A STUDY ON POLLEN MORPHOLOGY OF SAPINDALES AND BRASSICALES FROM MANDALAY AND BAGO REGIONS

Hnin Yu Maw[1], Nwe Nwe Yi[2], Swe Swe Linn[3]

Abstract

The pollen morphology of 10 species belonging to 10 genera of 5 families in Sapindales and Brassicales were studied. The specimens were collected from Mandalay and Bago Regions from May 2018 to December 2020. The collected species were 6 species of Sapindales and 4 species of Brassicales. The morphological characters of pollen grains of each species were also studied. The pollen grains of all species examined in this study are generally monads. The types of pollen grains were colpate and colporate. One, nine species were colpate and colporate respectively. The shapes of pollen were oblate spheroidal, spheroidal, suboblate and subprolate. The smallest pollen (9.0 – 14.0 µm) was found in *Limonia acidissima* L. and the largest pollen (30.0 – 32.6 µm) was observed in *Hypselandra variabilis* (Collett & Hemsl.) Pax & K. Hoffm. The sculpture patterns of pollen grains were psilate in 1 species, reticulate in 4 species and obscurely reticulate in 5 species. The pollen photomicrographs of each species were observed by polar view and equatorial view. The pollen morphology provides for identification and future systematic research work of orders Sapindales and Brassicales.

Keywords: Sapindales and Brassicales, Colpate and colporate, Palynology

Introduction

Pollen is Latin and means “fine dust” or “flour”. Its first use as a scientific word to describe the male sperm carrying units of flowering plants is credited to Carl Linnaeus in *Sponsalia Plantarum* published in 1747. Pollen is the dust of vegetable, which will burst when moistened with the appropriate liquid and propulsively explode a substance which is not discernable by the naked senses (Kesseler 2009).

Sapindales is an order of flowering plants, division Magnoliophyta (Angiospermae) in the subclass Rosidae of the class Magnoliopsida. The order Sapindales consists of 15 families and approximately 6200 species. The largest families are Rutaceae (about 1500 species), Sapindaceae (about 1500), Meliaceae (about 550 species), Anacardiaceae (about 600) species and Burseraceae (about 600 species). Most members of the Sapindales are woody plants with compound or lobed leaves and polypetalous (Arthur 2014).

The Brassicales are an order of flowering plants, belonging to the eurosids II group of dicotyledons. One characters common to many members of the order is the production of glucosinolate (mustard oil) compounds. The only families included were the Brassicaceae and Capparaceae as separate the Tropaeolaceae, Resedaceae and Moringaceae. The families Capparaceae and Brassicaceae are closely related (Hai 2015).

The aim and objectives of this research work were to identify and classify the morphological variation in pollen of Sapindales and Brassicales, to study and record the collected species systematically from the palynological point of view and to provide the different pollen characters which may be used in phylogenetic inferences.

[1] Department of Botany, Mandalar University
[2] Department of Botany, Myitkyina University
[3] Department of Botany, Meiktila University

Materials and Methods

Collection of Plants Materials and Pollen Samples

The specimens were kept under observation from Mandalay and Bago Regions from 2018 to 2020. The collected species were recorded individually by photographs during flowering period. Identification of specimens were carried out by referring to Hooker (1881-1887), Backer et al (1965-1968), Dassanayake (1980-2001). Myanmar name were referred to Hundley and Chit Ko Ko (1987) and Kress *et al*. (2003) in Myanmar.

Acetolysis of Pollen Grains

The pollen samples were acetolysed by the standard method of Erdtman (1960). The acetolysis solution was mixed using a measuring cylinder: 9 parts of glacial acetic acid, and 1 part of concentrated sulphuric acid was added. The acid was dropped gently down the side of the tube. The pollen samples from the glass vial were put into a test-tube and then acetolysis mixture (1cc) was poured into the test-tube containing the pollen samples and stirred with a glass rod. The test-tube was heated in a water-bath at 75°C about 20-30 minutes. After centrifuging and decanting, a few drops of dilute glycerine solution was added to the residue, then transferred and stored in air-tight glass vial.

A drop of sample was taken with a glass rod and placed on a slide, then covered with a cover slip. The terminology was used in accordance with Erdtman (1952), Moore & Webb (1978) and Hesse *et al.* (2009).

Results

1.Family – Anacardiaceae

Bouea oppositifolia (Roxb.) Meisn., Pl. Vasc. Gen. 2:55. 1837. (Figure 1 A)

Myanmar name : Taw mayan

Outstanding characters

Perennial trees, 5 – 25 m high; branches spreading crown. Leaves simple, opposite and decussate, exstipulate, glabrous. Inflorescences axillary paniculate, many-flowered. Flowers bisexual, actinomorphic, pentamerous, hypogynous.

Pollen morphology (Figure 1 B, C)

Tricolporate, oblate spheroidal, small, 10.8 – 18.0 × 12.0 – 15.6 µm in length and breadth; amb triangular; colpi longicolpate, 9.6 – 15.6 × 2.4 – 6.0 µm in length and breadth; pori lolongate, 4.8 – 7.2 × 2.4 – 6.0 µm in length and breadth; exine about 1.2 µm thick, sexine thicker than nexine; sculpturing psilate.

2. Familly – Rutaceae

Casimiroa edulis La Llave, Nov. Veg. Descr. 2:2. 1825. (Figure 1 D)

Myanmar name : Thagya thi

Outstanding characters

Perennial, evergreen trees, up to 6 m high; stems and branches terete, glabrous. Leaves palmately compound, alternate, exstipulate, oil gland on both surfaces. Inflorescences terminal or

axially, panicle, many-flowered, pubescent. Flowers bisexual, actinomorphic, pentamerous, hypogynous, greenish white, pubescent.

Pollen morphology (Figure 1 E, F)

Tricolporate, subprolate, small, 13.2 – 16.8 × 10.8 – 13.2 µm in length and breadth; amb triangular; colpi ¾ way up to the pole, 12.0 – 14.4 × 3.6 – 5.4 µm in length and breadth; pori circular, 2.4 – 7.2 µm in length and breadth; exine about 2.4 µm thick, sexine thicker than nexine; sculpturing reticulate, lumina heterobrochate, 0.6 – 2.4 µm width; muri simplibaculate, about 1.2 µm wide.

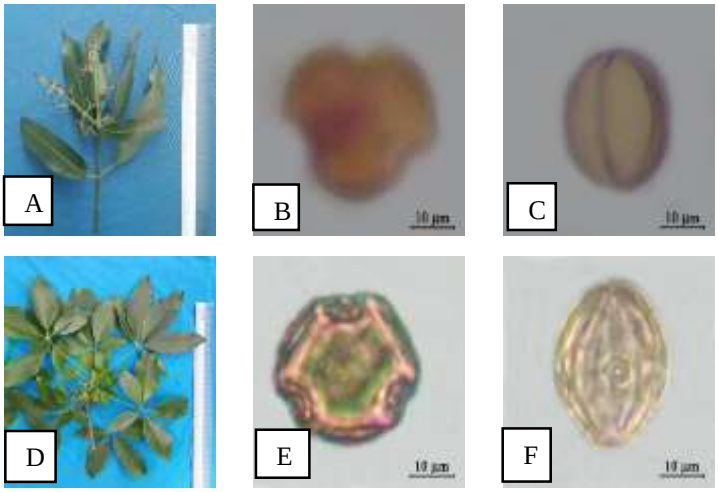

Figure 1. A. Inflorescences of *Bouea oppositifolia* (Roxb.) Meisn., B. Pollen in polar view of *B. oppositifolia* (Roxb.) Meisn., C. Pollen in equatorial view of *B. oppsitifolia* (Roxb.) Meisn., D. Inflorescences of *Casimiroa edulis* La Llav, E. Pollen in polar view of *C. edulis* La Llave, F. Pollen in equatorial view of *C. edulis* La Llave

3. *Limonia acidissima* L., Sp. Pl. (ed. 2) 554. 1763. (Figure 2 A)

Myanmar name : Thi, Mak pyen sum

Outstanding characters

Perennial, deciduous, armed trees with dark brown bark, up to 8 m high. Leaves unipinnately compound, imparipinnate, alternate, exstipulate, shining, glabrous on both surfaces. Inflorescences axillary or terminal, racemes. Flowers bisexual, actinomorphic, hypogynous, pentamerous, dark red, turning to yellowish-green.

Pollen morphology (Figure 2 B, C)

Tetracolporate, suboblate, small, 9.6 – 15.6 × 14.6 – 20.4 µm in length and breadth; amb quadrangular; colpi longicolpate, 8.4 – 14.4 × 2.4 – 4.8 µm in length and breadth; pori lalongate, 2.4 – 4.8 × 3.6 – 6.0 µm in length and breadth; exine 1.2 – 3.6 µm thick, sexine thicker than nexine; sculpturing reticulate, lumina heterobrochate, about 2.4 µm width; muri simplibaculate, about 1.2 µm wide.

4. Family – Meliaceae

Chukrasia tabularis A. Juss., Bull. Sci. Nat. Geol. 23(140): 241. 1830. (Figure 2 D)

Myanmar name : Yinma

Outstanding characters

Perennial, trees, up to 9 m high; stems and branches terete. Leaves unipinnately compound, paripinnate, alternate; exstipulate, pubescent. Inflorescences terminal or axillary, paniculate cyme, many-flowered, pubescent. Flowers bisexual, actinomorphic, pentamerous, hypogynous.

Pollen morphology (Figure 2 E, F)

Tetracolporate, oblate, small, 14.4 – 16.8 × 18.0 – 22.8 µm in length and breadth; amb quadrangular; colpi ¾ way up to the pole, 12.8 – 14.4 × 3.6 – 6.0 µm in length and breadth; pori lalongate, 3.6 – 6.0 × 4.8 – 7.2 µm in length and breadth; annuli present, 1.2 – 3.6 µm in diameter; exine 0.6 – 1.2 µm thick, sexine thicker than nexine; sculpturing obscurely reticulate.

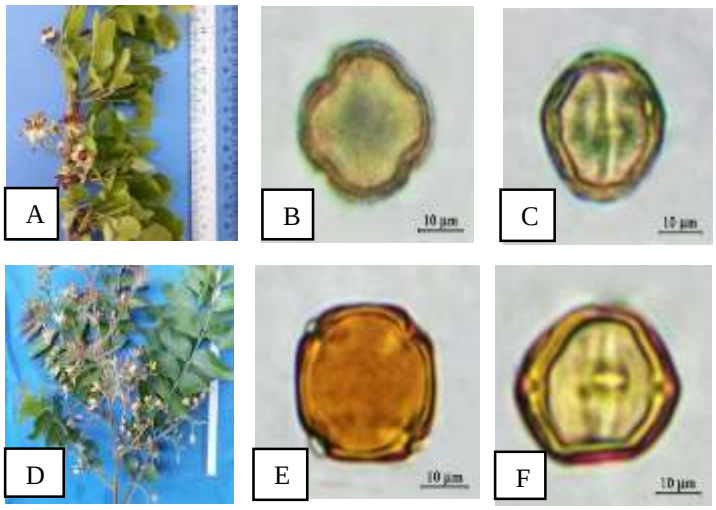

Figure 2. A Inflorescences of *Limonia acidissima* L., B. Pollen in polar view of *L. acidissima* L., C. Pollen in equatorial view of *L. acidissima* L., D. Inflorescences of *Chukrasia tabularis* A. Juss., E. Pollen in polar view *C. tabularis* A. Juss., F. Pollen in equatorial view of *C. tabularis* A. Juss.

5. *Cipadessa baccifera* (Roth.) Miq., Ann. Mus. Bot. Lugduno-Batavi 4:6. 1868. (Figure 3 A)

Myanmar name : Unknown

Outstanding characters

Perennial, erect shrubs, about 3m high. Leaves unipinnately compound, imparipinnate, alternate; exstipulate, pubescent. Inflorescences axillary paniculate cyme, many-flowered. Flowers bisexual, actinomorphic, pentamerous, hypogynous, white.

Pollen morphology (Figure 3 B, C)

Tetracolporate, oblate, small, 12.0 – 14.4 × 18.0 –21.2 µm in length and breadth; amb quadrangular; colpi ¾ way up to the pole, 10.8 – 13.2 × 4.8 – 6.2 µm in length and breadth; pori lolongate, 4.8 – 7.2 × 3.6 – 5.0 µm in length and breadth; exine 2.4 – 3.6 µm thick, sexine thicker than nexine; sculpturing psilate.

6. *Walsura trijuga* (Roxb. ex Sims) Kurz, J. Asiat. Soc, Bengal, Pt. 2, Nat. Hist. 44 (2): 148. 1875.

(Figure 3 D)

Myanmar name : Tagat ta gyi

Outstanding characters

Perennial, tree up to 6 m high; stems and branches terete, glabrous. Leaves unipinnately compound, imparipinnate, alternate; exstipulate. Flowers bisexual, actinomorphic, pentamerous, hypogynous.

Pollen morphology (Figure 3 E, F)

Tetracolporate, oblate spheroidal, medium, 19.2 – 24.0 × 21.6 – 26.4 µm in length and breadth; amb quadrangular; colpi longicopate, 17.2 – 22.8 × 3.5 – 5.7 µm in length and breadth; pori lolongate, 3.8 – 6.0 × 2.5 – 5.0 µm in length and breadth; exine about 2.4 µm thick, sexine thicker than nexine; sculpturing reticulate, lumina heterobrochate, about 1.2 µm width; muri simplibaculate, about 0.6 µm wide.

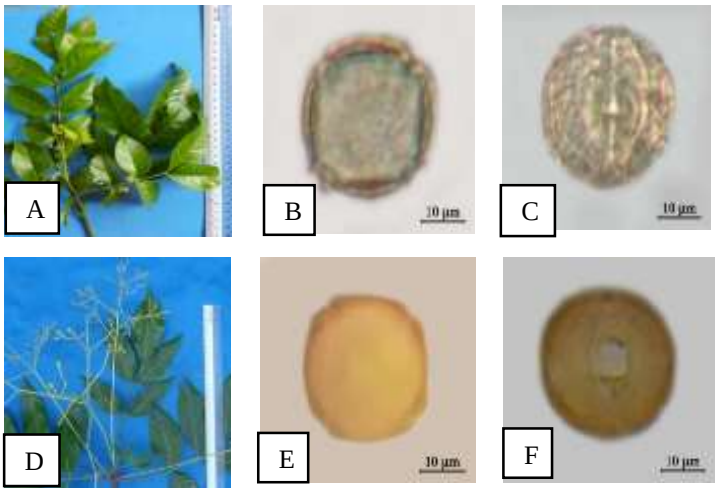

Figure 3. A. Inflorescences of *Cipadessa baccifera* (Roth.) Miq., B. Pollen in polar view of *C. baccifera* (Roth.) Miq., C. Pollen in equatorial view of *C. baccifera* (Roth.) Miq., D. Inflorescences of *Walsura trijuga* **(**Roxb. ex Sims) Kurz, E. Pollen in polar view of *W.trijuga* **(**Roxb. ex Sims) Kurz, F. Pollen in equatorial view of *W. trijuga* **(**Roxb. ex Sims) Kurz

7. Family – Capparaceae

Crateva adansonii DC., Prodr. 1: 243. 1824. (Figure 4 A)

Myanmar name : Kadet

Outstanding characters

Perennial, deciduous, small to medium size tree, glabrous. Leaves palmately trifoliate compound, alternate, glabrous on both surfaces. Inflorescences axillary or terminal corymb, many-flowered, pubescent. Flowers bisexual, zygomorphic, tetramerous, hypogynous, creamy white.

Pollen morphology (Figure 4 B, C)

Tricolpate, subprolate, small, 15.6 – 19.2 × 13.2 – 15.6 µm in length and breadth; amb triangular; colpi ½ way up to the pole, 8.4 – 10.8 × 3.6 – 5.0 µm in length and breadth; exine 1.2 – 2.4 µm thick, sexine thicker than nexine; sculpturing reticulate, lumina heterobrochate, 0.6 – 1.2 µm width; muri simplibaculate, about 1.2 µm wide.

8. *Hypselandra variabilis* (Collett & Hemsl.) Pax & K. Hoffm., Repert. Spec.Nov. Regni Veg. 41: 128. 1936. (Figure 4 D)

Myanmar name : Thamon

Outstanding characters

Perennial, trees, up to 5 m high; stems and branches terete, glabrous or slightly pubescent. Leaves palmately compound, alternate. Inflorescences axillary or terminal paniculate racemes, many-flowered, pubescent. Flowers bisexual, zygomorphic, tetramerous, hypogynous, pale green.

Pollen morphology (Figure 4 E, F)

Tricolporate, prolate spheroidal, medium, 30.0 – 34.8 × 27.6 – 31.2 µm in length and breadth; amb triangular; colpi longicolpate, 27.6 – 31.2 × 4.8 – 8.4 µm in length and breadth; pori lalongate, 3.6 – 7.2 × 6.0 – 8.4 µm in length and breadth; exine about 3.6 µm thick, sexine thicker than nexine; sculpturing obscurely reticulate.

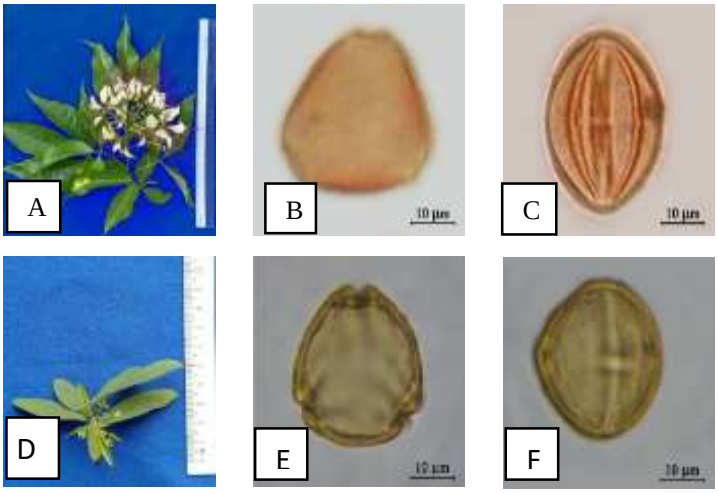

Figure 4. A. Inflorescences of *Crateva adansonii* DC., B. Pollen in polar view of *C. adansonii* DC., C. Pollen in equatorial view of *C. adansonii* DC., D. Inflorescences of *Hypselandra variabilis* (Collett & Hemsl.) Pax & K. Hoffm., E. Pollen in polar view of *H. variabilis* (Collett & Hemsl.) Pax & K. Hoffm., F. Pollen in equatorial view of *H. variabilis* (Collett & Hemsl.) Pax & K. Hoffm.

9. Family – Cleomaceae

Cleome rutidosperma DC., Prodr. 1: 241. 1824. (Figure 5 A)

Myanmar name : Pan hingala

Outstanding characters

Annual, erect or spreading herbs; stems and branches terete. Leaves palmately trifoliolate compound, alternate; exstipulate, both surfaces sparsely glandular. Inflorescences axillary cymes; peduncles terete, glabrous. Flowers bisexual, actinomorphic, tetramerous, hypogynous, pale purple.

Pollen morphology (Figure 5 B, C)

Tricolporate, prolate spheroidal, medium, 24.0 – 28.8 × 22.8 – 25.2 µm in length and breadth; amb triangular; colpi ¾ way up to the pole, 21.6 – 26.4 × 2.4 – 4.8 µm in length and

breadth; pori lalongate, 3.6 – 6.0 × 4.8 – 6.8 µm in length and breadth; exine about 2.4 µm thick, sexine thicker than nexine; sculpturing obscurely reticulate.

10. *Cleome viscosa* L., Sp. Pl. 2:672. 1753. (Figure 5 D)

Myanmar name : Gangala

Outstanding characters

Annual, erect, foetid herbs; stems and branches striated, often pale purplish, viscid glandular. Leaves palmately compound, alternate; exstipulate. Inflorescences terminal racemes, many-flowered. Flowers bisexual, zygomorphic, tetramerous, hypogynous, yellow.

Pollen morphology (Figure 5 E, F)

Tricolporate, prolate, medium, 22.8 – 31.2 × 16.8 – 20.4 µm in length and breadth; amb rounded triangular; colpi longicolpate, 21.6 – 30.0 × 6.0 – 7.6 µm in length and breadth; pori lalongate, 3.6 – 6.0 × 4.8 – 8.4 µm in length and breadth; exine 1.2 – 3.6 µm thick, sexine slightly thinner than nexine; sculpturing reticulate, lumina heterobrochate, 2.4 µm width; muri simplibaculate, about 1.2 µm wide.

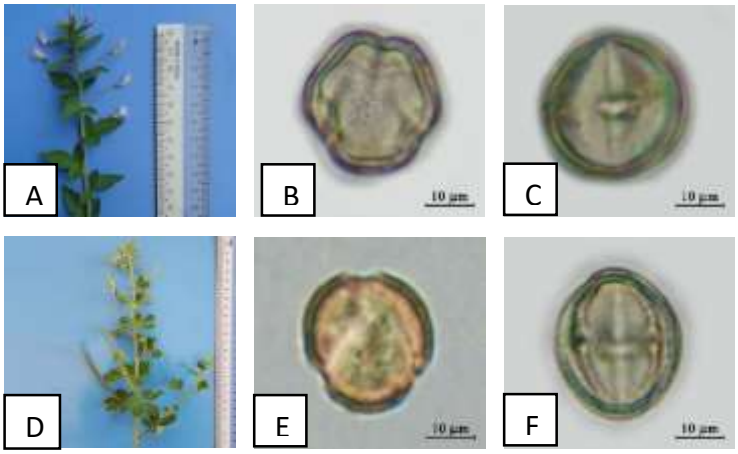

Figure 5. A. Inflorescences of *Cleome rutidosperma* DC., B. Pollen in polar view of *C. rutidosperma* DC., C. Pollen in equatorial view of *C. rutidosperma* DC., D. Inflorescences of *Cleome viscosa* L., E. Pollen in polar view of *C. viscosa* L., F. Pollen in equatorial view of *C. viscosa* L.

Discussion and Conclusion

In the present research, the pollen morphology of 10 species and 10 genera in 5 families belonging to the orders Sapindale and Brassicales has been identified and studied. The specimens were collected in Mandalay and Bago Regions and pollen morphological studies have been carried out.

In the present study, all the collected pollen grains are monad types. The types of pollen grains are occurrs as colpate and colporate. Colporate pollen are found in Sapindales, colpate and colporate pollen grains are observed in Brassicales. These characteristic findings have been similarly stated in earlier researches by Anbari *et al.* (2015), Erdtman (1952) and Mustard (1954).

In equatorial views, the shapes of pollen were oblate spheroidal, spheroidal, suboblate and subprolate. Oblate spheroidal are found in 3 species, subprolate in 3 species, spheroidal in 3 species and suboblate in 1 species.

In polar views, the amb of pollen grains are found as triangular, rounded quadrangular, rounded triangular, and straight quadrangular. Of all families, pollen grains are found to be triangular in 4 species, rounded quadrangular in only one species, straight quadrangular in 4 species and rounded triangular in 2 species. In the same way, these characters are similar to those stated by Khalik *et al.* (2002) and Yates (2005).

In this study, the pollen grains of *Chukrasia tabularis* A. Juss., and *Casimiroa edulis* La Llave were present annuli. They too have the same pollen characters as those described by Hesse *et al.* (2009) and Kesseler and Harley.(2009).

According to result, the different types of pollen characters will highlight not only the interesting pollen features but also the varieties of the pollen morphological data in the study of order Sapindales and Brassicales. These morphological features of pollen will support for identification and classificatioin of flowering plants.

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