

Pollen Morphology of Ten Species Found in Popa Area, Kyaukpadaung Township, Mandalay Region

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Abstract

The taxonomy and pollen morphology of 10 species from 9 genera belonging to 6 families have been classified and identified. All the specimens were collected from Popa area, Kyaukpadaung Township in Mandalay Region from July 2019 to January 2020. The collected species are 4 species of Monocots, *Gloriosa superba* L., *Dendrobium ochreatum* Lindl., *Habenaria dentata* (Sw.) Schltr., *Habenaria trichosantha* Wall., and 6 species of Eudicots, *Bauhinia malabarica* Roxb., *Desmodium capitatum* (Burm.f.) DC., *Abelmoschus rugosus* Wall., *Argyreia nervosa* (Burm.f.) Bojer., *Ipomoea hederrifolia* L., *Asytasia gangetica* (L.) Anders. The pollen grains of 10 species have been recorded with their aperture, shape, size, position and sculpture of the exine. Three species are pollinia and other species are monad. The shape of the pollen were found in prolate, spheroidal, oblate and suboblate. The sizes of pollen were small, medium and large. The smallest size of pollen was found in *Desmodium capitatum* (Burm.f.) DC., and the largest size of pollen was occurred in *Abelmoschus rugosus* Wall. An artificial key was constructed based on aperture type, grains shape, size and number, and exine ornamentation.

Keywords: Pollen Morphology, Popa Area, An artificial key

Introduction

Palynology is the study of spores and pollen grains. Spores and pollen grains have a number of morphological and ultrastructural features. These palynological features have provided a wealth of characters that have been important in inferring phylogenetic relationships of plants (Simpson 2006). The term Palynology was introduced by Hyde and Williams in the 1940's. It is derived from the Greek verb palynein, which means to spread or strew around pollen grains and spores are indeed often dispersed by the wind or by insects or other animals (Erdtman 1969).

The study of pollen grains and spores, both extant and extinct, as well as other organic microfossils. The term palynology is used by both geologists and biologists. They are also the vehicles in which the male gamete genetic code is carried to the female gamete. The pollen grains travels and deposits on the stigma of a receptive flower. Each pollen grain consist of the two celled male haploid plant enclosed in a thickened (Ahmed 2008)

Pollen grains contain high-energy storage reserves. They are composed of either starch or oil. The distribution of store product type can be phylogenetically information in the angiosperms. Palynological studies are not only help in solving many taxonomic problems but also play an important role in daily life. Pollen grains are everywhere in the air, the water, the soil and the foods we eat. The flowering plants contribute massively to the world's primary productivity and are arguably the most important component of global biodiversity. (Simpson 2006).

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Popa is the only prominent volcano, which became extinct some hundreds of years ago, situated 10 miles North East Kyaukpadaung Township, Meiktilar District, Mandalay Region, about 40 Km² southeast of Bagan and about 150 Km² of Mandalay, on the bank of the Ayeyarwady and central Myanmar. It is almost always evergreen, due to its elevation of 4981 feet above sea level. Many researchers have studied pollen morphology of different families in Myanmar. However, the complete description of pollen flora of Popa area is still lacking to study and record, it is needed to work a research on this area. Popa is the prominent area, therefore a research on pollen flora of Popa area is still needed to be studied and recorded.

According to APG IV (2016), Colchicaceae, Orchidaceae, Fabaceae, Malvaceae, Convolvulaceae, Acanthaceae, the list of these families were arranged for taxonomy and the genera and species were arranged in an alphabetically.

The aim and objectives of this research are to classify and identify the flowering plants, to record the pollen morphological characters of some members of the families and to fulfil the information concerning with pollen morphology in Popa area and to construct a pollen key for identification of taxa.

Materials and Methods

Collection of Plants and Pollen Samples

The plant specimens were collected from Popa area, Kyaukpadaung Township in Mandalay Region, from July 2019 to January 2020. The collected species were photographed to record their inflorescences and flowers. All the collected specimens were described by using Global Position System (GPS). Identification of specimens were carried out by referring to Hundley and Chit KoKo (1961), Backer (1965), Hutchinson (1967), Flora of Ceylon Dassanayake (1980), flora of British India Hooker (1898), Myanmar name were referred to Kress and Yin Yin Kyi (2003). All the fresh pollens were collected from the anthers of blooming flower and stored in the glass vials with glacial acetic acid.

Acetolysis of Pollen grains

Pollen samples were acetolysed by the method of Erdtman (1960). The pollen samples from the glass vial were put into a test-tube, then crushed with a glass rod. The acetolysis solution was mixed using a measuring cylinder: 9 parts of glacial acetic acid, and then 1 part of concentrated sulphuric acid was added. The acid was dropped gently down the side of the tube. Acetolysis mixture (1CC) was poured into the test-tube containing the pollen samples and stirred with a glass rod. The test-tube was heated in a water-bath to 70°C-80°C about 20-30 minutes. The test-tube was allowed to cool, and the sample diluted with distilled water and centrifuged for 20-30 minutes at 3000 rpm. This process was repeated twice and decanting the water each time. After centrifuging and decanting, a few drops of dilute glycerine solution was added to the residue, then transferred and stored in air tight glass vial.

A drop of sample was taken with a glass rod and placed on a slide, then covered with a cover-slide. The mounted slides were observed under light microscope to study the pollen morphology. For each species more than 20 pollen grains were measured and recorded on their aperture. The terminology used in the accordance with Erdtman (1952), Moore & Webb (1978) and Hesse (2009).

Results

The pollen morphology of 10 species from 9 genera of 6 families have been studied. The list of collected families were arranged into classification system of (APG IV 2016) and the arrangement of genera and species under the families were placed alphabetically as shown in Table 1. The pollen morphological characteristic of 10 species were presented in Table 2.

Table 1. List of the Collected Plants from Popa Area

Group	Order	Family	No.	Scientific name	Myanmar Name
Monocots	Liliales	Colchicaceae	1.	<i>Gloriosa superba</i> L.	Si medauk
	Asparagales	Orchidaceae	2.	<i>Dendrobium ochreatum</i> Lindl.	Taung nabay bauk
			3.	<i>Habenaria dentata</i> (Sw.) Schltr.	Ma min phyu
			4.	<i>Habenaria trichosantha</i> Wall.	Myaepauk
Eudicots	Fabales	Fabaceae	5.	<i>Bauhinia malabarica</i> Roxb.	Chinbyit
			6.	<i>Desmodium capitatum</i> (Burm.f.) DC.	Unknown
	Malvales	Malvaceae	7.	<i>Abelmoschus rugosus</i> Wall.	Unknown
	Solanales	Convolvulaceae	8.	<i>Argyreia nervosa</i> (Burm.f.) Bojer.	Kazun gyi
			9.	<i>Ipomoea hederrifolia</i> L.	Myat lay ni
	lamiales	Acanthaceae	10.	<i>Asytasia gangetica</i> (L.) Anders.	Kyauk htwe pan

1. *Gloriosa superba* L., Sp. Pl. 1: 305. 1753. (Figure 1. A,B,C)

Myanmar Name : Si medauk

English Name : Glory Lily

Flowering Period : July to September

Monosulcate, oblate, small, $17.5 - 22.0 \times 27.5 - 32.5 \mu\text{m}$ in length and breadth; amb elliptic; sulcate $5.0 - 7.5 \times 22.5 - 27.5 \mu\text{m}$ in length and breadth.

2. *Dendrobium ochreatum* Lindl. in Wall. Cat-7110: in Bot. Reg. under. T. 1765. (Figure 1. D,E,F)

Myanmar Name : Taung nabay bauk

English Name : Unknown

Flowering Period: July to September

Pollen grains united in pollinia; Pollinarium $90 - 98 \times 85 - 87 \mu\text{m}$ in length and breadth; pollinia number 4, $82 - 88 \times 78 - 85 \mu\text{m}$ in length and breadth, oblong in shape; pollinia sac rhomboidal.

3. *Habenaria dentata* (Sw.) Schltr., Fed. Repert. Beih. 4: 125. 1919.H. (Figure 1. G,H,I)

Orchis dentata Swartz, Kongl. Vetensk. Acad. Handl. 21: 207. 1800.

Myanmar Name : Ma min phyu

English Name : Unknown

Flowering Period: September to October

Pollen grains united in pollinia; massula $37.5 - 55.5 \times 87.5 - 93.5 \mu\text{m}$ in length and breadth, pollinia number 2, $10.0 - 10.5 \times 1.5 - 2.5 \text{ cm}$ in length and breadth, oblong in shape; pollinia sac linear.

4. *Habenaria trichosantha* Wall. Number. List n. 7028. 1828. (Figure 1. J,K,L)

Myanmar Name : Myaepauk

English Name : Unknown

Flowering Period : October to November

Pollen grains united in pollinia; massula $20.5 - 35.5 \times 90.0 - 95.5 \mu\text{m}$ in length and breadth, Pollinia 2, $10.0 - 12.5 \times 1.5 - 2.5 \text{ cm}$ in length and breadth oblong in shape; pollinia sac linear.

5. *Bauhinia malabarica* Roxb., Hort. Beng. 31. 1814. (Figure 1. M,N,O)

Paullinia asiatica L., Sp. Pl. 365.1753 (L., Fl. Zeyl. No.143. 1737).

Myanmar Name : Chinbyit

English Name : Unknown

Flowering Period : July to October

Triporate, suboblate, medium, $42.5 - 50.0 \times 40.5 - 51.5 \mu\text{m}$ in in length and breadth; amb circular; pori circular, $5.0 - 6.5 \mu\text{m}$ in diameter.

6. *Desmodium capitatum* (Burm.f.) DC. Prodr. 2: 336.1825.

(Figure 2. A,B,C)

***Hedysarum capitatum* Burm.f. Fl. India (a) Prodr. Fl. 167. 1768.**

Myanmar Name : Unknown

English Name : Horse bean

Flowering Period : June to December

Triporate, oblate, small, $20 - 25 \times 30 - 35 \mu\text{m}$ in length and breadth; amb triangular; pori alongate, $7.5 - 9.0 \times 11.0 - 12.5 \mu\text{m}$ in length and breadth.

7. *Abelmoschus rugosus* Wall. ex Wight & Arn., Prod. 1: 43. 1834. (Figure 2. D,E,F)

Myanmar Name : Unknown
 English Name : Unknown
 Flowering Period : April to July

Polyporate, pantoporate, spheroidal, very large, 130 – 145 μm in diameter; amb circular; pori circular, 6 – 10 μm in diameter; interpore space 15.0 – 18.0 μm in diameter.

8. *Argyreia nervosa* (Burm.f.) Bojer. Hort. Maurit. 224. 1837. (Figure 2. G,H,I)

Myanmar Name : Kazun gyi
 English Name : Unknown
 Flowering Period : June to December

Polyporate, pantoporate, spheroidal, large, 80 – 95 μm in diameter; pori circular, 7 – 10 μm in diameter; interpore space 16 – 18 \times 19 – 20 μm in length and breadth.

9. *Ipomoea hederrifolia* L., Syst. Nat. ed. 10.925.1759; Verdcourt, Fl. Trop. E. Africa 132. 1963. (Figure 2. J,K,L)

Myanmar Name : Myat lay ni
 English Name : Unknown
 Flowering Period : June to December

Polyporate, pantoporate, spheroidal, large, 100 – 115 μm in diameter; pori circular, 2 – 4 μm in diameter; interpore space 15 – 20 \times 19 – 25 μm in length and breadth.

10. *Asytasia gangetica* (L.) Anders. In Thw. enum. Pl. Ceyl. 235. 1860. (Figure 2. M,N,O)

Justicia gangetica L., Cent. II. Pl. 3. 1756.

Myanmar Name : Kyauk htwe pan
 English Name : Unknown
 Flowering Period : October to February

Tricolporate, perprolate, medium to large, 75.0 – 83.5 \times 37.5 – 45.0 μm in length and breadth; colpi longicolate 30 – 35 \times 2.0 – 2.5 μm in length and breadth, pseudocolpi present, the colpi alternate with two pseudocolpi; pori lalongate,

An Artificial Key to the Studied Species

1. Dispersal unit of pollen grains, pollinia -----2
1. Dispersal unit of pollen grains, monad -----4
 2. Type of pollen grains rhomboidal ----- 2. *Dendrobium ochreatum*
 2. Type of pollen grains massula ----- 3
3. Length of pollinia 37.5 – 55.5 μm ----- 3. *Habenaria dentata*
3. Length of pollinia 20.5 – 35.5 μm ----- 4. *Habenaria trichosantha*
 4. Type of pollen grains monosulcate ----- 1. *Gloriosa superba*
 4. Type of pollen grains not monosulcate ----- 5

5. Shape of pollen grains oblate ----- 6. *Desmodium capitatum*
5. Shape of pollen grains not oblate -----6
6. Shape of pollen grains prolate; sculpture reticulate -----
-----10. *Asytasia gangetica*
6. Shape of pollen grains not prolate; sculpture not reticulate -----
-----7
7. Sculpture obscurely ----- 5. *Bauhinia malabarica*
7. Sculpture echinate ----- 8
- 8 Size of pollen grains 80 – 95 μm in diameter-----
----- 8. *Argyreia nervosa*
8. Size of pollen grains 100 – 145 μm in diameter ----- 9
9. Exine thickness 2.0 – 4.0 μm -----
-----7. *Abelmoschus rugosus*
9. Exine thickness 5.5 – 6.5 μm -----
-----9. *Ipomoea hederrifolia*

Table 2. Pollen Morphological Characteristic of Ten species studied From Popa Area

No	Scientific Name	Type of Pollen grain	Shape of E.V	Size of E. V (µm)	Size of Pollen grain	Colpi Size (µm)	Pori Shape	Exine		Sculptures	Lumina wide(µm)	Muri wide (µm)
								Thickness (µm)	S>N			
1.	<i>Gloriosa superba</i> L.	S ₁	Obl	17.5-22.0 ×27.5-32.5	S	5-7.5 × 22.5-27	-	1.0-1.5	S>N	Sca	-	-
2.	<i>Dendrobium ochreatum</i> Lindl	Rhom	-	90 - 98 x85 – 87	-	-	-	1.0 - 2.0	S>N	Psi	-	-
3.	<i>Habenaria dentata</i> (Sw.)Schltr.	Massu	-	37.5 – 55.5 x 87.5 – 93.5	-	-	-	1.5-3.0	S>N	Psi	-	-
4.	<i>Habenaria trichosantha</i> Wall.	Massu	-	20.5 – 35.5 ×90.0 – 93.5	-	-	-	1.0 - 2.0	S>N	Psi	-	-
5.	<i>Bauhinia malabarica</i> Roxb.	P ₃	Sub-obl	42.5-50.0 x 50.0-52.0	M	-	Cir	2.0-2.5	S>N	Obsc	-	-
6.	<i>Demodium capitatum</i> Dc.	P ₃	Obl	20-25 x 30- 35	S	-	La	1.0-1.5	S>N	Psi	-	-
7.	<i>Abelmoshus rugosus</i> Wall.	P _∞	Sph	130-145	L	-	Cir	2.0-4.0	S>N	Ech	-	-
8.	<i>Argyreia nervosa</i> (Burm.f.)Bojer.	P _∞	Sph	80-95	L	-	Cir	5.0-6.0	S>N	Ech	-	-
9.	<i>Ipomoea hederrifolia</i> L.	P _∞	Sph	100-115	L	-	Cir	5.5-6.5	S>N	Ech	-	-
10.	<i>Asytasia gangetica</i> (L.)Andwes.	C ₃ P ₃	Pro	75.0- 83.5×37.5- 45.0	L	30-35 x 2.0-2.5	La	2.0-2.5	S>N	Reti	1.5-2.5	0.5-1.5

S₁ - Monosulcate

Obl - Oblate

S - Small

La- Lalongate

S>N - Sexine thicker than nexine

Reti – Reticulate

P₃ - Triporate

Pro - Prolate

M - Medium

Cir- Circular

Sca – Scabrate

Psi - Psilate

P_∞ - Polyporate

Sph - Spheroidal

L - Large

Obs – Obscurely

Massu - Massula

C₃P₃ - Tricolporate

Sub-obl - Suboblate

Ech – Echinata

Rhom - Rhomboidal

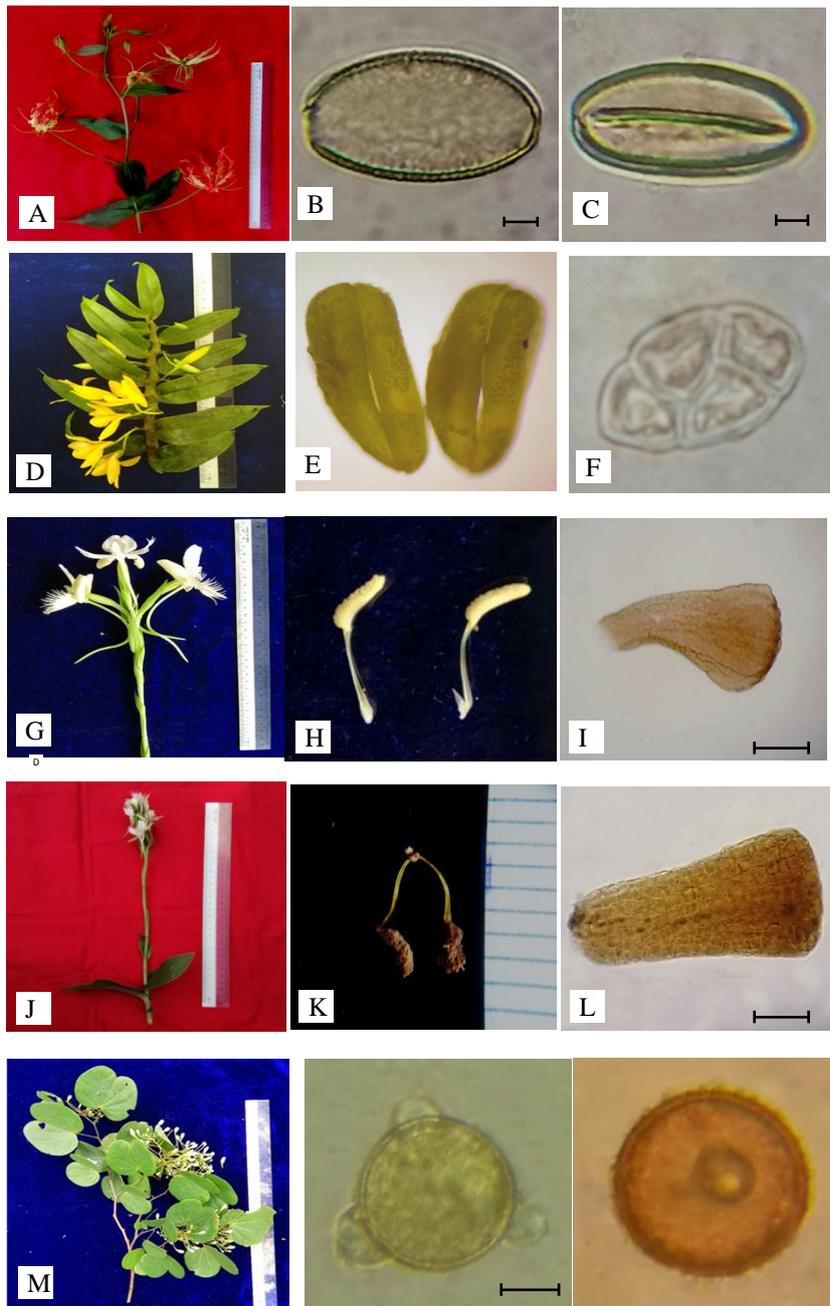


Figure 1. A. Inflorescence B. Polar view, C. Equatorial view of *Gloriosa superba* L.
 D. Inflorescence E. Pollinarium, F. Tetrad of *Dendrobium ochreatum* Lindl.
 G. Inflorescence, H. Pollinarium, I. Linear massula of *Habenaria dentata* (Sw.) Schltr.
 J. Inflorescence, K. Pollinarium, L. Linear massula of *Habenaria trichosantha* Wall.
 M. Inflorescence, N. Polar view, O. Equatorial view of *Bauhinia malabarica* Roxb
Scale bar = 10 μ m

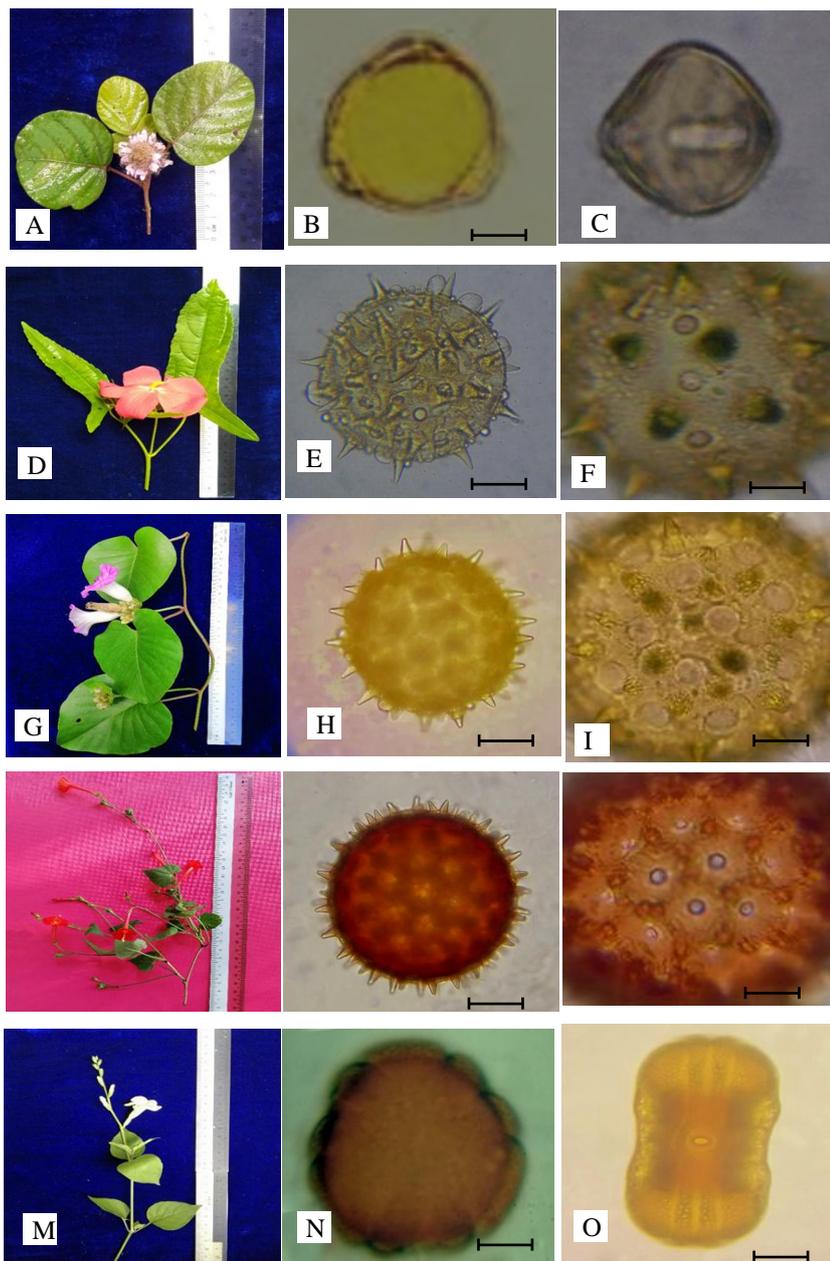


Figure 2. A. Inflorescence B. Polar view, C. Equatorial view of *Desmodium capitatu* (Burm.f.) DC.
 D. Inflorescence E. Surface view, F. Closed up view of *Abelmoschus rugosus* Wall.
 G. Inflorescence, H. Surface view, I. Closed up view of *Argyreia nervosa* (Burm.f.) Bojer.
 J. Inflorescence, K. Surface view, L. Closed up view of *Ipomoea hederrifolia* L.
 M. Inflorescence, N. Polar view, O. Equatorial view of *Asytasia gangetica* (L.) Anders.
Scale bar = 10 μ m

Discussion and Conclusion

The present research exhibited great diversity in pollen morphology of 10 species belonging to 9 genera of 6 families found in Popa area, Kyaukpadaung Township in Mandalay Region. Pollen morphology of 10 species were classified on the basis of aperture type, number, position, shape, size and sculpture pattern of exine. Among them, 6 species were eudicots and 4 species were monocots.

In this study, pollen morphology can be classified on the basis of aperture type, shape, size and sculpture pattern of the pollen. The pollen grains types were monad, tetrad and polyads. The pollen grains of colpate were found in *Asytasia gangetica* (L.) Anders., porate pollen grains were *Bauhinia malabarica* Roxb., *Desmodium capitatum* (Burm.f.) DC., *Abelmoschus rugosus* Wall., *Argyreia nervosa* (Burm.f.) Bojer., *Ipomoea hederrifolia* L., 3-species of pollinia were *Dendrobium ochreatum* Lindl., *Habenaria dentata* (Sw.) Schltr., *Habenaria trichosantha* Wall., and one species of monosulcate pollen grains was *Gloriosa superba* L. This types of pollen grains stated that by Erdtman (1971) & Hesse (2009).

In polar view, amb were found rounded, angular, triangular and circular. The porate of pollen grains are lalongate, and circular. Lalongate are *Desmodium capitatum* (Burm.f.) DC., circular are *Bauhinia malabarica* Roxb., *Abelmoschus rugosus* Wall., *Argyreia nervosa* (Burm.f.) Bojer., *Ipomoea hederrifolia* L., *Asytasia gangetica* (L.) Anders., which aperture and porate shape described that by Hesse (2009).

In equatorial view, the shape of pollen grains are found in triporate, tricolpate, polyporate and monosulcate. Triporate pollen were *Bauhinia malabarica* Roxb. found in *Bauhinia malabarica* Roxb., and *Desmodium capitatum* (Burm.f.) DC., tricolpate pollen was *Asytasia gangetica* (L.) Anders., polyporate were *Abelmoschus rugosus* Wall., *Argyreia nervosa* (Burm.f.) Bojer., *Ipomoea hederrifolia* L., and *Gloriosa superba* L. was monosulcate pollen, which pollen shape are the same as in Erdtman (1971) and Ahmed (2008).

In orchid, pollen cell walls differ according to pollen dispersal unit type and have all possible tetrad types: linear, rhomboidal and T-shaped (Davis 1966). The pollinia of genus *Habenaria* have linear grains, fusion of pollen grains in large, often irregular numbers but less than an entire theca, are called massulae that result are the similar to described by Moore *et al.* (1992).

In this study, three species of the pollen grains were found in pollinia. The two species of genus *Habenaria* have linear shaped and *Dendrobium ochreatum* Lindl. have rhomboidal shaped which characters are agreed with stated that Moore *et al.* (1992).

The pollen grains of Fabaceae are monads, triporate, tricolpate, tricolporate, prolate or oblate or spheroidal, the pollen grains single or united. The sculpture of *Bauhinia malabarica* Roxb. was found in obscurely, *Desmodium capitatum* (Burm.f.) DC., was psilate, which characters are the same as in Erdtman (1986).

In Malvaceae and Convolvulaceae family, pollen grains are usually spheroidal or globular in outline and colpate or porate with an echinate sculpture. The pores and spines are very distinctive. The grain of *Abelmoschus rugosus* Wall. is very large, polyporate pantoporate, sexine as thick than nexine. These characters were agreement with those reported by Moore *et al.* (1992).

In this result, the pollen grains of *Gloriosa superba* L were found as oblate, monocolpate, monosulcate, heteropolar, bilaterally symmetric, which characters are agreed that Selvarasu *et al.* (2012). The pollen of Family Acanthaceae have isopolar, bilateral, tricolporate, prolate spheroidal, the grain of *Asytasia gangetica* (L.) Anders. is sculpture reticulate, sexine thicker than nexine, colpi longicolpate, pseudocolpi present, pori lalongate, which characters agreed that Hesse *et al.* (2009).

According to the resulting data, the size, shape, aperture of pollen grains are varied from species to another. It was concluded that the pollen morphological resulting will contribute not only the interested pollen characters but also the different pollen features may be used in plant classification and identification. It is sincerely hoped that the present study will support useful information on the pollen morphology of the Popa area.

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