African Journal of Biotechnology Vol. 10(41), pp. 7981-7986, 3 August, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB10.1002
ISSN 1684–5315 © 2011 Academic Journals

Full Length Research Paper

The morphological diversification of pollinia of some members of Asclepiadaceae

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Accepted 2 June, 2011

Most of the natural systems of plant classification have been based on exomorphic characters. The flower is a primary reproductive character considered to be more important than any vegetative characters. The mass of pollen grains is basically called pollinia. Like pollen, the pollinium is also the key character for the identification of specific plant species belonging to the family Asclepiadaceae (Dicotyledons) and Orchidaceae (Monocotyledons). Pollinial characters are now being used as important taxonomical tool for reassessing the different types of plant groups. The morphological nature of pollinia is specific in each genus. The morphological diversifications of pollinium of different genera of Asclepiadaceae were studied with the help of light microscope and phase contrast microscope (Leica-DM1000). The shape, size, position, orientation of pollinia, translator attachment, furrow position, etc are important criterion for the studies of pollinial morphology. This study analyzed the pollinial morphology of some selected plant taxa like *Calotropis gigantea* (L.) Ait., *Daemia extensa* R.Br., *Dregea volubilis* Benth, *Gymnema sylvestre* R.Br, *Hoya globulosa* Hook.f. and *Tylophora indica* (Burm.f.) Merr. collected from different parts of West Bengal.

Key words: Asclepiadaceae, Orchidaceae, morphology, pollinia.

INTRODUCTION

Asclepiadaceae includes some 250 genera and over 2000 species, widespread in tropical and subtropical regions, especially in Africa and southern South America, with a moderate representation in northern and south-eastern Asia. Members of the family Asclepiadaceae are unique due to the association of pollen grains that form a sac-like definite structure called pollinia (singular pollinium). They are the product of only one anther, but are transferred during pollination as a single unit. This is also seen in Orchids. The pollinarium of most Asclepiadaceae is composed of two or more pollinia, each of which contains all of the microspores of a single anther locule embedded in a hard matrix and a translator apparatus, which develops from a stigmatic secretion and mechanically attach the pollinia to a pollinator (Corry, 1883; Schill and Jakel, 1978; Kunze, 1993; Swarupanandan et al., 1996). Pollinial wall is acetolysis resistant (Namboodiri and Sreedevi, 1980; Erdtman, 1952).

Pollinial morphology is taxonomically significant like the pollen morphology of other angiosperm. The size and shape of pollinial sacs, color of pollinia, nature of corpusculu, position of pollinia, structure of caudicle or translator, etc are important features for analysis of phylogenetic study. These characters are also required for efficiency of pollinia attachment to the pollinator during pollination. The species diversification through the pollinial structure is established in this study. The pollination efficiency of pollinia is well studied by different authors (Wyatt, 1976, 1978; Kephart, 1981; Broyles and Wyatt, 1993). Pollen morphology of Asclepiadaceae has been surveyed and summarized by Brown (1811), Corry (1883), Schill and Jakel (1978), Swarupanandan et al. (1996), Civeyrel (1999) Civeyrel et al. (1998), Verhoeven and Venter (1998b, 2001) and Sajith and Sreedevi (2005).

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Figure 1. a: A flowering twig; b: Pollinia of *Gymnema sylvestre* R.Br. (400X).

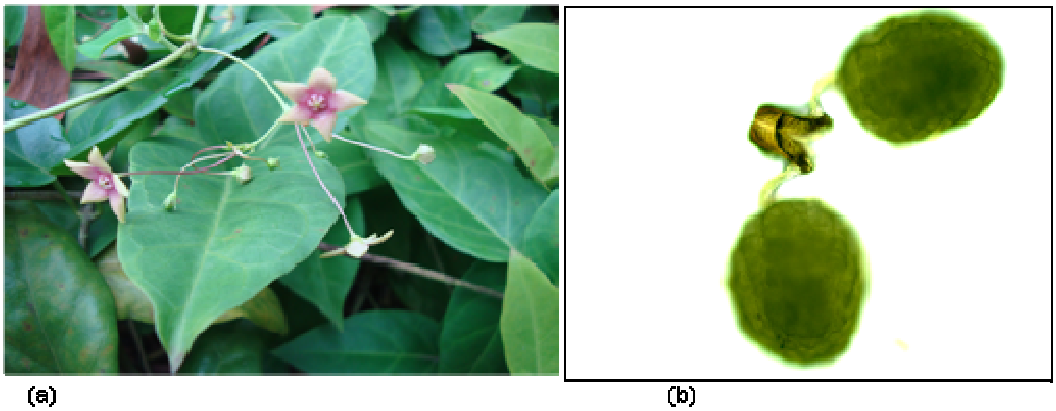

Figure 2. a: A flowering twig; b: Pollinia *of Tylophora indica* (Burm.f.) Merr. (400X).

MATERIALS AND METHODS

We selected six plants from Paschim Medinipur district of West Bengal of India. Generally, these plants grow in lateritic soil and have highly ethnomedicinal values. They are *Calotropis gigantea* (L.) Ait. (Figure 4a), *Daemia extensa* R.Br. (Figure 5a), *Dregea volubilis* Benth. (Figure 3a), *Gymnema sylvestre* R.B. (Figure 1a), *Hoya globulosa* Hook.f. (Figure 6a) and *Tylophora indica* (Burm.f.) Merr. (Figure 2a). Fresh flowers in the form of inflorescence were collected between 8 and 11 am and pollinia were removed from freshly opened flowers. The pollinia were collected randomly and measurements were taken using light microscope and phase contrast microscope (Leica-DM1000).

Pollinial morphology

The Asclepiadaceae has five pollinarium, each of which consists of two pollinia. Pollinia have a pair of pollinial sac connected to a central corpusculum through a pair of caudicles. The pollinial wall is made of amorphous sporopollenin enclosing the pollen mass each with a lamellate exine. Pollinial sac measurements relate to the length (from point of attachment to caudicle to the distal free end) and breadth (at the broadest point of the sac) of the sac.

RESULT AND DISCUSSION

The pollinia showed a great variation in form, varying from oval to globular. The size, shape, colour, pollinia attachment, orientation of pollinia, position of pollinia within anther, etc are valuable characters for the analysis of diversification of pollinia of the Asclepiadaceae.

The pollinial sacs are thin and flat. Their size, shape, colour, orientation of pollinia, position of caudicle or translator attachment to the corpusculum, differ according to genera. From Table 1, it was found that within the six members, the largest pollinial sac was found in *Calotropis* (Figure 4b) and smallest in *Gymnema* (Figure 1b). The shape of pollinial sacs are more or less oval but globular shape was found in *Tylophora* (Figure 2b). The genus *Gymnema* possesses intermediate shape which is neither oval nor globular. The colour also differs in different genera.

Pollinium orientation has been used as a diagnostic character for systematic studies in the family Asclepiadaceae. The classic division of Asclepiadoideae

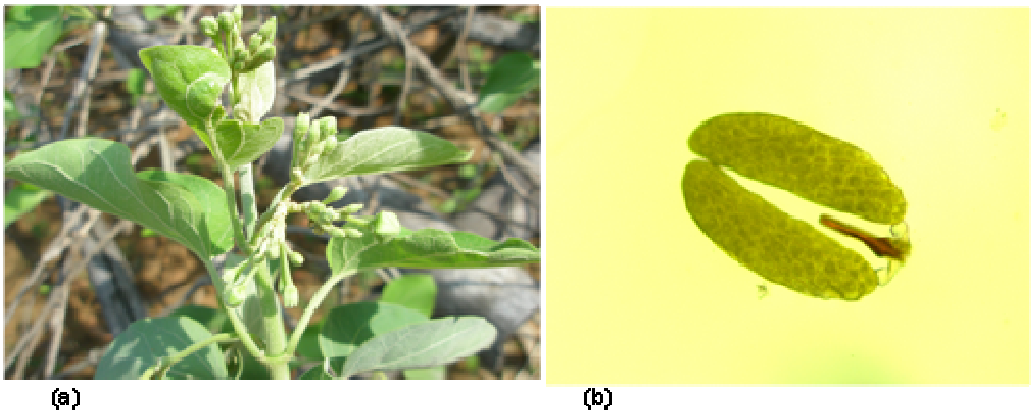

Figure 3. a: A flowering twig; b: Pollinia *of Dregea volubilis* Benth (100X).

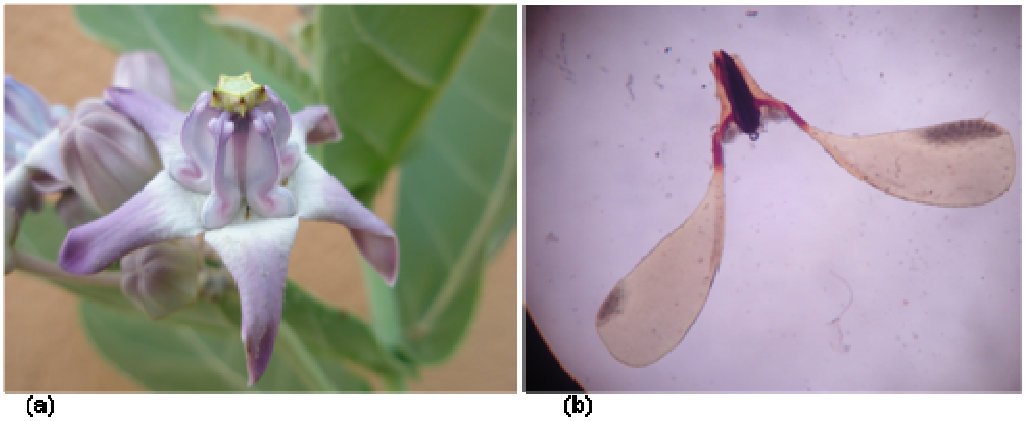

Figure 4. a: A flowering twig; b: Pollinia *of Calotropis gigantea*(L.) Ait. (40X).

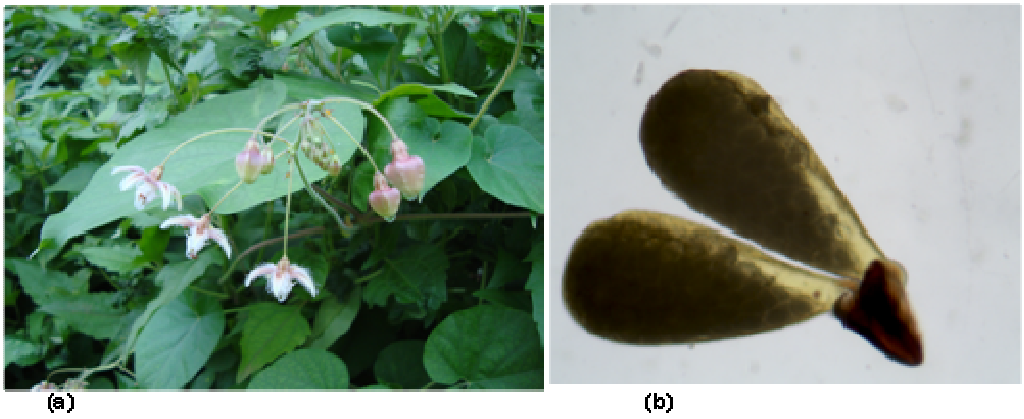

Figure 5. a: A flowering twig; b:Pollinia *of Daemia extensa* R.Br. (100X).

into three tribes is based on the orientation of the pollinium relative to the translator. Three tribes have been recognized by erect (Marsdenieae), horizontal (Gonolobeae) and pendulous (Asclepiadeae) pollinia (Swarupanandan et al., 1996). In *Calotropis* and *Daemia* (Figure 5b), the pollinia are pendulously orientated within the anther locule and horizontal orientation of pollinia is found in *Dregea* (Figure 3b), *Hoya* (Figure 6b) and *Gymnema*. But the orientation of pollinia of *Tylophora* is questioned due to the fact that pollinia are slightly erect,

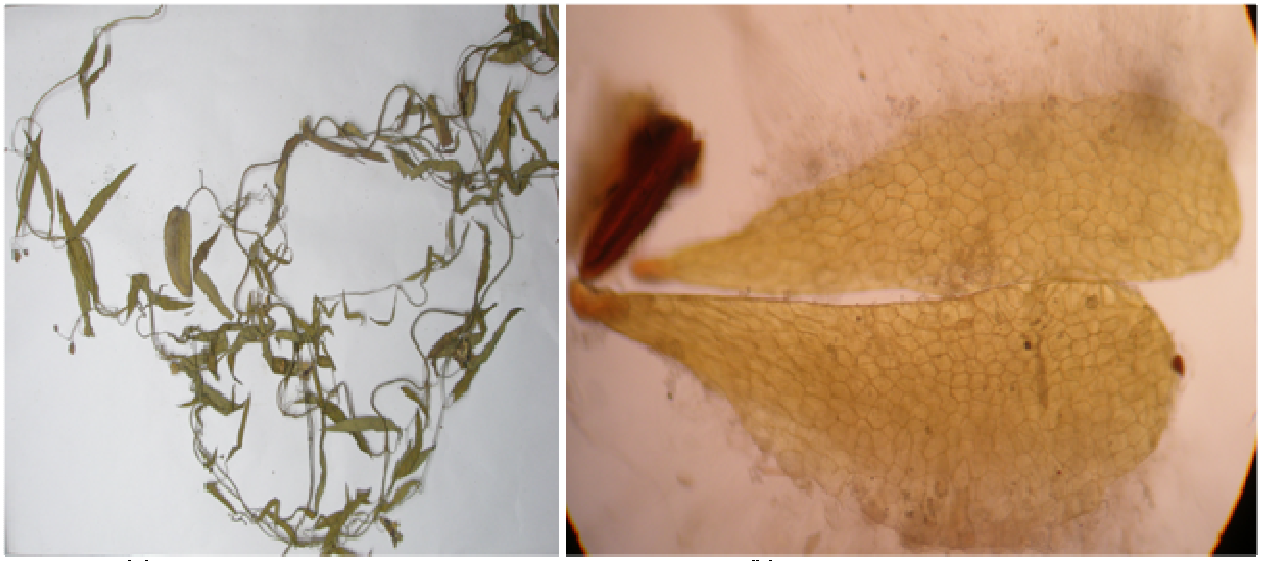

Figure 6. a: A flowering twig; b: Pollinia *of Hoya globulosa* Hook.f (40X).

Table 1. Pollinial size of six genera of Asclepiadaceae.

Name of plant	Length of pollinium sac(µm)	Breadth of pollinium sac(µm)	Length of caudicle or translator (µm)	Breadth of caudicle or translator (µm)	Length of corpusculum (µm)	Breadth of corpusculum (µm)
Calotropis gigantea (L.) Ait.	950	381	130	43	378	150
Daemia extensa R.Br.	451	187	138	94	30	15
Hoya globulosa Hook.f	875	208	125	35	218	107
Dregea volubilis Benth	360	116	104	21	250	82
Tylophora indica (Burm.f.) Merr.	190	140	80	25	90	60
Gymnema sylvestre R.Br	105	54	70	41	35	21

that is why this type of pollinia is recognized as erect pollinia. The structure of a typical pollinia is shown in Figure 7·

Position of attachment of translator or caudicle to the pollinia is also an important diagnostic feature to evaluate the morphological diversification of pollinia of different genera of Asclepiadaceae. The translator attachment is either apical or basal. In Periplocoideae, the translator attachment is absent because the mechanism in this subfamily is via adhesion, following flower maturation. This condition differs substantially from Secamonodeae and Asclepiadoideae in which the attachment of pollinia to the translator occurs much earlier in development by different mechanism (Brown, 1811; Swarupnandan et al, 1996). From Table 2, it was found that the basal attachment is found in *Calotropis, Dregea* and *Hoya* and apical attachment of pollinia was found in *Daemia, Tylophora* and *Gymnema.*

Conclusion

On the basis of our observation on pollinia, we conclude that the pollinia of different genera vary in morphology. These morphological features are accelerating for future studies of phylogenetic interrelationship among different

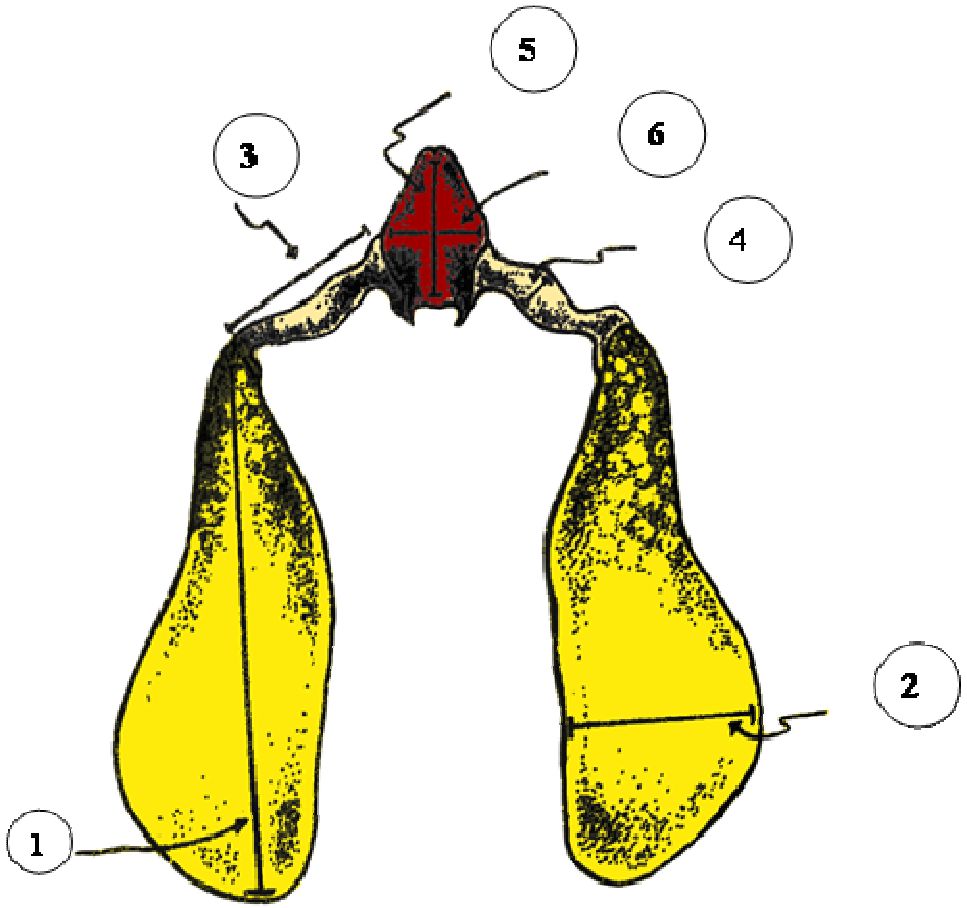

Figure 7. Typical pollinia (1. Length of pollinial sac, 2. Breadth of pollinial sac, 3. Length of caudicle or translator, 4. Breadth of caudicle or translator, 5. Length of corpusculum, 6. Breadth of corpusculum).

Table 2. Colour, shape, orientation and translator attachment of pollinial sacs of six members of Asclepiadaceae

Name of plant	Shape of pollinial sac	Colors of pollinia	Orientation of pollinia	Translator attachment to the pollinia
Calotropis gigantea (L.) Ait.	Oval	Canary yellow	Pendulous	Basal
Daemia extensa R.Br.	Oval	Canary yellow	Pendulous	Apical
Hoya globulosa Hook.f	Oval	Lemon yellow	Horizontal	Basal
Dregea volubilis Benth	Oval	Sulphur yellow	Horizontal	Basal
Tylophora indica (Burm.f.) Merr.	Globular	Canary yellow	Erect	Apical
Gymnema sylvestre R.Br	Intermediate	Mimosa Yellow	Horizontal	Apical

species of Asclepiadaceae.

ACKNOWLEDGEMENTS

We are grateful to UGC and the honorable Vice Chancellor of Vidyasagar University, Prof. Swapan Kumar Pramanik, and we also thankful to our respected faculties and the Department of Botany and Forestry, Vidyasagar University.

REFERENCES

Broyles SB, Wyatt R (1993). The consequences of self-pollination in Asclepias exaltata, a self incompatible milk weed. Am. J. Bot., 80(1): 41-44.

Civeyrel LA, Le Thomas, Ferguson K, Chase MW (1998). Critical reexamination of palynological characters used to delimit Asclepiadaceae in comparison to the molecular phylogeny obtained from plastid matK sequences, Mol. Phylogenet. Evol., 9: 517-527

Corry TH (1883). On the structure and development of the gynostegium, and the mode of fertilization in Asclepias cornuti, Decaisne (*A. syriaca* L.) Trans. Linn. Soc. London Bot., 2: 173-207.

Erdtman G (1952). Pollen morphology and plant taxonomy. Chronica Botanica C., Waltham, USA.

Erdtman G (1960). The acetolysis method. A revised description Svensk Botanisk Tidskrift. 54: p. 561.

Kephart SR (1981). Breeding system in *Asclepias incarnate*. L., *A. syrica*. L. and A. vercillata. L. Am. J. Bot., 68(2): 226-232.

Kunze H (1993). Evolution of the translator in Periplocaceae and Asclepiadaceae. Plant Syst. Evol., 185: 99-122.

Namboodiri AN, Sreedevi P (1980). Pollen and pollinial wall preparation for cytochemical and infrared spectroscopic studies: Nature of acetolysis-induced changes. Proceeding of the IV International Palynological Conference. Lucknow. 2: 569-573.

Sajith KS, Sreedevi B (2005). Pollianal Morphology and Pollen organization in Some Members of Asclepiadaceae, J. Palynol., 41: 79-100.

Schill R, Jakel U **(**1978). Beitrag zur Kenntnis der Asclepiadaceen-Pollinarien. Trop. Subtrop. Pflanzenwelt, 22: 1-122.

Swarupanandan K, Mangalym JK, Sonny TK, Kishorekumar K, Vasga SC (1996). The subfamilial and tribal classification of the family Asclepiadaceae. Bot. J. Linn. Soc., 120: 327-369.

Venter HJT, Verhoeven RT (2001). Pollen morphology of the Periplocoideae, Secamonoideae and Asclepiadoideae Apocynaceae). Ann. Missouri. Bot. Gard, 88: 569-582.

Wyatt R (1976). Pollination and fruit set in Asclepias: A reappraisal. Am. J. Bot., 63: 645-885.

Wyatt R (1978). Experimental evidence concerning the role of corpusculum in Asclepias pollination. Syst. Bot., 3: 313-321.