee and Kashinath Bhattacharya made their research work on the occurrence and allergising potential of airborne pollen in Berhampore, Murshidabad; and found 31 types of common airborne pollen. They also found *Saccharum officinarum* (grass), *Azadirachta indica*, *Cocos nucifera*, *Cyperus rotundus* and *Eucalyptus citriodora* which are the common aeroallergens causing respiratory allergy among susceptible individuals. They also found a correlation between pollen concentration and temperature, humidity. In the year 2011, Kavita Ghosal and Swati Gupta Bhattacharya made their research on the airborne pollen grains and their impact on human health in Hooghly district, West Bengal.

They found **Poaceae** pollen grains in large number followed by **Areceae**, *Azadirachta*, *Peltophorum*, *Defonix*, **Cyperaceae**, **Amaranthaceae**, and **Chenopodiaceae** etc. According to their research, females were more susceptible to the seasonal changes than males. SFT shown positive result in case of **poaceae**, **cocos**, *Azadirachta* etc. '+2 response' was found in case of *Lantana* pollen. Ige specific Immunoblotting showed the 38 kDa protein band in case of *Lantana*, which cause respiratory trouble in humans being. This research work proves that the pollen grains of *Lantana* sp were the main big factor behind the respiratory problems and allergies of this area. In the year 2012, Mir Musaraf Hussain & Jyotshna Mandal & Kashinath bhattacharya made their research work on airborne load of *Cassia* pollen in West Bengal. They mainly discussed about its atmospheric variation and health impact. According to their research *cassia* pollen found in the atmosphere during February to October. They mainly found- *Cassia occidentalis*, *Cassia tora* and *Cassia fistula*. In their research, they found 10-11 types of major allergic proteins. Commonly 32% peoples were affected with this pollen; from which *Cassia tora* affected 34.7% people.

This research was the first ever research which had seen the protein profiles of these three *Cassia* pollen. Identification and purification of *cassia* Ige-binding allergen components helped in allergen. During summer 2014, Samir Kumar Bera, Swati Chandar Gupta & Sneha Bera made their research work on pollen and spores in yellow rain from Lucknow, northern India and found that atleast 47 spores from different trees, **shrubs** and **herbs** were behind this. The large percentages of spores are from the tree taxa such as- **Sapotaceae**, *Syzygium cumini*, **Moraceae**, *Ailanthus excelsa*, *Acacia*, **Fabaceae**, *Bombax ceiba*, *Holoptelea integrifolia*, **Meliaceae** and **Oleaceae**. The presence of certain allergenic pollen such as *Ricinus communis* and **Asteraceae** during this yellow rain was also seen.

In the year 2017, Anup Kumar Sarkar, Manas Dev & Mallika Mazumdar studied the pollen morphology of some common economically important plants of Jalpaiguri district and found the pollen morphology of 22 species; belonging 10 families. Each species is unique in pollen morphology. Species belonging to same family also differ in pollen morphology. In the year 2018, Sandip Kumar Maity, Arjun Patra, Bikram Pal & Arati Malakar had done the palyno-taxonomic research work of some members of **Malvaceae** in Purba Mednipur district and found the flowering time and pollen morphology of that plants and prepared a pollen calendar of an area with foraging habit of honey bee species. In the year 2018, Kashinath Bhattacharya, Gaurab Sircar, Angira Dasgupta and Swati Gupta Bhattacharya made their research work on Spectrum of Allergens and Allergen Biology in India. Their research mainly based on Molecular Allergology. According to their research, there had not been any report on the molecular and structural nature of dust mite allergens from India but the preliminary clinical and hospitalization data revealed a significant level of asthma-related morbidity due to dust mites; so they believe that in India the ambient aerosol contains a largely different composition of "tropical" dust mite species and the allergen molecules



from some species(family of **Asteraceae**, **Arecaceae**, **Amaranthaceae**, **Poaceae** and **Cyperaceae** etc) must be effectively explored.

This research work will be incomplete if we cannot mention the **50 years survey** (published in journal on 2019) on aerobiological and immuno-chemical studies of pollen allergens in West Bengal was done by Sharadindu Adak, Rajat Kanti Sarkar and Kashinath Bhattacharya. They found 59 types of basic pollen in West Bengal. According to their studies pollen of **Poaceae**, **Azadirachta indica**, **Borassus flabelifer**, **Alstonia scholaris**, **Parthenium hysterophorus**, **Cassia** sp., **Madhuca indica**, **Shorea robusta** etc are the most common allergens. In May, they noticed maximum pollen concentration. Major allergenic proteins of **Cocos nucifera**, **Lantana camara**, **Helianthus annuus**, **Catharanthus roseus**, **Borassus flabellifer**, **Carica papaya**, **Areca catechu**, **Peltophorum pterocarpum**, **Cassia** sp. **Cycas circinalis**, **Alstonia scholaris**, **Delonix regia** were also seen and found that the **main chemical property of their allergen is glycoprotein**. The main important result of their research was- they found gymnosperm (**Cycas circinalis**) pollen, a major allergen for the first time in West Bengal as well as India. A cyclophilin protein **Cat\_r\_1** from the pollen of **Catharanthus roseus** was found, that was the only allergen from India whose structure has been solved by **NMR spectroscopy**.

### In Abroad

In the year 2013, Gary W.K. Wong, Ting Fan Leung, Fanny W.S.Ko made their research work of Allergic Diseases in the Asia-Pacific region. They beautifully presented the trends in asthma and allergies in the ASIA-PACIFIC region. Allergic rhinitis in the ASIA-PACIFIC REGION was also soundly described on their research work. They told about the future challenges of allergic disorders in ASIA and they educated the health-care workers and patients regarding achieving better control; so as to minimize the morbidity and mortality related to asthma and allergies. In year 2014, Zhuo Zheng, Jinhui Wei, Kangyou Huang, Qinghai xu, Houyuan Lu, Pavel Tarasov, Chuanxiu Luo, Celia Beaudouin, Yun Deng, Anding Pan, Yanwei Zheng, Yunli Luo, Takeshi Nakagawa, Chunhai Li, Shixiong Yang, Huanhuan Peng and Rachid Cheddadi made their research work on **East Asian Pollen database** and found pollen distribution and its quantitative relationship with vegetation and climate. They also predicted biomes based on pollen spectra.

They assembled 1748 pollen spectra from 2858 sites to make their research. In this same year, Tiwalade Adeyemi Adeniyi, Peter A. ADEONPEKUN, James D. OLOWOKUDEJO and Idowu S. AKANDE made their research work on Airborne Pollen Records of Shomolu Local Government Area in Lagos State. According to their research, the most dangerous period for inhabitants of Shomolu occurs between October and September when the highest level of grass and weeds pollen grains were recorded. Pollen grains of **poaceae** took an important allergen role along with the other two taxas named **Ludwigia** and **Cypraceae**. According to their research these plants might be responsible for the increasing incidents of wheezing/cough among allergy sufferers. In the year 2016, Pampa Chakraborty, Kavita Ghosal, Eva Sarkar and Swati Gupta Bhattacharya made their research work on Atmospheric pollen grains of a suburban area near **India–Bangladesh border**.

They beautifully represented the **Pollen calendar** and the Monthly mean variation of meteorological parameters of Habra town on their research paper. Their research paper was also indicating tree pollen grains as major aeropollen contributor and dominance of the herbaceous taxa located. Among allergic pollen, **Saccharum officinarum (Poaceae)** took the major portion followed by **Phoenix sylvestris**, **Cocos nucifera**, and **Azadirachta indica**. This research paper confirmed the synergistic effect of atmospheric pollen in triggering respiratory allergy and asthma and this pollen calendar would be helpful to combat respiratory allergy diseases and improve the quality of human life of that population. In the same year (published in 2018) J. T. M. Buters, C. Antunes, A. Galveias, K. C.Bergmann, M. Thibaudon, C. Galán, C. Schmidt Weber and J. Oteros made their research on Pollen and spore monitoring in the world. They found atleast 879 active pollen monitoring stations in the world; from which major portion was form Europe.

They found that, major numbers of monitoring stations are based on '**HIRST LOW**'. They also made an online map to visualize the interaction - i.e. where and by whom pollen and fungal spores are monitored in the world. ([https://oteros.shinyapps.io/pollen\\_map](https://oteros.shinyapps.io/pollen_map)), In the year 2019 (published in 2020), Miguel Blanca, Laura Victorio Puche, Mari'a Garrido-Arandia, Laura Martin-Pedraza, Alejandro Romero Sahagu'n, Jose' Damian Lo'pez-Sa'nchez, Carmen Gala'n, Antonio Marin, Mayte Villaba, Araceli Di'az-Perales and Maria Luisa SomozaID made their research work on **Prup 9**, which is a new allergen eliciting respiratory symptoms in subjects sensitized to peach tree pollen. Their research provide for the first-time evidence that supporting the role of **Peach Tree pollen** (pt pollen) in inducing sensitization and allergy in an indirectly exposed population in an area where this fruit is highly cultivated. From this pollen, several allergens were recognized. One of the PT allergens, Prup 9, was characterized on their research work to elicit respiratory symptoms in the studied population.

### OBSERVATIONS & CONCLUSIONS:

1. In abroad pollen allergy is a vital factor and there, rate of the pollen allergies is much higher than India.
2. Previously the pollen was counted and then a chart was made (**pollen map**) to track the pollen grains and their quantities as high, low, moderate. But now the palynologists make a digital pollen map, which is updated regularly with much detailed manner than previous. They also make pollen monitoring stations to track the pollen grains. So the evolution of pollen track is noticed.
3. The people of abroad are more sufferer than the people of India in respect to pollen allergy. So the scientists make a **pollen calendar**, which clearly notified which pollen comes in which season by which people can take necessary action to prevent it.
4. The scientists made their research so intensely that they found different kinds of pollen and their allergic reactions towards human. They also found new varieties (**purp 9**) and assumed what can it done in future and took necessary Precorsions.
5. Pollen dispersion and its quantitative link with vegetation and climate were investigated. Pollen spectra were also used to forecast biomes.
6. They strive to teach health-care personnel and patients about how to achieve better control in order to reduce asthma and allergy-related morbidity and mortality.
7. They try to create mass awareness between common people about pollen allergies and tell them about the Precorsions and home remedies they should take.
8. The seasonal periodicity of airborne pollen and the pollen productivity chart was made by the scientists. They also created a bar diagram depicting the impact of urbanization on pollen in the air, clearly distinguishing the seasons of spring, summer, and autumn in temperate zones.
9. Scientists discussed the clinical importance of **biopollutants**, their allergic responses to humans, and the potential for synergistic negative health impacts.
10. Diurnal periodicities, a vertical profile of pollen concentrations, and an allergic response to pollen extracts were all created by the researchers. They displayed a chart that indicated which pollens are extremely or lowly allergic, as well as which pollens are strong or weakly hypersensitive.
11. Pollen concentration and temperature, humidity, and the presence and allergising potential of airborne pollen were all wonderfully reported by the researchers.
12. Females were more responsive to seasonal changes than males, according to researchers. **SFT** reports were created in order to identify the most common allergens in the study area (Hooghly district, West Bengal, India). This study proved that pollen grains from *Lantana* sp. were the main cause of respiratory problems and allergies in this study's area.
13. Protein profiles of three major *Cassia* pollen species were created for the first time by Indian scientists. The identification and purification of *Cassia* Ige-binding allergen components aided in allergen identification and purification.
14. The researchers looked for pollen and spore in yellow rain from Lucknow, India, and discovered at least 47 spores from various trees, shrubs, and herbs. They discovered a few allergic pollens in this rain, proving that the locals' acute allergy reactions were caused by direct contact with the rain.
15. Scientists conducted research on several **Malvaceae** members in the Purba Mednipur region of West Bengal, India, and discovered the flowering period and pollen shape of those plants, as well as creating a pollen calendar for an area where honey bee species forage.
16. A study of molecular and structural characteristics of dust mite allergens from India was conducted; however no such particles were discovered. However, preliminary clinical and hospitalization data revealed a high degree of asthma-related morbidity owing to dust mites, leading them to infer that the ambient aerosol in India contains a significantly different composition of "tropical" dust mites.
17. Indian scientists discovered the cyclophilin protein **Cat\_r\_1** in *Catharanthus roseus* pollen, which was the only allergen from India whose structure had been determined by **NMR spectroscopy**.
18. The main chemical property of the common Indian allergen is glycoprotein is also found by the scientists.

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