

Aeropalynology with reference to allergy

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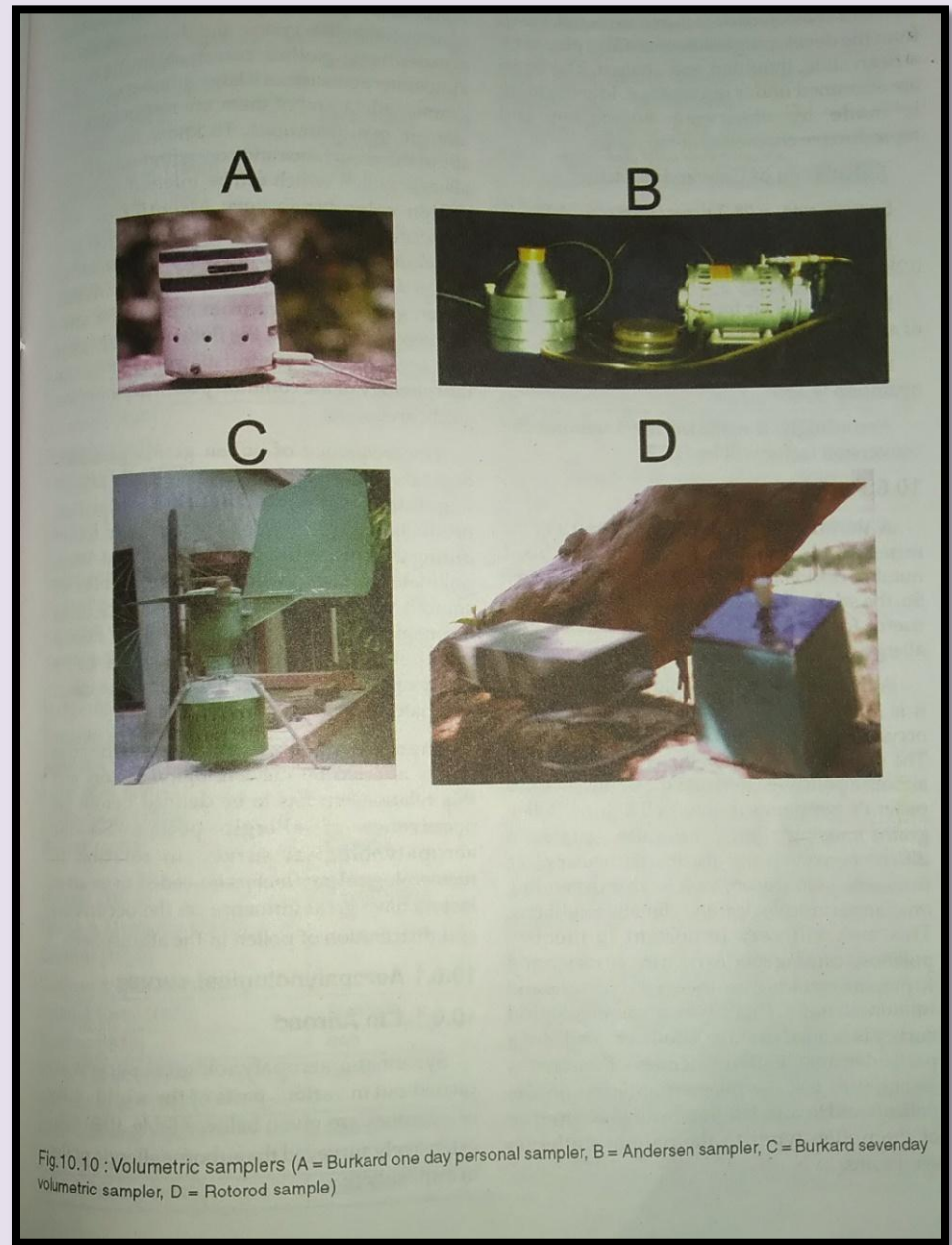
Definition-

Aeropalynology: Erdtman (1969) defines **aeropalynology** as the **study of palynomorphs** found in the atmosphere. The term **palynomorph** encompasses **pollen grains, spores and other bioparticles** that can not be dissolved in hydrofluoric acid.

Aeropalynology is a branch of palynology and related to **study of pollen and spores that are dispersed in the atmosphere**. The study **includes** their eventual dissemination, deposition and impact on human systems.

Pollen grains are dispersed more than **400 miles away** from the source plants. They can be found more than **two miles** above the surface. The **airborne pollen grains** originate from **anemophilous** plants and so they are **small, light, smooth walled, colourless, produced in large numbers, dry and lack nectar**. In other words they are custom made for wind transport. The first and foremost requirement in the study of airspora is to identify and detect the airborne palynomorphs and sporomorphs.





The airborne pollen are trapped for sampling by two major principles-(1) **simple gravimetric method** where pollen and spores **are deposited by normal gravitational force** on slides and

(2) **suction method** where the **atmospheric air is sucked in** with the help of instruments -called **samplers**. There are **many types of sampler** that can **suck certain volume of air according** to a known **velocity for a definite time**.

Along with **the air pollen and spore are sucked in** and **they get stuck either on a plastic band or sticky cello-tape**

(fitted according to sampler), which were **previously placed there for the purpose of trapping** pollen. Mention may be made of **Burkard seven days sampler, Burkard personal slide sampler, Burkard petri plate sampler. Anderson sampler**

The next task is to **analyze the trapped grains**. Analysis includes **identification and quantification of sporomorph and palynomorphs**.

Microscopic identification is dependable in most cases. The frequency of the identified grains is also calculated.

Trapping, identification and quantification are carried out throughout the year and the results are recorded. The data help to prepare the **pollen calendar** of a particular locality. **A pollen calendar reveals the name of plant species that release pollen and spore in particular month(s). It also reveals the approximate amount of grains released in that season.** The term '**pollen count**' is frequently used to represent **the concentration of pollen in atmosphere**. It is a **measure of how much amount of pollen and spore is present in the atmosphere in a particular area at specific time**. The count may consist of a particular type of pollen or spore, or all pollen and spore is present in the air. **Pollen count** is expressed as the number of pollen present in a **cubic metre or other standard volume of air over a twenty-four hour period at a particular place**. The samplers collect pollen grains **A sampler has a drum or rod coated with silicone grease or sticky cello-tape** **During trapping the rod/drum is rotated one turn only in an entire 24 hours of a day with the help of a motor fitted with the sampler. The trapped pollen grains are then analyzed for identification and quantification.**

Dominant pollen-

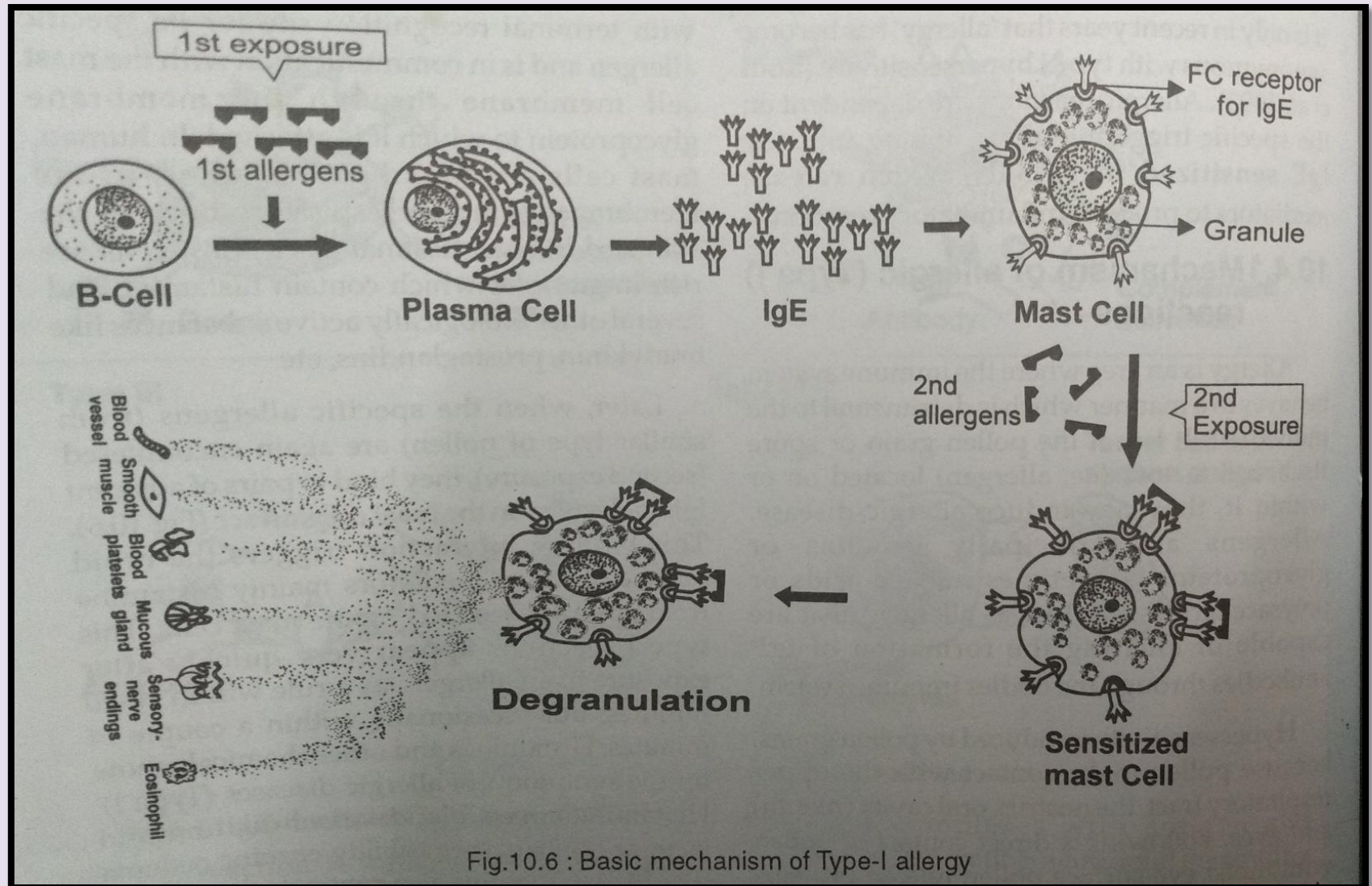
Group/Season	Dominant pollen types
Group I (Autumn)	<i>Cassia, Cocos, Eucalyptus, Trema</i> and grasses.
Group II (Winter)	<i>Borassus, Phoenix, Carica, Cassia, Casuarina, Croton, Dillenia, Eucalyptus,</i> Cyperaceae and grasses.
Group III (Spring)	<i>Acacia, Areca, Azadirachta, Bombax, Borassus, Carica, Cassia, Casuarina, Cheno-Amaranths, Cocos, Croton, Madhuca, Mangifera, Phyllanthus, Ricinus</i> and grasses.
Group IV (Summer)	<i>Acacia, Areca, Borassus, Barringtonia, Litchi, Cheno-Amaranthus</i> and grasses.
Group V (Rain)	<i>Cassia, Cheno-Amaranthus,</i> Cyperaceae and grasses.

Definition of Allergy-

The term allergy is defined as "an altered or accelerated reaction of a person to a second or subsequent exposures to a substance, usually harmless to the general population, to which he/she has been sensitized during the first exposure" - Shivanna and Agarwal et al. The sensitizing agents are known as allergens and it is defined as a substance to which a person is allergic (e.g. pollen and spores, food protein, house dust mites, furry animals etc.). Sometimes the term allergen is used as a synonym for antigen or immunogen. It is protein in nature. A normal adult inhales about 14-15 cubic meters of air per day, which contains a good number of bioparticles including pollen grains. So, the study of airborne allergic pollen is very useful for proper diagnosis and treatment of allergy. From medical, specialty clinical point of view it is important to know the details about the occurrence of the pollen load in the atmosphere. The correlation between the onset of different airborne pollen seasons and the occurrence of a patient's symptoms is now well known. Pollen grains causing allergy are quite variable in different ecozones and also in a particular place from season to season, year to year depending on changes in ecological and climatic conditions. This makes it very important to identify pollinosis (The allergic response of body parts to pollen is called "Pollinosis".) causing species from every region and to prepare extracts from them for diagnosis and immunotherapy. That's why an aerobiological survey is needed to make a pollen calendar of a particular area. Pollen calendar of an area is essential to test the relevant antigens on the patients and to correlate the seasonal occurrence of the pollen types to the patient's allergic symptoms.

The **Aerobiological survey of an area** involves **aeropalynological study, identification of airborne pollen grains, and determination of atmospheric pollen count.** Although the atmosphere consists of a large number of pollen grains, only a few of them are responsible for allergic manifestations. To know the details about the occurrence and concentration of these allergic pollen which can be inferred from the pollen calendar is very essential for the clinicians. A pollen calendar of a region is a prerequisite for the immunological treatment of pollen allergies. Pollen grains are generally found during their respective **pollination period.** Wind pollinated plants produce a large number of smooth-walled pollen grain which are often inconspicuous, colourless and lacking nectar. Such pollen grains are mostly found in the air and are potentially more allergic than the insect pollination i.e. entomophilous plants.

Mechanism of type I hypersensitivity-



Mechanism of allergic (Type 1) reactions

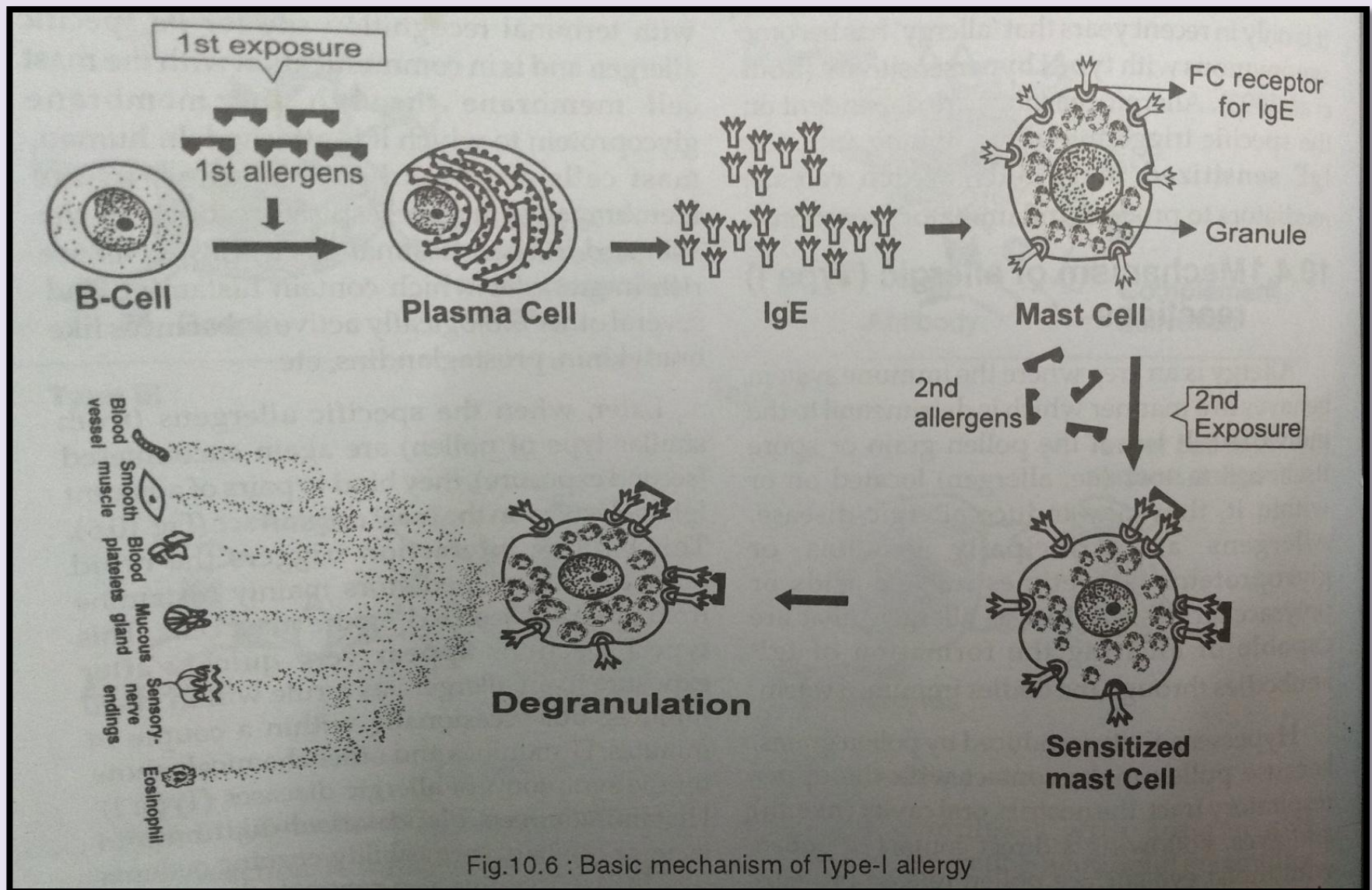
It is not the pollen grain or spore itself, but factors (i.e. allergen) located on or within it, that may induce allergic disease. Allergens are principally proteins or glycoproteins (sometimes nucleic acids or polysaccharides may act as allergen) that are capable of eliciting the formation of IgE antibodies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

Sensitization phase-(Hypersensitivity is induced by pollen grains,because pollen make contact with the upper

respiratory tract, the nostrils, oral cavity (mouth) and eyes. Following a direct contact of pollen with moist eye surface pollen release proteins to induce hay fever or rhinitis. Pollen grains deposited in the uppermost ciliated portion of the respiratory tract, cannot reach to lungs. The nasal cavity filtering them out by inducing a high degree of turbulence in the airflow that are deposited in the trachea and upper bronchi.)For more information and understanding.

Most pollen grains are swallowed and become accumulated in stomach. Pollen discharge their proteins while passing through the stomach and a moderate proportion of proteins are introduced into the bloodstream to start hypersensitivity reaction. 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 in 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 bound to the surface of a single mast cell 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 mast cell membrane through the membrane glycoprotein to which it is attached. In human, mast cells are found in the lungs, in the membranes of upper respiratory tract, in the skin and in the intestinal tract. Mast cells are rich in granules which contain histamine and several other biologically active substances like bradykinin, prostaglandins, etc.(refer to figure)

Mechanism of type I hypersensitivity-



The effector phase-

Later, when the specific allergens (from similar type of pollen) are again encountered (second exposure), they bind to pairs of adjacent IgE molecules on the mast cell surface. This binding interaction triggers the rapid release of tissue mediators mainly histamine from granules secreted by the mast cells. This type I reactions appear very quickly after exposure to an allergen, as a rule within 10-20 minutes, but occasionally within a couple of minutes. Histamines and other chemicals show up the symptoms of allergic diseases (Type I). Histamine effects blood vessel dilation and increase capillary permeability, ensuing oedema

Histamine also contracts the smooth muscles and stimulates the exocrine glands. In the bronchi histamine contracts the smooth muscles, swells the membranes, and produces thick mucous leading to congestion, making breathing more strenuous . In the skin, histamine produces wheal and elevated patches with itching and adjoining redness. Symptoms also appear in nose and eyes like sneezing, blocked nose, cold plus reddened, swollen and itching eyes.(refer to figure)

Some important pollen allergies,diseases and their symptoms-

Common pollen/spore allergies Allergic diseases may involve any part of the body, the most frequently involved being the nose, eye and chest with resultant symptoms of hay fever, rhinitis or asthma. The skin and eyes also commonly show allergic symptoms. Some of the common pollen allergies are described below.

Hay fever: This is a seasonal type of allergy. The pollen grains of certain grasses, weeds and trees are the main causes of this type of allergy, although mold spores can also cause the symptoms. Depending on where the patients live and the pollination period of a particular plant, attacks may occur seasonally either in spring, summer, winter or rainy season. Various symptoms may occur. The lining 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 the eyes may be similarly affected. The British Scientist, Dr. Blackley in 1873 was the first to prove that pollen grains are the causative agent for hay fever. Later, Wyman (1876), Dunbar (1903) and others directly proved that the pollen grains of ragweed or *Ambrosia* are responsible to cause the common hay fever of United States. Hay fever or allergic rhinitis also called pollenosis (also spelt as pollinosis) is the best-known allergy of all.

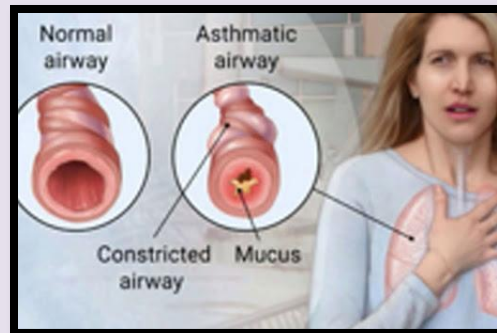


Rhinitis: It is **perennial type of allergy**. The symptoms are similar to hay fever, but appear all the year round. The condition is caused by **non-seasonal allergens such as pollen grains of grasses and other plants which flower round the year**. Sometimes house dust components and certain **mold spores** are also the causative agents for rhinitis.

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



Asthma : Asthma may 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 due to the **swollen mucous membrane and formation of mucous in the airway**. **Breathing becomes difficult and forced breathing becomes necessary**. A **wheezing sound appears due to the rush of air through the narrowed airways**. At the same time, a **troublesome cough can develop**. Asthma may begin at any age and if neglected trends to recur and become chronic.



Diagnostic tests and medication-

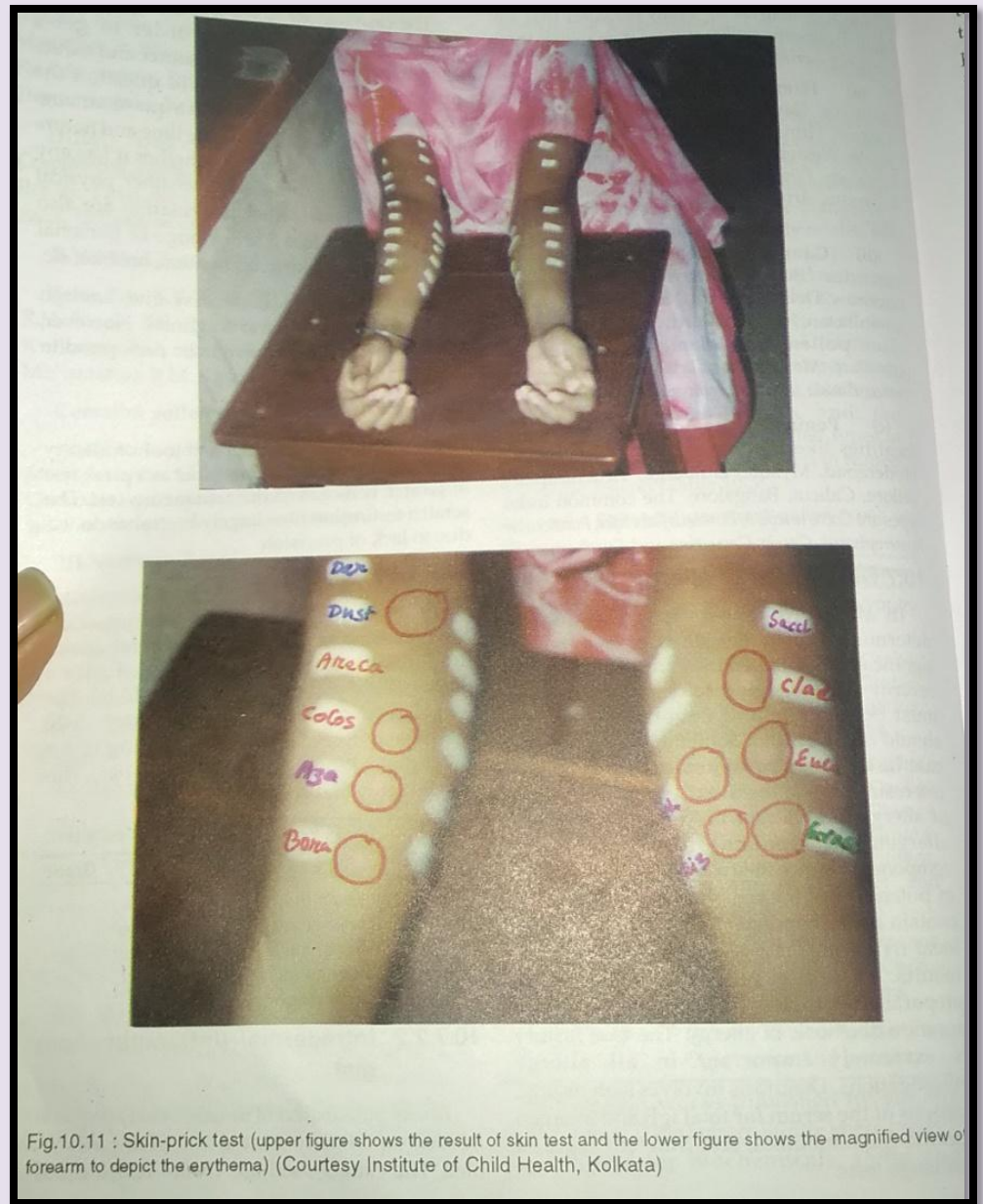


Fig.10.11 : Skin-prick test (upper figure shows the result of skin test and the lower figure shows the magnified view of forearm to depict the erythema) (Courtesy Institute of Child Health, Kolkata)

It is important to **consult doctor if the allergic symptoms persist more than a week or two**. Doctor will study the **medical history of the patient**. If it is noted that the **symptoms recur at the same time each year**, the doctor will **proceed to diagnose the causative agent of allergy under the hypothesis that a seasonal allergen is involved**.

Blood and skin test are performed to detect the causative agents of respiratory allergy. Among the blood tests mention may be made of **Enzyme Linked Immuno Sorbent Assay (ELISA)**, **Paper Radio Immuno Sorbent Test (PRIST)** and **Radio Allergic Sorbent Test (RAST)**. These tests indicate the **amount of IgE present in the serum of patients**. Although these tests offer advantages over skin test, **they are time consuming, expensive and somewhat less sensitive**. **These tests become compulsory for those patients who have certain disorders in the skin**.

The **skin test is most commonly employed as it is simple, convenient, and highly specific and less expensive**. To perform the test the antigenic extract of each type of pollen found in the local area of the patient is applied to a scratch made on the arm of the

patient or injected under the patients' skin. In positive reaction at the test site of scratch/prick) an elevated reddened area with a surrounding flush, called wheal, appears. The size of the wheal provides the diagnostic clue.

Medication and avoidance-

Medication is the best treatment to relieve symptoms of allergy due to pollen and spore. Though **antihistamine** and **corticosteroids**(examples of antiallergic drugs) are very effective in controlling allergic disorders, they have **serious side effects after prolonged usage**.

Avoidance of allergen as a primary mode of therapy might give relief to some extent.

Avoidance includes the followings:

- (1) **reduction in exposure to the particular species** in which a patient is **allergic**,
- (2) **moving to a place where the allergenic plant does not grow**. Allergy specialists strongly discourage this Approach because patient may develop allergies to other plants.
- (3) It is **advisable to remain in indoors when the pollen count is highest especially in the early morning and late afternoon**.
- (4) To wear **Face Mask**, which is designed to **filter pollen out of the air during inhalation**.
- (5) After returning from **outdoors** it is **recommended to take bath and use fresh cloth**.
- (6) Use of **air cleaners** like **air conditioners and air purifiers** inside the rooms can reduce pollen level inside
- (7) To **dry wet clothes in dryer instead of hanging outside, where pollen may get trapped on the wet clothes**.
- (8) Pollen grains generally **settle down in the evening** and so it is **advisable to close all windows in the evening**.
- (9) To avoid **planting the allergenic plants around house**.
- (10) The **house compound must be free from weeds and grasses**.
- (11) **To install Electronic/electrostatic precipitator**

Some important allergic pollen and spores.

Cyanodon dactylon, *Betula verrucosa*, *Cryptomeria japonica*, *Ambrosia artemisifolia*, *Zea mays* etc are some common source of pollen allergens.

	Common name	Latin name	Major allergens
1.	Birch	<i>Betula verrucosa</i>	Bet v I, II
2.	Bermuda grass	<i>Cynodon dactylon</i>	Cyn d I
3.	Blue grass	<i>Poa pratensis</i>	Poa p I, V, IX
4.	Japanese cedar	<i>Cryptomeria japonica</i>	Cry j I, II
5.	Mugwort	<i>Artemisia vulgaris</i>	Art v I – III
6.	Orchard grass	<i>Dactylis glomerata</i>	Dac g I, V
7.	Ragweed, short	<i>Ambrosia artemisiifolia</i>	Amb a I – VII,
8.	Ragweed, giant	<i>Ambrosia trifida</i>	Amb t V
9.	Western ragweed	<i>Ambrosia psilostachya</i>	Amb p V
10.	Rye grass	<i>Lolium perenne</i>	Lol p I – V
11.	Timothy grass	<i>Phleum pratense</i>	Phl p I, II, V
12.	Maize	<i>Zea mays</i>	Zea m I, Zm PRO 1,2,3
13.	Olive tree	<i>Olea europea</i>	Ole e I, Ole e
14.	Velvet grass	<i>Holcus latanus</i>	Hol I I, Hol I V
15.	A tropical grass	<i>Sorghum halepense</i>	Sor h I
16.	Parietaria	<i>Parietaria officinalis</i> <i>Parietaria judaica</i>	Par ol Par j I

Respiratory allergy is a very common disease among all populations all over the world.

It is a seasonal and local problem. It is related to the appearance and the concentration of specific airborne allergens in that particular area.

In India 20 to 30% of the population suffer from allergic rhinitis and 15% suffer from asthma .

So it is necessary to develop a network of centres in various biozones of India to collect data of the dispersed palynomorphs and sporomorphs. These centres will prepare pollen calendars from the collected data and broadcast the pollen count.

This will be very useful for clinicians and as well as patients. The centres will also perform the clinical and immunological tests based on local allergens to local patients.

Reference-

1. **A Textbook of Palynology** by Kashinath Bhattacharya , [Manas Ranjan Majumdar](#), [Swati Gupta Bhattacharya](#)
2. Plant Anatomy by Pijush Roy
3. Images- Internet source