

# Pollen Morphology of Ten Species Found in Nyaung Myint Village, Meiktila Township

Swe Swe Linn<sup>1</sup>

## Abstract

The pollen morphology of ten species found in Nyaungmyint village, Meiktila Township were studied. The plant specimens of 10 species belonging to 10 genera of 8 families were identified and classified. The pollen grains were prepared by the standard method described by Erdtman(1960). This collection record a family of basal angiosperms is Nymphaeaceae and 7 families of eudicots are Apocyanaceae, Boraginaceae, Capparaceae, Convolvulaceae, Malvaceae, Nyctaginaceae, Zygophyllaceae. The pollen units of ten species were found as polyads and monads. Polyads was occurred in only one species of *Calotropic gigantea* (L.) R. Br. and nine species were monads. The aperture types of pollen grains were found as porate and colporate. The pollen shapes are mostly occurred in spheroidal but rarely in oblate and prolate. The pollen grains sizes were small, medium, large and very large. The sculpture patterns of pollen grains were found as echinate, obscurely reticulate, retipilate and verrucate. An artificial key to the species was also constructed on the basic different palynological characters of pollen grains. The differences between pollen characters will support the identification and classification of species.

Keywords: Pollen morphology, Families, Nyaungmyint, Meiktila

## Introduction

Palynology is one the most effective tools we have to reconstruct past environment. Because exine, the hard outer shells of pollen grain, of different species are unique and can survive in favorable conditions for thousands of years, palynologists can identify many plants that were presented in the past. Pollen is the male gamete of the flowering plants through which genetic information is transmitted from the male parent to the offspring. To the naked eye, pollen of flowering plants all appears to be simple yellow grains of powder. Each grain possesses a species-specific pattern on its surface by which it can be identified and classified (Erdtman 1971).

These palynological features have provided a wealth of characters that have been important in inferring phylogenetic relationship of plants. The specimens were collected from Nyaungmyint village, Meiktila Township in Mandalay Region. Nyaungmyint village is located in the south eastern part of Meiktila Township. This area lies between 95° 55' 48" and 95° 55' 59" east longitude and 20° 45' 26" and 20° 45' 36" north latitude. The altitude of this area is about 195 meter above sea-level. Its temperature is 80.89° F and the annual rainfall of about 32 inches.

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. In addition, the features of spores and pollen grains can often be used to identify a particular plant taxon. In this paper, the pollen morphology of 10 species comprising 7 families of eudicots species and 1 family of primitive were studied.

Many of the palynological studies are based on the detailed knowledge of pollen morphology is of significance in taxonomy, phylogeny, paleobotany, and aeropalynology. Pollen analysis can be tool for the reconstruction of past vegetation and environments, and it's also be applied concerning climate change, archaeology, geology, honey analysis and forensic science (Moore *et al.* 1991).

Each pollen type has its own unique set of characteristics which means that the species or plant family can usually be identified. The main features which distinguish one type of pollen from another are size, shape and ornamentation or the outer wall. Pollen grains come in

---

<sup>1</sup> Lecturer, Dr, Department of Botany, University of Mandalay

a wide variety of shapes although the majority is basically spherical or oval or disc-shaped. The outer wall features include pores and furrows. The surface of the grain can also have a meshed, granular, grooved, spined or striated surface or can appear very smooth.

In the present paper, the pollen type, number, position, shape, size and sculpture pattern of exine on members of families Nymphaeaceae, Zygophyllaceae, Malvaceae, Capparaceae, Nyctaginaceae, Apocyanaceae, Boraginaceae and Convolvulaceae were recorded and described. Thus, this paper is carried out to fulfil the different pollen character may be used in plant identification.

### Materials and Methods

The specimens were collected from Nyaungmyint village, Meiktila Township, during June to September, 2016. The species were identified by using the literature of Hooker (1879), Dassanayake (1980-2001), Staples (2010). Myanmar names were referred to Hundley and Chit Ko Ko (1987) and Kress *et al.* (2003). Pollen samples were freshly collected from the anthers of blooming flowers and stored in glass vial with glacial acetic acid.

Pollen samples were acetolysed by the method of Erdtman (1960). The acetolysis solution was mixed using a measuring cylinder: 9 parts of glacial acetic acid and 1 part of concentrated sulphuric acid was added. 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 at 80°C for 15 minutes. The test-tube was allowed to cool, and the sample diluted with distilled water and centrifuged for 30 minutes at 3000 rpm. After centrifuging and decanting, in a few drops of dilute glycerine jelly was added to the residue, then transferred and stored in air-tight glass vial. The mounted slides were observed under light microscope to study the pollen morphology. For each species more than 10 pollen grains were measured and recorded. The terminology used in the accordance with Erdtman (1952, 1971), Hoen (1999) and Hesse *et al.* (2009).

### Results

In this research, 10 species belonging to 10 genera of 8 families were systematically arranged into the classification system of APG IV (Byng *et al.* 2016). The genera and species under the families were also arranged by alphabetically as shown in Table 1.

Table 1. List of studied species collected from Nyaungmyint village

Group	Order	Family	No.	Scientific Name	Myanmar Name
Basal angiosperm	Nymphales	Nymphaeaceae	1.	<i>Nymphaea nauchali</i> Brum.	Kya bya
Eudicots	Zygophyllales	Zygophyllaceae	2.	<i>Tribulus terrestris</i> L.	Su le
		Malvales	3.	<i>Fioria vitifolia</i> (L.) Mattei	Thin paung
			4.	<i>Pavonia odorata</i> Willd.	Bala
	Brassicales	Capparaceae	5.	<i>Cleome viscosa</i> L.	Hin gala; Pingu pan
	Caryophyllales	Nyctaginaceae	6.	<i>Boerhavia diffusa</i> L.	Pa yan na wa
	Gentianales	Apocyanaceae	7.	<i>Catharanthus pusillus</i> (Murr.) G. Don.	Taw nga yoke
			8.	<i>Calotropic gigantea</i> (L.) R. Br.	Mayo gyi
	Boraginales	Boraginaceae	9.	<i>Heliotropium indicum</i> L.	Sin hna maung
	Solanales	Convolvulaceae	10.	<i>Ipomoea pes-tigridis</i> L.	Myauk kazun



## Description of Pollen Morphology

### 1. *Nymphaea nauchali* Burm. f., FL. Ind -120.1768. (Figure 1)

*N. stellata* Willd., Sp. Pl. 2:1153. 1799.

Myanmar name : Kya pya; Kya ni, Kya nyo  
 English name : Indian blue water-lily; Indian water-lily  
 Family : Nymphaeaceae

Monosulcate, zonosulcate, oblate, medium, 35-40 x 40 - 45µm in length and breadth; amb rounded; sulcus 17.5-20.0 x 40.0-42.5µm in length and breadth; exine about 1.3µm thick, sexine as thick as nexine; sculpturing verrucate, about 1.3-2.5 µm in wide. (Figure 1. A & B)

### 2. *Tribulus terrestris* L., Sp. Pl. 1:387. 1753. (Figure 2)

*T. languinosus* L., Sp. Pl. 1: 387. 1753.

Myanmar name : Su le  
 English name : Small caltrops  
 Family : Zygophyllaceae

Polyporate (50-60), pantoporate, spheroidal, medium 42.5-50.0 µm in diameter; amb circular; pori circular, 1.3-2.5 µm in diameter, interporal space 12.5-18.8µm; exine 3.8-5.0 µm thick, sexine as thick as nexine; sculpturing retipilate, the lumina heterobrochate, 3.8-7.5 µm in width, the muri simplibaculate, about 1 µm wide, the pila 3.8-5.0 µm in length. (Figure 2- A & B)

### 3. *Fioria vitifolia* (L.) Mattei, Boll. R. Orto. Bot. Palermo 2:72. 1917. (Figure 3)

*Hibiscus vitifolius* L., Sp. Pl. 696. 1753.

Myanmar name : Thin paung  
 English name : Unknown  
 Family : Malvaceae

Polyporate (about 54), pantoporate, spheroidal, very large, 105 - 113 µm in diameter; amb rounded; pori circular, 7.5-10.0 µm in diameter, interporal space 12.5-15.0µm; exine 3.8-5.0 µm thick, sexine thicker than nexine; sculpturing echinate, spines 20-25µm in length, tips pointed, straight, basal cushion not developed, interspinal space 15-20 µm. (Figure 3- A & B)

### 4. *Pavonia odorata* Willd., Sp. Pl. 3. 837. 1800. (Figure 4)

*Hibiscus odoratus* Roxb. Hort. Beng. 50.1814.

Myanmar name : Ba la  
 English name : Unknown  
 Family : Malvaceae

Polyporate (about 60), pantoporate, spheroidal, very large 110-125 µm in diameter; amb rounded; pori circular 2.5-3.8 µm in diameter, interporal space 12.5-13.8µm; exine 3.8-5.0 µm thick, sexine thicker than nexine; sculpturing echinate, spines 17.5-20.0 µm in length, tips pointed, straight or curved, basal cushion not developed, interspinal space 12.5-15.0 µm. (Figure 4- A & B)

### 5. *Cleome viscosa* L., Sp. Pl.672.1753. (Figure 5)

*Polanisia viscosa* (L.) DC., Prod. 1:242.1834.

Myanmar name : Gant galar; Pingu pan  
 English name : Spider flower  
 Family : Capparaceae

Tricolporate, zonocolporate, spheroidal, small, 17.5- 20.0 µm in diameter; amb rounded triangular, angulaperturate; colpi longicolpate, 12.5-17.5 x 2.5-3.8 µm in length and breadth;

pori circular, 2.5-5.0  $\mu\text{m}$  in diameter ; exine about 2.5 $\mu\text{m}$  thick, sexine thinner than nexine; sculpturing obscurely reticulate. (Figure 5- A & B)

**6. *Boerhavia diffusa* L., Sp. Pl. 3.1753. (Figure 6)**

Myanmar name : Pa yan na wa  
English name : Spreading hogweed  
Family : Nyctaginaceae

Polyporate (about 40), pantoporate, spheroidal, large, 75.0 - 87.5  $\mu\text{m}$  in diameter; pori circular, 2.5-3.8  $\mu\text{m}$  in diameter, interporal space 12.5-18.8 $\mu\text{m}$ ; exine 3.8-5.0  $\mu\text{m}$  thick; sexine thicker than nexine; sculpturing echinate, spines about 2.5 $\mu\text{m}$  in length, tips pointed, straight, interspinal space 1.25-2.5  $\mu\text{m}$ . (Figure 6- A & B)

**7. *Calotropic gigantea* (L.) R. Br. in Ait. f., Hort. Kew. ed 2.2:78. 1811. (Figure 7)**

*Asclepias gigantea* L., Sp. Pl. 214. 1753.

Myanmar name : Mayo gyi  
English name : Giant swallow-wort, crown flower plant; milk weed  
Family : Apocynaceae

Pollinia, pollinium sac, 1350-1600 x 432.5-575.0  $\mu\text{m}$  in length and breadth, ovate-oblong shaped, lemon yellow, pendulous; corpusculum 575-675 x 120-240  $\mu\text{m}$  in length and breadth, semi circular in head, yellowish brown; translator arm 300-450 x 32-50  $\mu\text{m}$  in length and breadth, cylindrical shaped, brownish yellow; single grain small, spheroidal, 2.5-15.0  $\mu\text{m}$  in diameter. (Figure 7- A & B)

**8. *Catharanthus pusillus* (Murr.)G. Don., Gen. Hist. 4:95.1837. (Figure 8)**

*Vinca pusilla* Murr., Comm. Gutting. 3: 66.1773.

Myanmar name : Taw nga yoke  
English name : Unknown  
Family : Apocynaceae

Tricolporate, zonocolporate, spheroidal, medium, 42.5- 45.0  $\mu\text{m}$  in diameter; amb rounded triangular, angulaperturate; colpi longicolpate, 35.0-37.5 x 3.8-5.0  $\mu\text{m}$  in length and breadth; pori lalongate, 7.5-10.0 x 5.0-7.5 $\mu\text{m}$  in length and breadth; exine 2.5-3.8 $\mu\text{m}$  thick, sexine thicker than nexine; sculpturing obscurely reticulate. (Figure 8- A & B)

**9. *Heliotropium indicum* L., Sp.Pl.130. 1753. (Figure 9)**

Myanmar name : Sin hna maung; Sin let maung  
English name : Unknown  
Family : Boraginaceae

Tricolporate, zonocolporate, prolate, medium, 37.5-42.5 x 25- 30  $\mu\text{m}$  in length and breadth; amb rounded triangular, angulaperturate; colpi brevicolpate, 7.5-12.5 x 2.5-5.0  $\mu\text{m}$  in length and breadth; pori lalongate, 2.5-6.3 x 12.5-17.5 $\mu\text{m}$  in length and breadth; exine about 2.5 $\mu\text{m}$  thick, sexine thicker than nexine; sculpturing obscurely reticulate. (Figure 9- A & B)

**10. *Ipomoea pes-tigridis* L., Sp. Pl. 162. 1753. (Figure 10)**

*I. hepaticaefolia* L., Sp. Pl. 161. 1753.

Myanmar name : Myauk kazun  
English name : Tiger's footprint  
Family : Convolvulaceae

Polyporate (about 50), pantoporate, spheroidal, large, 87.5 - 95.0  $\mu\text{m}$  in diameter; pori circular, 5.0-7.5  $\mu\text{m}$  in diameter, interporal space 10-15 $\mu\text{m}$ ; exine 3.8-5.0  $\mu\text{m}$  thick; sexine thicker than nexine; sculpturing echinate, spines 7.5-12.5 $\mu\text{m}$  in length, straight, blunt, basal cushion distinct, interspinal space 5-10  $\mu\text{m}$ . (Figure 10- A & B)

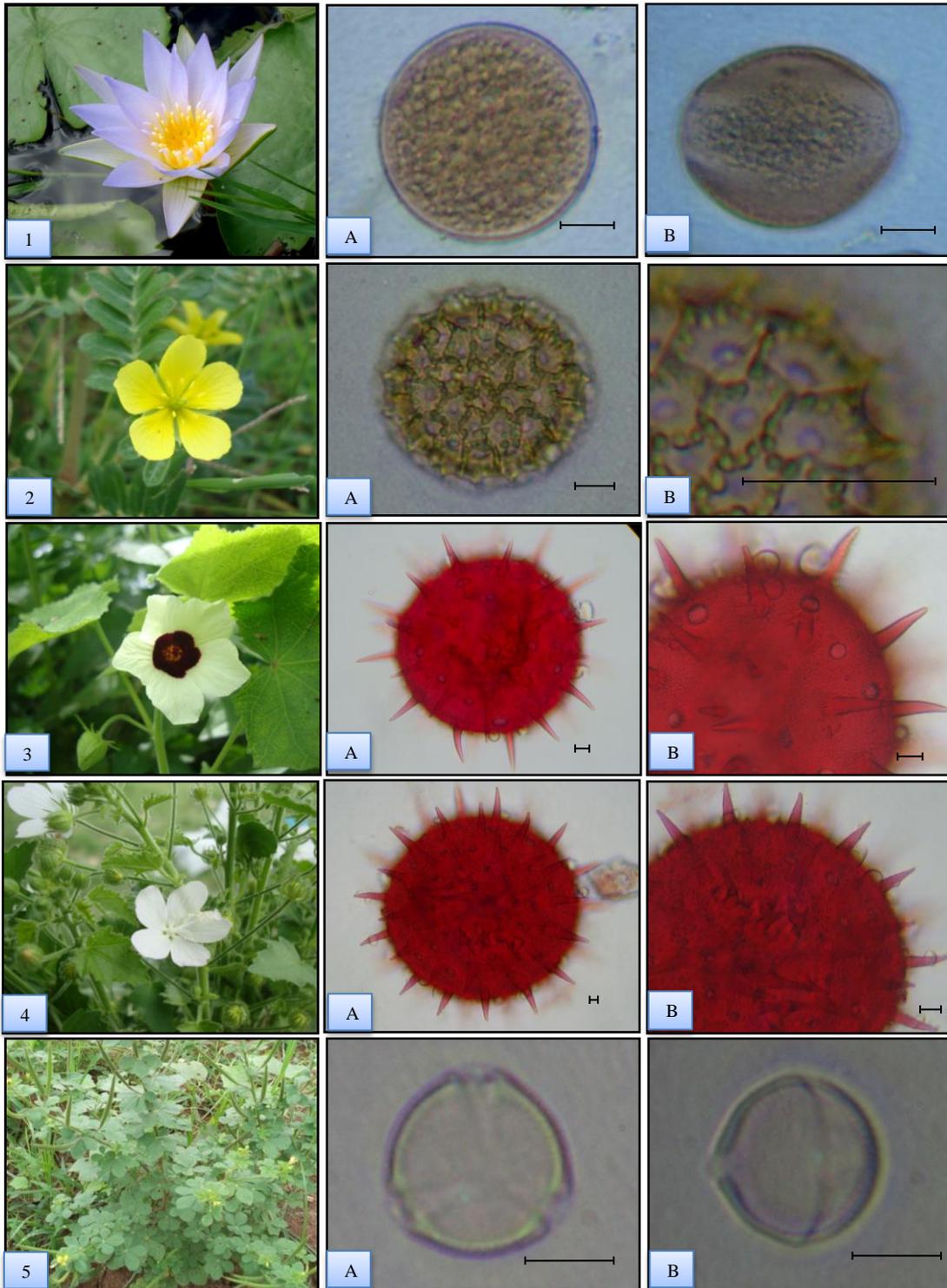


Figure 1. Flower, A. Polar view, B. Equatorial view of *Nymphaea nauchali* Brum.

2. Inflorescences, A. Surface view, B. Close-up view sculpture of *Tribulus terrestris* L.

3. Inflorescences, A. Surface view, B. Close-up view sculpture of *Fioria vitifolia* (L.) Mattei

4. Inflorescences, A. Surface view, B. Close-up view sculpture of *Pavonia odorata* Willd

5. Inflorescences, A. Polar view, B. Equatorial view of *Cleome viscosa* L.

Scale bar- 10 $\mu$ m

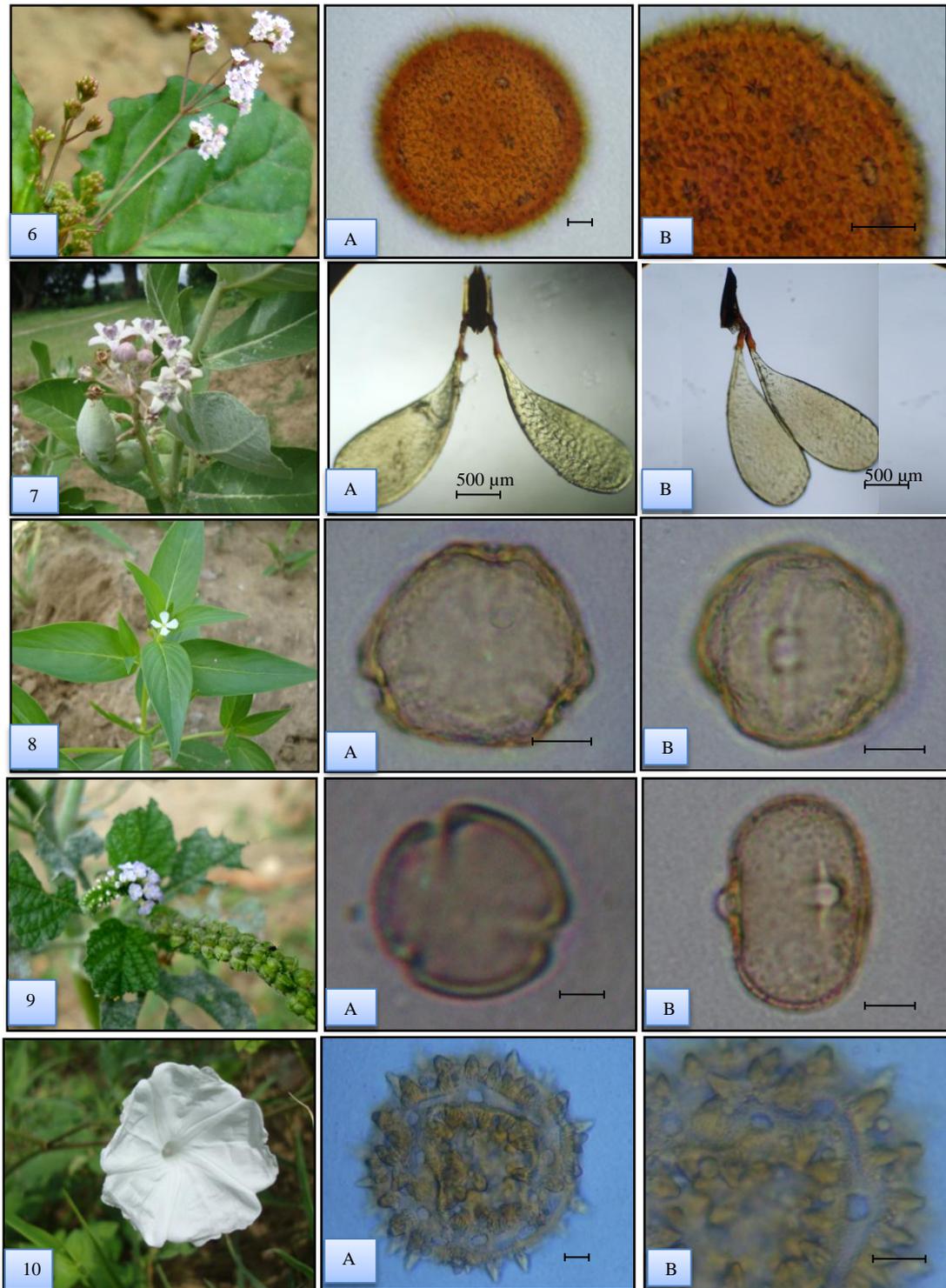


Figure 6. Inflorescences, A. Surface view, B. Close-up view sculpture of *Boerhavia diffusa* L.  
 7. Inflorescences, A. Pollinarium, B. Side-view of *Calotropic gigantea* (L.) R. Br.  
 8. Inflorescences, A. Polar view, B. Equatorial view of *Catharanthus pusillus* (Murr.) G. Don  
 9. Inflorescences, A. Polar view, B. Equatorial view of *Heliotropium indicum* L.  
 10. Inflorescences, A. Polar view, B. Close-up view sculpture of *Ipomoea pes-tigridis* L. Scale bar- 10µm

### An Artificial Key to the Studied Species by Structure of Pollen Characters

1. Pollen grains polyads ----- 7. *Calotropis gigantea*
1. Pollen grains monads ----- 2
  2. Aperture sulcate ----- 1. *Nymphaea nauchali*
  2. Aperture not sulcate ----- 3
3. Aperture tricolporate ----- 4
3. Aperture polyporate ----- 6
  4. Pollen grains size less than 21  $\mu\text{m}$  in length; sexine thinner than nexine ----- 5. *Cleome viscosa*
  4. Pollen grains size more than 24  $\mu\text{m}$  in length; sexine thicker than nexine ----- 5
5. Shape spheroidal; colpi longicolpate; pori lalongate ----- 8. *Catharanthus pusillus*
5. Shape prolate; colpi brevicolpate; pori lalongate ----- 9. *Heliotropium indicum*
6. Sculpture retipilate; sexine as thick as nexine ----- 2. *Tribulus terrestris*
6. Sculpture echinate; sexine thicker than nexine ----- 7
7. Pollen grains size less than 97  $\mu\text{m}$  in length; spine length less than 13  $\mu\text{m}$  ----- 8
7. Pollen grains size more than 103  $\mu\text{m}$  in length; spine length more than 16  $\mu\text{m}$  ----- 9
  8. Pore number 50; basal cushion present ----- 10. *Ipomoea pes-tigridis*
  8. Pore number 40; basal cushion absent ----- 6. *Boerhavia diffusa*
9. Pore number 60; pori size less than 4  $\mu\text{m}$  in diameter ----- 4. *Pavonia odorata*
9. Pore number 54; pori size more than 7  $\mu\text{m}$  in diameter ----- 3. *Fioria vitifolia*

### DISCUSSION AND CONCLUSION

In this paper, pollen morphology of 10 species belonging to 10 genera of 8 families has been studied. The classifications of pollen morphology are based on aperture type, number, position, shape, size and sculpture pattern of exine.

In this study, the types of pollen grains are found polyads and monads. Polyads are found only one species of *Calotropis gigantea* (L.) R. Br. and the nine species are monads. Monads are considered the simplest in the evolutionary line while polyads are most advanced (Panicker 2004, as cited in Rajurkar *et al.* 2013). In the evolutionary line nine species of monads are the simplest and polyads of *Calotropis gigantea* (L.) R. Br. is advanced.

The types of aperture in monad are mostly porate, colpate and rarely sulcate. Sulcus pollen grains are found in *Nymphaea nauchali* Brum; three species of colpate grains are *Catharanthus pusillus* (Murr.) G. Don., *Cleome viscosa* L., *Heliotropium indicum* L. and the remaining six species are porate.

Walker and Doyle (1975) described that angiosperms have two basis pollen grains, the monosulcate and tricolpate. Monosulcate types are boat-shaped with one long one germinal aperture. It is characteristics of primitive dicotyledons. The monophyly of eudicots is well supported by at least one palynological apomorphy: a tricolpate or tricolporate is derived pollen grains. Many eudicots have pollen grains with more than three apertures (Simpson 2006). In the studied species, the aperture one is possess in *Nymphaea nauchali* Brum. and the rest of nine species are possess in three to poly. Thus, *Nymphaea nauchali* Brum. is primitive

family and nine species are eudicots family, which result are agree with those described by Walker & Doyle and Simpson.

Among the studied species, the apertures position of monad grains are zonoaperturate and pantoaperturate. The grains of zonoaperturate are four species and the six species are pantoaperturate.

In this paper, the equatorial view of pollen shape is described by the polar axis and equatorial diameter ratio. In monad grains, the shapes of pollen are oblate, prolate and spheroidal. The grain of prolate is *Heliotropium indicum* L.; oblate is *Nymphaea nauchali* Brum.; and the remaining species are spheroidal.

Hesse (2009) stated that, pollen size varies from less than 10  $\mu\text{m}$  to more than 100  $\mu\text{m}$ ; very small spores are less than 10  $\mu\text{m}$ , small 10 - 25  $\mu\text{m}$ , medium 26 -50  $\mu\text{m}$ , large 51-100  $\mu\text{m}$  and very large more than 100  $\mu\text{m}$ . In the present study, the sizes of pollen are varied from small, medium and large or very large. The smallest pollen is *Cleome viscosa* L. and the largest is *Pavonia odorata* Willd.

Walker and Doyle (1975) stated that the sculpture patterns on appearance are also varied significantly from one species to another. Iwanami *et al.* (1988) recorded that, the outer surface of the exine is marked with various kinds of sculpture and ornamentation. In this paper, the sculpturing patterns of the pollen were observed as retipilate, verrucate, obscurely reticulate and echinate. According to Simpson (2006), anemophilous flowers tend to be smooth (psilate) and entomophilous flowers tend to have elaborately sculptured pollen. The varied sculptures of nine species are entomophilous flowers with biotic agent of dispersal. *Tribulus terrestris* L. is retipilate; *Nymphaea nauchali* Brum. is verrucate; *Catharanthus pusillus* (Murr.) G. Don., *Cleome viscosa* L. *Heliotropium indicum* L. are obscurely reticulate; echinate pollen is five species and the pollinia of *Calotropis gigantea* (L.) R. Br. is obscure sculpture.

According to the resulting data, the size, shape, aperture and sculpture of pollen grains are varied from species to another. It was concluded that the pollen morphological resulting will contribute not only interested pollen character but also the different pollen features may be used in plant identification.

#### Acknowledgements

I would like to express my gratitude to Dr Nu Nu Yee, Professor and Head, Department of Botany, University of Mandalay, for her kind permission to carry out this research work and for providing me the necessary facilities. I would like to thank Dr Soe Soe Aung and Dr Moat War Dine Naw, Professors, Department of Botany, University of Mandalay, for her suggestion to continue my research work. I am very grateful to Dr Aye Aye Htun, Professor and Head (Rtd.), Department of Botany, University of Distance Education, Mandalay, for her encouragement and detailed supervision. I am greatly indebted thanks to my supervisor Dr Sai Aung Hsan, Pro-Rector (Rtd.), Panglong University, Panglong, for his suggested this research work.

**REFERENCES**

- Byng, J. W., Chase, M. W., Christenhusz, M. J. M., Fay, M. F., Judd, W. S., Mabberley, D. J., Sennikov, A. N., Soltis, D. E., Soltis, P. S., and Stevens, P. F. 2016. "An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants": APG. The Linnean Society of London, Botanical Journal of the Linnean Society, 181: 1-20.
- Dassanayake, M. D. 1980-2001. "A revised handbook to the flora of Ceylon". Vol.12. University of Peradeniya, Department of Agriculture, Peradeniya, Sri Lanka.
- Erdtman, G. 1952. "Pollen morphology and plant taxonomy (Angiosperms)". The ChronicaBotanica. Co., Waltham, Mass.
- Erdtman, G. 1960. "The acetolysis method". A revised description. Seven. Bot. Tidskr. 54: 561-564.
- Erdtman, G. 1971. "Pollen Morphology and Plant Taxonomy (Angiosperms)". Hafnar Publishing Co. New York.
- Hesse, M., Hakbritter, H., Zetter, R., and Weber, M. 2009. "Pollen Terminology An Illustrated Handbook". Springer- Verlag Wien. New York.
- Hoen, P. 1999. "Glossary of pollen and spore terminology", second and revised edition, Utrecht. Netherland.
- Hooker, J. D. 1879. "The Flora of British India", Clarendon- Press. Oxford, London.
- Hundley, H. G. and Chit Ko Ko. 1978. "List of Trees, Shrubs, Herbs and Principle Climber of Burma". Supdt, Govt. Print & Staty Yangon, Myanmar.
- Hutchinson, J. 1967. Key to the Families of Flowering Plants of the World, Clarendon Press. Oxford, London.
- Iwanami, Y., Sasakuma, T., and Yamada, Y. 1988. 'Pollen: Illustration and Scanning Electron Micrographs'. Kodansha (Tokyo) and Springer, Berlin Heidelberg New York Tokyo.
- Kress, J. W., Defilipps, R. A., and Yin Yin Kyi. 2003. A checklist of the trees, shrubs, herbs and climbers of Myanmar. Department of Systematic Biology-Botany, Natural Meuseum of Natural History, Washington DC, USA.
- Moore, P.D., Webb, J. A. and Collinson, M. E. 1991. "Pollen Analysis", 2<sup>nd</sup> ed. Oxford. Blackwell Scientific Publication. London.
- Simpson, N. G. 2006. "Plant Systematics". Elsevier academic press. Printed in Canada.
- Walker, J.W., Doyle, J.A. 1975. The bases of angiosperm phylogeny. Ann. Missovri Bot. Gard., 62-664-723.