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PALYNOLOGICAL STUDY OF SOIL SAMPLE COLLECTED FROM AN ARCHAEOLOGICAL SITE (GULABI BAGH) IN LAHORE, PAKISTAN

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ABSTRACT

Soil samples collected from an archaeological site Gulabi Bagh Lahore to evaluate pollen morphology and type of pollen present in the surface soil or their origin either they belong to vegetation of the same area or somewhat migrated. For that purpose soil was collected from 2 feet deep of the ground on 17th November 2008. Standard methods were used for the treatment of soil samples and slides were prepared. The results indicated total 10 pollen taxa in the soil sample belonging to 9 families and 10 genera. Among them nine were introduced or cultivated and only one belonging to the natural vegetation. The shapes of pollen were mostly prolate and spheroidal. Polyporate number of aperture and porate type of aperture was characteric in all the pollen taxa except one in *Jatropha curcas* Linn. which was non aperturate. It was also observed that maximum pollen size was recorded in *Murraya koenigii* (Linn.) Spreng. and the minimum pollen size was observed in *Imperata cylindrica* (Linn.) P. Beauv**.**

Key words: Gulabi Bagh,Palynological data, Standard ,Prolate,Polyporate,Aperturate

INTRODUCTION

Palynology is the science that studies contemporary and fossil palynomorphs, including pollen, spores, orbicules, dinoflagellate cysts, acritarchs, chitinozoans and scolecodonts, together with particulate organic matter (POM) found in sedimentary rocks and sediments (Jansonius and McGregor 1996). Major conceptual development was occurred when it was realized that the spores/pollen could be utilized to reconstruct the sequence of past vegetation changes and hence environmental and climatic alterations (Erdmann, 1943).

Nair (1979) reported that pollen grains and spores constitute an important morphological entity, reflecting the facts and facets of pollen evolution. Among the various characters of exine, the aperture is considered to be the most conservative. Lee (1990) explains the significance of pollen diversity in pollen size, exine, thickness, aperture type and number, and wall stratification. Yildiz *et al.,* (2009) worked on palynological investigations of endemic taxa from Northern Cyperus collected from soil.

In Pakistan, the research dates back to early sixties. Malik *et al*., 1964; Bhutta, 1968; Ashraf 1973; Zahur *et al*., 1978; Meo *et al*., 1988 (ab); 1999; Hafiz and Baig, 1989; Nasreen and Khan 1998; Mumtaz *et al*., 2000 and Dawar *et al*., 2002 have provided a commendable quantity of basic and applied information in palynology. Moreover, at international level there has been an explosion of information published on many aspects of pollen and spores.

This study is based on the hypothesis that what type of pollen present in soil or either they belong to vegetation of the same area or somewhat migrated. Because palynological studies have played a vital role in the identification and delimitation of various taxa. This variation would prove as a taxonomic criteria in the classification of plant species.

MATERIALS AND METHODS

The soil samples were collected from the research area "**Gulabi Bagh", located** between 31° 13′ to 31° 43′ N latitudes and 74° 00 to 74° 39′ E longitude with the elevation ranging from 211 to 213 meters .The soil collected from 2 feet deep of the ground on 17th November 2008 and preserved in plastic bags. Soil samples were treated by methods of Shackley (1981) for pollen analysis. The pollen grains were prepared for light microscope using the standard methods described by Erdtman (1952) (Perveen *et al.,* 2004; Qaiser and Perveen, 2004) and observation were made with a Meiji CO., LTD, Japan, model no. 35440, light microscope, using digital camera 12.1 mega pixel using 10X eye piece. The size, symmetry, shape, aperture, spine and exine of the pollen were determined. The terminology used is in accordance with Erdtman (1952, 1960, 1969), Faegri and Iversen (1964) and Walker and Doyle (1975).

RESULTS AND DISCUSSION

A total of 10 pollen taxa were identified in soil sample collected from an archaeological site Gulabi Bagh. The pollen taxa belong to 9 families and 10 genera

(Table 1). The identified families Caesalpiniaceae, Combretaceae, Euphorbiaceae, Lythraceae, Malvaceae, Mimosaceae, Poaceae, Rosaceae, Rubiaceae and Rutaceae. The pollen identified belonging to the natural vegetation of the study area. Among them nine are cultivated taxa and one is wild plant.

Results

1. Family: Mimosaceae, **Botanical name**: *Acacia nilotica* (Linn.)Delile

Palynomorph: Polyads of 16 grained, 8 grains peripheral and 8 grains centrally placed in two groups, each group containing 4 grains, medium to large. Individual cell sub-globose in priphery and square in center, grain 3 porate, prolate to subspherical contour of peripheral grain circular. Prilate to finely granulate, testate, pores distinct, diameter of pores is 1.8µm, size of peripheral grain 8.4µm. Heteropolar, Exine 2.8µm thick.

2. **Family:** Caesalpiniaceae, **Botanical name:** *Cassia fistula Linn.*

Palynomorph: Tricolporate, non-angular, colpi length 21 µm and breadth 12.6µm. Pollen size is 264.6µm Mesocolpium 1.89µm. Apocolpium 8.4µm. Exine 1.05µm thick. Sexine thicker than nexine. Tectum reticulate-regulate. Grains prolate-spheroidal, contour sub-triangular, small to medium, granulate, testate, colpi and pores distant , colpi 2-7µm wide and more than the length of polar axis ,spherical , variable in diameter 3.6-4.6µm and an gulo aperature. Isopolar.

3. Family: Malvaceae, **Botanical name**: *Hibiscus rosa-sinensis Linn.*

Palynomorph: Pantoporate, spherical to globose, isopolar, radial symmetry in polar view and bilateral in equatorial view, circular to oval. Pollen size is 143µm, exine 3.5µm thick, echini 9µm high, echini base 5µm wide, echini apexes 25.3µm apart, inter echini base distance 18µm, pore diameter 5µm. Number of spines are 24 and number of pores are 16. Pollen echinate and echini large in size and spaced widely, easy to count and distinct with blunt apex. Echini arranged regularly. Central spines which form a ring are somewhat different. Dimorphic with apex blunt, rounded and bifurcated. In some spines the apex is as much wide as base. Tectum is finely reticulate, perforated and densely granulated between spines. Aperture large and clear. Isopolar.

4. Family: Poaceae, **Botanical name:** *Imperata cylindrica (Linn.) P. Beauv*

Palynomorph: Areolate with medium scabrae-type, Spheroidal, Annulate, operculate, annulate, annulus reduced, annulus 3µm in diameter, 0.85µm thick, size of pollen is 2.5µm often slightly thicker pores. Exine 0.33µm thick, sexine slightly thicker or thinner than nexine. Tectum areolate, scabrae medium size in groups of 2-25, closely-widely distributed on small-large size regular or irregular areolae. Isopolar.

5. **Family:** Rubiaceae, **Botanical name:** *Ixora coccinea Linn.*

Palynomorph: Grains isopolar, radially symmetrical, triangular, goniotreme, prolate, 3 zono-colpate, some grains show occasional para syncolpate furrows, bordered by distinct margins. Size of the pollen was 21.1µm. Exine 0.54µm thick, stratification distinct, crassimarginate, granula nexine, homogenous, psilate.

6. Family: Euphorbiaceae, **Botanical name:** *Jatropha curcas Linn.*

Palynomorph: Oblong, nonaperturate, colpate, or colporate, or foraminate, or rugate; 2-celled. Size of the pollen was 31.1µm. Heteropolar.

7. **Family:** Lythraceae, **Botanical name:** *Lagerstroemia indica Linn.*

Palynomorph: Tricolporate. Prolate-spheroidal. Aperature long elliptic, acute ends. Length 15µm long, breath 10µm, size of the pollen is 150µm , sexine thicker than nexine. Colpi 12µm long. Exine 3µm thick. Isopolar.

8. Family: Rutaceae, **Botanical name:** *Murraya koenigii (Linn.) Spreng.*

Palynomorph: Tri-colporate, Prolate aperature. Ectocolpus long narrow, small, more or less circula. Sexine thicker than nexine. Length 30.1µm, and breadth 12µm, size of the cell is 360µm, colpi 35.5µm long. Mesocolpium 32.5µm. Apocolpium 1.25µm. Exine 2.5µm thick. Tectum striate-foveolate. Isopolar.

9. Family: Combretaceae, **Botanical name:** *Quisqualis indica Linn.*

Palynomorph: Grains tricolporate, prolate and granulate. Colpi alternating with pseudocolpoid thin walled areas which are contiguous at the poles. Size of the pollen is 23µm. Grains similar type and sometime with distinct pseudocolpi. Isopolar.

10. Family: Rosaceae, **Botanical name:** *Rosa indica Linn.*

Palynomorph: Tricolporate, prolate perforate, striate, composed of muri and wide striae separating them. Striae are deep and run parallel. The sculpture of apocolpium and mesocolpium is striate. Length of pollen 6µm, breath of pollen 4µm. Size of pollen 24µm, Shape of pollen: Elliptical. Isopolar.

The study revealed that the pollen grains isolated from soil collected from Gulabi Bagh were newly deposited belonging to the local vegetation of archaeological site, when they compared with the local vegetation of the site. Although some species were not

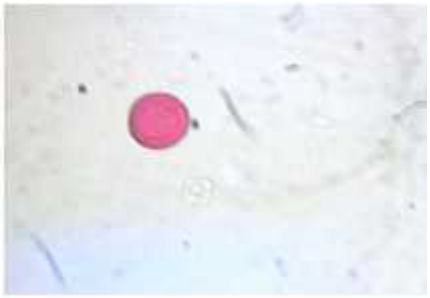
observed there e.g. *Imperata cylindrical* (Linn.) P. Beauv which indicated that it has been dispersed from any other site by wind. Although the herbaceous pollen of *Imperata cylindrica* (Linn.) P. Beauv was not present in the study area but the size of the pollen (2.5µm) indicates the wind dispersal dependence of the species. The pollen can move in soil with the help of organic matter, with soil water and faunal activity also reported by Davidson *et al.,* (1999). As the species belonging to the semi arid region thus the presence of pollen belonging to the same vegetation confirmed that the pollen spectra can be recognized by the dominant vegetation type of that particular area. These results are also in accordance with Xinmiao *et al.,* (2006) who studied the surface pollen and its relationship to vegetation on the southern slope of the eastern Qilian Mountains. He collected a total of 13 surface pollen samples from main vegetation. The results showed that dominating vegetation types can be recognized by their pollen spectra.

Table1. Pollen Morphology of the Identified Species

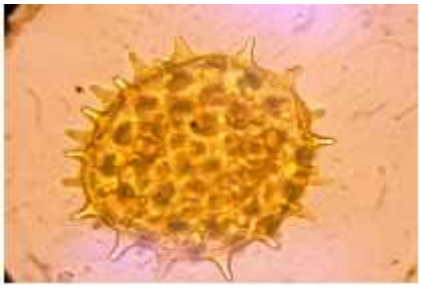
Sr. No.	Plant Species	Pollen apperture	No. of Apertures	Pollen Shape Class	Polarity of Pollen
1.	Acacia nilotica (Linn.)Delile	Porate	Tricolporate	Prolate	Heteropolar
2.	*Cassia fistula* Linn.	Porate	Tricolporate	Prolate-spheroidal	Isopolar
3.	*Hibiscus rosa-sinensis* Linn.	Porate	Pantoporate	Spheroidal	Isopolar
4.	*Imperata cylindrica* (Linn.) P. Beauv	Porate	Annulate	Spheroidal	Isopolar
5.	*Ixora coccinea* Linn.	Porate	Zono-colpate	Prolate	Isopolar
6.	*Jatropha curcas* Linn.	Non-Porate	Non-aperturate	Prolate	Heteropolar
7.	*Lagerstroemia indica* Linn.	Porate	Tricolporate	Prolate-spheroidal	Isopolar
8.	*Murraya koenigii* (Linn.) Spreng.	Porate	Tricolporate	Prolate	Isopolar
9.	*Quisqualis indica* Linn.	Porate	Tricolporate	Prolate	Isopolar
10.	*Rosa indica* Linn.	Porate	Tricolporate	Prolate	Isopolar

***Acacia nilotica* (Linn.)Delile**

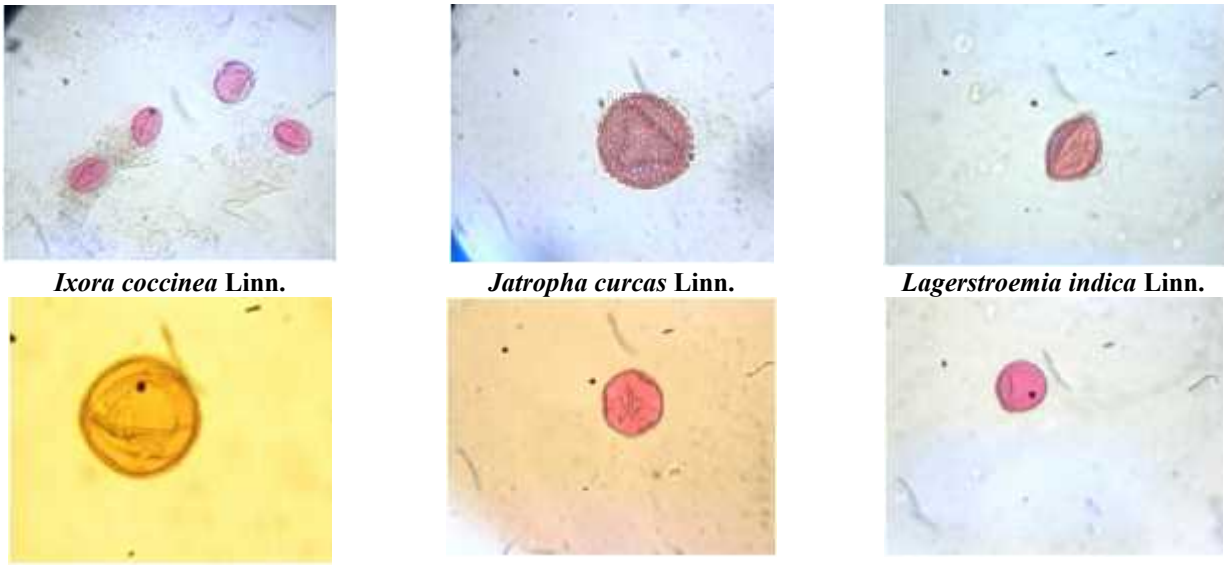
***Cassia fistula* Linn**



***Hibiscus rosa-sinensis* Linn.**



***Imperata cylindrica (Linn.)* P. Beauv**



***Ixora coccinea* Linn.** ***Jatropha curcas* Linn.** ***Lagerstroemia indica* Linn.**

***Murraya koenigii* (Linn.)** **Spreng. *Quisqualis indica* Linn.** ***Rosa indica* Linn.**

Fig. 1: LM pollen images of plant species identified from the soil sample of Gulabi Bagh (10X)

Conclusion: The study has shown that dominating surface pollen belongs to Caesalpinaceae, Malvaceae, and Rosaceae, which generally represent local plant. with the vegetation that produces them. Most pollen grains will be windswept from surface soil during soil deposition. The erosion degree differs from one another in different pollen taxa because size plays an important role in the dispersal and loss of pollen.

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