

Morphology of Pollinia, Pollinaria and Pollen of Orchids from Loikaw Area, Kayah State

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Abstract

This paper deals with the pollinia and pollinaria morphology of orchids found in Loikaw area, Kayah State. During the study period, about 114 species of orchids had been collected, studied and recorded. In this paper, the pollinial morphology of 12 species representing 12 genera was presented. The number, shape and size of pollinial sac and pollen tetrad, and the attachment of caudicle, stipe and viscidium are important criterion for the studies of pollinial morphology. The pollinarium without any accessory organs for attachment is called naked pollinia. The number of pollinia were 2, 4 and 8: 2 pollinia were observed in 7 genera, 4 pollinia in 3 genera and 8 pollinia in 2 genera. The shape of pollinial sac was mostly globoid to oblongoid in studied species. The shape of pollen tread may vary from tetragonal to rhomboidal. The exine sculpture pattern was finely reticulate in most species but coarsely reticulate in *Brachycorythis*. These diverse pollinial characters will contribute the valuable information for plant taxonomy.

Key words: **Pollinia, Orchids, Pollinarium, Viscidium, Pollen tetrad.**

Introduction

Loikaw is the capital of Kayah state in Myanmar. It lies between. 19° 40' 27" N Latitude and 97° 12' 34" E Longitude. The total area of Loikaw is 29.9 sq km. Generally, the elevation of this area is 893m above sea level. Many wild orchids were widely distributed in Kayah state. In Loikaw area, the orchid population is at risk of extinction due to their habitat destruction by local ethnic people who took off wild orchids from the forest of Kayah state and its vicinity, and sold in the market of Loikaw city. Most of the local and visited orchids lovers were collected native orchids from the market for various purposes. Therefore it is essential to record the local wild orchids that naturally distributed in Kayah state.

Members of the family Orchidaceae are unique due to the association of pollen grains that form a sac like definite structure called pollinia. Like pollen, the pollinium is also the key characters for the identification of specific plant species belonging to the family Orchidaceae. The morphological nature of pollinia is specific in each genus of Orchidaceae. The pollinial sac and accessory organs such as stipes, caudicle, and viscidium are combined into a single unit structure called pollinarium. The pollinarium of most Orchidaceae is composed of two or more pollinial sac, caudicle, stipe, viscidium etc. The number of pollinial sac may vary from 2 to 8 but commonly 4 in most species. The number, size and shape of pollinial sacs, and structure of caudicle and viscidium are important features for analysis of phylogenetic study.

In Orchidaceae, the pollen grains are liberated as pollen tetrad into two discrete types. In all cases, the shape of pollen tetrad appeared to be tetragonal, rhomboidal and rectangular. The pollen tetrad types are mostly common among orchid species and thus considered to be unreasonable distinguishing features in orchid.

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Morphological diversification of Orchidaceae had been studied by various researchers in Shan state, neighbour of Kayah state. This research is a report of the pollinaria and pollinia of orchids native to the region of Kayah state and its vicinity. The purpose of this study is to record variable orchids that naturally growing in the study area, to differentiate the morphology of pollinia with respect to specific taxa, to conserve local wild orchids of Kayah state and its vicinity, and to give the valuable information of pollinial morphology in the natural system of plant classification.

Materials and Methods

For the present study, orchids were either purchased from orchid hunters or collected from some nurseries of orchids lovers in Loikaw area. Specimen collections were carried out from December 2017 to October 2018. During the study period 43 genera and 114 species were investigated. Fresh flower were recorded during anthesis and pollinia were collected from freshly opened flowers.

To study pollinial morphology, the pollinia were removed from mature flowers with the help of needle and mounted without treatment on a glass slide. Pollinial sac and pollinarium were studied by using dissecting microscope and observation was made with digital camera Cannon A 3500 IS. Pollinarium measurements were made under light microscope by using ocular micrometer. At least five pollinarium of each species were measured two times observing shape, length and breadth of pollinial sac, stipe, caudicle and viscidium.

To study the pollen tetrads, pollinia were placed on a clean glass slide and crushed with the help of a needle. A few drop of glycerine were used to avoid the desiccation of pollen tetrad and to separate the pollen tetrad and then covered with cover slip and observed under light microscope. Measurement was recorded at 40 x magnifications using 10x eye piece. At least 10 pollen tetrads per species were used to measure length and width of pollen tetrads and individual pollen, and to document the exine sculpture. The pollinaria and pollinia are characterized using the following parameters; number of pollinia per pollinarium, size and shape of the individual pollinia, stipe and pollen tetrads, and structure of caudicles and viscidium. The pollinial description of all species were arranged alphabetically and presented with color plates.

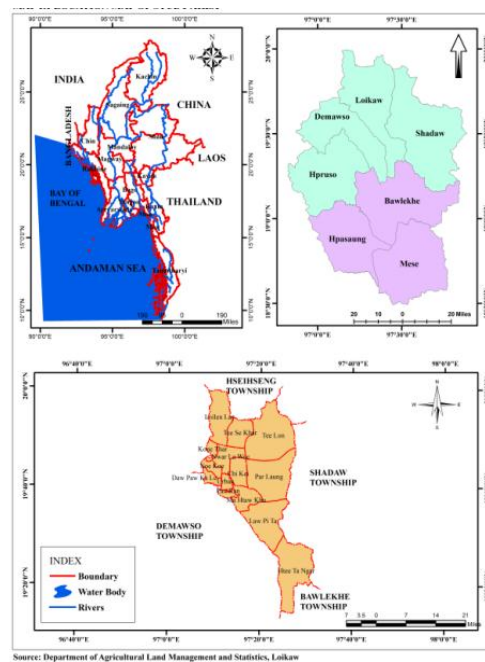


Figure 1. Map of Kayah state and Loikaw township

The collected specimens were identified by referring the literature as Flora of British India (Hooker, 1894), Flora of Java (Backer 1963), Flora of Ceylon (Dassanayake 1981) and Flora of China (Zhengyi *et al.* 1994). The pollinial nomenclature were investigated by using the following references: An illustrated guide to pollen analysis (Moore & Webb 1978), Glossary of pollen and spore terminology (Hoen 1999) and Illustrated Hand book on pollen Terminology (Paldat 2005).



Figure 2. Local wild orchids sold in the markets of Loikaw area

RESULTS

A total of 114 species and 43 genera had been collected and studied from the study area. Each species of *Ascocentrum*, *Acriopsis*, *Armadorum*, *Brachycorythis*, *Calanthe*, *Cirrhopetalum*, *Cymbidium*, *Gastrochilus*, *Geodorum*, *Goodyera*, *Hygrochilus*, *Micropera*, *Ornithochilus*, *Othochilus*, *Paphiopedillum*, *Papilionanthe*, *Pectilis*, *Peristylus*, *Phaius*, *Polystachya*, *Porpax*, *Rhynchostylis*, *Smitinandia*, *Spathoglottis*, *Staurochilus*, *Thrixspermum* and *Thunia*, two species of *Chiloschista*, *Holcoglossum*, *Panisea* and *Sunipia*, three species of *Aerides*, *Cleisostoma*, *Habenaria*, *Luisia* and *Pholidota*, seven species of *Coelogyne*, *Eria* and *Vanda*, nine species of *Bulbophyllum*, and thirteen species of *Dendrobium* were recorded. Out of these, each species of 12 genera were selected to describe the pollinial description.

Pollinia and pollen description of selected species

1. *Acriopsis indica* Wight.

Pollinia 2, attachment of pollinium ventral; pollinial sac ellipsoid, equal, bony, yellow; viscidium oblong; stipe about filiform, white; caudicle not prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

2. *Aerides rosea* Lodd. ex Lindl. & Paxton,

Pollinia 2, attachment of pollinium ventral; pollinial sac globoid, equal, about 800µm in diameter, bony, yellow; viscidium rectangular; stipe, filiform, white; caudicle not prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

3. *Brachycorythis helferi* (Hook.f.) Summerh.

Pollinia 2; attachment of pollinium basal; pollinial sac ovoid, about 1500x750 µm in length and breadth granular farinaceous, sectile, grayish; viscidium oblong in shape, white; stipe absent; caudicle long, thick, yellowish white; pollen tetrad tetragonal; exine sculpture coarsely reticulate.

4. *Calanthe triplicata* (Willem.) Ames.

Pollinia 8; attachment of pollinium basal; pollinial sac clavate, subequal, soft, creamy white; viscidium elliptic, white; stipe absent; caudicle prominent, thick, yellow; pollen tetrad rhomboidal; exine sculpture reticulate.

5. *Coelogyne puchella* Rolfe,

Pollinia 4, attachment of pollinium basal; pollinial sac ovoid, equal, soft, yellow; viscidium triangular; stipe absent, caudicle not prominent; pollen tetrad rectangular; exine sculpture reticulate.

6. *Dendrobium pachyglossum* Parish. & Rchb. f.

Pollinia 4, attachment of pollinium absent; pollinial sac oblongoid, equal, soft, yellow; pollen tetrad rhomboidal; exine sculpture reticulate.

7. *Eria reticosa* Wight.

Pollinia 8, attachment of pollinium basal; pollinial sac ovoid, laterally flattened, subequal, soft, yellow; viscidium elongated; stipe absent; caudicle least prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

8. *Ornithochilus difformis* (Wall. ex Lindl.) Schltr.

Pollinia 2, attachment of pollinium ventral; pollinial sac ovoid, equal, bony, yellow; viscidium oblong; stipe ribbon-like, translucent, white; caudicle least prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

9. *Peristylus goodyeroides* (D. Don) Lindl.

Pollinia 2; attachment of pollinium basal; pollinial sac ovoid, granular farinaceous, sectile, yellow; viscidium oblong in shape, white; stipe absent; caudicle least prominent, filiform, white; pollen tetrad tetragonal; exine sculpture coarsely reticulate.

10. *Sunipia andersonii* (King & Pantl.) P. F. Hunt.

Pollinia 4, attachment of pollinium ventral; pollinial sac globoid, equal, soft, pale yellow; viscidium suborbicular; stipe 2, dilated at the distal end, ribbon-like, white; caudicle least prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

11. *Thrixspermum centipeda* Lour.

Pollinia 2, attachment of pollinium basal; pollinial sac oblongoid, equal, bony, white; viscidium irregular in shape; stipe absent; caudicle not prominent; pollen tetrad rhomboidal; exine sculpture finely reticulate.

12. *Vanda denisoniana* Benson, & Rchb. f.

Pollinia 2, attachment of pollinium ventral; pollinial sac globoid, equal, bony, yellow; viscidium suborbicular; stipe ribbon like, translucent, white; caudicle least prominent; pollen tetrad rhomboidal; exine sculpture reticulate.

Discussion and Conclusion

The present study is a report of morphological study of the pollinaria and pollinia of orchids native to the region of Kayah state and its vicinity. During the study period, 114 species belonging to 43 genera were recorded. Among these orchids, 12 species were selected to conduct pollinial description of each species.

The pollinia showed a great variation in diverse morphology of number, shape and size of pollinial sac and pollen tetrad, and the structure of pollinarium. These characters are valuable keys for the analysis of diversification of pollinia of Orchidaceae. The morphological structure of typical pollinia are shown in Figures.

In this research, the number of pollinia is 2, 4 and 8. The basic number of 4 pollinia was observed in the genera *Coelogyne*, *Dendrobium*, and *Sunipia* but *Calanthe* and *Eria* possess the increased number of 8 pollinia, the decreased number of 2 pollinia found in the rest species.

The package of pollinia may be soft, bony or sectile. Bony pollinia were observed in *Acropsis*, *Aerides* and *Vanda*. The pollinia of *Brachycorythis* and *Peristylus* are sectile which means that pollinia comprising several packets connected by elastoviscin. The sectile pollinaria display more or less equal shaped massulae in most species. The pollinia of the remaining species are soft and granular.

The shape of different pollinial sac exhibited a great variation from oblongoid to ovoid or globoid. In this study, the shape of pollinial sac is commonly globoid, ovoid and oblongoid in most genera, but elliptic in *Acropsis* and clavate in *Calanthe*. The color of pollinial sac is gray in *Brachycorythis*, creamy white in *Calanthe* and *Thrixspermum* and yellow in the rest species.

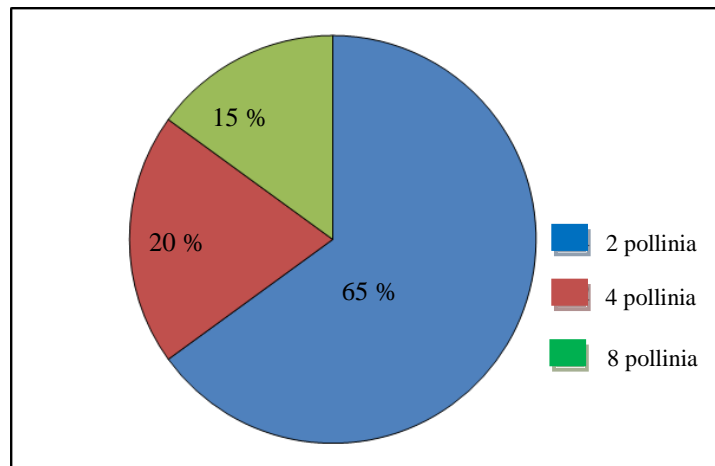


Figure 3: Percentage of pollinia numbers show in selected species

In this study, both basal and ventral attachment were found. The basal attachment of stalk was observed in genera *Brachycorythis*, *Calanthe*, *Coelogyne*, *Eria* and *Peristylus* where as the pollinia of others species have been attached by the ventral position. The pollinia of *Dendrobium* are devoid of caudicle and stipe. So they are called naked pollinia. This character is considered to be a primitive character of pollinia.

The presence or absence and conspicuous or inconspicuous of caudicles are distinct characters among Orchids. The most conspicuous caudicles was observed in genera *Brachycorythis*. The least conspicuous caudicle was found in rest species.

In this research, the stipe was ribbon-like and translucent in *Sunipia* and *Vanda*. The stipe were either filiform or thick in the rest species. The studied species have diverse shape of viscidium. The viscidium is found to have different shape_ irregular in *Thrixspermum*, oblong in *Brachycorythis*, *Ornithochilus* and *Peristylus*, triangular in *Coelogyne*, elliptic in *Calanthe*, elongated in *Eria*, rectangular in *Aerides* and suborbicular in rest species.

The pollen grains of Orchids were liberated as tetrad into two discrete types: tetragonal type of tetrad and tetrahedral type of tetrad. In this research, tetragonal pollen tetrad was found in *Brachycorythis* and *Peristylus*, rectangular in *Coelogyne*, and rhomboidal in the rest species. The arrangement of microspores in the isobilateral or tetragonal tetrad was considered to be primitive character of Orchidaceae (Chesselet & Linder ; 1993).

Table 1. Comparison of pollinial morphology of studied species

No.	Scientific name	No. of pollinia	Package of pollinia	Shape of pollinia	Attachment of pollinium	Caudicle length	Shape of stipe	Shape of viscidium	shape of pollen tetrad	Exine sculpture
1.	<i>Acriopsis indica</i> Wight.	2	bony	ellipsoid	ventral	not prominent	filiform	oblong	rhomboidal	reticulate
2.	<i>Aerides rosea</i> Lodd. ex Lindl. & Paxton,	2	bony	globoid	ventral	not prominent	filiform	rectangular	rhomboidal	reticulate
3.	<i>Brachycorythis helferi</i> (Rchb.f.) Summerh.	2	sectile	ovoid	basal	prominent	-	oblong	rhomboidal	coarsely reticulate
4.	<i>Calanthe triplicata</i> (Willem.) Ames.	8	soft	clavate	basal	not prominent	-	elliptic	rhomboidal	reticulate
5.	<i>Coelogyne puchella</i> Rolfe,	4	soft	ovoid	basal	not prominent	-	triangular	rectangular	reticulate
6.	<i>Dendrobium pachyglossum</i> Parish. & Rchb.f.	4	soft	oblongoid	naked		-	-	rhomboidal	reticulate
7.	<i>Eria reticosa</i> Wight.	8	soft	ovoid	basal	not prominent	-	elongated	rhomboidal	reticulate
8.	<i>Ornithochilus difformis</i> (Wall ex Lindl) Schltr.	2	bony	ovoid	ventral	not prominent	ribbon - like	oblong	rhomboidal	reticulate
9.	<i>Peristylus goodyeroides</i> (D.Don) Lindl.	2	sectile	ovoid	basal	prominent	-	oblong	tetragonal	coarsely reticulate
10.	<i>Sunipia andersonii</i> (King & Pantl) P.E. Hunt.	4	soft	globoid	ventral	not prominent	ribbon - like	suborbicular	rhomboidal	reticulate
11.	<i>Thrixpernum centipede</i> Lour.	2	soft	oblongoid	apical	not prominent	-	irregular	rhomboidal	reticulate
12.	<i>Vanda denisoniana</i> Benson. & Rchb.f.	2	bony	globoid	ventral	not prominent	ribbon - like	suborbicular	rhomboidal	reticulate

Pollen cohesion into tetrad may be achieved by a continuous exine layer (Chesselet & Linder; 1993). The result of this study indicate that most investigated species have finely reticulate exine sculpture but coarsely reticulate in *Brachycorythis* and *Peristylus*. The position of reticulate exine in pollen tetrad of Orchidaceae has been established as a primitive characters (Chesselet & Linder ; 1993).

On the basic of investigation on pollinia and pollinarium, it can be concluded that the pollinia of different genera show variable pollinial morphology. Therefore, importance of informations relating to the specialized structures of pollinia and pollen in orchids is being increasingly realized in plant identification. Finally, it is hoped that these morphological features of pollinia are accelarting for future studies of phylogenetic interrelationship among different species of Orchidaceae.

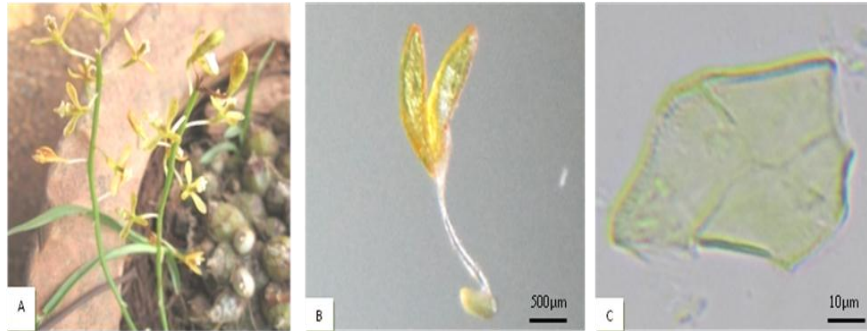


Fig. 4.. *Acriopsis indica* Wight. A. Inflorescence B. Pollinarium C. Pollen tetrad

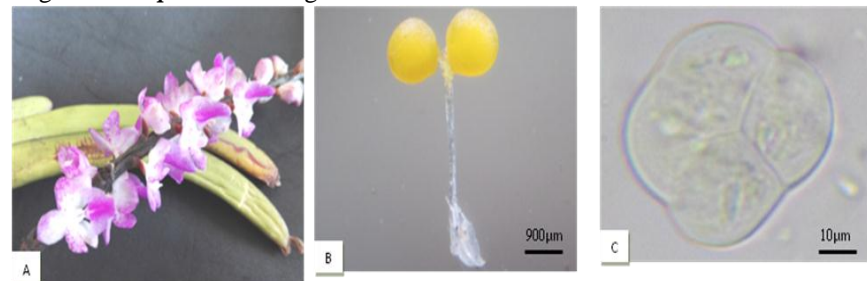


Fig. 5. *Ariedes rosea* Lodd. A. Inflorescence B. Pollinarium C. Pollen tetrad

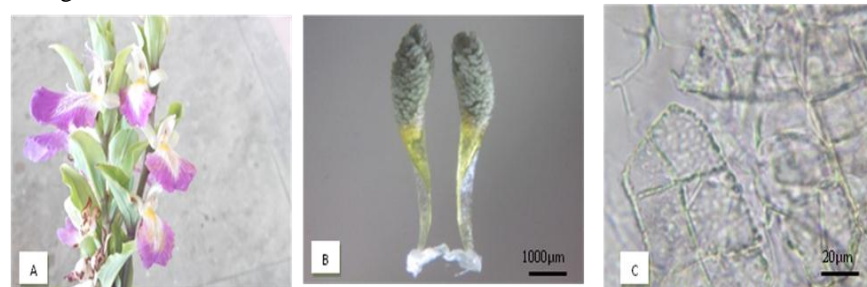


Fig. 6. *Brachycorythis helferi* (Hook.f.) Summerh. A. Inflorescence B. Pollinarium C. Pollen tetrad

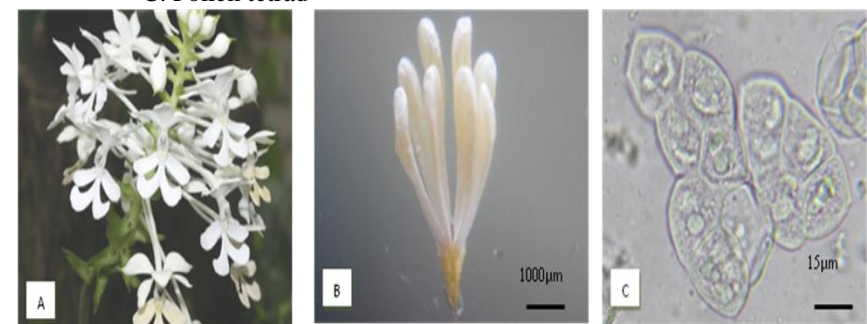


Fig. 7. *Calanthe triplicata* (Willem.) Ames, A. Inflorescence B. Pollinarium C. Pollen tetrad

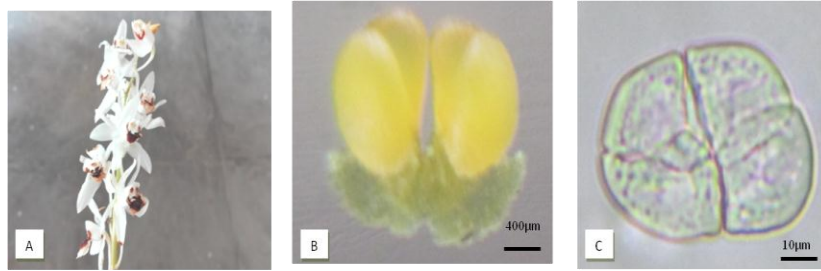


Fig.8. *Coelogyne puchella* Rolfe, A. Inflorescence B. Pollinarium
C. Pollen tetrad

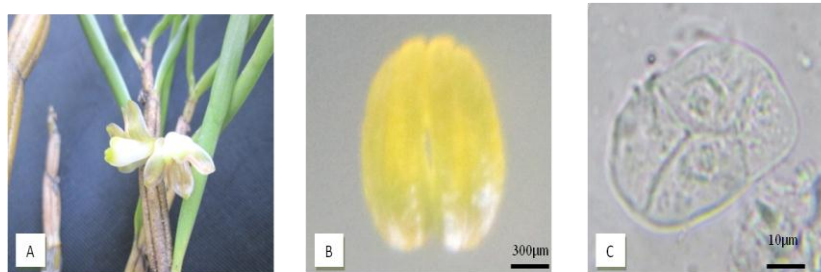


Fig. 9. *Dendrobium pachyglossum* Parish & Rchb. f. A. Inflorescence
B. Pollinarium C. Pollen tetrad

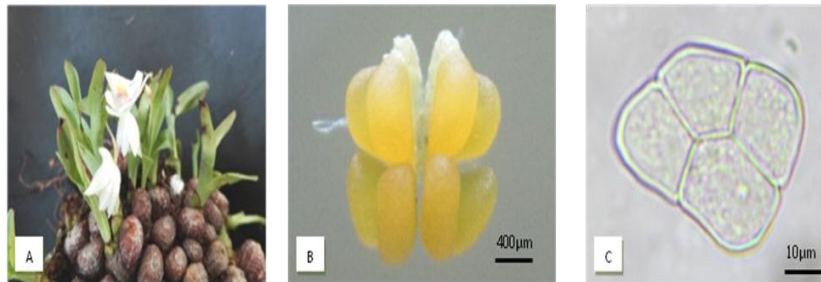


Fig. 10. *Eria reticosa* Wight. A. Inflorescence B. Pollinarium C. Pollen tetrad

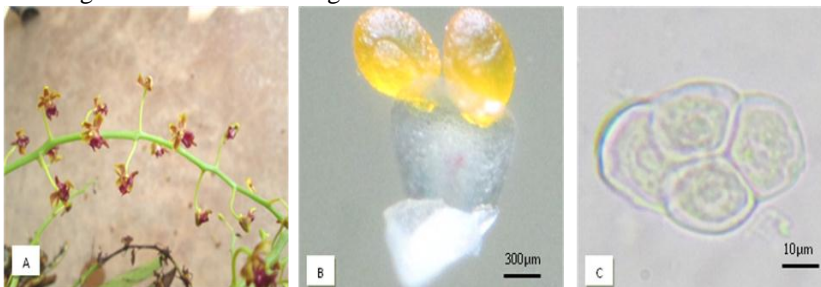


Fig. 11. *Ornithochilus difformis* (Wall. ex Lindl.) Schltr. A. Inflorescence
B. Pollinarium C. Pollen tetrad

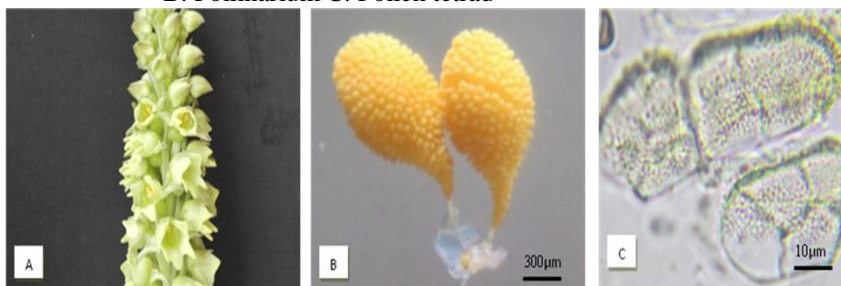


Fig.12. *Peristylus goodyeroides* (D. Don) Lindl., A. Inflorescence
B. Pollinarium C. Pollen tetrad

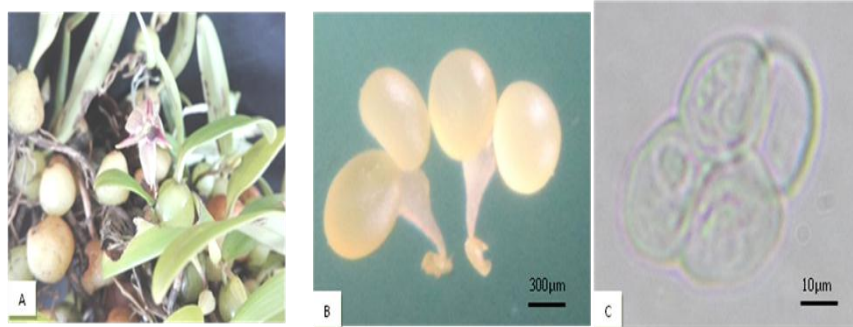


Fig. 13. *Sunipia andersonii* (King & Pantl.) Hunt. A. Inflorescence
B. Pollinarium C. Pollen tetrad

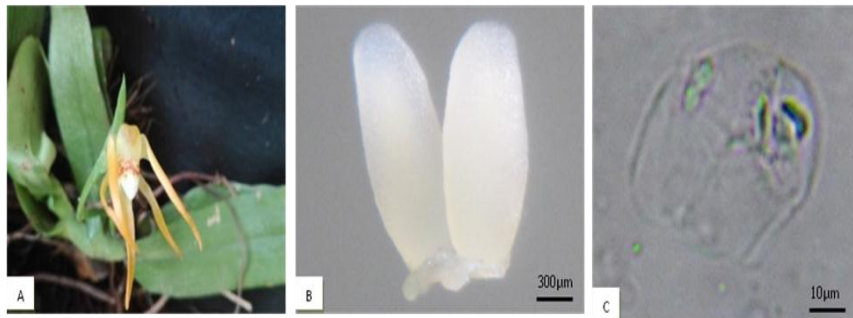


Fig 14. *Thrixspermum centipeda* Lour. A. Inflorescence B. Pollinarium C. Pollen tetrad

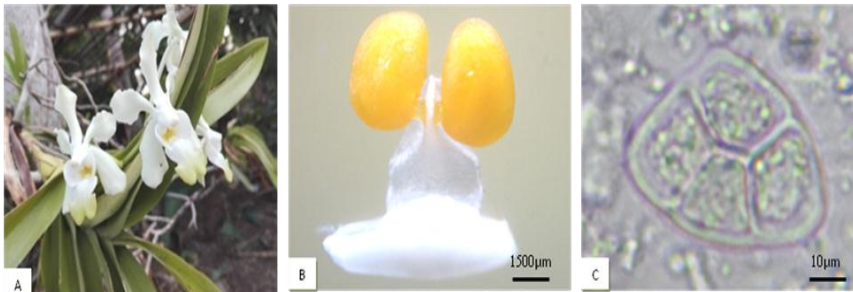


Fig.15. *Vanda denisoniana* Benson & Rchb. f. A. Inflorescence B. Pollinarium
C. Pollen tetrad

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