

## Research Article

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# Comparative Study of Pollen Morphology of some members of Euphorbiaceae family

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Accepted 19 May 2014

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### Abstract

Pollen morphology is of great significance in taxonomy, phylogeny, palaeobotany, aeropalynology and pollen allergy. Five (5) species of the family Euphorbiaceae (*Euphorbia hirta*, *Euphorbia hyssopiifolia*, *Euphorbia heterophylla*, *Ricinus communis* and *Jatropha gossypifolia*) were studied palynologically to determine the morphological features and diversity as an aid in the classification of its members. Pollen analytical studies of these species showed a lot of variations in the types of apertures, shapes, sexine pattern, pollen size, colpi length and width. However, the variations above are generally reduced within species of the same genera. For instance, *E. hirta*, *E. heterophylla* and *E. hyssopiifolia* were observed to have tricolpate ( $C_3$ ) aperture type giving reason for them being in the same genera. Similar form and symmetry observed in all the species studied also were reason for them being in the same family.

**Keywords:** Pollen morphology, Exine structure, Euphorbiaceae

## INTRODUCTION

Analysis of fossil pollen grains is the most important approach to reconstruction of past flora, vegetation and environment (Faegri and Iversen, 1989). Pollen morphology is also important in understanding the functional aspects of pollen such as pollination biology and pollen- pistil interaction. Pollen identification, the basis of palynology, is based exclusively on pollen morphology. Pollen morphology is of great significance in taxonomy, phylogeny, palaeobotany, aeropalynology and pollen allergy. Pollen of various plants representing potential source of nectar and pollen for the honeybees is an important pre-requisite for the developing apiary (Kalpana and Ramanujam, 1997). Pollen study has significant application in the recognition of bee plants. Kral (1992) has made palynological investigation of forest trees in relation to forest history and natural mixture of tree species on the basis of their pollen profile. Pollen from different flowers has specific shapes, size and ornamentation. Microscopical analysis of pollen of plants forged by bees is an established method to determine the source of honey in an area (Shubharani *et al.*, 2013). Adekanmbi and Ogundipe (2006) described the pollen morphology of twenty (20) cultivated plants of Nigeria.

Euphorbiaceae, the spurge family is a large family of flowering plants with 300 genera and about 7,500 species belonging to the order Euphorbiales (AiryShaw, 2009). The order consists of five (5) families and Euphorbiaceae is the largest of them. Most are herbs, but some, especially in the tropics, are also shrubs or trees. The family Euphorbiaceae is assessed taxonomically and phylogenetically in the light of different disciplines of botany. It lacks anatomical homogeneity, probably because of diverse habits and habitats. It is heterogeneous palynologically, chemically and embryologically. It is however, fairly homogenous from embryological point of view (Rao and Airyshaw, 2003). Euphorbiaceae is of considerable economic importance since members of this family provide drugs for human health, food for consumption, rubber, timber and ornamentals for recreational purposes. They provide a large variety of

phytotoxins (toxic substances produced by plants), mainly *diterpene esters*, alkaloid, glycosides and ricin-type toxins. This study focuses mainly on the pollen morphology of five (5) species in this family. They are: *Euphorbia hirta*, *Euphorbia heterophylla*, *Euphorbia hyssopifolia*, *Jatropha gossypifolia* and *Ricinus communis*. All the species mentioned are shrubs with the exception of *Euphorbia hirta*, which is an herb.

Noor *et al.*, (2004) has done the palynological studies of cultivated plants of Rawalpindi, Pakistan. Perveen and Qaiser (2009; 2010) conducted the pollen studies of the family Moringaceae and Berberidaceae. Several taxonomists identify plant species on the basis of phenotypic character of plant. But now the pollen morphological studies can provide a basis for the identification of plant species.

The report of a comprehensive and elaborate pollen morphological studies of this nature in the study environment is almost non-existing. The study is aimed at comparing pollen morphology of five members of Euphorbiaceae family (*Euphorbia hirta*, *Euphorbia heterophylla*, *Jatropha gossypifolia*, *Ricinus communis* and *Euphorbia hyssopifolia*) as an aid in the classification of its members. The results of this study would provide baseline information on the identification, classification, conservation and sustainable exploitation of members of this family through appropriate biotechnological measures.

## MATERIAL AND METHODS

Fresh pollen samples were collected from the flowers of *Euphorbia hirta*, *E. heterophylla*, *E. hyssopifolia*, *Ricinus communis* and *Jatropha gossypifolia* within Kogi State University campus, Anyigba in October, 2011. Anthers from both flower buds and the already opened flowers were carefully removed with a piercing needle and a pair of forceps and crushed in a beaker containing alcohol. These were sieved, centrifuged at 2,500 r.p.m for 5 minutes and decanted. The pollen sediments were treated with glacial acetic acid to remove water before acetolysis. Acetolysis mixture was freshly prepared in a ratio of 9:1 from acetic anhydride and concentrated sulphuric acid. Acetolysis was carried out by boiling the sediments in a water bath at 100°C (Erdtman, 1969; Agwu and Akanbi, 1985). The mixture was placed in water-bath at 100°C for 5 minutes, stirred and then centrifuged for five (5) minutes and supernatant decanted. The recovered precipitates were washed with glacial acetic acid, and finally washed twice with distilled water, centrifuged each time and decanted. The recovered precipitates were stored in a plastic vials in glycerin and ethanol solution (2:1).

One drop of thoroughly shaken precipitates suspension was mounted on microscope slide and covered with an 18×18mm cover slip. The mount was sealed off with colourless nail varnish to prevent drying up of the precipitates. The prepared slide was then examined microscopically with Olympus microscope at x400 magnification for counting and Leica microscope at x1000 magnification for detailed morphological studies. Pollen identification, morphological examination and analysis was done with the help of reference descriptions and photomicrographs from Agwu and Akanbi (1985); Shubharani *et al.*, 2013 and prepared slides of pollen samples in the Palynological Research Unit; Department of Biological Sciences, Kogi State University, Anyigba.

## RESULTS AND DISCUSSIONS

Five (5) species in the family *Euphorbiaceae* namely: *Euphorbia hirta*, *Euphorbia heterophylla*, *Euphorbia hyssopifolia*, *Ricinus communis* and *Jatropha gossypifolia* were studied and analyzed palynologically. For each pollen species studied, the morphological features that were investigated include; the aperture, sculpturing pattern, size of the pollen grain, exine thickness, colpi length and width.

In taking down the dimensions and other parameters, averages of ten (10) pollen grains were used and this helped in easy description and convenient identification of the pollen studied.

### POLLEN DESCRIPTION

*Euphorbia hirta*. Linn

**Aperture:** Tricolpate (C<sub>3</sub>). Colpi usually as long as P. axes, colpi clearly distinct.  
**Colpi length:** 15.3µm (10.0-15.0) µm  
**Colpi width:** 0.6µm (0.3-0.8)µm  
**Dimensions:** P = 18.5 µm (15.0-22.5) µm  
 E = 13.7 µm (12.5-17.5) µm  
 P/E = 1.35  
 Longest axis: 22.5 µm

**Exine:** Sexine finely reticulated, nexine thinner than sexine.  
 Total exine thickness: 1.5µm (1.1-1.9) µm  
 Sexine: 1.01 µm (0.7-1.2) µm  
 Nexine: 0.49µm (0.3-0.7) µm  
 S/N: 2.06  
 Exine thickness: medium  
**Sculpturing:** Fine reticulation  
**Form and symmetry:** Isopolar, radially symmetrical. Grain: small size.  
 Shape class: subprolate to prolate.

*Euphorbia hyssopifolia*. Linn

**Aperture:** Tricolpate (C<sub>3</sub>). Colpi usually as long as P axes, colpi clearly distinct.

Colpi length: 16.0 µm (13.5-18.5) µm

Colpi width: 0.92 µm (0.8-1-) µm

**Dimensions:** P = 20.5 µm (17.5-25.0) µm

E = 16.4 µm (12.5-20) µm

P/E = 1.38

Longest axis: 25 µm

**Exine:** Sexine finely reticulated, nexine thinner than sexine. Total exine thickness: 1.62 µm (1.2-2.0) µm

Sexine: 1.12 µm (0.8-1.3) µm

Nexine: 049 µm (0.3-0.7) µm

S/N = 2.29

Exine thickness: medium

**Sculpturing:** Fine reticulation

**Form and Symmetry:** Isopolar, radially symmetrical, the shape ranges from subprolate to prolate. Grain: small size.

*Ricinus communis*. Linn

**Aperture:** Tricolporate (C<sub>3</sub>P<sub>3</sub>), zonocolporate, colpi not clearly distinct, colpi as long as P axes. Pori equatorially elongated.

Pore = os ± rectangular. Amb circular, ora transversally elliptic

Colpi length: 22.6 µm (16.5-22.6) µm

Colpi width: 0.81 µm (0.6-1.0) µm

Dimension: P = 27.3 µm (22.5-30.0) µm

E = 24.0 µm (22.5-30) µm

P/E = 1.15.

Longest axis: 30.0 µm

**Exine:** Rather thin (0.97). nexine thinner than sexine, sexine finely reticulate, tectum psilate.

Total exine thickness: 0.97 µm (0.8-1.1) µm

Sexine: 0.68 µm (0.5-0.7) µm

Nexine: 0.29 µm (0.2-0.4) µm

S/N = 2.34

**Sculpturing:** Scabrate (made up of scabrae).

**Form and Symmetry:** Isopolar, radially symmetrical. Shape class: prolate spheroidal to subprolate. Grain medium size.

*Euphorbia heterophylla*. Linn

**Aperture:** Tricolpate (C<sub>3</sub>). Colpi not clearly distinct

Colpi length: 38.6 µm (30.0-39.0) µm

Colpi width: 1.5 µm (1.0-2.0) µm

**Dimensions:** P = 44.0 µm (37.5-47.5) µm

P/E = 1.08

Longest axes: 50 µm

**Exine:** Rather thick. Sexine pattern; Gammate

Total exine thickness: 1.8 µm (1.0 2.7) µm

Sexine: 1.25 µm (0.7-1.7) µm

Nexine: 0.61 (0.3-1.0) µm

S/N = 2.0

Sculpturing: Coarsely reticulated

Forms and symmetry: Isopolar, radially symmetrical. Shape class; prolate spheroidal. Grain medium size.

*Jatropha gossypifolia*. Linn

Aperture: Inaperturate

Dimensions: P = 69.6  $\mu\text{m}$  (65-75)  $\mu\text{m}$ E = 67.8  $\mu\text{m}$  (64.0-70.0)  $\mu\text{m}$ 

P/E = 1.01

Longest ax: 75.0  $\mu\text{m}$ 

Exine: thick. Nexine thinner than the sexine. Grain tectate, stratification indistinct.

Total exine thickness: 3.7  $\mu\text{m}$  (3.0-4.0)  $\mu\text{m}$ Sexine: 2.55  $\mu\text{m}$  (2.0-3.0)  $\mu\text{m}$ Nexin: 1.19  $\mu\text{m}$  (0.9-1.5)  $\mu\text{m}$ 

S/N = 2.15

Sculpturing: Coarse reticulation

Form and symmetry: Isopolar, radially symmetrical. Grain large size. Shape class: circular.

**Table 1.** Summary of Pollen Morphological Characteristics of the Species Studied

SpeciesMorphological features	<i>Euphorbia hirta</i>	<i>Euphorbia hyssopifolia</i>	<i>Euphorbia heterophylla</i>	<i>Ricinus communis</i>	<i>Jatropha gossypifolia</i>
Polar distance P Mean and Range ( $\mu\text{m}$ )	18.5 (15.0-22.5)	20.5 (17.5-25.0)	44.0 (40.0-50.0)	27.3 (22.5-30.0)	69.6 (65.0-75.0)
Equatorial distance E Mean and Range ( $\mu\text{m}$ )	13.7 (12.5-17.5)	16.4 (2.5-20.0)	40.5 (37.5-47.5)	24.0 (22.5-30.0)	67.8 (64.0-70.0)
P/E	1.35	1.38	1.08	1.15	1.01
Shape	Sub-prolate to prolate	Sub-prolate to prolate	Prolate to spheroidal	Prolate spheroidal to sub-prolate	Circular
Exine thickness ( $\mu\text{m}$ )	1.5 (1.1-1.9)	1.62 (1.2-2.0)	1.8 (1.0-2.7)	0.97 (0.8-1.1)	3.7 (3.0-4.0)
No. of Aperture	3	3	3	3	Inaperture
Exine pattern	Fine reticulation	Fine reticulation	Gemmate	Fine reticulation	Coarse reticulation
Sculpturing	Fine reticulation	Fine reticulation	Coarse reticulation	Scabrate	Coarse reticulation

In this study, variations in the family are reduced within species of the same genera. These variations were observed by their aperture and its modifications, the various shapes, sexine pattern, colpi length and width. In contrary, the sculpturing pattern of all the pollen species studied apart from that of *Ricinus communis* showed consistency in being reticulate. Findings agree favourably with the report of Gosh *et al.* (2007). This study revealed that, the family is mostly multipalynous and the results agrees favourably with the reports of Muhammed *et al.* (2007) who highlighted the taxonomic utility of the Family Euphorbiaceae at different hierarchy. All the species studied in this family are essentially radially symmetrical and isopolar and this agrees with the report of Dallwitz and Watson (1992).

Inter and intrageneric variations in shape range from circular to prolate. For instance, in the genus *Euphorbia*, *E. hirta* and *E. hyssopifolia* are subprolate to prolate and this agrees with the description of Gosh *et al.* (2007). However, *E. heterophylla* were observed to be prolate spheroidal in this same genus. Other pollen species from other genera like *Ricinus communis* were observed to be prolate spheroidal to subprolate and that of *J. gossypifolia* circular.

The aperture of *R. communis* is *tricolporate* ( $C_3P_3$ ) as revealed by this present study and this also agrees favourably with the descriptions of Gosh *et al.* (2007), while *E. hirta*; *E. heterophylla* and *E. hyssopifolia* all belonging to the same genus were found to be *tricolpate* ( $C_3$ ), and *J. gossypifolia* *inaperturate*. The sexine pattern of the species studied are generally finely reticulate with the exception of *E. heterophylla* which is gemmate. Exine thickness ranges from rather thin (0.97) as found in *R. communis* to thick (3.7) as in *J. gossypifolia*. However, most of species studied belong to medium class of exine thickness, except in *E. heterophylla* which is rather "thick". Sizes of various pollen species studied also varies, ranging from small size in *E. hirta* and *E. hyssopifolia* to large size as found in *J. Gossypifolia* and *R. communis* belong to medium class of pollen size. Since absolute pollen size is a relative parameter which is subject to a great deal of variation depending on among other factors-method of preparation, age of pollen slides and the level of maturity of pollen grains, the parameter seems of least specificity and hence, of limited diagnostic significance and therefore, much importance should not be attached to the size variation shown above.

## CONCLUSION

Most pollen grains of Euphorbiaceae family are isopolar and radially symmetrical. According to this study, the variations and similarities in pollen morphological characters within the genera and species are enough to confirm and throw more light on its taxonomic classifications. These studies will be useful for identifying the flora and improve the conservation status of economically important plants as well as acting as a reference guide in identifying various species in their respective families.

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