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PALYNOLOGICAL CHARACTERIZATION OF FLORA OF LAHORE UNIVERSITY OF MANAGEMENT SCIENCES, LAHORE

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Abstract

The present study reveals palynomorphic characterization of flora of Lahore University of Management Sciences, Lahore. In this respect, 67 plant species belonging to 40 different families including 56 dicots, 10 monocots and 1 gymnosperm have been studied by using light microscopy. The pollen features studied includes structure, volume, aperture, polar length, equatorial diameter, P/E ratio, pollen shape, pollen size, pollen aperture and tectum. The present study demonstrates that the pollen morphology of both herbaceous and woody vegetation exhibits a huge diversity of pollen characters. Pollen shape was mostly prolate spheroidal but oblate spheroidal, prolate, sub prolate, spheroidal and tricolpate were also observed in some species. Pollen aperture varied from porate to colpate and some species were inaperturate. Pollen tectum has been found reticulate in most species, while psilate, scabrate, verrucate, echinate and striate were also observed. Furthermore, the family name and common name have also been studied. Maximum pollen size is 176.92 µm found in Pinus caraniensis (pinaceae) and minimum pollen size is 88.87µm observed in Morus alba (Moraceae). This work is anticipated to be advantageous in documentation for taxonomic recognition of the plants of Lahore University of Management Sciences, Lahore.

Keyword: Herbaceous and woody flora, Palynological evaluation, Vegetation exhibits, Taxonomic recognition and Palynomorphic characters.

INTRODUCTION

Palynology is the science of pollen based on the observation of palynomorphs that covers all aspects of pollen and spore. The term palynology was introduced by Hyde and Williams in 1944, derived from Greek word palynein which means to scatter, and is similar to Latin pollen where palyno is meaning 'to sprinkle' and pale meaning “flour” or 'dust' (Halbritter *et al*., 2018). Pollen morphology is extremely important because it is utilized to identify and understand relationships between species at various taxonomic levels (Khan *et al*., 2018). The Palynomorphic data provides an important proof for the separation of identification of taxa at different levels (Abdulrehman *et al*. 2019).

The study of palynomorphs can help us to understand energy state, life, and habitat in which they are produced. Pollen is the source of male gamete transfer. Unicellular pollen grain is represented by microscopic seed plants, whereas multicellular pollen is represented by male gametophytic generation (Gomez *et al*., 2015). Surface patterns like grooves, spores, spines, and reticulation across exine give a means of distinguishing pollen grains as well as a useful trait to employ in taxonomic investigations (Blackmore and Ferguson, 1986). In gymnosperms and angiosperms, pollen grain is referred as male gametophyte that produces male gametes. Pollen in each species has distinct morphological characters, helping analysts in classifying pollen. Pollen wall contains two layers i.e., outer and inner. The outer layer is referred as exine that is made up of an unusual substance called sporopollenin. The inner layer is called as intine that is composed of cellulose. This layer is similar to plant cell wall (Frenguelli, 2003).

There are three main characters to identify any pollen i.e., 1- aperture, type and number, 2- Shape and size, 3- Sculpture of exine. The thin or missing parts in exine from where pollen tube emerges are called apertures. Pollen have 3-D structure. They are spherical or ovoidal mostly and have other shapes also. Ratio between polar axis length and equatorial diameter is also used to define pollen. Tectum may be complete, partially dissolved or absent. Sculptural elementary be hemispherical, tiny flakes or granular (Frenguelli, 2003).

Pollen characters include exine sculpture, ornamentation pattern and exine infrastructure. All these characters along with other morphological and molecular features are helpful in systematical studies (Van der Ham, 2010). Surface patterns like grooves, spores, spines, and reticulation across exine give a means of distinguishing pollen grains as well as a useful trait to employ in taxonomic investigations (Blackmore and Ferguson, 1986). Surface patterns like grooves, spores, spines, and reticulation across exine give a means of distinguishing pollen grains as well as a useful trait to employ in taxonomic investigations (Blackmore & Ferguson, 1986).

According to Erdtman (1963), there are two types of palynology: fundamental and applied. The fundamental palynology which studies pollen and spore morphology in both living and fossils while applied palynology deals with Geopalynology, Palynotaxonomy, Pharmacopalynology, Mellitaxonomy, Archaeopalynology, Mellitopalynology, Atriopalynology, and Forensic palynology. Plant breeding, agriculture, horticulture, and plant physiology all use palynological studies.

Herbaceous plants have no woody stems above ground and are vascular plants (Clapham *et al*., 1994). Graminoids fobs and ferns are examples of herbaceous plants (Bebarta, 2012). Graminoids are plants having grass-like appearance which include true grasses, rushes and sedges, whereas herbaceous broad leaved plants are called as fobs (Chapman and Bolen, 2015). Herbaceous plants are typically low-growing plants that differ from woody plants like trees and having soft green stems that are not lignified. Herbaceous plant development above ground is ephemeral and often seasonal in nature. Various herbaceous plant families have been investigated by various researchers (Zafar *et al*., 2007; Meo and Khan, 2006; Mbagwu *et al*., 2008; Willis, 1973; Mabberley, 1997). Lahore University of management sciences (LUMS), Lahore, is one of the best research universities in Pakistan. It was established by a renowned businessman, Syed Babar Ali in 1984. It covers an area of 100 acres (40 ha) between 31°28’12” N and 74°24’40” E. It is originally located in Khyaban e Jinnah, opposite Sector U5, D.H.A.

phase 5, Lahore and Punjab. The average rainfall is 575mm. The vast area of university is covered with vegetation that gives it an attractive look as well as moderate climate. LUMS, Lahore is a historical institution and have great diversity of woody plant species. However, no research work has been done on woody plants of campus.

MATERIALS AND METHODS

The regular field trips of the study area were conducted for the documentation of plants and collection of flowers during the months of December 2021 and June 2022. The anther containing pollen of these plants were removed from the flower with the help of scissors and collected in glass viols containing glacial acetic acid. After collection, pollen were prepared for microscopic studies by using the standard Acetolysis procedure of Erdtman (1952) and Saxena (1993).

After Acetolysis, the prepared samples were subjected to microscopy using light microscope. The slide was examined under light microscope (S/N – EU 1850218) at 10X, 40X, and 60X. The measurements of the pollen were based on 3-4 pollen per specimen. Pollen shape that includes polar axis or length (P) and equatorial axis or diameter (E) was computed. The terms in the present study were used according to Wodehouse (1928), Erdtman (1952), Faegri and Iverson (1964) and walker and Doyle (1976).

RESULTS

The present study showed huge variations in palynomorphic characterization of 67 plant species belonging to 40 different families including 56 dicots, 10 monocots and 1 gymnosperm. The families included are: Alliaceae, Amaranthaceae, Amaryllidaceae, Anacardiaceae, Apocynaceae, Asparagaceae, Asteraceae, Brassicaceae, Caryophyllaceae, Clusiaceae, Commelinaceae, Convolvulaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Hemerocallidaceae, Lamiaceae, Lecythidaceae, Liliaceae, Lythraceae, Myrtaceae, Moraceae, Moringaceae, Malvaceae, Meliaceae, Nyctaginaceae, Oleaceae, Oxalidaceae, Pinaceae, Plumbaginaceae, Poaceae, Polminaceae, Primulaceae, Putranjivaceae, Rutaceae, Rubiaceae, Scrophulariaceaea, Solanaceae, Tropaeolaceae and Verbenaceae as shown in in Table no. 1. The analysis has been made by using light microscope. In this study, pollen shape, aperture, tectum, size, and unit are features of consideration. Minimum size of pollen is 88.87 µm. The shape of pollen includes prolate spheroidal, oblate spheroidal, prolate, sub prolate and spheroidal. The pollen of most species shows prolate spheroidal shape that is observed in 32 species.

Colpate, colpoporate, dicolpate, hexacolpate, microechinate, monocolpate, monoporate, pantocolpate, pantoporate, syncolpate, tetraporate, Tricolporate, trizonocolpate, tricolpate, tetracolporate and triporate are obtained as pollen aperture. Inaperturate pollen are also observed in some species. Equatorial diameter varies from 4.92 ± 0.60µm to 19.94 ± 0.13 µm, polar length varies from 4.92 ± 0.60µm to 20.31 ± 0.63 µm and P/E ratio varies from 88.87 to 176.92. The tectum variations are psilate, echinate, rugulate, reticulate, scabrate, aerolate, echinolophate, fossulate, granulate, perforate, porate, rough, smooth, verrucate and striate. Mostly, pollen are free as monad but polyad are also observed in *A. lebbeck and A. julibrissin*.

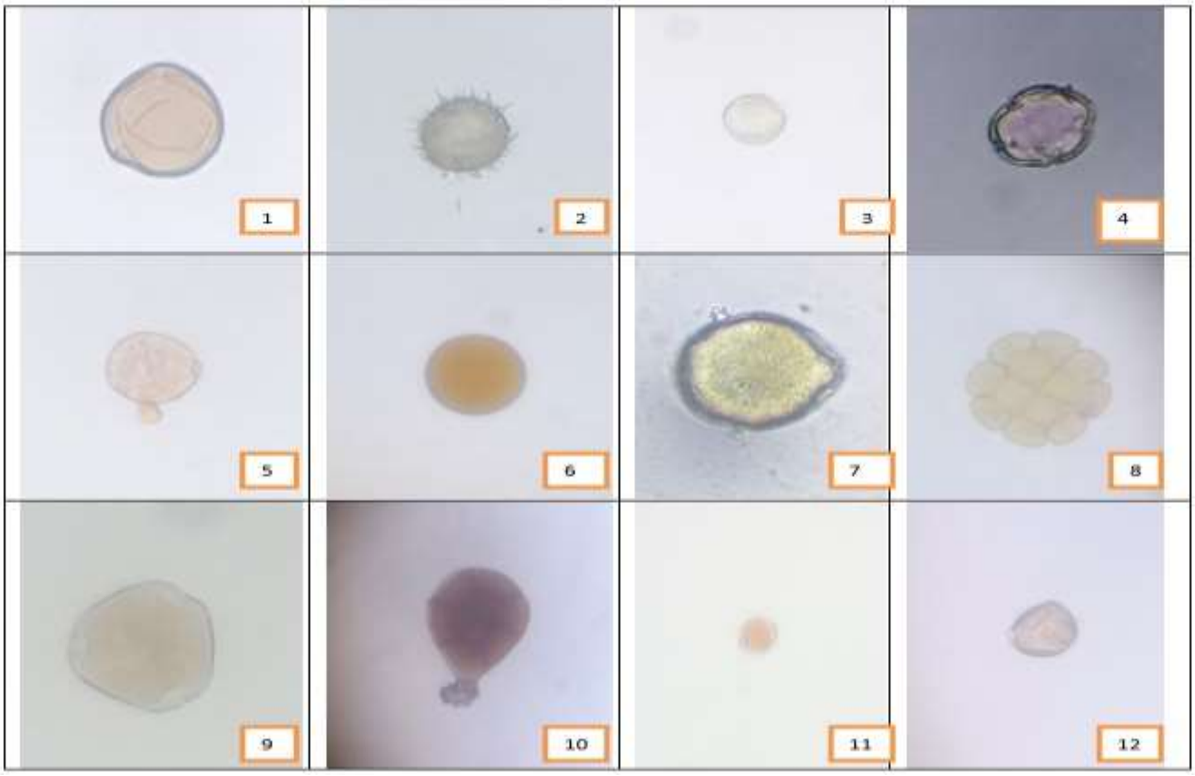

Plate 1: 1. *Pulmeria obtusa* 2. *Nerium oleander* 3. *Tabernaemontana divaricata* 4. *Dracomontana dao* 5. Diospyros malabarica 6. *Jatropha integerrima* 7. *Bauhinia variegata* 8. *Albizia lebbeck* 9. *Cassia fistula* 10. *Albizia julibrissin* 11. *Petersianthus quadrialatus* 12. *Barringtonia asiatica*

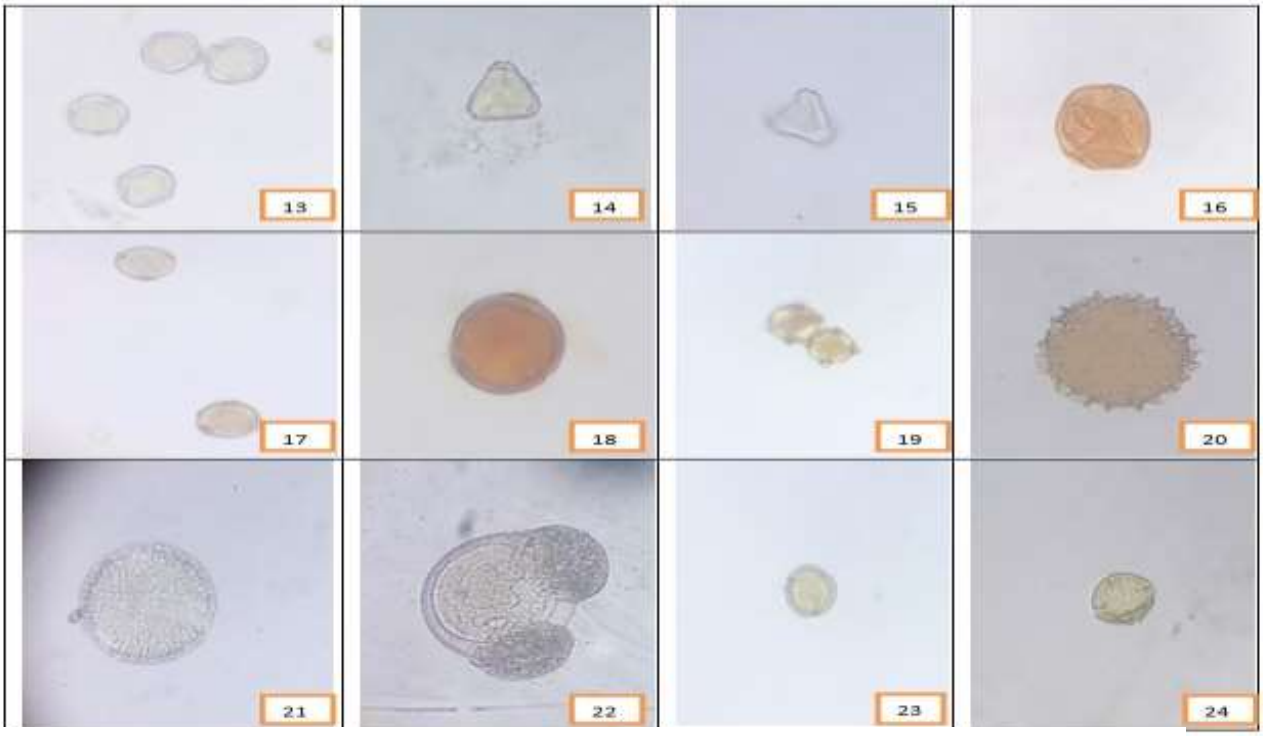

Plate 2: 13. *Punica granatum* 14. *Callistemon viminalis* 15. *Syzygium cumini* 16. *Morus alba* 17. *Moringa oleifera* 18. *Brachychiton acerifolius* 19. *Azadirachta indica* 20. *Bougainvillea spectabilis* 21. *Jasminum humile* 22. *Pinus canariensis* 23. *Putranjiva roxburghii* 24. *Citrus japonica*

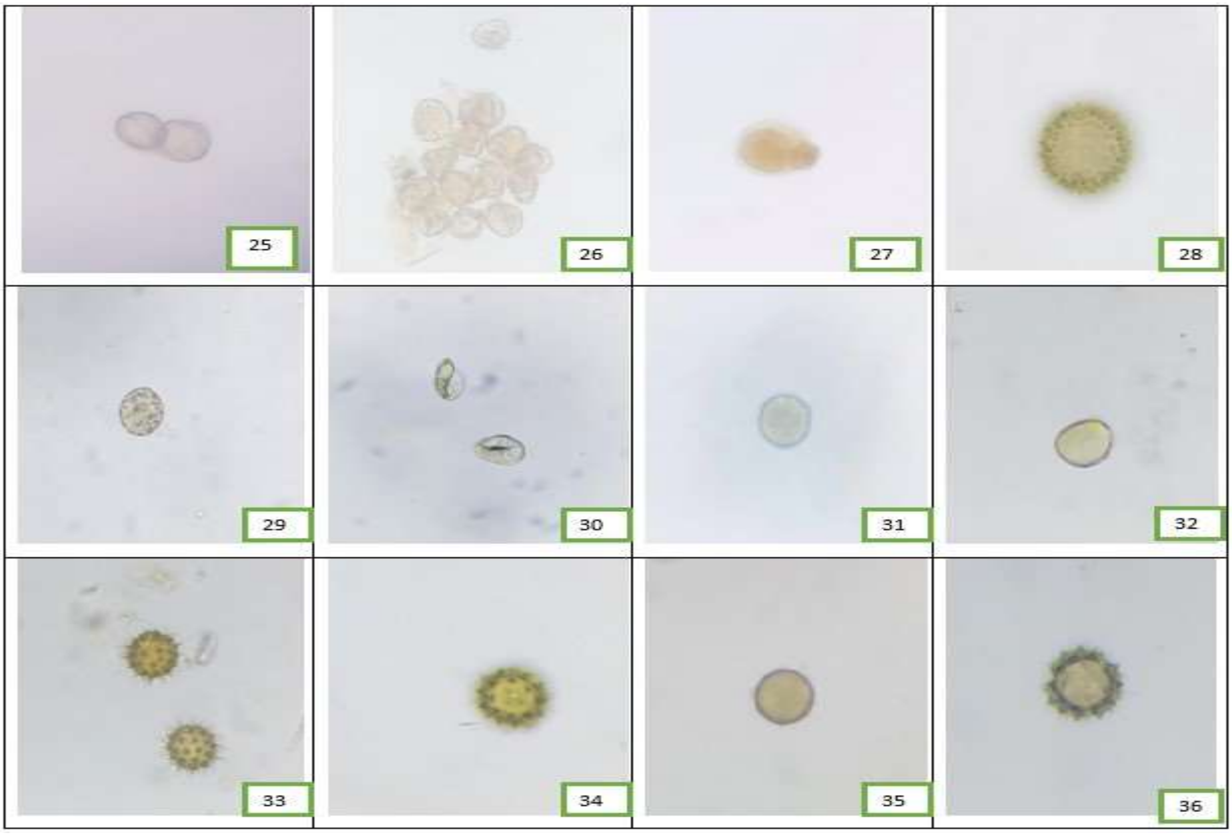

Plate 3: 25. *Ixora finlaysoniana* 26. *Rondeletia odorata* 27. *Lantana camara* 28. *Alcea rosea*. 29. *Amaranthus viridis*, 30: *Asparagus densiflorus*, 31: *Catharanthus roseus*, 32: *Chlorophytum comosum*, 33: *Cosmos caudatus* 34. *Dahlia pinnata*, 35. *Dianthus barbatus*, 36: *Dimorphotheca fruticosa*,

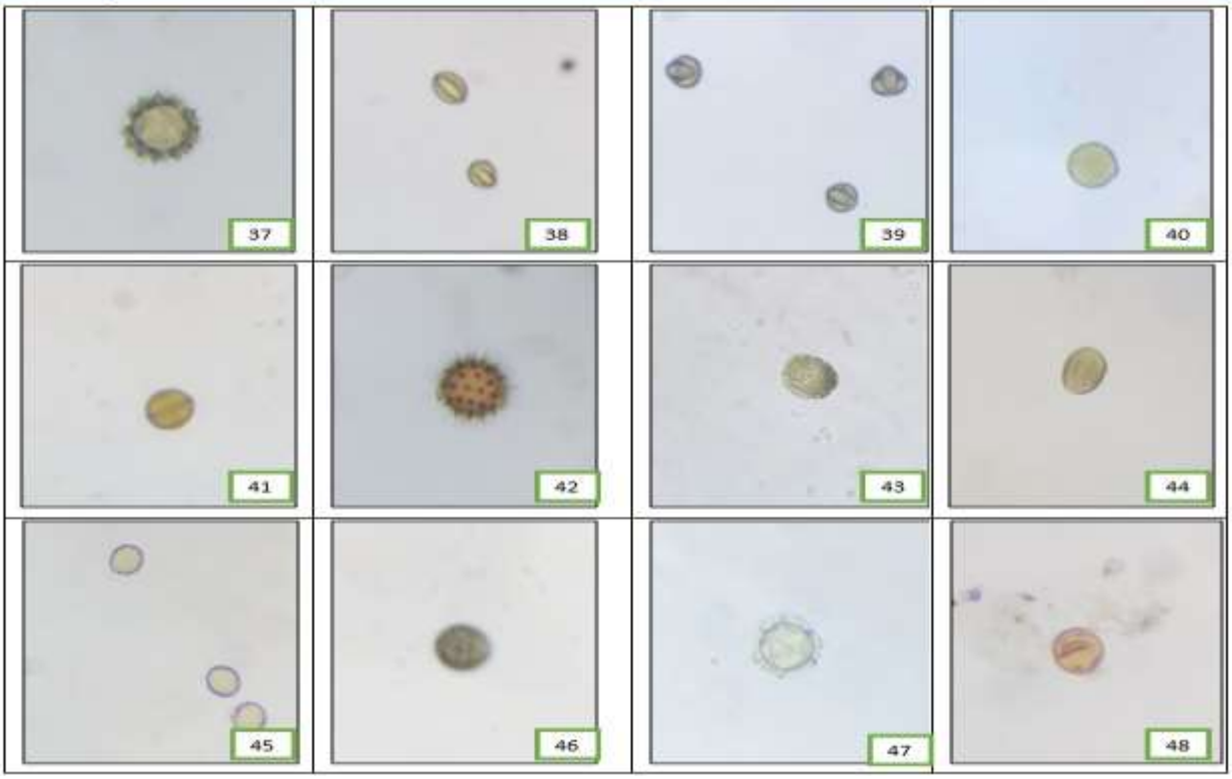

Plate No. 4: 37. *Eclipta prostrata*, 38: *Euphorbia hirta*, 39: *Euphorbia milii* 40:*Evolvulus nummularius*, 41:*Gerbera jamesonii*, 42: *Helianthus annuus*, 43:*Hemerocallis lilioasphodelus*, 44: *Hippeastrum reginae*, 45. *Hypericum hircinum* 46: *Jasminum sambac*, 47: *Launaea nudicaulis*, 48: *Lepidium didymum*

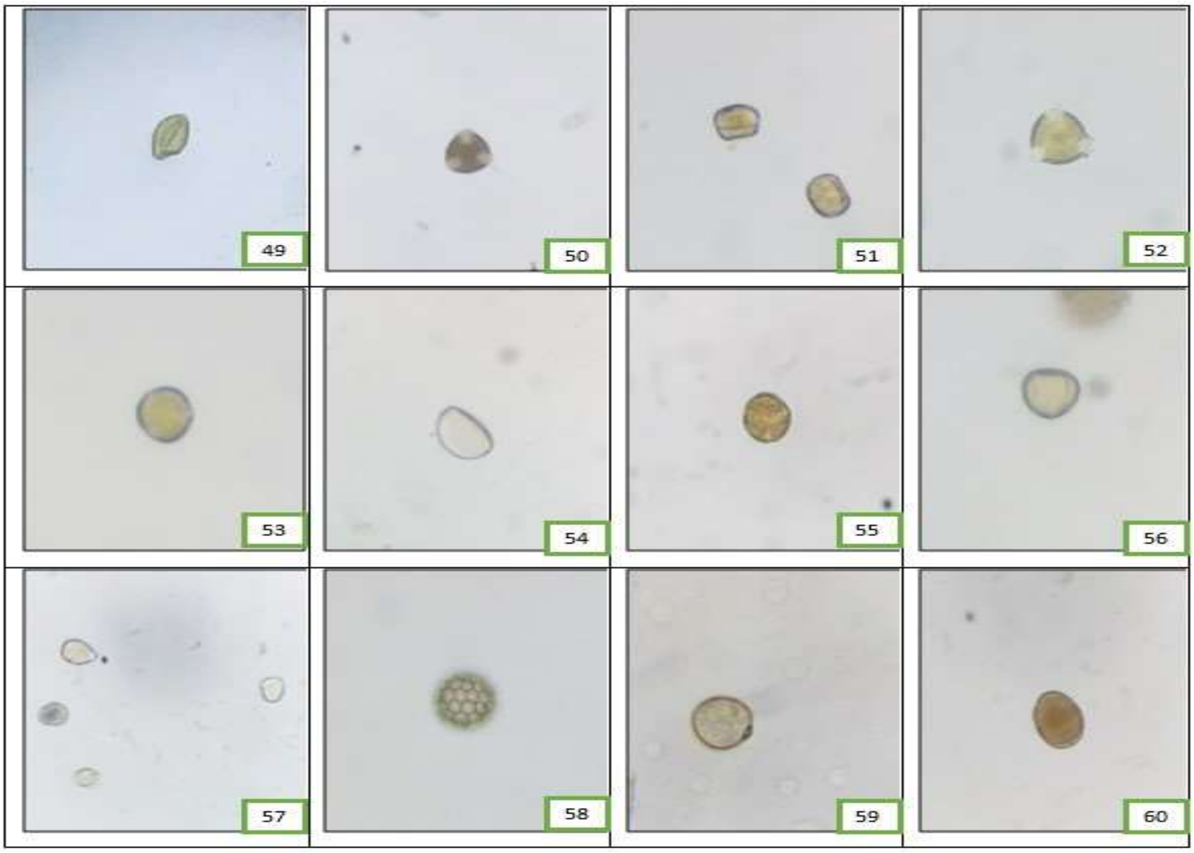

Plate No. 5: 49: *Lilium bulbiferum,* 50: *Limonium sinuatum,* 51: *Lysimachia maritime* 52: *Mazus pumilus,* 53:*Mercurialis annua,* 54:*Nothoscordum bivalve,* 55:*Oxalis corniculata,* 56:*Oxalis latifolia,* 57: *Petunia hybrid* 58:*Phlox drummondii,* 59:*Poa annua,* 60:*Salvia splendens,*

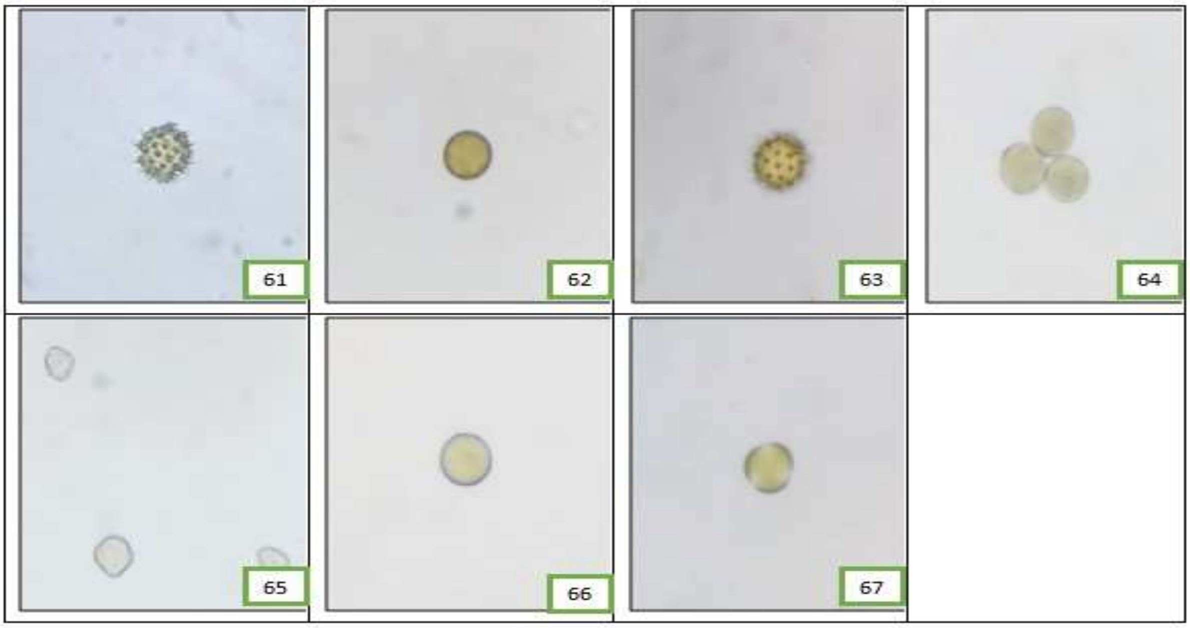

Plate No. 6: 61: Sphagneticola trilobata, 62: Stellaria media, 63: Tagetes erecta 64: Tradescantia pallida, 65: Tropaeolum majus, 66: Verbena bonariensis, 67: Youngia japonica

Table 1. General Pollen Characters of Flora of Lahore University of Management Sciences, Lahore

Sr. No.	Scientific Name	Common Name	Family Name	Polar length (P) in µm	Equatorial length (E) in µm	P/E ratio	Pollen shape	Pollen size Aperture pattern and Symmetry Tectum	Tectum
1	*Nothoscordum bivalve* (L.) Britton	Crow-poison, False garlic	Alliaceae	7.24±0.81	7.56±0.97	95.77	Oblate-spheroidal	Monocolpate, bilaterally symmetrical	Granulate
2	*Amaranthus viridis* L.	Slender amaranth	Amaranthaceae	4.92±0.60	4.92±0.60	100	Prolate-spheroidal	Pantoporate,radially symmetrical	Granulate
3	*Hippeastrum reginae* Herb.	Amaryllis, Christmas rose	Amaryllidaceae	17.2±2.54	18.28±3.02	94.09	Oblate-spheroidal	Monoporate, radially symmetrical	Reticulate
4	*Dracontomelondao* (Blanco)	Argus pheasant	Anacardiaceae	14.15±0.82	14.35±0.80	98.61	Oblate spheroidal	Pentoporate	Rough
5	*Plumeria obtusa* L.	Gul-e-cheen	Apocynaceae	75.25±0.25	75.31±0.35	99.93	Oblate spheroidal	Colpate	Smooth
6	*Nerium oleander* L.	Kaner	Apocynaceae	28.33±1.66	29.16±1.44	97.15	Oblate spheroidal	Tetraporate, porate, porus	Echinate
7	*Tabernaemontana divaricata* (L.)	Crape jasmine	Apocynaceae	27.15±2.78	26.45±2.77	102.64	Prolate spheroidal	Colpoporate	Smooth
8	*Catharanthus roseus* (L.) G.Don	Bright eyes, Old maid	Apocynaceae	12.04±0.41	12.04±0.41	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Psilate
9	*Asparagus densiflorus* (Kunth) Jessop	Asparagus-fern, Foxtail fern	Asparagaceae	5.00±0.56	5.08±0.56	98.43	Oblate-spheroidal	Dicolpate,bilaterally symmetrical	Rugulate
10	*Chlorophytum comosum* (Thunb.) Jacques	Spider Plant	Asparagaceae	7.36±0.36	7.64±0.82	96.34	Oblate-spheroidal	Tricolporate, bilaterally symmetrical	Smooth
11	*Cosmos caudatus* Kunth	Cosmos, Cut-leaf cosmos	Asteraceae	5.68±0.88	5.68±0.88	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
12	*Dahlia pinnata* Cav.	Garden Dahlia	Asteraceae	7.2±0.30	7.2±0.30	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate

13	*Dimorphotheca fruticosa* (L.) DC.	White daisy bush	Asteraceae	5.08±0.35	5.08±0.35	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
14	*Eclipta prostrata* (L.) L.	White twinheads, False daisy	Asteraceae	4.68±0.13	4.6±0.18	101.74	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
15	*Gerbera jamesonii* Bolus	Barberton daisy, Gerbera daisy	Asteraceae	8.24±0.69	8.24±0.69	100	Prolate-spheroidal	Dicolpate, radially symmetrical	Psilate
16	*Helianthus annuus* L.	Sunflower	Asteraceae	6.12±0.36	6.12±0.36	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
17	*Launaea nudicaulis* (L.) Hook.f.	Naked launaea, Bold-leaf launaea	Asteraceae	6.96±0.22	6.96±0.40	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
18	*Sphagneticola trilobata* (L.) Pruski	Yellow creeping daisy	Asteraceae	5.28±0.50	5.28±0.50	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Echinate
19	*Tagetes erecta* L.	African marigold, Mexican marigold	Asteraceae	9.44±0.29	9.44±0.29	100	Prolate-spheroidal	Pantoporate, radially symmetrical	Echinate
20	*Youngia japonica* (L.) DC.	Oriental false hawksbeard	Asteraceae	5.68±1.10	5.8±1.12	97.93	Oblate-spheroidal	Tricolporate, radially symmetrical	Echinolophate
21	*Lepidium didymum* L.	Lesser swine-cress	Brassicaceae	5.16±0.60	5.08±0.62	101.57	Prolate-spheroidal	Tricolpate, radially symmetrical	Reticulate
22	*Dianthus barbatus* L.	Sweet William	Caryophyllaceae	8.52±1.10	8.52±1.10	100	Prolate-spheroidal	Pantoporate, radially symmetrical	Scabrate
23	*Stellaria media* (L.) Vill.	Common chickweed	Caryophyllaceae	6.6±0.81	6.6±0.81	100	Prolate-spheroidal	Pantoporate, radially symmetrical	Verucate
24	*Hypericum hircinum* L.	Stinking tutsan	Clusiaceae	5.08±0.60	5.12±0.54	99.22	Oblate-spheroidal	Tricolporate, radially symmetrical	Reticulate

25	*Tradescantia pallida* (Rose) D.R.Hunt	Purple Heart, Purple queen	Commelinaceae	8.84±0.47	8.84±0.47	100	Prolate-spheroidal	Tetraporate, radially symmetrical	Rugulate
26	*Evolvulus nummularius* (L.) L.	Roundleaf Bindweed,	Convolvulaceae	7.2±0.33	7.28±0.33	98.90	Oblate-spheroidal	Pantocolpate, radially symmetrical	Granulate
27	*Diospyros malabarica* (Desr.)	Gaub	Ebenaceae	35.41±1.88	34.58±3.32	102	Prolate spheroidal		
28	*Jatropha integerrima* Jack.	Peregrina	Euphorbiaceae	66.56±1.19	66.5±1.22	100.09	Prolate spheroidal	Inaperturate, porate	Verucate
29	*Euphorbia hirta* L.	Asthma-plant, Hairy Spurge	Euphorbiaceae	3.64±0.69	3.88±0.69	93.81	Oblate-spheroidal	Tricolporate, radially symmetrical	Reticulate
30	*Euphorbia milii* Des Moul.	Crown-of-thorns, Christ Thorn	Euphorbiaceae	8.08±0.70	8.12±0.77	99.51	Oblate-spheroidal	Tricolporate, radially symmetrical	Psilate
31	*Mercurialis annua* L.	Annual mercury	Euphorbiaceae	4.72±0.25	4.76±0.28	99.16	Oblate-spheroidal	Tricolporate, radially symmetrical	Reticulate
32	*Bauhinia variegate* L.	Kachnar	Fabaceae	63.33±1.44	64.16±1.44	98.71	Oblate spheroidal	Tricolpate, colpate	
33	*Albizia lebbeck* (L.)	Siris	Fabaceae	24.08±0.14	24±0	100.33	No shape name	Inaperturate	Perforate, psilate fossulate
34	*Cassia fistula* L.	Golden shower	Fabaceae	33.27±0.66	34±1.22	97.85	Oblate spheroidal	Tricolporate	Psilate
35	*Albizia julibrissin* Durazz.	Mimosa	Fabaceae	21.66±5.20	21.66±5.20	100	No shape name	Inaperturate	Psilate
36	*Hemerocallis lilioasphodelus* L.	Yellow daylily, Lemon lily	Hemerocallidaceae	7.52±0.56	7.56±0.56	99.47	Oblate-spheroidal	Monocolpate, bilaterally symmetrical	Reticulate

37	*Salvia splendens* Sellow ex Schult.	Scarlet sage	Lamiaceae	10.28±0.72	11.04±0.89	93.12	Oblate-spheroidal	Hexacolpate, radially symmetrical	Reticulate
38	*Petersianthus quadrialatus* Merr.	Toog	Lecythidaceae	20.31±0.63	19.94±0.13	101.85	Prolate spheroidal	Colpate	Smooth
39	*Barringtonia asiatica* (L.)	Fish poison tree	Lecythidaceae	25.62±1.09	25.62±1.09	100	Spheroidal	Syncolpate, colpate	Psilate
40	*Lilium bulbiferum* L.	Orange lily, Fire lily, Tiger lily	Liliaceae	14.52±3.73	15.44±2.66	94.04	Oblate-spheroidal	Monocolpate, bilaterally symmetrical	Reticulate
41	*Punica granatum* L.	Pomegranate	Lythraceae	19.95±1.60	21±1.36	95	Oblate spheroidal	Tricolporate	Fossulate, rugulate
42	*Brachychiton acerifolius*	Flame tree	Malvaceae	32.5±2.04	31.25±1.44	104	Prolate spheroidal	Tricolporate	Scabrate, verrucate
43	*Alcea rosea* L.	Hollyhock	Malvaceae	26.2±2.49	26.2±2.49	100	Oblate-spheroidal	Pantoporate,radially symmetrical	Echinate
44	*Azadirachta indica* A. Juss.	Neem	Meliaceae	34.91±0.14	34.83±0.14	100.23	Prolate spheroidal		
45	*Morus alba* L.	Shehtoot	Moraceae	46.66±2.88	52.5±2.5	88.87	Oblate spheroidal	Triporate, porate	Psilate
46	*Moringa oleifera* Lam.	Moringa	Moringaceae	30.35±2.35	29.9±0.22	101.5	Prolate spheroidal		
47	*Callistemon viminalis* (Sol.ex Gaertn.)	Bottle brush	Myrtaceae	19.08±1.58	21.08±3.76	90.51	Prolate spheroidal	Tricolporate	Psilate
48	*Syzygium cumini* (L.)	Jamun	Myrtaceae	16.91±0.63	14.16±1.44	119.42	Sub-prolate	Tricolporate	Psilate
49	*Bougainvillea spectabilis* Willd.	Bougainvillea	Nyctaginaceae	32.5±2.5	30.83±2.88	105.41	Prolate spheroidal	Microechinate	Porate
50	*Jasminum humile* L.	Peeli chameli	Oleaceae	47.5±2.88	48.12±2.39	98.71	Oblate spheroidal	Inaperturate	Verucate

51	*Jasminum sambac* (L.) Aiton	Arabian jasmine	Oleaceae	9.32±0.39	9.36±0.37	99.57	Oblate-spheroidal	Trizonocolporate, radially symmetrical	Reticulate
52	*Oxalis corniculata* L.	Creeping wood sorrel, Sleeping beauty	Oxalidaceae	8.36±1.23	8.52±1.06	98.12	Oblate-spheroidal	Tricolpate, radially symmetrical	Reticulate
53	*Oxalis latifolia* Kunth	Broadleaf woodsorrel	Oxalidaceae	6.24±1.08	6.24±1.13	100	Prolate-spheroidal	Tricolpate, radially symmetrical	Reticulate
54	*Pinus canariensis* L.	Canary pine	Pinaceae	76.66±1.44	43.33±1.44	176.92	Prolate		
55	*Limonium sinuatum* (L.) Mill.	Wavyleaf sea-lavender	Plumbaginaceae	12.04±0.44	12.12±1.41	99.34	Oblate-spheroidal	Tricolpate, radially symmetrical	Reticulate
56	*Poa annua* L.	Annual bluegrass	Poaceae	6.32±0.64	6.24±0.50	101.28	Prolate-spheroidal	Monoporate, bilaterally symmetrical	Areolate
57	*Phlox drummondii* Hook.	Annual phlox, Drummond phlox	Polemoniaceae	6.32±0.58	6.32±0.58	100	Prolate-spheroidal	Pantoporate, radially symmetrical	Reticulate
58	*Lysimachia maritima* (L.) Galasso, Banfi & Soldano	Sea milkwort, Black saltwort	Primulaceae	2.8±0.36	3.0±0.33	93.33	Oblate-spheroidal	Tricolporate, radially symmetrical	Psilate
59	*Putranjiva roxburghii* Wall.	Patajan	Putranjivaceae	29.93±0.125	29.37±1.25	101.91	Prolate spheroidal		
60	*Ixora finlaysoniana* Wall.	White jungle flame	Rubiaceae	15.56±0.65	15.37±0.43	101.23	Prolate spheroidal	Tricolporate	Reticulate, microreticulate
61	*Rondeletia odorata* Jacq.	Panama rose	Rubiaceae	18.25±1.11	19.2±1.71	95.05	Oblate spheroidal		
62	*Citrus japonica* Linn.	Kumquat	Rutaceae	24.25±2.99	23.56±2.95	102.93	Prolate spheroidal		
63	*Mazus pumilus* (Burm.f.) Steenis	Japanese mazus	Scrophulariaceae	6.04±0.99	6.00±0.94	100.67	Prolate-spheroidal	Tricolporate, radially symmetrical	Psilate

64	*Petunia hybrida* E.Vilm.	Garden petunia	Solanaceae	6.44±0.93	6.4±0.66	100.63	Prolate-spheroidal	Tricolporate, radially symmetrical	Striate
65	*Tropaeolum majus* L.	Nasturtium	Tropaeolaceae	6.32±0.94	6.48±0.98	97.53	Oblate-spheroidal	Tricolpate, radially symmetrical	Reticulate
66	*Lantana camara* L.	Lantana	Verbenaceae	30.83±4.38	31.25±4.50	101.36	Prolate spheroidal	Tricolporate	Psilate
67	*Verbena bonariensis* L.	Brazilian vervain, Purpletop vervain	Verbenaceae	6.64±1.03	6.64±1.03	100	Prolate-spheroidal	Tricolporate, radially symmetrical	Psilate

DISCUSSION

In this research work, pollen morphology of 67 plant species of herbaceous flora belonging to 40 different families of LUMS has been done by using light microscopy. This study shows that the pollen morphology of herbaceous and woody vegetation exhibits a huge diversity. Pollen shape, size, aperture, tectum, and polar layout are the most common variations. Maximum pollen size is 176.92µm in polar view found in *Pinus caraniensis* belonging to family Pinaceae and minimum pollen size is 88.87µm in polar view observed in *Morus alba* belonging to family Moraceae. The most common pollen shapes are prolate-spheroidal and oblate-spheroidal. Tricolpate pollen aperture is the most common type.

Pollen characteristics in the current study of 67 plant species are not completely identical to one another, even within the same family, characteristics are firmly comparative, and pollen characters alone are not sufficient as recognizable proof and arrangement of taxa. This evidence leads to the conclusion that pollen morphology provides tremendous help for taxonomic research. For the identification and classification of taxa, pollen morphological characteristics are necessary.

The main element in evolutionary lines is the stability and variation of pollen grains. All of the pollen from the investigated plant species indicate that the majority of these plants are angiosperms. It reveals connections to the study region and other plant species.

CONCLUSION

The atmospheric pollen distribution of a location is constantly changing due to numerous biotic and abiotic variables, as in the case of the Asteraceae, Euphorbiaceae, Verbenaceae, and other families in the current study. This has an impact on the development and phonology of the research area. Thus, it is essential to conduct periodic phonological surveys and pollen morphological investigations of various regions. In this current research, pollen morphology of some common herbaceous and woody plant species of Lahore University of Management Sciences, Lahore has been conducted. The focus of the current work is the microscopic morphological assessment of pollen characteristics that help in taxonomy. One of its goals is to record the herbaceous and woody flora of LUMS. The identification of the species in the future will be helpful by this research. Hence, it can be concluded that palynology is one of the most important tools to achieve fruitful taxonomic solutions.

FUTURE PERSPECTIVES

Since the present study based on palynological characterization of herbaceous and woody flora of Lahore University of Management Sciences, Lahore. This study will help in future for the identification of species by using polliniferous material. As pollen morphology plays an important role in taxonomic and phylogenetic history of the vegetation. Palynological investigations provide valuable information for the differentiation and identification of closely related and problematic taxa. Palynological information has wider application and will study in future as an aid to the identification of related taxa and various major plant groups. Palynological study is very helpful in different fields of sciences including plant physiology, plant breeding, genetics and molecular biology. Thus, palynology can be helpful to find out pollen diversity of the species. Further morphological, palynological and molecular studies will help to solve problems related to the identification of species.

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Conflict of interest

The authors declare no conflict of interest.

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The authors collectively assert that there are no conflicts of interest and each author has made an equal contribution to the work.

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