POLLEN MORPHOLOGICAL STUDIES OF THE SUBFAMILY CAESALPINIOIDEAE (LEGUMINOSAE) FROM SOUTHERN NIGERIA

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Abstract

Pollen morphological studies of 39 species belonging to 9 genera of the subfamily Caesalpinioideae have been carried out. Some of the observations are compared with earlier investigations. Besides, some intra-specific variations have also been given.

Introduction

The subfamily Caesalpinioideae comprises 152 genera and 28,000 species (Polhill *et al.*, 1981), mainly trees and shrubs of tropical savanna and forest of South America, tropical Africa and Asia. Hutchinson and Dalziel (1958) reported 58 genera and 192 species from West Africa and out of these, 42 genera and 101 species occur in Nigeria.

Earlier contributions on the pollen morphology of subfamily Caesalpinioideae are by Brenan (1963, 1967), Cowan (1968, 1975, 1981), Erdtman (1952), Ferguson (1980), Graham and Barker (1980), Graham *et al.* (1980), Larsen (1975), Senesee (1976) and Smith (1964). From Nigeria, the only notable contribution is by Sowunmi (1973) who studied 18 species distributed in 14 genera. The present paper is a continuation of a project "Biology of Nigerian legumes" and reports the pollen morphology of 39 species belonging to 9 genera.

Material and Methods

Polliniferous material was obtained from specimens collected and deposited by Dr Husaini, S. W. H. in the herbarium of the Botany Department, University of Benin, Nigeria. The taxa studied along with their life forms, pollen characteristics and N. P. C. formulae are summarised in Table 1. The measures recorded for the various pollen grain dimensions are the average of measurements of 10 grains (mean & range) and the terminology used in this paper is that of Erdtman (1952) and Faegri and Iversen (1964). The pollen slides, etc. were prepared by the usual standard techniques (Erdtman, 1960; Nair, 1970).

Description

TRIBE—AMHERSTIEAE

Berlinia confusa Hoyle

Pollen grains radially symmetrical, isopolar, amb rounded-triangular, lobate, subprolate.

P = 51.00 μm (46.8-55.2 μm)
E = 41.50 μm (36.4-46.6 μm)
P/E = 1.23

Table 1—Summary of the palynological data of the southern Nigerian Caesalpiniodeae

Taxa	*Life Form	Polar Axis		Equitorial Axis		P/E Index	N.P.C. Formula
		Range (μm)	Mean (μm)	Range (μm)	Mean (μm)		
Tribe : Amherstieae							
Berlinia confusa Hoyle	T	46.8-55.2	51.00	36.4-46.6	41.50	1.23	343
B. coriacea Keay	T	43.2-52.8	48.00	33.6-40.0	36.80	1.30	343
Gilbertiodendron demonstrans (Baill) J. Leonard	T	51.3-60.2	55.75	44.3-49.8	47.05	1.18	345
G. dewevrei (DeWilld.) J. Leonard	T	27.7-34.7	31.20	24.1-25.9	25.0	1.25	345
G. mayombense (Pellegr.) J. Leonard	T	29.6-36.7	33.15	26.0-33.1	29.55	1.12	345
Tamarindus s indica L.	T	32.6-43.0	37.70	35.6-39.2	37.40	1.01	345
Tribe : Caesalpinieae							
Caesalpinia pulcherrima (L.) Sw. (pink)	S	68.9-70.8	69.85	68.9-69.0	68.95	1.01	343
C. pulcherrima (L.) Sw. (red.)	S	77.8-79.7	78.75	69.0-72.8	70.90	1.11	343
C. pulcherrima (L.) Sw. (Yellow)	S	67.9-70.2	69.05	67.2-70.2	68.70	1.01	343
Peltophorum pterocarpum (DC). Backer	T	40.7-49.5	45.10	47.7-67.4	57.45	0.79	343
Tribe : Cassieae							
Cassia alata L.	S	16.5-21.8	19.15	14.7-18.3	16.50	1.16	345
C arereh Del.	T	33.6-40.7	37.15	24.7-33.6	29.15	1.27	345
C. auriculata L.	T	35.8-44.7	40.25	23.0-30.1	26.55	1.52	345
C. bicapsularis L.	S	28.3-31.8	30.05	20.1-23.2	21.65	1.39	345
C. corymbosa Lam.	S	27.2-35.2	31.20	22.4-27.2	24.80	1.25	345
C corymbos var. *plurijuga* Lam.	S	29.2-31.6	30.40	27.0-28.8	27.90	1.09	345
C. fistula L	T	30.1-33.6	31.85	19.4-24.7	22.05	1.44	345
C. hirsuta L.	S	39.6-46.4	43.00	36.3-41.6	38.95	1.10	345
C. jaegeri Keay	H	25.6-33.0	29.30	25.6-27.7	26.65	1.10	345
C. laevigata Willd.	S	10.4-19.6	15.00	9.2-16.4	12.80	1.17	345
C. marginata Roxb.	T	14.3-19.6	16.95	11.0-16.3	13.65	1.24	345
C. mimosoides L.	S	17.8-22.4	20.10	17.1-21.3	19.20	1.05	345
C. multijuga Rich.	S	28.3-35.4	31.85	21.2-31.8	26.50	1.20	345

Contd **Table—1**

Taxa	*Life Form	Polar Axis		Equitorial Axis		P/E Index	N P C Formula
		Range (μm)	Mean (μm)	Range (μm)	Mean (μm)		
C. nodosa Buch.-Ham ex Roxb.	T	26.1-42.5	34.30	23.2-37.4	30.30	1.13	345
C. obtusifolia L.	S	28.3-35.4	31.85	26.5-33.6	30.05	1.06	345
C. occidentalis L.	S	31.1-38.2	34.65	15.7-26.4	21.05	1.65	345
C. plansiliqua L.	T	26.5-37.1	31.80	25.0-35.6	30.30	1.05	345
C. podocarpa Guill & Peer	S	31.8-38.9	35.35	24.7-35.4	30.05	1.18	345
C. Siamea Lam.	T	31.8-38.9	35.35	29.4-34.7	32.05	1.10	345
Cassia sieberiana DC.	T	24.4-28.8	26.60	28.3-31.6	29.95	0.89	345
C. sophera L.	S	28.8-35.2	32.00	28.8-32.0	30.40	1.05	345
C. spectabilis DC.	T	37.7-48.1	42.90	28.9-34.5	31.70	1.35	345
Dialium guineense Willd.	T	16.4-23.6	20.00	10.3-14.1	12.20	1.64	345
Tribe : Cercideae							
Bauhinia forficata Link.	S	72.0-79.2	75.60	67.2-72.6	69.90	1.08	345
B. monandra Kurz	S	43.2-56.1	49.65	44.8-52.8	48.80	1.02	345
B. purpurea L.	T	36.8-56.1	46.46	36.3-44.2	40.25	1.15	345
B. tomentosa L.	S	35.5-53.1	44.30	31.7-47.3	39.50	1.12	345
Tribe : Detarieae							
Afzelia bella Harms var. *Bella*	T	27.1-58.2	42.65	27.3-48.4	35.8	1.19	345
A. bipindensis Harms	T	26.1-52.5	39.30	21.5-47.6	34.55	1.14	345

* H=HERBS; S=SHRUBS; T=TREES; L=LIANAS

Aperture tricolpate, zonally arranged, colpi length 28.8 μm, medially constricted, membrane granular and thin, margin distinct. Exine uniformly thickened (3.2 μm); Sexine 1.8 μm thick, subtectate, division not clear, greatly striated. Nexine 1.3 μm thick, dark in colour.

B. coriacea Keay

(Pl. 1, Fig. 1)

Pollen grains radially symmetrical, isopolar, amb rounded triangular, lobate, subprolate.

P = 48.00 μm (43.2-52.8 μm)
E = 36.80 μm (33.6-40.0 μm)
P/E = 1.30

Aperture tricolpate, zonally arranged, colpi length 20.8 μm, medially constricted, membrane thin, finely granular, margin distinct. Exine uniformly thickened (3.8 μm); Sexine 2.7 μm thick, subtectate, striate, ectosexine 1.2 μm thick, endosexine 1.5 um thick, columellate. Nexine 1.0 μm thick, dark in colour.

Gilbertiodendron demostrans (Baill) J. Leonard
(Pl. 1, Fig. 2)

Pollen grains radially symmetrical, isopolar, amb rounded-triangular, angulaperturate, subprolate.

P = 55.75 μm (51.3-60.2 μm)
E = 47.05 μm (44.3-49.8 μm)
P/E = 1.18

Aperture tricolporate, zonally arranged, colpi length 40.71 μm, colpi tapers sharply to a point before the pole, margin distinct, os circular, diameter 4.10 μm. Exine uniformly thickened (4.1 μm); Sexine 2.4 μm thick, subtectate, striate, division not distinct. Nexine 1.4 μm thick, smooth, brown in colour.

G. dewevrei (De Willd) J. Leonard.

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, subprolate.

P = 31.20 μm (27.7-34.7 μm)
E = 25.00 μm (24.1-25.9 μm)
P/E = 1.25

Aperture tricolporate, zonally arranged, colpi length 14.1 μm, tapers towards the pole, margin distinct, membrane thin and granular, os circular, diameter 7.09 μm. Exine uniformly thickened (2.4 μm); Sexine 1.3 μm thick, subtectate, coarsely striate, division not clear. Nexine 1.0 μm thick, smooth, dark in colour.

G. mayombense (Pellegr.) J. Leonard

Pollen grains radially symmetrical, isopolar, amb rounded triangular, angulaperturate, prolate spheroidal.

P = 33.15 μm (29.6-36.7 μm)
E = 29.55 μm (26.0-33.1 μm)
P/E = 1.12

Aperture tricolporate, zonally arranged, colpi length 19.2 μm, tapers to a point, outline of os indistinct, membrane thin and granular. Exine uniformly thickened (2.7 μm); Sexine 1.2 μm thick, subtectate, finely reticulate, division not clear. Nexine 1.4 μm thick, smooth, dark in colour.

Tamarindus indica L.

Pollen grains radially symmetrical, isopolar, amb circular, apocolpium circular, diameter 12.41 μm, angula-perturate, subprolate.

P = 37.70 μm (32.4-43.0 μm)
E = 37.40 μm (35.6-39.2 μm)
P/E = 1.01

Aperture tricolpoidorate, zonally arranged, pore diameter 9.6 μm, membrane thin

but slightly protruding beyond grain surface, operculum present. Exine uniformly thickened (2.6 μm); Sexine subtectate, 0.7 μm thick, reticulate, lumina small, circular, division not clear. Nexine 1.9 μm thick, slightly wavy.

TRIBE—CAESALPINIEAE

Caesalpinia pulcherrima (L.) Sw. Pink Flower
(Pl. 1, Fig. 3)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 69.85 μm (68.0-70.8 μm)
E = 68.95 μm (68.9-69.0 μm)
P/E = 1.01

Aperture trisyncolporate, colpi united at the pole with arm length 35.14 μm, membrane thin and slightly granular, margin diffused. Exine uniformly thickened (3.5 μm); Sexine 2.4 μm thick, subtectate, reticulate, ectosexine 1.4 μm thick, minutely pilate, endosexine 1.0 μm thick, columellate. Nexine 1.0 μm thick, smooth, slightly wavy outline.

C. pulcherrima (L.) Sw. Red Flower
(Pl. 1, Fig. 4)

Pollen grain radially symmetrical, isopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 78.75 μm (77.8-79.7 μm)
E = 70.90 μm (69.0-72.8 μm)
P/E = 1.11

Aperture trisyncolporate, colpi united at the pole with arm length 35.12 μm, membrane thin and granular, margin diffused, os circular, diameter 6.2 μm. Exine uniformly thickened (3.6 μm); Sexine 2.5 μm thick, subtectate, reticulate, lumina circular, small, ectosexine 1.7 μm thick, endosexine 0.8 μm thick, columellate. Nexine 1.0 μm thick, smoothly dark.

C. pulcherrima (L.) Sw. Yellow Flower
(Pl. 1, Fig. 5)

Pollen grains radially symmetrical, isopolar, amb circular, prolate-spheroidal, angulaperturate,

P = 69.05 μm (67.9-70.2 μm)
E = 68.70 μm (67.2-70.2 μm)
P/E = 1.01

Aperture trisyncolporate (rarely trisyncolporate as found in 3% of the grains inspected), colpi united at the pole with arm length 2.91 μm, margin diffused, faintly demarcated, os circular, diameter 4.68 μm. Exine uniformly thickened (3.3 μm); Sexine 1.8 μm thick, subtectate, reticulate, minutely pilate, ectosexine 0.9 μm thick, endosexine 0.8 μm thick, columellate. Nexine 1.5 μm thick, light brown in colour, smooth.

Peltophorum pterocarpum (DC.) Backer
(Pl. 1, Fig. 6)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, suboblate.

P = 45.10 μm (40.7-49.5 μm)
E = 57.45 μm (47.7-67.2 μm)
P/E = 0.79

Aperture tricolpate, zonally arranged, colpi length 31.86 μm, margin not distinct, membrane thin and granular. Exine uniformly thickened (4.2 μm); Sexine 2.4 μm thick, subtectate, wavy, reticulate, ectosexine 1.4 μm thick, retipilate, endosexine 1.0 μm thick, columellate, lighter in colour than ectosexine. Nexine 1.8 μm thick, smooth dark.

TRIBE—CASSIEAE

Cassia alata L.

Pollen grain radially symmetrical, isopolar, amb rounded triangular, angulaperturate, prolate-spheroidal.

P = 19.15 μm (16.5-21.8 μm)
E = 16.50 μm (14.7-18.3 μm)
P/E = 1.16

Aperture tricolporate, zonally arranged, colpi length 11.24 μm, tapers to the pole, membrane thin, smooth, slightly protruding beyond grain surface in 20% of the grains inspected, margin distinct, os circular, diameter 5.39 μm. Exine uniformly thickened (3.3 μm), Sexine 1.4 μm thick, tectate, psilate, ectosexine 0.9 μm thick, endosexine 0.4 μm thick, columellate. Nexine 1.9 μm thick, smooth.

C. arereh Del.

(Pl. 1, Fig. 7)

Pollen grains radially symmetrical, isopolar, amb rounded to triangular, side length 35.30 μm, angulaperturate, subprolate, apocolpium triangular, side length 11.86 μm.

P = 37.15 μm (33.6-40.7 μm)
E = 29.15 μm (24.7-33.6 μm)
P/E = 1.27

Aperture tricolporate, zonally arranged (rarely triporate as found in 10% of the grains inspected), colpi length 17.17 μm, os circular, diameter 7.08μm (in colporate grains). Pore diameter in porate grains 8.85 μm, membrane thin, slightly protruding beyond grain surface. Exine uniformly thickened (2.8 μm); Sexine 1.4 μm thick, tectate, psilate, ectosexine 0.7 μm thick, endosexine 0.7 μm thick, columellate. Nexine 1.3 μm thick, slightly wavy.

C. auriculata L.

(Pl. 1, Fig. 8)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate.

P = 40.25 μm (35.8-44.7 μm)
E = 26.55 μm (23.0-30.1 μm)
P/E = 1.52

Aperture tricolporate, zonally arranged, colpi length 17.17 μm, constricted medially, hardly tapers to the pole membrane thin, smooth, flat on the grain surface, os circular,

diameter 8.62 μm. Exine uniformly thickened (2.6 μm); Sexine 1.6 μm thick, tectate, psilate, ectosexine 0.8 μm thick, endosexine 0.7 μm thick, columellate. Nexine 1.0 μm thick, smooth, dark brown in colour.

C. bicapsularis L.

(Pl. 1, Fig. 9)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate.

P = 30.05 μm (28.3-31.8 μm)

E = 21.65 μm (20.2-23.2 μm)

P/E = 1.39

Aperture tricolporate, zonally arranged, colpi taper to a point near the pole, length 14.16 μm, membrane thick and slightly protruding beyond grain surface, margin distinct, os circular, diameter 5.16 μm. Exine uniformly thickened (3.4μm); Sexine 1.9 μm thick, tectate, psilate, ectosexine 7.0 μm thick, endosexine 0.9 μm thick, columellate. Nexine 1.4 μm thick, smooth, mottled brown.

C. corymbosa Lam.

Pollen grains radially symmetrical, amb rounded triangular, isopolar, lobate, apocolpium small, circular, diameter 3.14 μm, subprolate.

P = 31.20 μm (27.2-35.2 μm)

E = 24.80 μm (22.4-27.2 μm)

P/E = 1.26

Aperture tricolporate, zonally arranged, colpi length 20.00 μm, membrane thin, and smooth, margin distinct, os circular, small, diameter 2.43 μm. Exine uniformly thickened (2.4 μm); Sexine 1.6 μm thick, subtectate, LO pattern minutely pilate, ectosexine 0.6 μm thick, endosexine 1.0 μm thick, columellate. Nexine 0.7 μm thick, smooth, darker than sexine.

C. corymbosa Lam. var, *plurijuga*

(Pl. 1, Fig. 10)

Pollen grains radially symmetrical, isopolar, circular in colpate grains and rounded-triangular in colporate grains, angulaperturate in colporate grains and lobate in colpate grains, prolate spheroidal.

P = 30.40 μm (29.2-31.6 μm)

E = 27.90 μm (27.0-28.8 μm)

P/E = 1.09

Aperture tricolporate, zonally arranged (rarely tricolpate as found in 20% of the grains inspected), colpi length 17.6 μm, membrane thick, slightly bulging out in colporate grains, os circular, diameter 5.26 μm. Exine uniformly thickened (2.2 μm); Sexine 1.7 μm thick, subtectate, minutely pilate, ectosexine 0.7 μm thick, endosexine 1.0 μm thick, collemellate. Nexine 0.4 μm thick, smooth.

C. fistula L.

(Pl. 1, Fig. 11)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate.

P = 31.85 μm (30.1-33.6μ m)
E = 22.05 μm (19.4-24.7 μm)
P/E = 1.44

Aperture tricolporate, zonally arranged, colpi length 19.47 μm, slightly expanded medially, membrane thin, slightly granular, margin not distinct, os circular, diameter 4.89 μm. Exine uniformly thickened (1.1 μm); Sexine 0.6 μm thick, tectate, psilate, stratification distinct but thin. Nexine 0.4 μm thick, lighter in colour than sexine.

C. hirsuta L.

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, apocolpium circular, diameter 21.06 μm, prolate-spheroidal.

P = 43.00 μm (39.6-46.4 μm)
E = 38.95 μm (36.3-41.6 μm)
P/E = 1.10

Aperture tricolporate, zonally arranged, colpi length 18.24 μm, membrane thick and conspicuously protruding beyond the grain surface, smooth, margin distinct, os circular, diameter 12.8 μm. Exine uniformly thickened (34 μm); Sexine 2.4 μm thick, subtectate, reticulate, largely pilate, ectosexine 1.0 μm thick, endosexine 1.4 μm thick, columellate. Nexine 1.0 μm thick, smooth.

C. jaegeri Keay

Pollen grains radially symmetrical, isopolar, amb rounded triangular, angulaperturate, apocolpium circular, diameter 4.18 μm, prolate-spheroidal.

P = 29.30 μm (25.6-33.0 μm)
E = 26.65 μm (25.6-27.7 μm)
P/E= 1.10

Aperture tricolporate, zonally arranged, colpi length 14.40 μm, covered by a thick membrane which protrudes beyond the surface, margin distinct, os circular, diameter 4.80 μm. Exine uniformly thickened (4.6 μm); Sexine 1.3 μm thick, subtectate, reticulate, minutely pilate, ectosexine 0.5 μm thick, endosexine 0.7 μm thick, columellate. Nexine 3.3 μm thick, smooth, lighter in colour than sexine.

C. laevigata Willd
(Pl. 1, Fig. 12)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, apocolpium circular, diameter 3.20 μm, subprolate.

P = 15.00 μm (10.4-19.6 μm)
E = 12.80 μm (9.2-16.4 μm)
P/E = 1.17

Aperture tricolporate, zonally arranged, colpi length 8.10 μm, membrane thin, operculum present in 40% of the grains inspected, margin distinct, os circular, diameter 3.2 μm. Exine uniformly thickened (2.3 μm) but widens abruptly at the aperture. Sexine tectate, 1.3 μm thick, psilate, ectosexine 0.7 μm thick, endosexine columellate, 0.6 μm thick, has a shining surface. Nexine 0.9 μm thick, smooth, dark.

C. marginata Roxb.

Pollen grain radially symmetrical, isopolar, amb rounded triangular, angulaperturate, subprolate.

P = 16.95 μm (14.3-19.6 μm)
E = 13.65 μm (11.0-16.3 μm)
P/E = 7.24

Aperture tricolporate, zonally arranged, colpi length 11.84 μm, membrane thin, smooth and flat on the grain surface, margin distinct, os circular, diameter 2.84 μm. Exine uniformly thickened (2.8 μm); Sexine 1.6 μm thick, tectate, psilte, ectosexine 0.7 μm thick, endosexine 0.9 μm thick, columellate. Nexine 1.2 μm thick, smooth, brown.

C. mimosoides L.

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 20.10 μm (17.8-22.4 μm)
E = 19.20 μm (17.1-21.3 μm)
P/E = 1.05

Aperture tricolporate, zonally arranged, colpi length 11.24 μm, membrane thin and slightly protruding beyond grain surface, margin not distinct, os circular, diameter 4.52 μm. Exine uniformly thickened (1.1 μm); Sexine 0.6 μm thick, subtectate, reticulate, lumina circular, pilate, division distinct but thin. Nexine 0.5 μm thick, smooth, dark brown.

C. multijuga Rich.

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, subprolate.

P = 31.85 μm (28.3-35.4 μm)
E = 26.50 μm (21.2-31.8 μm)
P/E = 1.20

Aperture tricolporate, zonally arranged, colpi length 17.71 μm, tapers to the pole, membrane thin, smooth, margin distinct, os circular, diameter 8.83 μm. Exine uniformly thickened (2.3 μm); Sexine 1.6 μm thick, tectate, psilate, ectosexine 0.9 μm thick, endosexine 0.6 μm thick, columellate. Nexine 0.7 μm thick, smooth, darker than sexine.

C. nodosa Bauch.-Ham. ex Roxb.
(Pl. 1, Fig. 13)

Pollen grain radially symmetrical, isopolar, amb circular, angulaperturate, apocolpium circular, diameter 4.64 μm, prolate-spheroidal.

P = 34.30 μm (26.2-42.5 μm)
P = 30.30 μm (23.2-37.4 μm)
P/E = 1.13

Aperture tricolporate, zonally arranged, colpi length 23.1 μm, tapers gradually to the poles, membrane thin, granular, flat on the grain surface, margin distinct, os circular, diameter 3.68 μm. Exine uniformly thickened (2.9 μm); Sexine 1.8 μm thick, subtectate, minutely pilate, outline wavy, ectosexine 0.7 μm thick, columellate. Nexine 1.1 μm thick, wavy, darker than sexine.

C. obtusifolia L.
(Pl. 1, Fig. 14)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 31.85 μm (28.3-35.4 μm)
E = 30.05 μm (26.5-33.6 μm)
P/E = 1.06

Aperture tricolporate, zonally arranged, colpi length 21.24 μm, medially constricted and gradually tapers to the pole, membrane thin, smooth, margin distinct, os circular, Exine uniformly thickened (2.6 μm); Sexine 7.7 μm thick, tectate, psilate, ectosexine 1.0 μm thick, endosexine 0.7 μm thick, columellate. Nexine 0.8 μm thick, lighter than sexine in colour.

C. occidentalis L.

P = 34.65 μm (31.1-38.2 μm)
E = 21.05 μm (15.7-26.4 μm)
P/E = 1.65

Aperture tricolporate, zonally arranged, colpi length 13.01 μm, rarely tapers to the pole, membrane thin, smooth, margin distinct, os circular, diameter 7.08 μm. Exine uniformly thickened (3.8 μm) but sharply reduced at the aperture (3.1 μm). Sexine 2.6 μm thick, tectate, psilate, ectosexine 1.4 μm thick, endosexine 1.2 μm thick, columellate. Nexine 1.1 μm thick, smooth, dark brown.

C. planisiliqua L.
(Pl. 1, Fig. 16)

Pollen grains radially symmetrical, isopolar, amb rounded triangular, apocolpium circular, diameter 4.17 μm, angulaperturate, prolate-spheroidal.

P = 31.80 μm (26.5-37.1 μm)
E = 30.30 μm (25.0-35.6 μm)
P/E = 1.05

Aperture tricolporate, zonally arranged, colpi length 27.71 μm, membrane thin, smooth and flat on the surface of the grain, os circular, diameter 6.47 μm. Exine uniformly thickened (4.0 μm); Sexine 2.8 μm thick, subtectate, minutely pilate, ectosexine 1.5 μm thick, endosexine 1.3 μm thick, columellate. Nexine 1.2 μm thick, smooth outline, lighter in colour than sexine.

C. podocarpa Guill. & Perr.

Pollen grains radially symmetrical, isopolar, amb rounded triangular, angulapert-u rate, subprolate.

P = 35.35 μm (31.8-38.9 μm)
E = 30.05 μm (24.7-35.4 μm)
P/E = 1.18

Aperture tricolporate, zonally arranged (rarely triporate-as in 20% of the grains inspected), colpi length 17.17 μm, membrane thin, slightly granular, margin distinct, os circular, diameter 5.68 μm, (8.72 μm in prorate grains). Exine uniformly thickened

(2.8 μm.); Sexine 1.3 μm thick, tectate, pilate, ectosexine 0.7 μm thick, endosexine 0.5 μm thick, columellate. Nexine 1.4 μm thick, smooth outline, dark brown.

C. siamea Lam.

(Pl. 1, Fig. 17)

Pollen grains radially symmetrical, subisopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 35.35 μm (31.8-38.9 μm)
E = 32.05 μm (29.4-34.7 μm)
P/E = 1.10

Aperture tricolpate, zonally arranged, colpi length 12.8 μm, membrane thin, smooth and slightly sunken into the groove, margin distinct. Exine uniformly thickened (1.9 μm); Sexine 1.4 μm thick, subtectate, wavy, pilate, ectosexine 0.6 μm thick, endosexine 0.7 μm thick, columellate. Nexine 0.5 μm thick, smooth, but wavy.

C. sieberiana DC.

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, oblate-spheroidal.

P = 26.60 μm (24.4-28.8 μm)
E = 29.95 μm (28.3-31.6 μm)
P/E = 0.89

Aperture tricolporate, zonally arranged, colpi length 11.24 μm, membrane thin, flat, and smooth, margin distinct, os circular, diameter 7.08 μm. Exine uniformly thickened (2.3 μm); Sexine 1.8 μm thick, subtectate, minutely pilate, division distinct but thin, columellate. Nexine 0.5 μm thick, smooth, light yellow in colour, brighter than sexine.

C. sophera L.

(Pl. 1, Fig. 18)

Pollen grains radially symmetrical, isopolar, amb rounded triangular, angulaperturate, prolate-spheroidal.

P = 32.00 μm (28.8-35. μm)
E = 30.40 μm (28.8-32.0 μm)
P/E = 1.05

Aperture tricolporate, zonally arranged, colpi length 20.8 μm, medially expanded to enclose a circular os with a diameter of 7.18 μm, membrane thin, flat and smooth, margin distinct. Exine uniformly thickened (3.3 μm); Sexine 2.1 μm thick, tectate, psilate, ectosexine 0.9 μm thick, endosexine 1.1 μm thick, columellate. Nexine 1.1 μm thick, forms a smooth dark band after the endosexine.

C. spectabilis DC.

(Pl. 1, Fig. 19)

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate.

P = 42.90 μm (37.7-48.1 μm)
E = 31.70 μm (28.9-34.5 μm)
P/E = 1.35

Aperture tricolporate, zonally arranged, colpi length 24.78 μm, medially constricted, does not taper to the pole membrane thin, smooth, margin distinct, os circular, diameter 7.62 μm. Exine uniformly thickened (3.9 μm); Sexine 2.8 μm thick, tectate, psilte, ectosexine 1.4 μm thick, endosexine 1.4 μm thick, columellate. Nexine 1.1 μm thick, smooth outline, dark brown.

Dialium guineense Willd

Pollen grain radially symmetrical, isoploar, amb rounded triangular, angulaperturate.

P = 20.00 μm (16.4-23.6 μm)
E = 12.20 μm (10.3-14.1 μm)
P/E = 1.64

Aperture tricolpoidorate, colpi length 14.1 μm, not well developed, membrane thin, smooth, margin distinct, os circular, diameter 2.11 μm. Exine uniformly thickened (3.11 μm), Sexine 1.4 μm thick, tectate, striate, ectosexine 0.7 μm thick, endosexine 0.6 μm thick, columellate. Nexine 1.7 μm thick, smooth outline, darker than sexine.

TRIBE—CERCIDEAE

Bauhinia forficata Link.

Pollen grains radially symmetrical, subisopolar, amb circular, prolate-spheroidal.

P = 75.60 μm (72.0-79.2 μm)
E = 69.90 μm (67.2-72.6 μm)
P/E = 1.08

Aperture tricolpoid, colpoid length 30.01 μm, membrane thin, granular, margin not distinct. Exine uniformly thickened (2.2 μm); Sexine 1.2 μm thick, subtectate, pilate, tectum with suprabaculae, reticulate, lumina distinct, muri short, (1.2 μm high). Nexine 1.0 μm thick, serrated.

B. monandra Kurz

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, apocolppium triangular, side length 25.6 μm, prolate-spheroidal.

P = 49.65 μm (43.2-56.1 μm)
E = 48.80 μm (44.8-52.8 μm)
P/E = 1.02

Aperture tricolporate, colpi length 23.23 μm, os membrane thick, slightly protrudes beyond the grain surface, margin distinct, os circular, diameter 8.14 μm. Exine uniformly thickened (3.9 μm); Sexine 2.3 μm tnick, greatly striate, stratification obviously masked by striations. Nexine 1.6 μm thick, ligat yellow, smooth.

B. purpurea L.

Pollen grains radially symmetrical, amb circular, subisopolar, apocolpium triangular, side length 20.80 μm, angulaperturate, subprolate.

P = 46.45 μm (36.8-56.1 μm)
E = 40.25 μm (36.3-44.2 μm)
P/E = 1.15

Aperture tricolpoidorate, colpi length 24.00 μm, membrane thin, smooth, margin not distinct, os circular, diameter 4.80 μm. Exine uniformly thickened (6.4 μm); Sexine 4.1 μm thick, subtectate, striate, ectosexine 2.1 μm thick, endosexine 2.0 μm thick, columellate. Nexine 2.3 μm thick, smooth.

B. tomentosa L.

(Pl. 1, Fig. 20)

Pollen grains radially symmettical, subisopolar, amb circular, apocolpium triangular with side length 18.61 μm, angulaperturate, subprolate.

P = 44.30 μm (35.5-53.1 μm)
E = 39.50 μm (31.7-47.3 μm)
P/E = 1.12

Aperture tricolpoidorate colpi length 26 μm, membrane thin, smooth, margin distinct. Exine uniformly thickened (3.8 μm); Sexine 1.9 μm thick, subtectate, striate, ectosexine 1.0 μm thick, endosexine 0.9 μm thick, columellate. Nexine 1.8 μm thick, smooth, yellow in colour.

TRIBE--DETRAIEAE

Afzelia bella Harms. var. *bella*

Pollen grains usually arranged in tetrahedral tetrads which can easily be disintegrated. Single grains are radially symmetrical, heteropolar, amb circular, apocolpium circular, diameter 6.21 μm., angulaperturate, subprolate.

P = 42.65 μm (27.1-58.2 μm)
E = 35.85 μm (27.3—48.4 μm)
P/E= 1.19

Aperture tricolporate, zonally arranged, colpi length 11.00 μm, membrane thin and with free elments of varied forms and height, os subcircular, meridial diameter 6.80 μm, equitorial diameter 6.30 μm. Exine thicker at the equator (5.9 μm) than at the pole (4.2 μm). Sexine 4.7 μm. thick at the equator, subtectate, reticulate, lumina of varied shape but usually 8 μm wide, ectosexine 1.6 μm thick, endosexine 2.4 μm thick, columellate. Nexine 1.7 μm thick, smooth, darker than sexine.

A. bipindensis Harms

Pollen grains radially symmetrical, isopolar, amb circular, angulaperturate, prolate-spheroidal.

P = 39.30 μm (26.1-52.2 μm)
E = 34.55 μm (21.5-47.6 μm)
P/E= 1.14

Aperture tricolporate, zonally arranged, colpi length 13.40 μm, grooves narrow, os subcirular, meridian diameter 6.40 μm, equitorial diameter 7.31 μm, membrane thin and warty, margin not distinct. Exine thickest at the pole (7.2 μm); Sexine 5.1 μm thick subeectate, reticulate with large meshes, ectosexine 2.4 μm thick, endosexine 2.7 μm thick, columellate. Nexine 2.2 μm thick, smooth, wavy outline.

Discussion

A survey of the pollen grains of members of the Caesalpinioideae has revealed

variations in the size, shape, aperture, structure and sculpture and it has been found to provide data readily applicable to the problem of the tribal classification.

Tribe—Amherstieae

Pollen type—Pollen of the Amherstieae is diverse but basically, one principal pollen type together with several others are found among species of eurypalynous genera (e.g. *Berlinia*). The most common is the tricolporate striate grain characterising the tree genera studied. Some species have very coarse, rope-like striations, e.g. *Gilbertiodendron demonstrans*. In the genus *Berlinia*, there are at least two distinct pollen types-one (*Berlinia grandifolia*, *B. coriacea*) are coarsely striate while *B. confusa* is psilate-punctate.

Taxonomic consideration—The principal pollen type in the Amherstiae is tricolporate and striate with other patterns occurring primarily among species of the eurypalynous genera e.g. *Berlinia*. This coarsely striate form is especially distinctive and outside the tribe, it is found in two species assigned to the tribe Dectarieae (Graham & Barker, 1980).

Tribe—Caesalpinieae

There are several morphological groups in this tribe. The genus *Caesalpinia* L. has a unique aperture construction consisting of a broad, granular-membraned margo surrounding a weakly developed diffused-margin colpus, with a prominent developed os as in *C. pulcherrima* L. var. yellow. Tsukada (1963) has described the members of this genus as tricolporate but the present study has revealed that the colpus of *Caesalpinia pulcherrima* fuse at the pole to form a syncolporate grain. This feature may prove useful in separating the genus from other members of the tribe. The three floral forms of *C. pulcherrima* differ in grain size and they may be raised to varietal status. A slightly different type of pollen exists in two other genera—*Delonix* and *Peltophorum* as the pollen grains are colpate and the luminae are greatly increased to show the muri as the bacules were noted in these two taxa.

Tribe—Cassieae

The pollen types in this tribe is uniform. In the 21 species and 1 variety of *Cassia* studied, shaped range from oblate-spheroidal as in *C. sieberiana* to prolate as in *C. auriculata*, *C. bicapsularis*, and *C. fistula*. The predominant aperture type is the tricolporate but colpate grains were found among colporate ones in *C. arereh*, *C. corymbosa* var. *plurijuga* and *C. siamea* Lam. while porate grain was found only in *C. podocarpa*. These two variants (i.e. porate and colpate grains) which occur in this tribe seem to support the idea that their presence is due to the thinning of thickening of the ectosexine or endosexine. The pollen of *Dialium guineense* is comparable to that of *Cassia*. They differ only in their size and that it is slightly striate.

Tribe—Cercideae

In the present study, 4 species of *Bauhinia* L. have been studied and all have been found to have diverse characters. Some members of the genus for example *B. forficata* possess conspicuous baculae. Others have coarse striations as in *B. monandra* and verucae as in *B. tomentosa*. Apart from this diversity, the members of the tribe have been found

to possess large pollen grains (usually between 40 μm-80 μm) and this is typical of several legume genera known to be bat pollinated.

TRIBE—DETARIEAE

It has been reported (Graham & Barkar, 1980) that the tribe Detarieae is one of the largest and palynolgically the most complex tribe of the Caesalpinioideae. Adaptive radiation involving an array of pollinating vectors has produced a taxonomically difficult assemblage where pollen groups frequently do not parallel categories based on floral and vegetative features. Apart from this diversity within the tribe, differences have also been met with even within genera. This is evident in the three species of *Afzelia* studied. In general, their sizes are usualy between 52 and 85 μm. They have a coarse open reticulum elevated on comparatively long columella and also colporate aperture. A major deviation from these characteristics was noted in *A. bella* Harms var. *bella* where the grains are united in tetrahedral tetrads. Senesse (1976) and Sowunmi (1973) have reported similar results.

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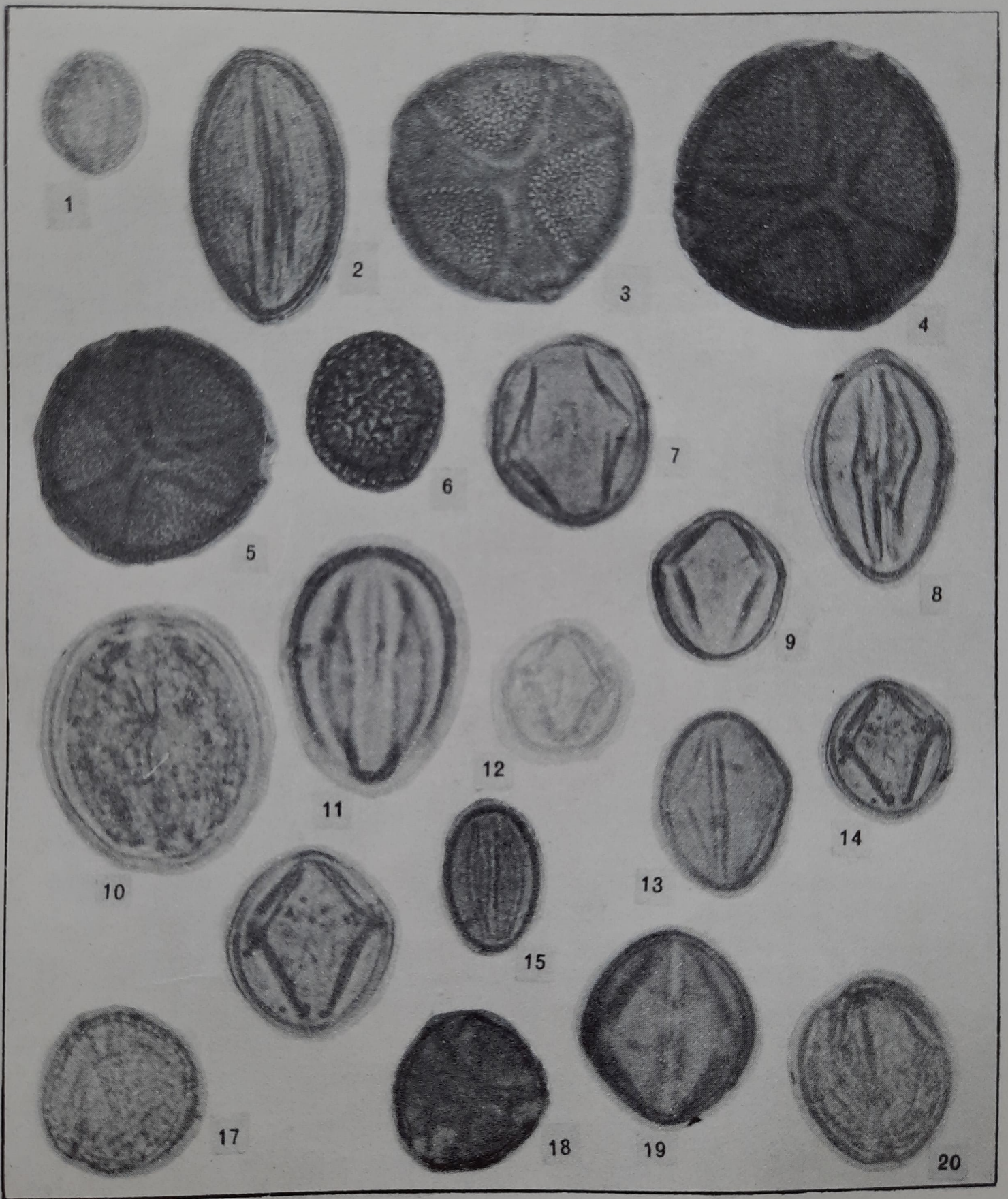
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Explanation of Plate

PLATE 1

(All photomicrographs are enlarged Ca. × 1000)

1. *Berlinia coriacea* Keay
2. *Gilbertiodendron demonstrans* Baill. J. Leonard.
3. *Caesalpinia pulcherrima* (L.) Sw. (Pink flower)
4. *Caesalpinia pulcherrima* (L.) Sw. (Red flower)
5. *Caesalpinia pulcherrmia* (L.) Sw. (Yellow flower)
6. *Peltophorum pterocarpum* (DC.) Backer
7. *Cassia arereh* Del.
8. *Cassia auriculata* L.
9. *Cassia bicapsularis* L.
10. *Cassia corymbosa* Lam. var. *plurijuga*
11. *Cassia fistula* L.
12. *Cassia laevigata* Willd.
13. *Cassia nodosa* Buch-Ham. ex Roxb.
14. *Cassia obtusifolia* L.
15. *Cassia occidentalis* L.
16. *Cassia planisiliqua* L.
17. *Cassia siamea* Lam.
18. *Cassia sophera* L.
19. *Cassia spectabilis* DC.
20. *Bauhinia tomentosa* L.