Study on Pollen morphology of Entomophilous plants in Dagon University Campus

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Abstract

The present work has been conducted to study entomophilous plants. They are collected from Dagon University Campus. The pollen morphological characteristics of all the species were described. The aperture number, position, shape, size and sculpture pattern of each grain were examined by electron microscope. The aperture types of pollen grains are varied. There are both inaperturate and aperturate types. The pollen grains of entomophilous flowers are usually thick-walled, sticky and spiny to enhance adhesion to insect bodies. Pollen grains vary in shape from spherical to triangular.

Keywords: Sticky, reticulate, echinate

Introduction

A study on the salient features of entomophilous plants in Dagon University Campus was conducted. Many plant species are pollinated by insects howeverin this paper, 6 species were identified and recorded among the collected specimens.The collected plants were studied as taxonomy point of view and pollen morphology point of view.Pollen related families and genera are usually more or less the same type. The sculpture and pattern of the outer wall, exine, the number of aperture on the wall, size and shape of the pollen grain, etc. play an important role in identification and relationships of plants at various taxonomic levels.The flora adaptations of entomophilous flowers are large, conspicuous and brightly coloured to attract the insects. The flowers produce sweet smell and have nectar glands. The stigma is rough and sticky due to mucilaginous secretion. When flowers are small, they are grouped to produce inflorescence or some parts to become attractive.

Materials and methods

Plant collection and Identification

The entomophilous plants were collected from Dagon University Campus, East Dagon Area, Yangon Region.The collected plants were photographed to record their habits and flower characters.Identification of specimens was accomplished in accordance with the taxonomic procedures. Floristic literatures of Hooker (1885), Backer (1963-1968), Heywood (1993), Dassanayake (1980-1998) and HLI. Qi-ming and WU Delin (SCBG), (2007-2009) were used for the study and Myanmar names were referred to Hundley *et al*., (1987) and kress *et al*., (2003).

Pollen collection

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Pollen samples were freshly collected from the anthers of blooming flowers. For each species pollen was stored in glass vials with 1 cc of glacial acetic acid and then the specimen was labelled.

Acetolysis of pollen grains (Erdtman 1952)

The samples were transferred into a test-tube and then crushed with a galss rod and 1 cc of acetic acid and 5 to 9 drops of concentrated sulphuric acidwas added to it. Then it was heated in a waterbath to 70°C - 80°C for 15-30 minutes. On cooling, pollen sample was examined under light microscope.

Pollen measuring

Pollen grains were measured and recorded on their polar length (P); equatorial diameter (E); length and wide of the copi; diameter and length of pores and exine thickness. These measurements were based on 20 grains per sample. The terminology in the identification of pollen were used according to (Erdtman 1952; Moore *et al*. 1991; Paldat 2005; Hoen 1999; Hesse 2009).

Table1. Pollen shape classes (Erdtman, 1952)

Shape classes	(PA/ED) x 100
Per-oblate	< 0.50 μm
Oblate	0.50 - 0.75 μm
Sub-oblate	0.75 - 0.88 μm
Oblate spheroidal	0.88 - 0.99 μm
Spheroidal	1.00 μm
Prolate spheroidal	1.01 - 1.14 μm
Sub-prolate	1.14 - 1.33 μm
Prolate	1.33 - 2.00 μm
Per-prolate	2.00 μm >

Table2. Pollen size classes (Erdtman, 1945)

Size classes	Length of longest axis
Very small spores	< 10 μm
Small spores	10 - 25 μm
Medium size spores	25 - 50 μm
Large spores	50- 100 μm
Very large spores	100 - 200 μm
Gigantic spores	200 μm >

Results

1. Morphological character of *Zizyphus jujuba* (L.) Lamk. & Mill.

Trees; **stem**is cylindrical, about 4 m high. **Leaves**are simple, alternate, petiolate, puberulent, spinous stipules. **Inflorescences**are axillary, fascicle cymes.**Flowers**are white, bracteate, ebracteolate, pedicellate, bisexual, regular, actinomorphic, pentamerous, hypogynous. **Sepals** 5aposepalous, ovate, valvate, sepaloid. **Petals** 5 apopetalous, concave, valvate, petaloid(white). **Stamens** 5, apostemonous, opposite to the petals; filaments equal and curved; anthers dithecous, introrse, dorsifixed, longitudinally dehiscent, inferior. **Ovary**is superior, bicarpellary, syncarpous, bilocular, basal axile placentation; style very short; stigma bifid, disc present and superior.

Description of Pollen Morphology

Tricolporate, zonocolporate, suboblate, small, 16.2-18.0 x 19.5-21.2 µm in length and breadth; amb triangular; colpi longicolpate; pori lalongate; exine 1.2-1.7 µm thick, sexine thicker than nexine; sculpturing faintly reticulate.

2. Morphological character of *Luffa aegyptiaca* Mill.

Annual tendril, climbing **herbs**; **stems** stout. **Leaves** large**,** alternate, simple, petiolate.

Inflorescences - monoecious, male long or short racemose or clustered and female solitary.

Male flowersare yellow, bracteate, ebracteolate, pedicellate, incomplete, unisexual, regular, actinomorphic, pentamerous, cyclic, hypogynous. **Sepals** (5), synsepalous, campanulate, triangular, acute, valvate, sepaloid, persistent, inferior. **Petals** (5), synpetalous, campanulate, valvate, petaloid (yellow), inferior. **Stamens** (5) fuse, epipetalous; filaments synandrium; anther yellow, monothecous or dithecous, longitudinally dehiscent andsuperior.

Female flowersare yellow, **calyx** and **corolla** as in male flowers; **ovary**is inferior, tricarpellary, syncarpous, unilocular, parietal placentation; style short; stigma trilobes, disc absent.

Description of Pollen Morphology

Tricolporate, zonocolporate, oblate spheroidal, large, 67.5-75.0 x 70.0-82.5 µm in length and breadth; amb rounded; colpi parasyncolpate; pori lalongate; exine 2.5-3.7 µm thick, sexine thicker than nexine; sculpturing reticulate.

3. Morphological character of *Ludwigia adscendens* (L.) Hara

Perennial aquatic **herbs** with creeping or floating stems. **Leaves** are alternate, simple, petiole 0.5-1.0 cm, stipulate. **Inflorescences**are axillary and solitary cymes**. Flowers**are white or pale yellow, ebracteate, bracteolate, pedicellate, complete, bisexual, regular, actinomorphic, pentamerous, cyclic, epigynous. **Sepals** 5, lanceolate, aposepalous, valvate, sepaloid, persistent, superior. **Petals** 5, obovate, apopetalous, petaloid, contorted, superior. **Stamens** 5+5 are free, biseriate, the outer short with smaller anthers, antipetalous, the inner longer with larger anthers, antisepalous; filaments white; anthers dithecous, dorsifixed, extrorse, longitudinal, dehiscence, superior. **Ovary**is inferior, pentacarpellary, syncarpous, pentalocular, axile placentation; style short and stout; stigma capitate, disc present.

Description of Pollen Morphology

Triporate, zonoporate, suboblate, large, 50.0-55.0 x 60.0-65.0 µm in length and breadth; amb rounded triangular; pori circular, crassimarginate; exine 2.0-2.5 µm thick, sexine thicker than nexine; sculpturing reticulate.

4. Morphological character of *Malachra capitata* L.

Annual erect **herbs**; **stems** cylindrical, reddish-brown. **Leaves** simple, alternate, petiolate, stipulate. **Inflorescences** terminal and axillary, capitulum. **Flowers** yellow, campanulate, bracteate, ebracteolate, pedicellate, complete, bisexual, regular, actinomorphic, penta-merous, cyclic, hypogynous. **Epicalyx** absent. **Sepals** (5), synsepalous, lanceolate, campanulate, valvate, sepaloid, persistent, inferior. **Petals** 5, apopetalous, obovate, contorted, petaloid (yellow), deciduous, inferior. **Stamens** numerous, fused, monadelphous, epipetalous; staminal tube yellow; filaments filiform; anthers monothecous, extrorse, dorsifixed, longitudinally dehiscent, inferior. **Ovary** superior, ovoid, pentacarpellary, syncarpous, pentalocular, axile placentation; stigma five lobes, disc absent.

Description of Pollen Morphology

Polyporate (about 70-80), pantoporate, very large, 100.0-130.0 µm in diameter; amb circular; pori circular; exine 6.0-7.5 µm thick, sexine thinner than nexine; sculpturing echinate.

5. Morphological character of *Urena lobata* L.

Erect **shrubs**; **stems** woody, densely hairy. **Leaves** alternate, simple. **Inflorescences** axillary and solitary cymes, peduncle absent. **Flowers** pink, ebracteate, ebracteolate, pedicellate, green, tomentose, complete, bisexual, regular, actinomorphic, pentamerous, cyclic, hypogynous. **Epicalyx** 4-5, free, elliptic-lanceolate, connate at the base, pubescent. **Sepals** (5), synsepalous, campanulate, valvate, sepaloid (pale green), persistent, inferior. **Petals** 5, apopetalous, margin crenate, contorted, petaloid (pink), deciduous, inferior. **Stamens** numerous, fused, monadelphous, epipetalous; filaments filiform; anthers red, monothecous, extrorse, dorsifixed, longitudinal dehiscence, inferior. **Ovary** superior, globose, yellowish-green, pentacarpellary, syncarpous, pentalocular, axile placentation; style short and slender; stigma five branches, each with two lobes, dark pink or red, disc absent.

Description of Pollen Morphology

Polyporate (about 60), pantoporate, very large, 125.0-130.0 µm in diameter; amb circular; pori circular; exine 2.5-3.8 µm thick, sexine thicker than nexine; sculpturing echinate.

6. Morphological character of *Ixora coccinea* L.

Shrubs; **stems** cylindrical. **Leaves** opposite and decussate, simple, petiolate, stipulate, interpetiolar. **Inflorescences** dichasial paniculated cymes. **Flowers** red, bracteate, ebracteolate, complete, bisexual, regular, actinomorphic, tetramerous, cyclic, epigynous. **Sepals** (4), synsepalous, valvate, campanulate, glabrous, sepaloid, superior. **Petals** (4), synpetalous, salverform, contorted in buds, petaloid (red), superior. **Stamens** 4, apostemonous, alternate to the petals, epipetalous, exserted; filaments very short; anthers yellow, dithecous, introrse, basifixed, longitudinally dehiscent, superior. **Ovary** inferior, bicarpellary, syncarpous, bilocular, axile placentation; style long and terminal; stigma bifid.

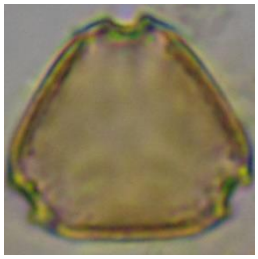
Description of Pollen Morphology

Tricolporate, zonocolporate, spheroidal, small, 22.5-25.0 µm in diameter; amb rounded; colpi longicolpate; pori lalongate; exine 2.5-3.0 µm thick, sexine thicker than nexine; sculpturing reticulate.

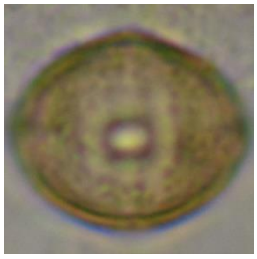
Figure 1.*Zizyphus jujuba* (L.) Lamk. & Mill.

Insect pollinated flower

Androecium and Gynoecium



Polar view of pollen



Equatorial view of pollen

Figure 2.*Luffa aegyptiaca* Mill.


Insect pollinated flower


Male flower

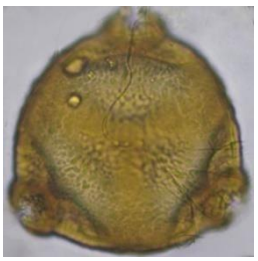

Polar view of pollen


Equatorial view of pollen

Figure 3. *Ludwigia adscendens* (L.) Hara


Insect pollinated flower


Androecium and Gynoecium


Polar view of pollen

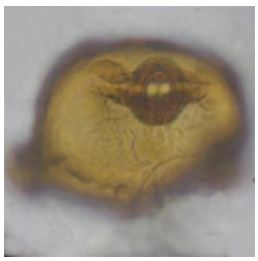
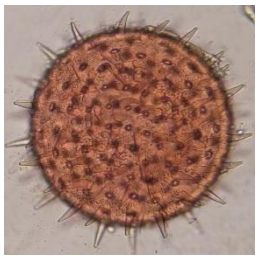

Equatorial view of pollen

Figure 4. *Malachra capitata* L.


Insect pollinated flower


Androecium and Gynoecium


Surface view of pollen

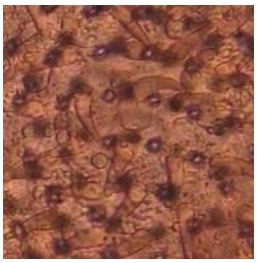
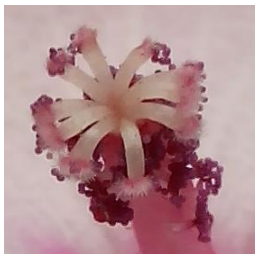
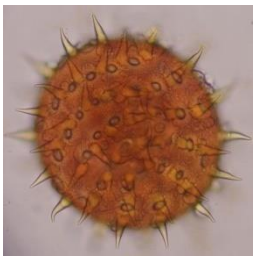

Surface view of pollen

Figure 5. *Urena lobata* L.


Insect pollinated flower


Androecium and Gynoecium


Surface view of pollen

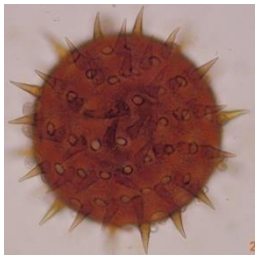
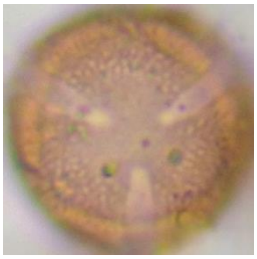

Surface view of pollen

Figure 6. *Ixora coccinea* L.


Insect pollinated flower


Androecium and Gynoecium


Polar view of pollen


Equatorial view of pollen

Discussion and conclusion

Entomophilous plant species have frequently evolved mechanisms to make themselves more appealing to insects, such as they are brightly coloured or scented flowers, nectar or appealing shapes and patterns. The ideal pollinating insect is hairy so that pollen adheres to itss body and spends time exploring the flowers and it comes into contact with the reproductive structure. In the present work, 6 entomophilous plant species belong to 6 genera of 5 families.

The size of pollen grains classes based on the length of the longest spore axis have been suggested (Erdtman, 1945). Hesse (2009) described that pollen size varies from less than 10µm to more than 100 µm. Very small spores are less than 10µm, small 10-25 µm, large 51-100 µm and very large more than 100 µm. In the study, the sizes of pollen are found as small, medium, large and very large grains.

Walker and Doyle (1975) stated that the sculpture patterns on appearance are also varies significantly from one species to another. In this research, the sculpture pattern of the pollen were observed as reticulate and echinate.

In this present study, *Zizyphus jujuba* (L.) Lamk. & Mill. is tree; leaves simple, alternate, stipulate. The flower bisexual, regular; the sepals and petals are each five, valvate; stamens five; ovary superior. These characters are in accordance with those that described by Heywood (1993). Pollen grains 3-colporate, suboblate, triangular, Erdtman, G. (1952).

In this present research, *Luffa aegyptiaca* Mill. is annual tendril, climbing herb. Leaves alternate, simple. Inflorescence solitary; unisexual; the sepals and petals are each (5), petaloid yellow; stamens (5), filaments synandrium; ovary inferior, unilocular, parietal placentation, which are in accordence with those stated by Hooker (1993). Pollen grains tricolporate; oblate to prolate; sexine thicker than nexine; reticulate, Erdtman, G. (1952).

Ludwigia adscendens (L.) Hara. is perennial herb. Leaves alternate, simple, stipulate; the margins entire. Flowers bisexual, actinomorphic. Sepals 5, valvate, persistent. Petals 5. Stamens 5+5, the anthers dithecous. Ovary inferior, pentacarpellary, axile placentation; the stigma capitate, which are in agreement with those stated by Warren L. Wagner, Flora of Ceylon (vol-IX, 1995). Pollen grains triporate; amb rounded triangular, Erdtman, G. (1952).

In this present study, *Malachra capitata* L., and *Urena lobata* L. are separated the following characters. *Malachra capitata* L. is herb. Peduncles stellate hairy. Flowers yellow. Epicalyx absent. *Urena lobata* L. is shrub; stems stellate hairy. Flowers pink. Epicalyx present, which are in agreement with those stated by HU Shiu-ying, flora of Hong Kong (vol-I, 2007). Pollen grains polyporate; sculpturing echinate, (Erdtman, G. 1952).

Ixora coccinea L. is shrub, about 1 m high. The laminae elliptic, oblong or obovate. The character is in accordance with those that described by Heywood (1993). Pollen grains 3-4 colporate; sculpturing reticulate, (Erdtman, G. 1952).

In conclusion, plants and pollinators have co-evolved physical characteristics and it makes them more likely to interact successfully, which has in turn led to the great diversity of flower in nature. The plants benefit from attracting a particular type of pollinators to its flower, ensuring that pollen will be carried to another flower of the same species and hopefully resulting in successful reproduction. Therefore, these helping pollinators are essential to our continued survival, health and well-being. Not only they pollinate most of the flowering plants, but also benefit us all because of the invaluable ecosystem services they provide to the enviroments and to our farms, forests and gardens.

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