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Palyno-Morphological Study of Allergenic Flora of Samarkand, Uzbekistan

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Abstract

This study set out to look into the palyno-morphological characteristics of specific allergenic species from diverse plant families in Samarkand, Uzbekistan. Six different species *i.e. Betula pendula*, *Fraxinus pennsylvanica*, *Magnolia × soulangeana*, *Pinus brutia var. eldarica*, *Populus alba*, *Quercus robur* were collected, pressed, identified, and then examined under a microscope. Under light microscope, both quantitative and qualitative characteristics of the pollen grains were recorded, including pollen type, pollen size, pollen shape (polar and equatorial view), P/E ratio, mesocolpium distance, exine thickness, colpi type, colpi length, and width. It was found that a warm spring in Uzbekistan causes an early commencement of the vegetative and dusting phases, in contrast to the climatic circumstances of the researched entities' motherland (cold spring). Studies in aeropalinology and morphology enable the resolution of numerous environmental issues. The findings highlighted the importance of pollen morphology as an identifying aid and showed how the tested species' palynological characteristics varied. In order to promote future phylogenetic description of the Uzbekistan flora, the current study may help us better understand the palynomorphological traits of native plants. This essay only briefly and inadequately addresses these issues. The information gathered will be used to make an atlas of allergic plants in Samarkand and an electronic warning system for the general public about the spread of pollen from the city's allergenic plants in the future.

Keywords

Morphology, Pollen, Light Microscopy, Uzbek Flora, Allergenic Plants

1. Introduction

Both allergists and botanists are becoming more interested in allergenic plants, whose pollen is one of the primary causes of allergy disorders. It has recently become a major medical, biological, and social issue on a massive level. Everyone is aware that grass and tree pollen allergies are the most prevalent; globally, 400 million people experience some form of allergic reaction to pollen (hay fever), which is characterized by symptoms like runny nose, sneezing, itching with red eyes, coughing, and severe breathing difficulties [1]. Trees, shrubs, grasses at the end of summer are aggravating in the spring and summertime. Adults and children both develop allergies to pollen. The majority of the symptoms are brought on by pollen from grasses and deciduous trees. These plants' pollen can result in allergic rhinitis as well as pulmonary conditions as coughing, bronchial asthma, and breathing difficulties [2]. The period of flowering has also extended as a result of global warming. There are more deciduous trees now, and more pollen is produced as a result. Naturally, there is a seasonal variation in pollen production. It's intriguing to note, compared to rural areas, where there is a significantly larger quantity of pollen, more people in cities experience allergies to trees' pollen. Numerous scientific researches have demonstrated that pollen in cities is shielded from the environment by a layer of pollution. These include different petroleum products and carbon dioxide (CO_2). Such a hazardous layer increases the allergenicity of pollen. Allergy-related illnesses are the third most prevalent illnesses, according to the WHO. Compared to cancer and rheumatism, allergic illnesses are 30 and 2000 times more prevalent, respectively. It is well known that allergic illnesses can affect both children and adults [1] [3].

Our nation's government has made significant decisions to address this issue. For instance, the Resolution of the President of the Republic of Uzbekistan No. PP-4063 of December 18, 2018, "On Measures for the Prevention of Non-Communicable Diseases, a Healthy Lifestyle, and Increasing the Population's Physical Activity" No. PP-3715 of May 11, "On Comprehensive Measures to Improve the Prevention, Diagnosis and Treatment of Allergic Diseases," and "On Measures for the Prevention of Non-Communicable Diseases, a Healthy Lifestyle" [1]. N.V. Mavlyanova (1997) conducted research on the immunobiological characteristics of cotton pollen in Uzbekistan and its function as an allergenic in the particular diagnosis of pollinosis in 1997 under Tashkent conditions. Many researches provide information on the pathophysiology, pathology, current treatments for, and preventative measures for, rhinitis in addition to a list of certain allergic plant species present in Uzbekistan. They also research the physicochemical, immunobiological, and allergenic features of cotton pollen and identify the technical aspects of the creation of a preparation from it, suitable for the particular diagnosis of allergies (2020) [4] [5]. The study indicated that there has been minimal exploration done in this field, which suggests that there hasn't been much study done on allergenic plants. The hazardous species of allergenic plants that are now present in Tashkent were chosen as the research subjects, because there hasn't been enough done in Uzbekistan in this field.

The aim of this work was to use light microscopy (LM) to evaluate the intricate pollen morphology, including form, size, and exine ornamentation, of species from Uzbekistan in order to correctly identify the species and progress the phylogenetic tree. The objective is to examine the morphometric characteristics of various allergenic species' propagules in Samarkand, Uzbekistan.

Here is a detailed explanation of how the weather can influence flowering and allergy disorders. The weather plays an important role in many aspects of our lives, including how plants grow and how allergies affect us. In this section, we will discuss how the weather can impact the timing of flowering and the onset and severity of allergy symptoms.

1) Weather and Flowering

a) Temperature. Temperature is one of the most significant factors that influence when plants flower. Warm temperatures in the spring can cause plants to bloom earlier than usual, while prolonged cold temperatures can delay flowering. This can have an impact on the availability of food sources for pollinators such as bees and butterflies, which rely on nectar from flowers. Changes in the timing of flowering can also have broader ecological impacts, affecting the timing of other seasonal events such as migration patterns.

b. Rainfall. Rainfall is another important factor that affects flowering. A lack of rainfall can cause stress on plants, leading to reduced growth and delayed or stunted flowering. Conversely, too much rainfall can lead to waterlogged soils and root damage, which can also affect plant growth and flowering. The timing and amount of rainfall can also impact the availability of water for plants, which can impact their ability to produce flowers.

2) Weather and Allergy Disorders

a. Temperature and Pollen Production. Warmer temperatures can also lead to an increase in pollen production, which can exacerbate allergy symptoms for those who are sensitive to pollen. This is because temperature can affect the timing and rate of plant growth and development. When the temperature is warmer, plants tend to grow more quickly, which means they may produce more pollen at a faster rate than they would under cooler conditions.

b) Rainfall and Allergens. Heavy rainfall can wash away pollen and temporarily reduce allergen levels in the air. However, this can also promote the growth of mold, which can trigger allergic reactions in some individuals. Rainfall can also affect the distribution of pollen in the air. Dry and windy conditions can spread pollen over longer distances, increasing exposure to allergens.

c) Windy Conditions. Windy conditions can also impact allergy symptoms. When it is windy, pollen and other allergens can be carried further and remain airborne for longer periods of time, increasing exposure to these substances. Additionally, wind can cause respiratory irritation, which can exacerbate allergy symptoms.

In conclusion, the weather plays a crucial role in the timing and intensity of flowering and allergy disorders. Temperature, rainfall, and wind can all impact when and how much plants bloom, as well as how much pollen and other allergens are produced and spread throughout the air. For those with allergies or who rely on flowering plants for sustenance, it is important to stay aware of local weather patterns and take appropriate measures to manage their symptoms.

2. Materials and Methods

2.1. Plant Collection

Six plant species belonging to different families were collected in different field trips in various area of Smarkand Uzbekistan. Plants were identified by expert taxonomists, pressed and preserved to be used as specimen for palynological investigations.

2.2. Slide Preparation

The sample was procured during the massive reproductive phase of allergic flora for fixing the pollen. Utilizing the acetocarmine technique, pollen morphological characteristics of allergenic species were studied. Mature pollen was also kept in Karuna's fixative at the exact time. The fixation took place for somewhere between 30 minutes and several hours. The sample was then cleaned with distilled water before being placed in a solution of 80% ethanol for storage. The stored anther was then spread out on a glass slide and crushed in an acetocarmine drop. The sample was cleaned of extra tissue, covered with a cover glass, and slowly warmed up on an alcohol lamp.

2.3. Light Microscopy

With a Samsung ES70 digital camera, a Canon A123 digital camera, a trinocular microscope model N-300M (with HDCE-X5), and a Motic B1-220A-3 binocular microscope, microphotographs were obtained with a computer microphotographic attachment. Morphological characteristics such as shape, size, ornamentation, polarity, polar diameter, equatorial diameter, exine thickness, colpi number, colpi length, colpi width, and P/E ratio were examined.

Here's a brief description of to study the pollen morpgological characteristics of allergenic species beside acetocarmine technique.

1) Acetocarmine technique: A staining technique that uses a solution of acetic acid and carmine to stain pollen grains, making their morphology visible under a light microscope.

2) Scanning electron microscopy (SEM): A high-resolution imaging technique that uses a beam of electrons to create detailed images of the surface structure of pollen grains.

3) Light microscopy: A technique that uses visible light to observe pollen grains that have been stained with various dyes.

4) Fluorescence microscopy: A technique that uses fluorescent dyes to label specific structures within a pollen grain, allowing them to be visualized under a fluorescence microscope.

5) Transmission electron microscopy (TEM): A high-resolution imaging technique that uses a beam of electrons to create detailed images of the internal

structure of pollen grains.

6) Confocal laser scanning microscopy (CLSM): A fluorescence microscopy technique that uses lasers to illuminate labeled structures in a single plane of focus, creating high-resolution 3D images of pollen grains.

7) Polarized light microscopy: A technique that uses polarized light to visualize the birefringence properties of pollen grains, which can provide information about their chemical composition.

Each of these techniques can provide valuable information about pollen morphology and structure, depending on the specific research question being addressed.

3. Results and Discussion

To determine the timing of dusting and investigate the morphology of pollen, we collected the pollen from a few allergenic plants in the Samarkand environment *i.e. Betula pendula*, *Fraxinus pennsylvanica*, *Magnolia × soulangeana*, *Pinus brutia var. eldarica*, *Populus alba*, *Quercus robur* (Table 1).

3.1. *Betula pendula* Roth

Family: Betulaceae

Palyno-Morphological Description: The Size of pollen grain was small because ranges under 10 - 25 µm as numerical data. Polar view is triangular (Convex), the exine is rounded outward while the Pollen Type is Tricolpate, because Colpi and pore is visible in light microscope photograph. Mesocolpium distance between two colpi measured was (4.99 µm). For pollen shape determination, polar and equatorial axis ratio is calculated was (1.14). Exine thickness was recoded (1.866 µm). Colpi length recoded (3.02 µm) while width was (2.96 µm) (Figure 1(a)).

3.2. *Fraxinus pennsylvanica* Marshall

Family: Oleaceae

Palyno-Morphological Description: The Size of pollen grain was Very small

Table 1. Qualitative and quantitative palyno-morphological characters of allergenic species.

Sr. No.	Allergenic Plant Species	Pollen Size (µm)	Pollen Type	Mesocolpium Distance Between Two Colpi (µm)	P/E Ratio	Exine Thickness (µm)
1.	*Betula pendula* Roth	10 - 25	Tricolpate	4.99	1.140	1.866
2.	*Fraxinus pennsylvanica* Marshall	<10	Prolare-Spheroidal	5.05	1.12	1.32
3.	*Magnolia ×soulangeana* Soul.-Bod.	10 - 25	Tricolpate	11.8	1.06	1.052
4.	*Populus alba* L.	<10	Tetracalpoate	5.34	1.06	1.746
5.	*Pinus brutia var. eldarica* (Medw.) Silba	25 - 50	Heteropolar	5.0	1.14	1.87
6.	*Quercus robur* L.	<25	Tricolpate	4.9	1.1	1.8

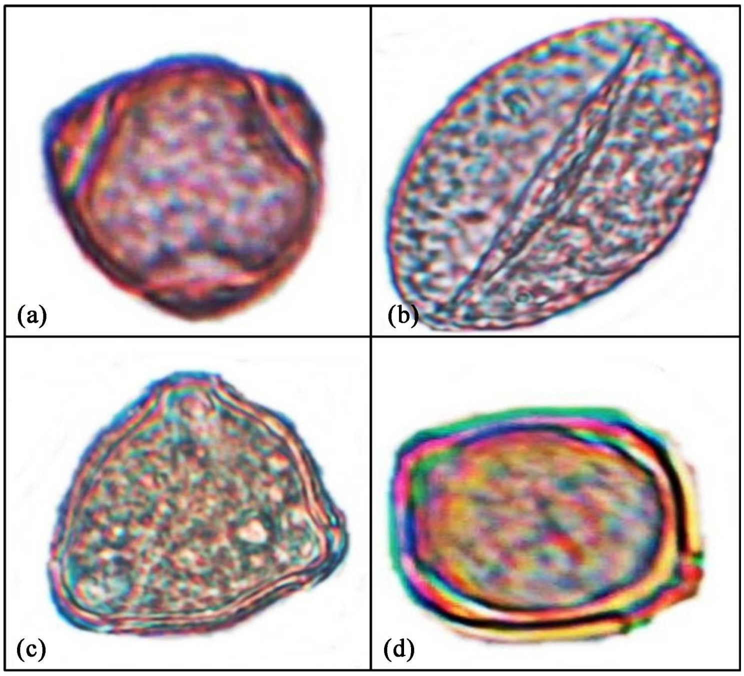

Figure 1. Light micrographs of pollen grains (a) *Betula pendula* (b) *Fraxinus pennsylvanica* (c) *Magnolia ×soulangeana* (d) *Populus alba.*

because ranges under less the < 10 µm as numerical data. Equatorial View is Prolate-spheroidal. Mesocolpium distance between two colpi measured was (5.05 µm). For pollen shape determination, polar and equatorial axis ratio is calculated (1.12). Exine thickness was recoded (1.32 µm). Colpi length recoded (3.21 µm) while width was (2.43 µm) (**Figure 1(b)**).

3.3. *Magnolia × soulangeana* Soul.-Bod.

Family: Magnoliaceae

Palyno-Morphological Description: The Size of pollen grain was small because ranges under 10 - 25 µm as numerical data. Polar view is Triangular (Convex), the exine is rounded outward while the Pollen Type is Tricolpate, because Colpi and pore is visible in light microscope photograph. Mesocolpium distance between two colpi measured was (11.8 µm). For pollen shape determination, polar and equatorial axis ratio is calculated (1.06). Exine thickness was recoded (1.052 µm). Colpi length recoded (6.31 µm) while width was (1.94 µm) (**Figure 1(c)**).

3.4. *Populus alba* L.

Family: Salicaceae

Palyno-Morphological Description: The Size of pollen grain was very small because ranges under less the < 10 µm. Polar view is Tetrahedral Angular while in equatorial view it's four angled Circle. The Pollen Type is Tetraporate, because Colpi and pore is visible in light microscope photograph. Mesocolpium distance between two colpi measured was (5.34 µm). For pollen shape determination, polar and equatorial axis ratio is calculated (1.06). Exine thickness was recoded (1.746 µm). Colpi length recoded (3.0 µm) while width was (2.9 µm) (**Figure 1(d)**).

3.5. *Pinus brutia* var. *eldarica* (Medw.) Silba

Family: Pinaceae

Palyno-Morphological Description: The Size of pollen grain was large because ranges under 25 - 50 µm, large grains as numerical data. Polarity as heteropolar. No suitable term for polar view. Distance between two wings measured was (5.0 µm). For pollen shape determination, polar and equatorial axis ratio is calculated (1.14). Exine thickness was recoded (1.87 µm). Wing length recoded (3.026 µm) while width was (2.968 µm) (**Figure 2(a)**, **Figure 2(b)**).

3.6. *Quercus robur* L.

Family: Fagaceae

Palyno-Morphological Description: The Size of pollen grain was small because ranges under 10 - 25 µm as numerical data. Polar view is triangular (Convex), the exine is rounded outward while the Pollen Type is Tricolpate, because Colpi and pore is visible in light microscope photograph and spheroidal in Equatorial View. Mesocolpium distance between two colpi measured was (4.99 µm). For pollen shape determination, polar and equatorial axis ratio is calculated (1.14). Exine thickness was recoded (1.866 µm). Colpi length recoded (3.026 µm) while width was (2.968 µm) (**Figure 2(c)**, **Figure 2(d)**).

The Palyno-morphological traits are an extra tool for the systematic study of

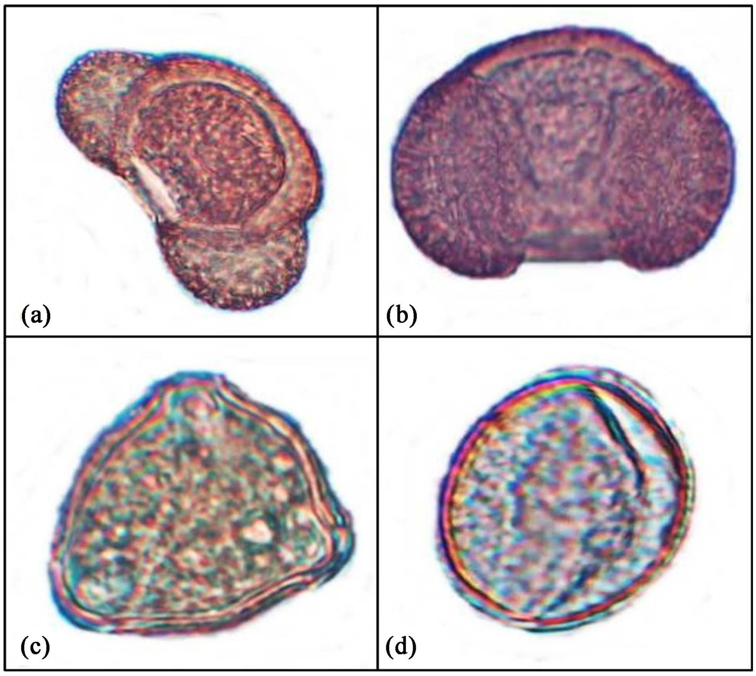

Figure 2. Light Micrographs of Pollen grains: *Pinus brutia* var. *Aldarica* (a) Polar view (b) Equatorial view; *Quercus robur* (a) Polar view (b) Equatorial view.

plant groupings and are essential for the identification, classification, and species demarcation of various types of plants. The variation in the shapes and types of pollen is obvious among different allergenic species. The development of pollen calendar and electronic alarming system may help to control spread of pollen allergy.

Here is a detailed explanation of how the shapes and types of pollen can vary among different allergenic species. The shape and type of pollen grains produced by plants can have a significant impact on their potential to cause allergies. In this section, we will discuss how pollen morphology varies among different plant species and its role in determining which species are likely to cause allergies.

1) Types of Pollen

a) Wind-Pollinated Plants. Many plants that cause allergies are wind-pollinated, meaning they rely on the wind to carry their pollen from one plant to another. Wind-pollinated plants produce small, lightweight pollen that is easily carried over long distances. This type of pollen is more likely to become airborne and trigger allergic reactions, as it can be inhaled deep into the respiratory system.

b) Insect-Pollinated Plants. In contrast, many plants that produce large, heavy pollen grains are insect-pollinated, meaning they rely on insects such as bees and butterflies to transfer their pollen between plants. These types of pollen grains are less likely to become airborne and cause allergies, as they are too heavy to be carried on the wind.

2) Shapes of Pollen Grains

a) Circular or Spherical Pollen Grains. Some plant species produce pollen grains that are circular or spherical in shape. These shapes are less likely to cause allergic reactions, as they are less likely to stick to the respiratory tract and cause irritation.

b) Elliptical or Asymmetrical Pollen Grains. Other plant species produce pollen grains that are elliptical or asymmetrical in shape. These shapes are more likely to become lodged in the respiratory tract and cause allergic reactions, as they can hook onto the lining of the airways.

In conclusion, the shape and size of pollen grains can vary significantly among different plant species, and these variations can affect their potential to cause allergies. Wind-pollinated plants that produce small, lightweight pollen grains are more likely to trigger allergic reactions than insect-pollinated plants that produce large, heavy pollen grains. Additionally, the shape of pollen grains can impact how they interact with the respiratory system, with elliptical or asymmetrical shapes being more likely to cause irritation. It is important for individuals with allergies to be aware of which plant species are likely to cause a reaction and take appropriate precautions when exposed to these allergens.

4. Conclusion

Today, the study of allergenic plants has become a particularly crucial issue on poor air quality and an uncertain environment. With regard to seasonal epidemics of an allergic disease like hay fever, it is crucial to act promptly and appropriately given the phenological diversity of the kingdom plantae. Botanists, palliative care physicians, and allergists must pay special attention to and take great care with such a project. It was observed that a warm spring in Uzbekistan causes the growth and dusting phases to begin earlier than they would under colder climatic conditions (the motherland of the investigated objects). Therefore, aeropalinological and morphological investigations can provide solutions to a variety of environmental issues. This work offers a succinct and insufficient reflection of these issues. Future data gathering will be used to compile an atlas of allergenic plants in Tashkent and develop a population-wide electronic warning system for the spread of pollen from such plants.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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