Pollinial Morphology of Genus *Bulbophyllum* and *Vanda* of Orchidaceae found in Shan State

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Abstract

Pollinial morphology of Orchidaceae was studied from Shan State. The specimens of 8 species belonging to 2 genera were collected. In the present study, two pollinia were found in genus *Vanda* and four pollinia were occurred in genus *Bulbophyllum*. The smallest pollinarium (3.0 – 3.4 × 3.8 – 4.2mm) was found in *Bulbophyllum secundum* Hook. f.and the largest pollinarium (46.2 – 46.6× 21.3 – 21.9 mm) was observed in *Vanda denisoniana* Benson & Rchb. f. Pollinial morphology of 8 species was recorded in their number, shape, size, colour and attachment of caudicle or stipe and viscidium to the pollinia. The pollinial morphology provides the knowledge for identification and future systematic research work of family Orchidaceae.

Keywords: Pollinia, caudicle, viscidium, *Bulbophyllum, Vanda*

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 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 and 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 and 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 was selected and studied.

The present study aimed to investigate the morphological differences in pollinia of Orchidaceae, to knowledge regarding 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 Northern and Southern Shan State from the palynological point of view.

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Materials and Methods

The Orchidaceous plants were collected from Shan State. All the collected species were recorded by digital images. Precise locations of the specimen collections were made by using Global Positioning System (GPS) Map Navigator.

Identification of specimens was carried out by referring to the key and description stated by Hooker (1894), Schweinurth (1960), Backer and Brick (1968), Holttum (1964), Dassanayake (1981) and Seidenfaden (1992). Myanmar names of the collected species were referred to Hundley and Chit Ko Ko (1961), and Kress *et al*. (2003). For pollinarium preparation, the methods described by Chase (1987) as cited in Hidayat *et al.* (2006) were used with several modifications.

Results

List of the collected plants

Pollinial morphology of 8 species belonging to 2 genera of Orchidaceae was studied. The lists of collected species are arranged by alphabetically as shown in Table 1.

Table 1. List of the collected species

Family	No.	Scientific Name	Myanmar Name
Orchidaceae	1	*Bulbophyllum affine* Lindl.	Thazinkye
	2	*B. comosum* Collett & Hemsl.	Shan thazin
	3	*B. dixonii* Rolfe	Unknown
	4	*B. secundum* Hook. f.	Thazin net
	5	*Vanda coerulea* Griff. ex Lindl.	Moe Lon hmaing
	6	*V. coerulescens* Griff.	Moe lone hmine ah pyar lay
	7	*V. denisoniana* Benson & Rchb.f.	Tha yet the
	8	*V. testacea* (Lindl.) Rchb. f.	Waso pan

1. *Bulbophyllum affine* Lindl., Gen. Sp. Orchid. Pl. 48. 1830. (Figure 1 A)

Myanmar name : Thazinkye

Common name : Unknown

Flowering period : From March to April

Pollinial morphology (Figure 1 B)

Pollinarium 17 – 18 × 14.4 – 15.6 mm in length and breadth; pollinia number 4; pollinial sac 12 – 14 × 7.8 – 8.5 mm in length and breadth, ovate oblong in shape, fulvous, caudicle absent; stipe absent; viscidium absent.

2. *Bulbophyllum comosum* Collett & Hemsl., J. L. Soc., Bot. 28: 130, 1890. (Figure 1 C)

Myanmar name : Shan thazin

Common name : Unknown

Flowering period : From January to February

Pollinial morphology (Figure 1 D)

Pollinarium 3.0 – 3.6 × 3.4 – 4.0 mm in length and breadth; pollinia number 4; pollinial sac 2.5 – 3.0 × 1.7 – 2.0 mm in length and breadth, obovate in shape, tawny; caudicle absent; stipe absent; viscidium absent.

3. *Bulbophyllum dixonii* Rolfe, Bull. Misc. Inform. Kew 412. 1908. (Figure 1 E)

Myanmar name : Unknown

Common name : Dixon's Bulbophyllum

Flowering period : From June to September

Pollinial morphology (Figure 1 F)

Pollinarium 18 – 20 × 14 – 16 mm in length and breadth; pollinia number 4; pollinial sac 18 – 20 × 4.0 – 4.5 mm in length and breadth, oblong in shape, buff; caudicle absent; stipe absent; viscidium absent.

4. *Bulbophyllum secundum* Hook. f., Fl. Brit. India 5:764. 1890. (Figure 1 G)

Myanmar name : Thazin net

Common name : Unknown

Flowering period : From January to April

Pollinial morphology (Figure 1 H)

Pollinarium 3.0 – 3.4 × 3.8 – 4.2 mm in length and breadth; pollinia number 4; pollinial sac 3.0 – 3.4 × 1.5 – 1.7 mm in length and breadth, gibbous in shape, peach; caudicle absent; stipe absent; viscidium absent.

5. *Vanda coerulea* Griff. ex Lindl., Edward's Bot. Reg. 33:, Sub. Pl. 30. 1847. (Figure 2 A)

Myanmar name : Moe Lon hmaing

Common name : Unknown

Flowering period : From July to December

Pollinial morphology (Figure 2 B)

Pollinarium 24 – 36 × 21.6 – 24.0 mm in length and breadth; pollinia number 2; pollinial sac 11.5 – 17.0 × 10.8 – 12.0 mm in length and breadth, ovate in shape, tawny, attachment of pollinium ventral; caudicle not prominent; stipe single, 21 – 24 × 10.8 – 12.0 mm in length and breadth, triangular in shape, white; viscidium 12 – 18 × 20 – 23 mm in length and breadth, quadrangular in shape, white.

6. *Vanda coerulescens* Griff., Not. Pl. Asiat. 3: 352. Pl. 331. 1851. (Figure 2 C)

Myanmar name : Moe lone hmine ah pyar lay

Common name : Unknown

Flowering period : From March to April

Pollinial morphology (Figure 2 D)

Pollinarium 18 – 20 × 13.2 – 13.8 mm in length and breadth; pollinia number 2; pollinial sac 9 – 10 × 6.6 –7.8 mm in length and breadth, elliptic in shape, fawn, attachment of pollinium ventral; caudicle not prominent; stipe single, 8.5 – 9.5 × 6 – 7 mm in length and breadth, triangular in shape, white; viscidium 6.5 – 7.0 × 7.2 – 8.4 mm in length and breadth, quadrangular in shape, white.

7. *Vanda denisoniana* Benson & Rchb. f., Gard. Chron. 528, 1869.(Figure 2 E)

Myanmar name : Tha yet hte

Common name : Unknown

Flowering period : From April to June

Pollinial morphology (Figure 2 F)

Pollinarium 46.2 – 46.6 × 21.3 – 21.9 mm in length and breadth; pollinia number 2; pollinial sac 11.2 – 11.5 × 10.7 – 11.0 mm in length and breadth, orbicular in shape, fulvous, attachment of pollinium ventral; caudicle not prominent; stipe single, 17.4 – 18.0 × 11.0 – 11.3 mm in length and breadth, triangular in shape, white; viscidium 18.6 – 19.2 × 24.0 – 24.6 mm in length and breadth, quadrangular in shape, white; pollen tetrad rhomboidal in shape, 20 – 26 × 23.5 – 30.0 μm in length and breadth; individual grain 8.5 – 11.5 × 6.5 – 10.0 μm in length and breadth; exine 2.5 – 3.0 μm thick, sexine thicker than nexine.

8. *Vanda testacea* (Lindl.) Rchb. f., Gard. Chron., n.s. 8: 166, 1877. (Figure 2 G)

Aerides testaceum Lindl., Gen. Sp. Orchid. Pl. 238. 1830.

Myanmar name : Waso pan

Common name : Unknown

Flowering period : From February to April

Pollinial morphology (Figure 2 H)

Pollinarium 9.9 – 11.8 × 10.2 – 12.0 mm in length and breadth; pollinia number 2; pollinial sac 6.6 – 7.9 × 5 – 6 mm in length and breadth, elliptic in shape, ochreous, attachment of pollinium ventral; caudicle not prominent; stipe single, 7.2 – 8.0 × 3.3 – 4.0 mm in length and breadth, cylindrical in shape, white; viscidium 2.2 – 2.6 × 4.8 – 5.7 mm in length and breadth, irregular in shape, white.

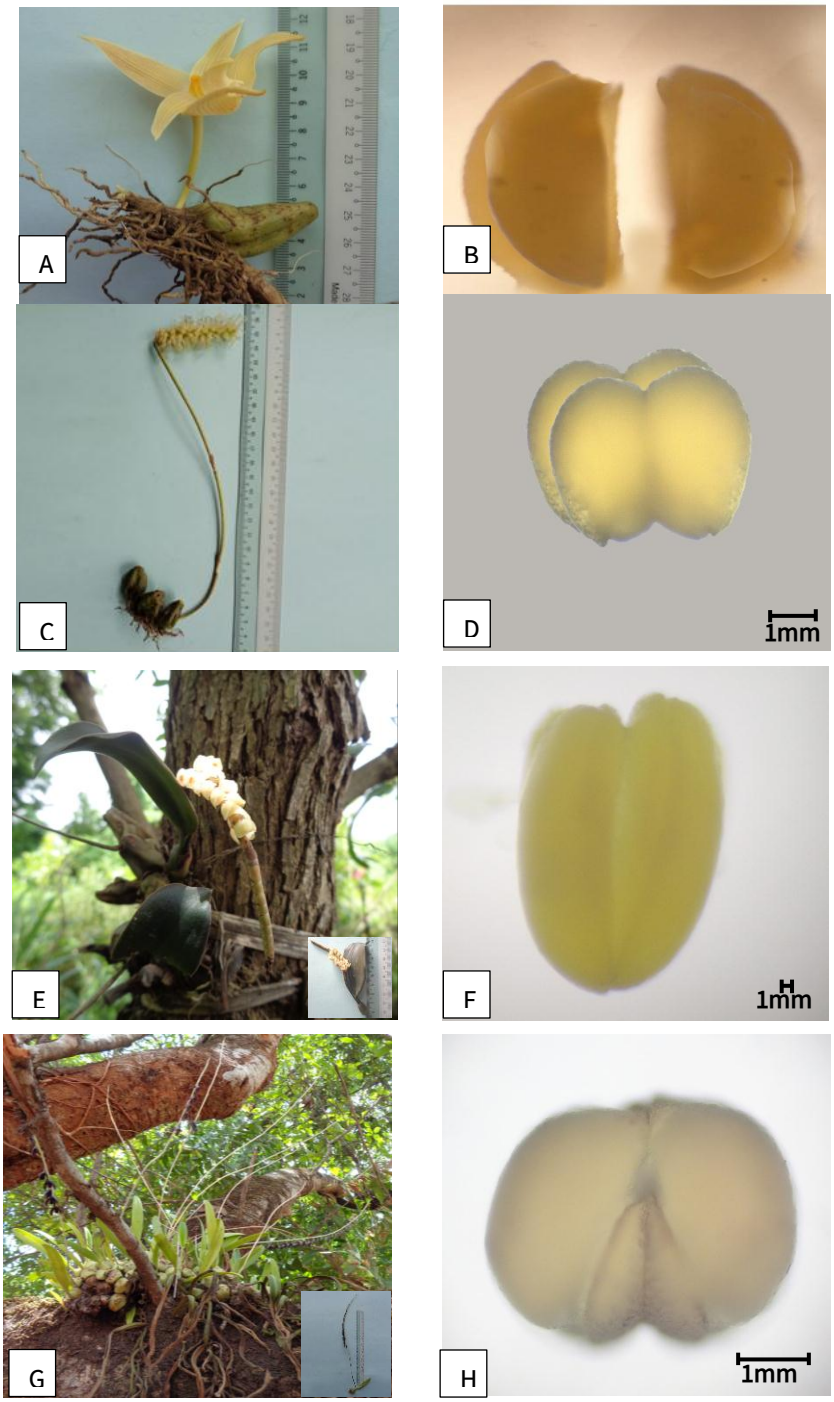

Figure 1. A. Inflorescences of *Bulbophyllum affine* Lindl.
B. Pollinarium of *B. affine* Lindl.
C. Inflorescences of *B. comosum* Collett & Hemsl.
D. Pollinarium of *B. comosum* Collett & Hemsl.
E. Inflorescences of *B. dixonii* Rolfe
F. Pollinarium of *B. dixonii* Rolfe
G. Inflorescences of *B. secundum* Hook. f.
H. Pollinarium of *B. secundum* Hook. f.

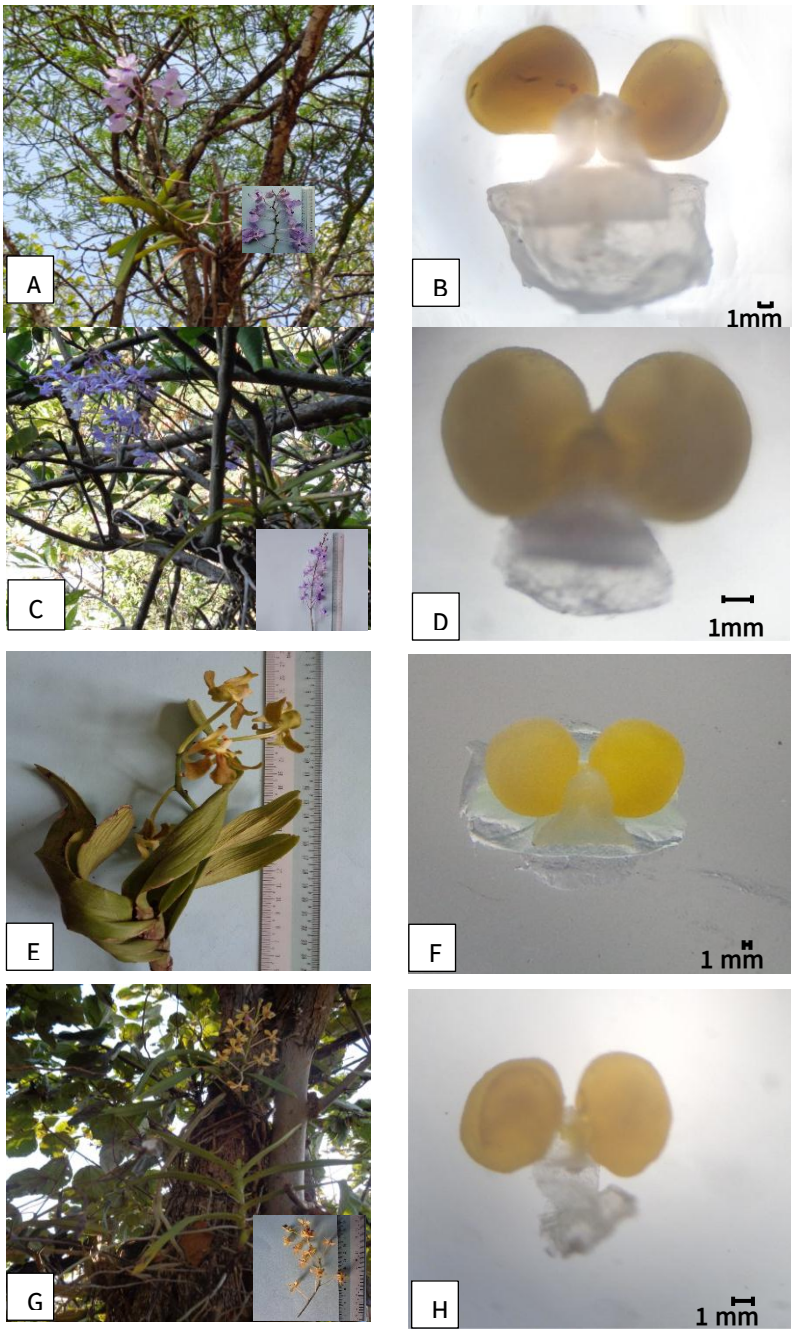

Figure 2. A. Inflorescences of *Vanda coerulea* Griff. ex Lindl.
B. Pollinarium of *V.coerulea* Griff. ex Lindl.
C. Inflorescences of *V. coerulescens* Griff.
D. Pollinarium of *V. coerulescens* Griff.
E. Inflorescences of *V. denisoniana* Benson & Rchb.f.
F. Pollinarium of *V. denisoniana* Benson & Rchb.f.
G. Inflorescences of *V. testacea* (Lindl.) Rchb. f.
H. Pollinarium of *V. testacea* (Lindl.) Rchb. f.

Discussion and Conclusion

Pollinial morphology of 8 species belong to 2 genera of Orchidaceae were studied in this research. The collected species of Orchidaceae were classified and identified according to the number, size, shape, colour, attachment of pollinia, caudicles, stipe and viscidium.

In the present study, the number of pollinia occurred in Orchidaceae were 2 and 4. Among them, the two pollinia were found in four species: *Vanda coerulea* Griff. ex Lindl., *V. coerulescens* Griff., *V. denisoniana* Benson & Rchb.f. and *V. testacea* (Lindl.) Rchb. f. ; four pollinia were found in four species: *Bulbophyllum affine* Lindl., *B. comosum* Collett & Hemsl., *B. dixonii* Rolfe and *B. secundum* Hook. f.

The shape of pollinial sac was elliptic in 2 species: *V. coerulescens* Griff. and *V. testacea* (Lindl.) Rchb. f.; ovate–oblong, obovate, oblong, gibbous, ovate and orbicular were found in one species each.

The colour of pollinial sac were fulvous, tawny,buff, peach, fawn and ochreous. The fulvous colour was found in 2 species: *Bulbophyllum affine* Lindl. and *V. denisoniana* Benson & Rchb.f.; The tawny colour was found in 2 species: *Bulbophyllum comosum* Collett & Hemsl. and *Vanda coerulea* Griff. ex Lindl.; buff, peach, fawn and ochreous were found in one species each.

The morphological characters of pollinarium were different from each other. In this paper, the size of the pollinaria ranges from 3.0 – 3.6 × 3.4 – 4.0 mm to 24– 36 × 21.6 – 24.0 mm. The smallest size was found in *Bulbophyllum comosum* Collett & Hemsl. and the largest size was observed in *Vanda coerulea* Griff. ex Lindl.. Moreover, pollinial sac was also measured, where it was found that *Bulbophyllum secundum* Hook. f. the smallest pollinial sac whose measurement was 3.0 – 3.4 × 1.5 – 1.7 mm. The largest pollinial sac by measurement was observed in *Vanda coerulea* Griff. ex Lindl. (11.5 – 17.0 × 10.8 – 12.0 mm).

Position of attachment of caudicle or stipe to the pollinia is also an important diagnostic feature to evaluate the morphological diversification of pollinia different genera of Orchidaceae (Sinha and Mondal 2011). The caudicles attachment was apical or ventral. It was found that the ventral attachment of pollinia was observed in 4 species: *Vanda coerulea* Griff. ex Lindl., *V. coerulescens* Griff., *V. denisoniana* Benson & Rchb.f. and *V. testacea* (Lindl.) Rchb. f.

Freudenstein and Rasumussen (1999) as cited in Hidayat *et al.* (2006) stated that the caudicle is one of the important states for orchid relationships. The caudicle was not–prominent in 4 species and the caudicle absent in 4 species.

Orchidaceae have diverse size of stipe, the length of stipe was differently observed in various sizes ranging from smallest length 7.2 – 8.0 × 3.3 – 4.0 mm to the largest length of 21 – 24 × 10.8 – 12.0 mm. The smallest length of stipe was observed in *Vanda coerulea* Griff. ex Lindl. and the largest length of stipe was found in *Vanda testacea* (Lindl.) Rchb. f.*.* The stipe was found in 4 species and absent in 4 species. In the present investigation, members of Orchidaceae were diversed number and shape of stipe. The number of stipe was single, double or absent. In this

paper, single stipe was found in 4 species and absence in 4 species. The shape of stipe was triangular in 3 species and cylindrical in 1 species. The colour of stipe was only white in all species.

The viscidium plays a role in attaching the pollinia to an insect allowing the pollinia to be carried to another flower (Hidayat *et al.* 2006). It was found that within the 8 species, the smallest viscidium was found in *Vanda testacea* (Lindl.) Rchb. f. (2.2– 2.6 × 4.8 – 5.7 mm) and the largest viscidium was observed in *V. denisoniana* Benson & Rchb.f. (18.6 – 19.2 × 24.0 – 24.6 mm).

The studied species were diversed in shape of viscidium. The shape of viscidium was found in quadrangular and irregular. The quadrangular shape of viscidium was found in 3 species and irregular shape in one species each. The colour of viscidium was only white in all species.

Orchidaceae are known for their large diversity in pollen morphology. This diversity has been described at different levels: variability in packing of pollen in pollinia, in pollen wall structure, and in pollen surface sculpturing. Hence, the structure and shape of pollinia have been used frequently for the classification orchids (Chaudhary *et al.* 2012).

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 class information and identification of some species in Orchidaceae.

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