Pollinial Morphology on Ten Species of Orchidaceae Found in Southern Shan State

Htet Htet Khaing[1], Nwè Nwè Yi[2]

Abstract

Pollinial morphology of 10 species belonging to 10 genera of family Orchidaceae were studied. The specimens of *Coelogyne lactea* Rchb. f., *Cymbidium lowianum* (Rchb. f.) Rchb. f., *Eria stricta* Lindl., *Hemipilia cordifolia* Lindl., *Hygrochilus parishii* (Rchb. f.) Pfitzer, *Papilionanthe teres* (Roxb.) Schltr., *Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik., *Robiquetia pachyphylla* (Rchb. f.) Garay, *Thunia alba* (Lindl.) Rchb. f and *Vanda bensoni* Bateman were collected from Southern Shan State from 2016 to 2017. In the present study, the two pollinia were found in *C. lowianum* (Rchb. f.) Rchb. f., *H. cordifolia* Lindl., *P. teres* (Roxb.) Schltr., *R. pachyphylla* (Rchb. f.) Garay and *V. bensoni* Bateman; four pollinia were found in *C. lactea* Rchb. f. and *H. parishii* (Rchb. f.) Pfitzer; eight pollina were observed in *E. stricta* Lindl., *P. tankervilleae* var. *pulchra* (King & Pantl.) Karthik. and *T. alba* (Lindl.) Rchb. f.The smallest pollinarium (4.8 - 5.4 × 4.8 - 5.4 mm) was found in *E. stricta* Lindl. and the largest pollinarium (33.6 - 36.0 × 50.4 - 54.0 mm) was observed in *T. alba* (Lindl.) Rchb. f. The number, shape, size and colour of pollinia were differ from one species to another. The attachment of caudicle or stipe and viscidium to the pollinia were vary from one another. The pollinial morphology provides the knowledge for identification of the species and future systematic research work of family Orchidaceae.

Key words: Orchidaceae, Pollinia, Caudicle, Stipe, Viscidium

Introduction

Palynology (Gr. palynos, dust) is the study of spores and pollen grains. The features of spores and pollen grains can often be used to identify a particular plant taxon (Simpson 2006). The pollen grains are usually bound together by threads of a clear, sticky substance (viscin) in masses called pollinia (Dodson 2015).The pollinarium is defined as pollinia, a pollen mass

1. PhD Candidate, Department of Botany, University of Mandalay
2. Professor & Head, Department of Biology, Sagaing University of Education

and accessory organs such as a caudicle, a stipe, and a viscidium. In Orchidaceae, this feature is an informative source both in taxonomy and phylogenetics (Freudenstein & Ramussen 1999 as cited in Hidayat *et al.* 2006).

The ancestral number of pollinia per pollinarium is eight and that from there, were independent reductions to six, four or two pollinia (Dressler 1993 as cited in Damon & Nieto 2012). Taxonomic study of family Orchidaceae had been studied on various regions of Myanmar. However, pollinial morphology of Orchidaceae is left to be studied and recorded. Therefore, pollinial morphology of Orchidaceae were selected and studied.

The present study aimed to investigate the morphological differences in pollinia of Orchidaceae, to share knowledge the development and variation in number and structure of pollinia in the family Orchidaceae and to provide the valuable pollinial information in plant classification and identification of Orchidaceae from the palynological point of view.

Materials and Methods

The Orchidaceous plants were collected from Taunggyi Township, Hopong Township and Kalaw Township, Southern Shan State from 2016 to 2017. All the collected species were recorded by digital images. Identification of specimens were carried out by referring to the key and description stated by Hooker (1894), Schweinurth (1960), Backer & Brick (1968), Holttum (1964), Dassanayake (1981) and Seidenfaden (1992). Myanmar names of the collected species were referred to Hundley & Chit Ko Ko (1961), and Kress *et al*. (2003). For pollinarium and pollen preparation, the methods described by Chase (1987) as cited in Hidayat *et al.* (2006) and Erdtman (1960) were used with several modifications.

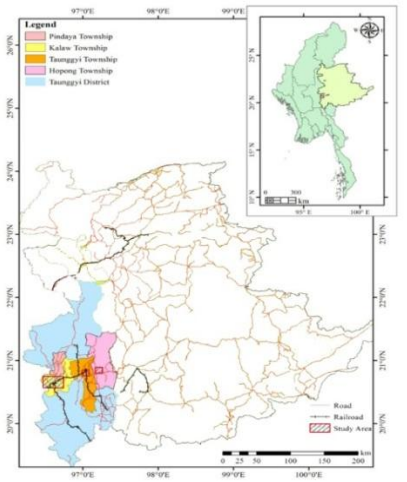

Figure 1. Map of the Collected Species from Southern Shan State

Results

Pollinial morphology of 10 species belonging to 10 genera of Orchidaceae was studied. The lists of collected species are arranged by alphabetically as shown in Table 1 and their pollinial morphology were presented in Table 2 and 3.

Table 1. List of the collected specimens

Family	No.	Scientific Name	Myanmar Name
Orchidaceae	1	*Coelogyne lacteal* Rchb. f.	Ngwe hnin phyu myokywe
	2	*Cymbidium lowianum* (Rchb. f.) Rchb. f.	Pan thet she kya
	3	*Eria stricta* Lindl.	Letset pan
	4	*Hemipilia cordifolia* Lindl.	Unknown
	5	*Hygrochilus parishii* (Rchb. f.) Pfitzer	Taung Karamet
	6	*Papilionanthe teres* (Roxb.) Schltr.	Yo set gyi
	7	*Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik.	Zayti thitkhwa
	8	*Robiquetia pachyphylla* (Rchb. f.) Garay	Unknown
	9	*Thunia alba* (Lindl.) Rchb. f.	Kyauk thikhwa phyu
	10	*Vanda bensoni* Bateman	Moe thuzar

1. *Coelogyne lacteal* Rchb. f., Gard. Chron. 1:692.1885. (Figure 2 A-C)

Myanmar name : Ngwe hnin phyu myo kywe

Common name : Unknown

Flowering period : From March to May

Pollinial morphology

Pollinarium 13.8 – 15.6 × 15.6 – 16.8 mm in length and breadth; pollinia number 4; pollinial sac 10.5 – 11.0 × 6.5 – 7.5 mm in length and breadth, gibbous in shape, saffron, attachment of pollinium apical; caudicle not prominent; stipe absent; viscidium 4.6 – 5.2 × 9.5 – 10.8 mm in length and breadth, strap in shape, saffron; pollen tetrad tetragonal in shape, 17.5–30.0 × 21 – 35 μm in length and breadth; individual grain 5 – 11 × 5 – 15 μm in length and breadth; exine 2 – 3 μm thick, sexine as thick as nexine.

2. *Cymbidium lowianum* (Rchb.f.) Rchb.f., Gard.Chron., n.s. 11: 332, f. 56.1879. (Figure 2 D-F)

Cymbidium giganteum var. *lowianum* Rchb. f., Gard. Chron., n.s. 7: 685.1877.

Myanmar name : Pan thet she kya

Common name : Low’s Cymbidium

Flowering period : From February to April

Pollinial morphology

Pollinarium 19.2 – 24.0 × 30 – 36 mm in length and breadth; pollinia number 2; pollinial sac 6.4 – 8.0 × 15 – 18 mm in length and breadth, bell in shape, fulvous, attachment of pollinium ventral; caudicle not prominent; stipe single, 2.4 – 4.8 × 3.6 – 4.8 mm in length and breadth, rectangular in shape, white; viscidium 10.8– 12.0 × 26.3 – 31.5 mm in length and breadth, strap in shape, white; pollen tetrad rhomboidal in shape, 33 – 39 × 35 – 70 μm in

length and breadth; individual grain 10 – 19 × 10 – 23 μm in length and breadth; exine 2.5 – 5.0 μm thick, sexine thicker than nexine.

3. *Eria stricta* Lindl., Coll. Bot. Ad pl. 41B. 1826. (Figure 3A-C)

Myanmar name : Letset pan

Common name : The Rigid Eria

Flowering period : From January to February

Pollinial morphology

Pollinarium 4.8– 5.4 × 4.8 – 5.4 mm in length and breadth; pollinia number 8; pollinial sac 3.0 – 3.3 × 2.0 – 2.3 mm in length and breadth, obovate in shape, beige, attachment of pollinium apical; caudicle not prominent; stipe absent; viscidium 1.0 – 1.3 × 2.4 – 2.7 mm in length and breadth, quadrangular in shape, beige; pollen tetrad rhomboidal in shape, 20.0 – 22.5 × 30 – 40 μm in length and breadth; individual grain 6.5 – 15.0 × 10 – 15 μm in length and breadth; exine 1.5 – 2.0 μm thick, sexine thicker than nexine.

4. *Hemipilia cordifolia* Lindl., Gen. Sp. Orchid. Pl. 296, 1835.

(Figure 3 D-F)

Myanmar name : Unknown

Common name : The heart-shaped leaf Hemipilia

Flowering period : From June to August

Pollinial morphology

Pollinarium 28.8 – 29.4 × 16.0 – 16.3 mm in length and breadth; pollinia number 2; pollinial sac 14.0 – 14.2 × 8.0 – 8.3 mm in length and breadth, obovate in shape, purple, attachment of pollinium apical; caudicle 13.0 – 13.2 × 1.8 – 2.0 mm in length and breadth, strap in shape, tawny; stipe absent; viscidium 1.8 – 2.0 × 2.0 – 2.2 mm in length and breadth, irregular in

shape, mauve; pollen tetrad rhomboidal in shape, 40 – 44 × 55 – 60 μm in length and breadth; individual grain 17.5 – 22.5 × 16.5 – 17.5 μm in length and breadth; exine 1.5 – 2.0μm thick, sexine thicker than nexine.

5. *Hygrochilus parishii* (Rchb.f.) Pfitzer, Nat. Pflanzenfam. 1: 112. 1897.(Figure 4 A-C)

Vanda parishii Rchb. f., Xenia Orchid. 2: 138. 1868.

Myanmar name : Taung karamet

Common name : The Moist Lip Palenopsis

Flowering period : From June to July

Pollinial morphology

Pollinarium 25.2 – 32.4 × 12.6 – 16.2 mm in length and breadth; pollinia number 4; pollinial sac 1 0.2 – 13.0 × 6.3 – 8.1 mm in length and breadth, orbicular in shape, fulvous, attachment of pollinium ventral; caudicle not prominent; stipe single, 18.9 – 24.3 × 6.0 – 7.8 mm in length and breadth, Y like in shape, white; viscidium 8.0 – 10.2 × 7.5 – 8.5 mm in length and breadth, quadrangular in shape, white; pollen tetrad rhomboidal in shape, 17.5 – 20.0 × 25 – 39 μm in length and breadth; individual grain 6 – 9 × 6.5 – 10.0 μm in length and breadth; exine 2.5 – 3.0 μm thick, sexine thicker than nexine.

6. *Papilionanthe teres* (Roxb.) Schltr., Orchis 9:78.1915. (Figure 4 D-F)

Dendrobium teres Roxb., Fl. Ind. (ed.1832) 3: 485. 1832.

Myanmar name : Yo set gyi

Common name : The Terete Leaf Papilionanthe

Flowering period : From March to May

Pollinial morphology

Pollinarium 36 – 42 × 30.0 – 34.8 mm in length and breadth; pollinia number 2; pollinial sac 15 – 20 × 14.5 – 17.4 mm in length and breadth,

orbicular in shape, fulvous, attachment of pollinium ventral; caudicle not prominent; stipe single, 19 – 21 × 7.5 – 8.4 mm in length and breadth, cylindrical in shape, white; viscidium 19.5 – 22.0 × 28.0 – 32.5 mm in length and breadth, obtriangular in shape, white; pollen tetrad rhomboidal in shape, 27.5 – 35.0 × 35 – 45 μm in length and breadth; individual grain 9.0 – 12.5 × 10 – 15 μm in length and breadth; exine 1.0 – 1.5 μm thick, sexine thicker than nexine.

7. *Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik., Fl. Ind. Enum:Monocot. 163. 1989. (Figure 5 A-C)

Phaiusblumei var. *pulchra* King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 109. 1898.

Myanmar name : Zayti thitkhwa

Common name : Unknown

Flowering period : From February to April.

Pollinial morphology

Pollinarium 16.0 – 18.4 × 24.0 – 27.6 mm in length and breadth; pollinia number 8; pollinial sac 5.6 – 6.6 × 10.0 – 12.5 mm in length and breadth, elliptic in shape, fulvous, attachment of pollinium apical; caudicle not prominent; stipe absent; viscidium 7.5 – 8.8 × 7.0 – 8.5 mm in length and breadth, irregular in shape, fulvous; pollen tetrad rhomboidal in shape, 27.5 – 37.5 × 32.5 – 51.5 μm in length and breadth; individual grain 6.5 – 15.0 × 10.0 – 14.5 μm in length and breadth; exine 3 – 5μm thick, sexine as thick as nexine.

8. *Robiquetia pachyphylla* (Rchb.f.) Garay, Bot. Mus. Leafl. 23 (4): 197, 1972.(Figure 5 D-F)

Aerides pachyphylum Rchb.f., Gard. Chron. 14:231. 1880.

Myanmar name : Unknown
Common name : The broad leafed Robiquetia
Flowering period : From April to June

Pollinial morphology

Pollinarium 13.2 – 13.8 × 12.0 – 12.6 mm in length and breadth; pollinia number 2; pollinial sac 5.4 – 5.9 × 5.0 – 5.4 mm in length and breadth, orbicular in shape, cream, attachment of pollinium ventral; caudicle not prominent; stipe single, 8.5 – 9.5 × 2.0 – 2.1 mm in length and breadth, strap in shape, white; viscidium 6.6 – 6.9 × 4.0 – 4.2 mm in length and breadth, rectangular in shape, white; pollen tetrad rhomboidal in shape, 25 – 27 × 32.0 – 37.5μm in length and breadth; individual grain 7.5 – 11.0 × 10.0 – 12.5μm in length and breadth; exine 1.5– 2.0μm thick, sexine thicker than nexine.

9. *Thunia alba* (Lindl.) Rchb.f., Bot. Zeitung (Berlin) 10:764.1852.

(Figure 6 A-C)

Phaius albus Lindl., Pl. Asiat. Rar. 2:, Pl. 198. 1831.

Myanmar name : Kyauk thikhwa phyu
Common name : Unknown
Flowering period : From January to April.

Pollinial morphology

Pollinarium 33.6 – 36.0 × 50.4 – 54.0 mm in length and breadth; pollinia number 8; pollinial sac 29.4 – 31.5 × 13.0 – 13.7 mm in length and breadth, obovate in shape, ocherous, attachment of pollinium apical; caudicle not prominent; stipe absent; viscidium 7.4 – 7.9 × 12.8 – 13.5 mm in length and breadth, irregular in shape, white; pollen tetrad rhomboidal in shape, 27.5 – 35.0 × 35.0 –42.5 μm in length and breadth; individual grain 12.5 – 20.0 × 12.5 – 21.0 μm in length and breadth; exine 1.5 – 2.0μm thick, sexine thicker than nexine.

10. *Vanda bensoni* Bateman, Bot., Mag. 92:, Pl. 5611. 1866.

(Figure 6 D-F)

Myanmar name : Moe thuzar
Common name : Unknown
Flowering period : From March to June

Pollinial morphology

Pollinarium 30 – 36 × 18 – 24 mm in length and breadth; pollinia number 2; pollinial sac 11.4 – 12.5 × 9 – 12 mm in length and breadth, orbicular in shape, tawny, attachment of pollinium ventral; caudicle not prominent; stipe single, 16 – 22 × 11.0 – 12.6 mm in length and breadth, triangular in shape, white; viscidium 13.5 – 18.0 × 17 – 23 mm in length and breadth, quadrangular in shape, white; pollen tetrad rhomboidal in shape, 20 – 33 × 20– 43 μm in length and breadth; individual grain 5.0 – 14.5 × 5 – 17 μm in length and breadth; exine 2.5– 5.0 μm thick, sexine thicker than nexine.

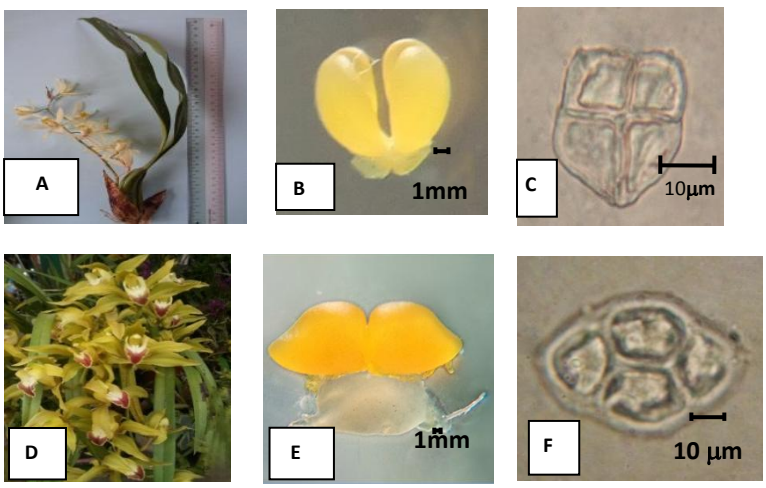

Figure 2. A. Inflorescences of *Coelogyne lacteal* Rchb. f.
B. Pollinarium of *C. lacteal* Rchb. f.
C. Tetragonal tetrad pollen of *C. lacteal* Rchb. f.
D. Inflorescences of *Cymbidium lowianum* (Rchb. f.) Rchb. f.
E. Pollinarium of *C. lowianum* (Rchb. f.) Rchb. f.
F. Rhomboidal tetrad pollen of *C. lowianum* (Rchb. f.) Rchb. f.

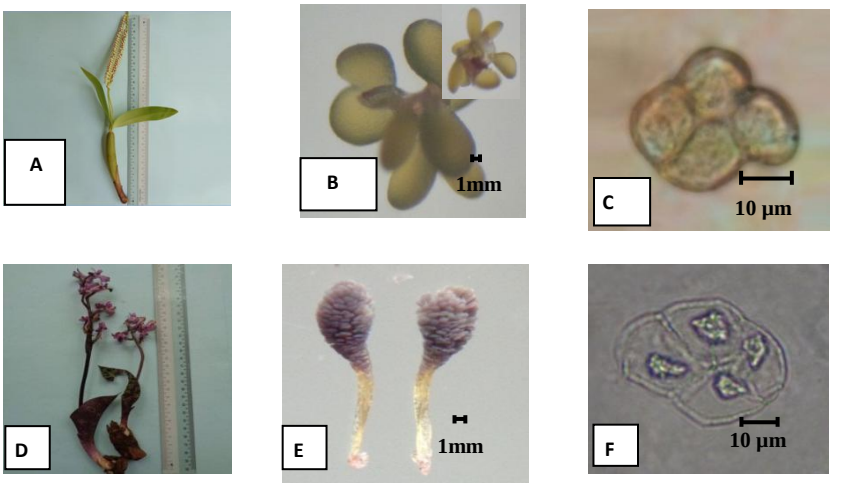

Figure 3. A. Inflorescences of *Eria stricta* Lindl.
B. Pollinarium of *E. stricta* Lindl.
C. Rhomboidal tetrad pollen of *E. stricta* Lindl.
D. Inflorescences of *Hemipilia cordifolia* Lindl.
E. Pollinarium of *H. cordifolia* Lindl.
F. Rhomboidal tetrad pollen of *H. cordifolia* Lindl.

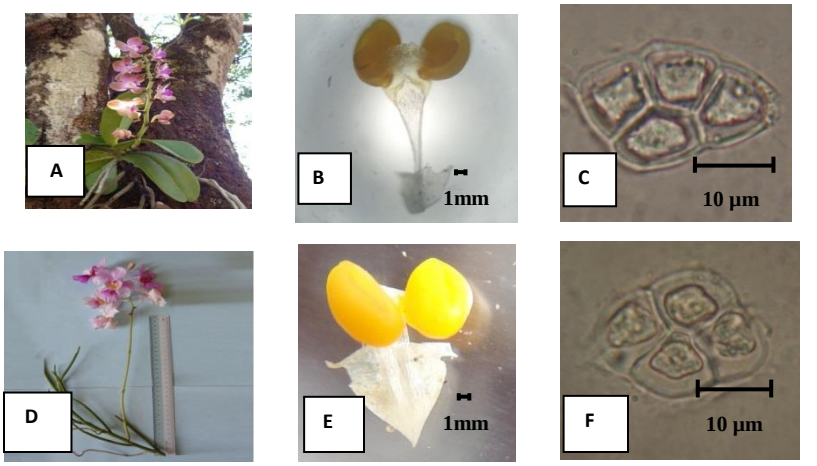

Figure 4. A. Inflorescences of *Hygrochilus parishii* (Rchb. f.) Pfitzer
B. Pollinarium of *H. parishii* (Rchb. f.) Pfitzer
C. Rhomboidal tetrad pollen of *H. parishii* (Rchb. f.) Pfitzer
D. Inflorescences of *Papilionanthe teres* (Roxb.) Schltr.
E. Pollinarium of *P. teres* (Roxb.) Schltr.
F. Rhomboidal tetrad pollen of *P. teres* (Roxb.) Schltr.

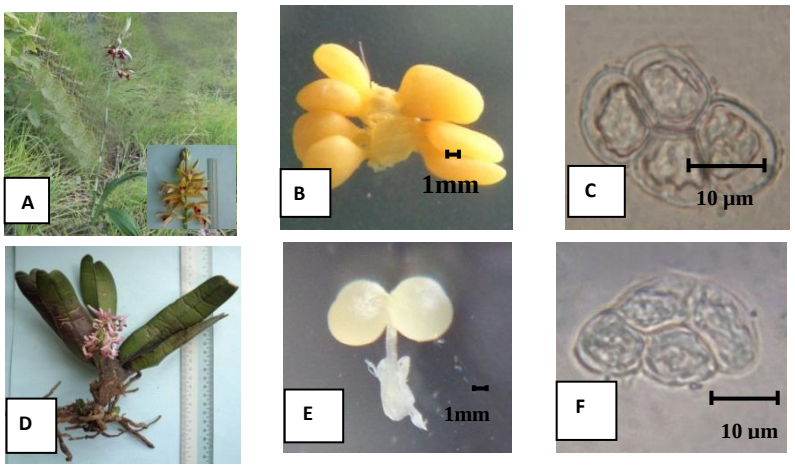

Figure 5. A. Inflorescences of *Phaius tankervilleae* var. *pulchra* (King &Pantl.) Karthik.
B. Pollinarium of *P. tankervilleae* var. *pulchra* (King & Pantl.) Karthik.
C. Rhomboidal tetrad pollen of *P. tankervilleae* var. *pulchra* (King & Pantl.) Karthik.
D. Inflorescences of *Robiquetia pachyphylla* (Rchb. f.) Garay
E. Pollinarium of *R. pachyphylla* (Rchb. f.) Garay
F. Rhomboidal tetrad pollen of *R. pachyphylla* (Rchb. f.) Garay

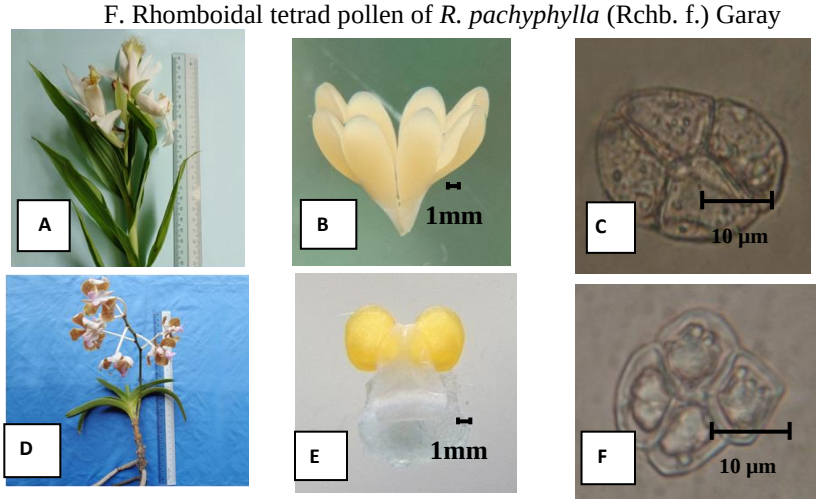

Figure 6. A. Inflorescences of *Thunia alba* (Lindl.) Rchb. f.
B. Pollinarium of *T. alba* (Lindl.) Rchb. f.
C. Rhomboidal tetrad pollen of *T. alba* (Lindl.) Rchb. f.
D. Inflorescences of *Vanda bensoni* Bateman
E. Pollinarium of *V. bensoni* Bateman
F. Rhomboidal tetrad pollen of *V. bensoni* Bateman

Discussion and Conclusion

Pollinial morphology of 10 species belonging to 10 genera of Orchidaceae were studied. The collected species of Orchidaceae were identified and classified according to the number, size, shape, colour, attachment of pollinia, caudicles, stipe and viscidium.

The number of pollinia occurred in Orchidaceae were 2, 4 and 8. Among them, the two pollinia were found in *Cymbidium lowianum* (Rchb. f.) Rchb. f., *Hemipilia cordifolia* Lindl., *Papilionanthe teres* (Roxb.) Schltr., *Robiquetia pachyphylla* (Rchb. f.) Garay and *Vanda bensoni* Bateman; four pollinia were found in *Coelogyne lactea* Rchb. f. and *Hygrochilus parishii* (Rchb. f.) Pfitzer; eight pollina were observed in *Eria stricta* Lindl., *Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik. and *Thunia alba* (Lindl.) Rchb. f.

linarium Morphology of 10 Species of Orchidaceae

fic name	Pollinarium		Pollinial sac			Caudicle		Stipe			
	L & B (mm)	Num-ber	L & B (mm)	Shape	Colour	Attach-ment	L & B (mm)	Num-ber	L & B (mm)	Shape	Colour	L & B
lactea	13.8–15.6 × 15.6–16.8	4	10.5 – 11.0 × 6.5 – 7.5	gib	sa	ap	n-pro	ab	Ab	ab	ab	4.6 – 9.5 –
lowianum chb. f.	19.2 – 24.0 × 30 – 36	2	6.4 – 8.0 × 15 – 18	bel	fu	ve	n-pro	si	2.4 – 4.8 × 3.6 – 4.8	rec	wh	10.8 – 26.3 –
Lindl.	4.8 – 5.4 × 4.8 – 5.4	8	3.0 – 3.3 × 2.0 – 2.3	obo	be	ap	n-pro	ab	Ab	ab	ab	1.0 – 2.4 –
ordifolia	28.8 – 29.4 × 16.0 – 16.3	2	14.0 – 14.2× 8.0 – 8.3	obo	p	ap	13.0 – 13.2 × 1.8 – 2.0	ab	Ab	ab	ab	1.8 – 2.0 –
parishii Fitzer.	25.2–32.4 × 12.6 – 16.2	4	10.2 – 13.0× 6.3 – 8.1	orb	fu	ve	n-pro	si	18.9 – 24.3× 6.0 – 7.8	Y	wh	8.0 – 1 7.5 –
ne teres ilt.	36 – 42 × 30.0 – 34.8	2	15 – 20 × 14.5 – 17.4	orb	fu	ve	n-pro	si	19 – 21× 7.5 – 8.4	cy	wh	19.5 – 28.0 –
ervilleae r (Kng & hik.	16.0 – 18.4× 24.0 – 27.6	8	5.6 – 6.6× 10.0 – 12.5	el	fu	ap	n-pro	ab	Ab	ab	ab	7.5 – 7.0 –
pachyphylla iarav.	13.2 – 13.8× 12.0 – 12.6	2	5.4 – 5.9× 5.0–5.4	orb	oc	ve	n-pro	si	8.5 – 9.5× 2.0 – 2.1	st	wh	6.6 – 4.0 –
r (Lindl.)	33.6 – 36.0 × 50.4 – 54.0	8	29.4 – 31.5 × 13.0 – 13.7	obo	oc	ap	n-pro	ab	Ab	ab	ab	7.4 – 12.8 –
oni	30 – 36× 18 – 24	2	11.4 – 12.5× 9 – 12	orb	ta	ve	n-pro	si	16 – 22× 11.0 – 12.6	tr	wh	13.5 – 17 –

h = absent	el = elliptic	obt = obtriangular	sa = saffron	wh = white
p= apical	fu = fulvous	oc = ochreous	si = single	y = yllke
g = beige	gib = gibbous	orb = orbicular	st = strap	mu = mauve
el = bell	ir = iregular	p= purple	ta = tawny	
r = cream	n-pro = not prominent	qu = quadrangular	tr = triangular	
l = cylindrical	obo = obovate	rec = rectangular	ve = ventral	

Table 3. Pollen Morphology of 10 Species of Orchidaceae

No.	Scientific Name	Types of pollen tetrad	Pollen tetrad of length & breadth(μm)	Individual grain of length & breadth(μm)	Exine Thickness (μm)	
1	*Coelogyne lactea* Rchb. f.	tetragonal	17.5–30.0 × 21–35	5–11 × 5–15	2–3	S
2	*Cymbidium lowianum* (Rchb. f.) Rchb. f.	rhomboidal	33–39 × 35–70	10–19 × 10–23	2.5–5.0	S
3	*Eria stricta* Lindl.	rhomboidal	20.0–22.5 × 30–40	6.5–15.0 ×10–15	1.5–2.0	S
4	*Hemipilia cordifolia* Lindl.	rhomboidal	40 – 44 × 55 – 60	17.5 – 22.5 × 16.5 – 17.5	1.5 – 2.0	S
5	*Hygrochilus parishii* (Rchb. f.) Pfitzer	rhomboidal	17.5–20.0 × 25–39	6–9× 6.5–10.0	2.5–3.0	S
6	*Papilionanthe teres* (Roxb.) Schltr.	rhomboidal	27.5–35.0 × 35–45	9.0–12.5 × 10–15	1.0–1.5	S
7	*Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik.	rhomboidal	27.5–37.5 × 32.5–51.5	6.5–15.0 × 10.0–14.5	3–5	S
8	*Robiquetia pachyphylla* (Rchb.f.) Garay	rhomboidal	25 – 27 × 32.0 – 37.5	7.5 – 11.0 × 10.0–12.5	1.5 – 2.0	S
9	*Thunia alba* (Lindl.) Rchb. f.	rhomboidal	27.5–35.0 × 35.0–42.5	12.5–20.0 × 12.5–21.0	1.5–2.0	S
10	*Vanda bensoni* Bateman	rhomboidal	20 – 33× 20 – 43	5.0 – 14.5 × 5 – 17	2.5 – 5.0	S

S/N = sexine and Nexine S = N = sexine as thick as nexine S > N = sexine thicker than nexin

The shape of pollinial sac were orbicular in *Hygrochilus parishii* (Rchb. f.) Pfitzer, *Papilionanthe teres* (Roxb.) Schltr., *Robiquetia pachyphylla* (Rchb. f.) Garay and *Vanda bensoni* Bateman; obovate in *Eria stricta* Lindl., *Hemipilia cordifolia* Lindl. and *Thunia alba* (Lindl.) Rchb. f.; gibbous, bell and elliptic in one species each.

The colour of pollinial sac were fulvous, saffron, beige, purple, cream, ochreous and tawny. The fulvous colour was found in *Cymbidium lowianum* (Rchb. f.) Rchb. f., *Hygrochilus parishii* (Rchb. f.) Pfitzer, *Papilionanthe teres* (Roxb.) Schltr. and *Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik.; saffron, beige, purple, cream, ochreous and tawny were found in one species each. The caudicles attachment was apical or ventral. The apical attachment was found in *Coelogyne lactea* Rchb. f., *Eria stricta* Lindl., *Hemipilia cordifolia* Lindl., *Phaius tankervilleae* var. *pulchra* (King & Pantl.) Karthik. and *Thunia alba* (Lindl.) Rchb. f.; the ventral attachment of pollinia was observed in *Cymbidium lowianum* (Rchb. f.) Rchb. f., *Hygrochilus parishii* (Rchb. f.) Pfitzer, *Papilionanthe teres* (Roxb.) Schltr., *Robiquetia pachyphylla* (Rchb. f.) Garay and *Vanda bensoni* Bateman.

The morphological characters of pollinarium were different from each other.The size of the pollinaria ranges from 4.8 – 5.4 × 4.8 – 5.4 mm to 33.6 – 36.0 × 50.4 – 54.0 mm. The smallest size was found in *Eria stricta* Lindl. and the largest size was observed in *Thunia alba* (Lindl.) Rchb. f.. The

size of pollinial sac was also different from one species to another. The smallest pollinial sac was *Eria stricta* Lindl. (3.0 – 3.3 × 2.0 – 2.3 mm). The largest pollinial sac was observed in *Cymbidium lowianum* (Rchb. f.) Rchb. f.(6.4 – 8.0 × 15 – 18 mm). The caudicle was prominent in *Hemipilia cordifolia* Lindl. and the not prominent in 9 species.

Orchidaceae have diverse sizes of stipes, the length of stipe was differently observed in various sizes ranging from smallest length 8.5 – 9.5 × 2.0 – 2.1 mm to the largest length 16 – 22 × 11.0 – 12.6 mm. The smallest length of stipe was observed in *Robiquetia pachyphylla* (Rchb. f.) Garay and the largest length of stipe was found in *Vanda bensoni* Bateman. The numbers of stipes were single, double or absent. In this paper, single stipe was found in 5 species. The shape of stipe was strap, cylindrical, triangular, Y like, rectangular in one species each. The colour of stipe was only white in all species.

The viscidium was found in all of the 10 species, the smallest viscidium was found in *Hemipilia cordifolia* Lindl. (1.8 – 2.0 ×2.0 – 2.2 mm) and the largest viscidium was observed in *Papilionanthe teres* (Roxb.) Schltr. (19.5 – 22.0 × 28.0 – 32.5 mm).The studied species were diversed in shape of viscidium. The shape of viscidium was found in strap, quadrangular, irregular, obtriangular and rectangular. The strap shape of viscidium was found in 2 species, quadrangular in 3 species, irregular in 3 species, obtriangular and rectangular shape in one species each. The colour of viscidium was saffron, white, beige, mauve and fulvous. The white colour of viscidium was observed in 6 species, saffron, beige, mauve and fulvous was found in one species each.

Kull *et al.* (2009) described that Orchidaceae have all six possible tetrad types: tetrahedral or tetragonal, decussate, square, rhomboidal, T shape and linear. In the present study, pollen tetrads were rhomboidal in 9 species and tetragonal in 1 species. These findings are comprised Hoen (1999) and Kull *et al.* (2009). The smallest size of tetrad pollen was found in *Coelogyne lacteal* Rchb. f. (17.5 – 30.0 × 21 – 35 µm) and the largest size of tetrad pollen

was observed in *Cymbidium lowianum* (Rchb. f.) Rchb. f.(33 – 39 × 35 – 70 µm).

The numbers of pollinia of *Hygrochilus parishii* (Rchb.f.) Pfitzer was 4, number of stipe was single and caudicle was not prominent. The present results were agreed with the finding of Hidayat *et al.* (2006).

In the present research, on the basis of observation on pollinia, it was stated that the pollinia of different genera vary in morphology. These morphological features of pollinia will be supported for classification and identification of some species in Orchidaceae.

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