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All Authors	Hnin Hnin Yu and Nwè Nwè Yi
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Pollinarial Morphology of Ten Species of Family Apocynaceae Found in Southern Shan State

Hnin Hnin Yu[1] & Nwè Nwè Yi[2]

Abstract

Pollinarial morphology of 10 species belonging to eight genera of Apocynaceae were studied. All the specimens were collected from Southern Shan State from July 2016 to September 2017. The flowering plants were collected, classified, identified and preserved. The pollen grains were found as tetrads and pollinia. Pollen tetrads were observed in two species *Hemidesmus indicus* (L.) R. Br. and *Streptocaulon tomentosum* Wight. and the eight species were pollinia. The small size of pollen tetrad was found in *Hemidesmus indicus* (L.) R. Br. and the large size of pollen tetrad was occurred in *Streptocaulon tomentosum* Wight. Pollinial morphology of 8 species was recorded with their size, shape, colour, orientation and translator attachment to the pollinia. The pollinia of each species were presented with photomicrographs.

Key words: Apocynaceae, Pollinarium, Southern Shan State

Introduction

Apocynaceae is one of the largest families of angiosperms, with 375 genera and over 5000 species. The notable morphological variation in reproductive traits in the family has resulted in distinct interpretations about the appropriate choice of characters for taxonomic classifications. Of the five subfamilies currently recognized in Apocynaceae, four (Apocynoideae, Asclepiadoideae, Periplocoideae, Secamonoideae) have some of the most elaborate and complicated flowers of all the angiosperms (Simoes *et al*. 2010).

Pollen unit refers to the number of pollen grains united together at the time of release. Most commonly the four microspores formed after microsporogenes is separate prior to pollen release such single, unfused pollen grains are called monads, found in the great majority of angiosperms. Pollen grains that are connate in precise units of more than four are called polyads. Fusion of pollen grains in large, often irregular number, but less than an entire theca is called massulae (Singular massula). Finally, the fusion of all pollen grains of an entire theca is called a pollinium (plural

[1]PhD Candidate, Department of Botany, University of Mandalay
[2]Professor and Head, Department of Biology, Sagaing University of Education

pollinia), found in the families Apocynaceae and Orchidaceae (Simpson 2006).

Pollen morphology of Asclepiadoideae is different from the pollen morphology of other families, due to the presence of pollen grains that form hard sac-like definite structure called pollinium. Asclepiadoideae is composed of 2 or more pollinia, in which all the pollen grains of a single anther locule are embedded in a hard structure and a translator attachment, which develops from a stigmatic secretion and mechanically attach the pollinia to the pollinator (Corry 1883, Schill & Jakel 1978, Kunze 1993, and Swarupannandan *et al*. 1996 cited in Rapini 2012). Pollinial wall is made of amorphous sporopollenin enclosing the pollen mass each with a lamellate exine (Sinha &Mondal 2011).

Taxonomic study of family Apocynaceae had been reported in the floristic studies on various regions of Myanmar. However, pollinarial morphology study of Apocynaceaeis still lacking. Therefore, a research on the pollinarial morphology of this family was selected and studied.

The aim and objectives of present study were to investigate the differences between the morphological characteristics of pollen and pollinarium of Apocynaceae, to provide the valuable pollinarium morphological characteristics that can be used in plant classification and identification of Apocynaceae.

Materials and Methods

Collection of Plant Materials

The specimens of the Family Apocynaceae were collected from Southern Shan State from July 2016 to September 2017. Morphology of pollen and pollinarium from mature flowers of 10 species belonging to 8 genera were examined at Department of Botany, University of Mandalay.

Identification of specimens were carried out by referring to the literature such as Hooker (1882), Small (1933), Backer & Bakhuizen (1965), Dassanayake (1983), Ping-Tao *et al*. (1995) and Middleton *et al*. (1999), Myanmar names were referred to Hundley & Chit KoKo (1961).

Collection of Pollen Samples

All the fresh pollen and pollinarium were collected from the anthers of open flowers. The collected flowers of each species were stored in glass vial with glacial acetic acid and labeled. For the isolation of pollinarium, pollinarium were manually picked under a dissecting microscope using forceps and sharp needles.

Results

List of the collected plants

Ten species belong to eight genera were studied. The list of collected species were presented in Table 1.

Table 1. List of the collected plants

Family	Subfamily	No.	Scientific Name	Myanmar Name
Apocynaceae	Periplocoideae	1	*Hemidesmus indicus* (L.) R. Br.	Than hlat pin
		2	*Streptocaulon tomentosum* Wight.	Myinsagoni
	Secamonoideae	3	*Toxocarpus wangianus* Tsiang	Unknown
	Asclepiadoideae	4	*Calotropis gigantea* (L.) R. Br.	Ma yogyi
		5	*Cynanchum dalhousiae* Wight.	Unknown
		6	*Hoya revoluta* Hook.	Unknown
		7	*Hoya thailandica* Thaithong	Unknown
		8	*Pentasachme caudatum* Wall. ex Wight.	Kyauk pan
		9	*Pergularia minor* Andr.	Daung da late
		10	*Pergularia pallida* Wight & Arn.	Taw daung da late

Subfamily Periplocoideae

1. *Hemidesmus indicus* (L.) R. Br. in Men. wern. Soc. 1. 1809. (Figure 1 A)

Periploca indica L. Sp. Pl. 211. 1753.

Hemidesmus wallichii Mig. f. Fl. Brit. Ind. 4. 5. 1883.

Myanmar name : Than hlat pin

English name : Unknown

Flowering period : August to November

Pollinarial Morphology (Figure 1B, C)

Pollen translator 150 – 450 × 90 – 310 μm in length and breadth, spatulate, mimosa yellow, orientation of pollen translator erect; pollen tetrad, rhomboidal in shape, 31.5 – 47.5 × 42.5 – 50.0 μm in length and breadth; single grain small, 20.0 – 21.3 μm in diameter; exine about 2.5μm thick; sculpturing psilate.

2. ***Streptocaulon tomentosum* Wight,** in Wight and Arn. Contrib. 64. 1834 (Figure 1D)

Myanmar name : Myinsagoni
English name : Unknown
Flowering period : September to December

Pollinarial Morphology (Figure 1E, F)

Pollen translator 310 – 325 × 90 – 100 μm in length and breadth, boat-shaped, mimosa yellow, orientation of pollen translator erect; pollen tetrad, homboidal in shape, 90 – 115 × 175 – 200 μm in length and breadth; single grain small, 16.3 – 18.8 μm in diameter; exine about 1.3 μm thick; sculpturing psilate.

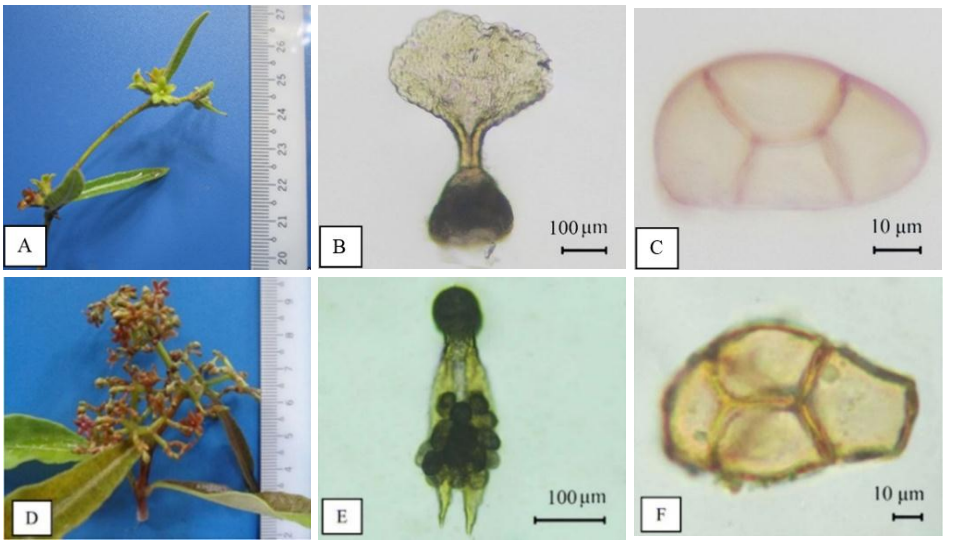

Figure 1 A. Inflorescences of *Hemidesmus indicus* (L.) R. Br.
B. Pollinial translator of *H. indicus* (L.) R. Br.
C. Tetrad of *H. indicus* (L.) R. Br.
D. Inflorescences of *Streptocaulon tomentosum* Wight.
E. Pollinial translator of *S. tomentosum* Wight.
F. Tetrad of *S. tomentosum* Wight.

Subfamily Secamonoideae

3. *Toxocarpus wangianus* Tsiang, Sunyatsenia. 4: 100. 1939. (Figure 2 A)

Myanmar name : Unknown
English name : Unknown
Flowering period : May to August

Pollinarial Morphology (Figure 2 B, C)

Pollinia 4, pollinial sac 250-325 × 200-250 μm in length and breadth, oblong in shape, lemon yellow, orientation of pollinium erect; corpusculum 200-250 × 225-275 μm in length and breadth, rounded in head of shape, brown; pollen tetrad, rhomboidal in shape, 62.5-75.5 × 37.5-40.5 μm in length and breadth; single grain 12.5-25.0 × 18.5-20.0 μm in length and breadth; exine about 1.3 μm thick, sexine thicker than nexine; sculpturing psilate.

Subfamily Asclepiadoideae

4. ***Calotropis gigantea*** (L.) R. Br. in Ait. Hort. Kew. ed 2, 2:78. 1811. (Figure 2D)

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

Myanmar name : Ma yogyi
English name : Giant swallow word
Flowering period : Throughout the year

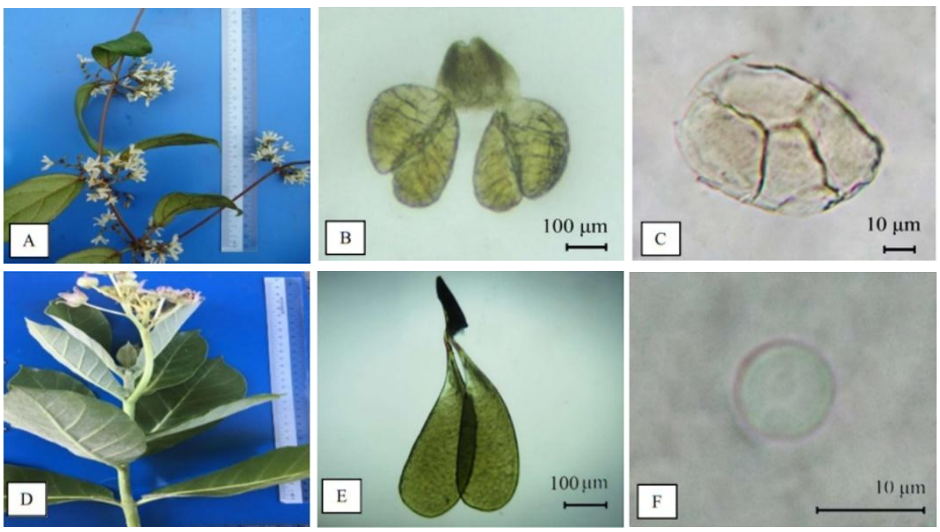

Figure 2.A. Inflorescences of *Taxocarpus wangianus* Tsaing
B. Pollinarium of *T. wangianus* Tsiang
C. Single grain of *T. wangianus* Tsiang
D. Inflorescences of *Calotropisgi gantea* (L.) R. Br.
E. Pollinarium of *C. gigantea* (L.) R. Br.
F. Single grain of *C. gigantea* (L.) R. Br.

Pollinarial Morphology (Figure 2E, F)

Pollinia 2, pollinial sac 1313 – 1375 × 500 – 538 μm in length and breadth; oblong in shape, sulphur yellow, orientation of pollinium pendulous; corpusculum 413 – 525 × 125 – 188 μm in length and breadth, angular in shape of head, reddish brown; translator arm 250 – 313 × 38 – 50 μm in length and breadth, cylindrical in shape, black yellow; translator attachment to the pollinia basal; single grain small, spherical, 1.3 – 10.0μm in diameter.

5. ***Cynanchum dalhousiae*** Wight., Contrib. Bot. Ind. 55. 1834.(Figure 3 A)

Myanmar name : Unknown
English name : Unknown
Flowering period : September to December

Pollinarial Morphology (Figure 3 B, C)

Pollinia 2, pollinial sac 487.5-562.5 × 212.5-237.5 μm in length and breadth, oblong in shape, lemon yellow, orientation of pollinium pendulous; corpusculum 362-412 × 175-180 μm in length and breadth, rounded in shape, reddish brown; translator arm 125-188 × 175-180 μm in length and breadth, triangular in shape, pale yellow; translator attachment to the pollinia basal; single grain small, spherical, 3.8 -17.5 μm in diameter.

6. ***Hoya revolute*** Hook. f. Fl. Brit. Ind. 4. 1883. (Figure 3D)
Hoya ovalifolia Wall., Cat. 8160 b. 1847.

Myanmar name : Unknown
English name : Unknown
Flowering period : June to September

Pollinarial Morphology (Figure 3 E, F)

Pollinia 2, pollinial sac 750-938×250-388 μm in length and breadth; ovate-oblong in shape, lemon yellow, orientation of pollinium horizontal; corpusculum 500-650 × 250-287 μm in length and breadth, angular in shape of head, reddish; translator arm about 50-63 μm in length and breadth, triangular in shape, yellow; translator attachment to the pollinia terminal; single grain small, spherical, 1.3-13.0 μm in diameter.

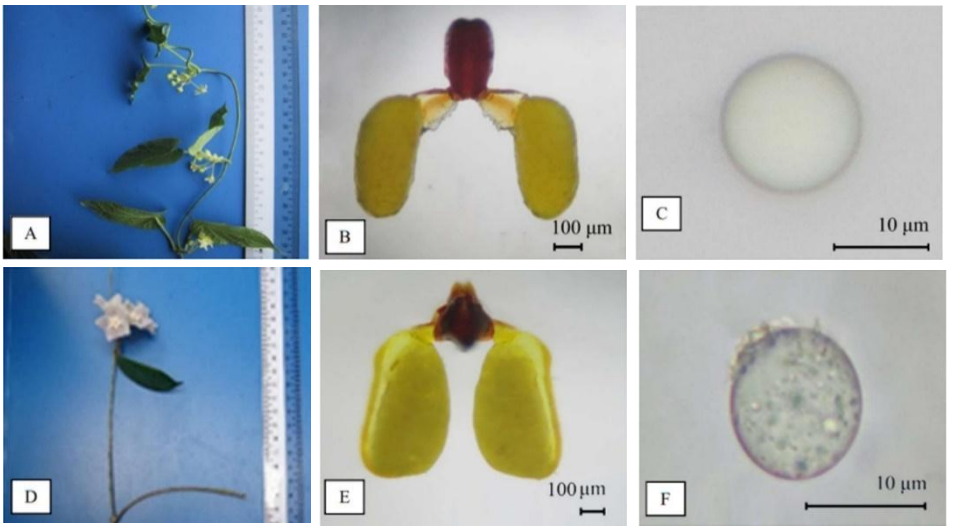

Figure 3. A. Inflorescences of *Cynanchum dalhousiae* Wight.
B. Pollinarium of *C. dalhousiae* Wight.
C. Single grain of *C. dalhousiae* Wight.
D. Inflorescences of *Hoya revoluta* Hook.
E. Pollinarium of *H. revolute* Hook.
F. Single grain of *H. revolute* Hook.

7. *Hoya thailandica* Thaithong. Nordic J. 21(2): 143. 2001. (Figure 4 A)

Myanmar name : Unknown
English name : Unknown
Flowering period : June to August

Pollinarial Morphology (Figure 4 B, C)

Pollinia 2, pollinial sac 600-760 × 225-275 µm in length and breadth; ovate-oblong in shape, lemon yellow, orientation of pollinium horizontal; corpusculum 375-400 × 95-150 µm in length and breadth, angular in shape of head, reddish; translator arm absent; single grain small, spherical, 5-40 µm in diameter.

8. ***Pentasachme caudatum*** Wall. ex. Wight, Contr. Bot. India 60. 1834 (Figure 4 D)
   Pentasachme championii Benth. Hooker's J. Bot. Kew Gard. Misc. 5: 54-55.

   Myanmar name : Kyukpan
   English name : Unknown
   Flowering period : April to October

Pollinarial Morphology (Figure 4 E, F)

Pollinia 2, pollinial sac 275-363 × 313-363 μm in length and breadth; ovoid in shape, lemon yellow, orientation of pollinium erect; corpusculum 100-163× about 62.5 μm in length and breadth, rounded in shape of head, orange; translator arm 10.0-12.5 × 5.0-7.2 μm in length and breadth, triangular in shape, white; translator attachment to the pollinia basal; single grain small, spherical, 1.3-6.3 μm in diameter.

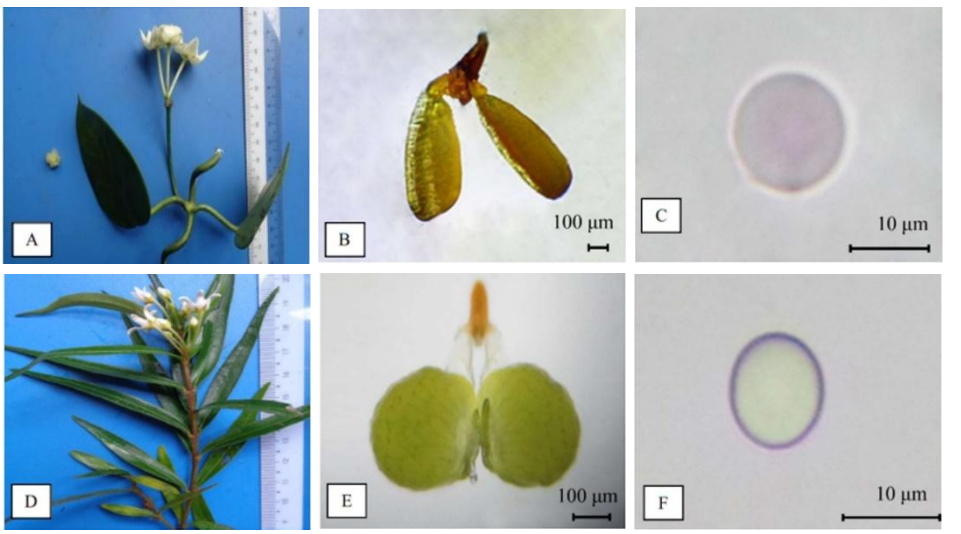

Figure 4. A. Inflorescences of *Hoya thailandica* Thaithong
B. Pollinarium of *H. thailandica* Thaithong
C. Single grain of *H. thailandica* Thaithong
D. Inflorescences of *Pentasachme caudatum* Wall. ex Wight.
E. Pollinarium of *P. caudatum* Wall. ex Wight.
F. Single grain of *P. caudatum* Wall. ex Wight.

9. *Pergularia minor* Andr. Bot. Rep. t. 1:2.1899. (Figure 5A)

Myanmar Name : Unknown
English Name : Unknown
Flowering period : May to August

Pollinarial Morphology (Figure 5B, C)

Pollinia 2, pollinial sac 450-575 × 250-275 μm in length and breadth; globosely obovoid in shape, canary yellow, orientation of pollinium erect; corpusculum 262.5-312.5 × 175.0-212.5 μm in length and breadth, rounded in shape of head, reddish; translator arm 75.0-137.5 × 62.5-87.5 μm in length and breadth, triangular in shape, pale yellow; translator attachment to the pollinia subbasal; single grain small, spherical, 12.5-50.0 μm in diameter.

10. ***Pergularia pallida*** Wight &Arn, Contrib. 42.2:76.1879. (Figure 5 D)

Myanmar name : Taw daung da late
English name : Unknown
Flowering period : June to September

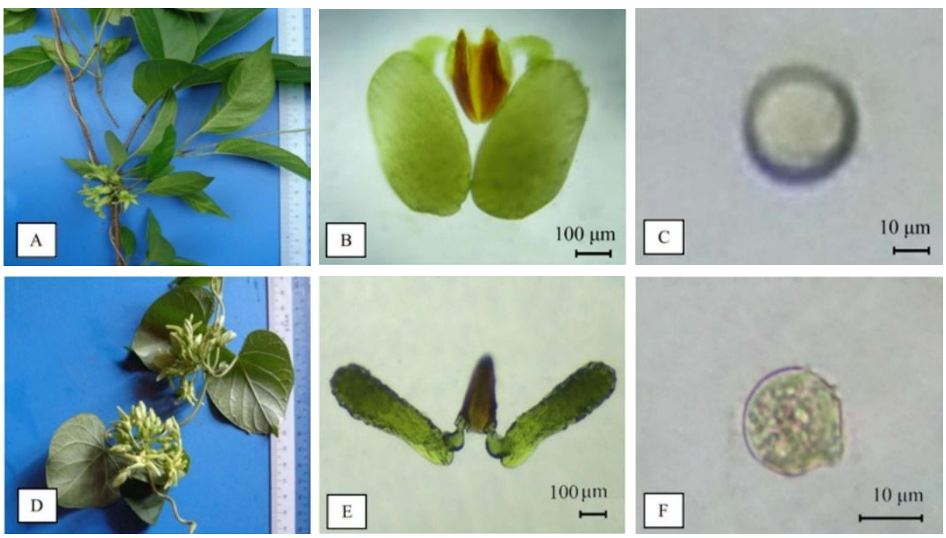

Figure 5. A. Inflorescences of *Pergularia minor* Andr.
B. Pollinarium of *P. minor* Andr.
C. Single grain of *P. minor* Andr.
D. Inflorescences of *Pergularia pallida* Wight &Arn.
E. Pollinarium of *P. pallida* Wight & Arn.
F. Single grain of *P. pallida* Wight & Arn.

Pollinarial Morphology (Figure 5 E, F)

Pollinia 2, pollinial sac 562.5–587.5×162.5–187.5 μm in length and breadth; obovate in shape, canary yellow, orientation of pollinium erect; corpusculum 300–313× 150–163 μm in length and breadth, rounded in shape of head, reddish brown; translator arm 112.5–125.0 μm in length and breadth, angular in shape, pale yellow; translator attachment to the pollinia basal; single grain small, spherical, 1.3–18.8 μm in diameter.

Discussion and Conclusion

The present study deal with pollen morphology of family Apocynaceae found in Southern Shan State. Apocynaceae is a large, widespread family of woody and herbaceous plants.

In the present study, 2 species of Periplocoideae, 1 species of Secamonoideae and 7 species of Asclepiadoideae were studied. *Hemidesmus indicus* (L.) R. Br. and *Streptocaulon tomentosum* Wight. were belong to the subfamily Periplocoideae. *Toxocarpus wangianus* Tsiang. was belong to the Secamonoideae. *Calotropis gigantea* (L.) R., *Cynanchum dalhousiae* Wight., *Hoya revoluta* Hook., *Hoya thailandica* Thaithong., *Pentasachme caudatum* Wall. ex. Wight., *Pergularia minor* Andr. and *Pergularia pallida* Wight &Arn. were belong to the subfamily Asclepiadoideae.

According to the collected data, 6 species are climbing herbs and shrubs and 3 species are woody lianas. Only one epiphytic species, *Hoya thailandica* Thaithong. can be found in the study area.

The pollen grains of 2 species were tetrads and the remaining 8 species were polyads or pollinia. The pollen grains of angiosperms display variation in many of their morphological features.

The size and shape of pollinial sac, colour of pollinia, nature of corpuscular, position of pollinia, structure of caudicle or translator were differed from one species to another. *Hemidesmus indicus* (L.) R. Br. possess spatulate-shaped translator; *Streptocaulon tomentosum* Wight. hadboat-shaped translator. *Hemidesmus indicus* (L.) R. Br. and *Streptocaulon tomentosum* Wight. had the rhomboidal shape of pollen tetrads. These characters agreed with Arekal & Ramakrishna (1980).

The pollen tetrad of *Toxocarpus wangianus* Tsiang. had the orientation of pollinia erect and pollen tetrads are agglutinated to four per pollinia anther. These characters were agreed with Ramarkrishna & Babu (2012).

The pollinia showed a great variation in form, varying from ovate to oblong. In the present study, different shapes of pollinia were observed in 7 species of subfamily Asclepiadoideae. Pollinia were ovate-oblong in *Hoya revolute* Hook. f. Fl. and *Hoya thailandica* Thaithong. and the remaining species were ovoid, obovate, globosely obovoid and obovate. These characters were in agreement with those reported by Sinha & Mondal (2011).

In this study, the horizontal orientation of pollinia was found in *Hoya revoluta* Hook. f. Fl., and *Hoya thailandica* Thaithong.; pendulous orientation of pollinia was occurred in *Calotropis gigantea* (L.) R. Br. and *Cynanchum dalhousiae* Wight. and the erect orientation of pollinia was observed in the remaining species. These characters were agreed with those stated by Sinha & Mondal (2011).

According to result, pollen and pollinarium characters are now being used as important taxonomical tool for reassessing the different types of plant groups. It is hoped that these differences of palynological characters will support the classification and identification of Apocynaceae.

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