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The systematic value of pollen morphology in trees and shrubs species of *Bauhinia* L. (Caesalpinioideae-subg. *Bauhinia* - sect. *Pauletia*) occurring in Brazil[1]

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ABSTRACT

We analyzed the pollen grains of 30 taxa of the genus *Bauhinia* L., within five series: *Aculeatae* (9 species); *Acuminatae* (1 species); *Cansenia* (17 species); *Pentandrae* (2 species); and *Perlebia* (1 species). The pollen grains were acetolysed, after which they were photographed and analyzed under light microscopy. Non-acetolysed pollen grains were analyzed under scanning electronic microscopy. Characters such as shape, size, exine and aperture constitution were studied. The species were separated by a dichotomous key, which showed pollen grains that were classified as very large; isopolar or apolar; oblate, suboblate, oblate spheroidal or spherical; large or small in terms of the polar area; inaperturate, 3-porate or (3-7)-colpate; and microreticulate or reticulate, with or without supratectal elements (gemmae, bacula, clavae). The variation in pollen morphology confirms the eurypalynous status of the genus *Bauhinia*.

Key words: *Bauhinia*, Brazil, Leguminosae, palynology

Introduction

Bauhinia L. is a pantropical genus, a member of the subfamily Caesalpinioideae (Leguminosae), with approximately 300 species. Wunderlin *et al*. (1987) divided *Bauhinia* into 4 subgenera, 22 sections and 30 series. Six sections of three subgenera have native representatives in the neotropics: *Bauhinia* (sect. *Bauhinia*, sect. *Pauletia*, sect. *Amaria*); *Elayuna* (Raf.) Wunderlin, K. Larsen & S. Larsen (sect. *Benthamia*); and *Phanera* (Lour.) Wunderlin, K. Larsen & S. Larsen (sect. *Schnella*, sect. *Caulotretus*).

The infrageneric taxonomic organization of *Bauhinia* proposed by Wunderlin *et al*. (1987) consists of a group of species represented by trees, shrubs or subshrubs, multicaules, sometimes semi-scandent, although never with tendrils. The branches may have pairs of adpetiolar spines or are unarmed, and have extrafloral nectaries and well-developed intrastipular trichomes on the inner surface of the stipules. The hypanthium is short-turbinate or, in general, long and tubular, the calyx is spathaceous or irregularly adnate at the apex and opens at the base in 2-5 lobes. The fruit is woody or coriaceous and dehiscent. The taxonomic arrangement of Wunderlin *et al*. (1987) is used in this study.

Several investigators have examined the pollen of *Bauhinia* species, including Barth & Bousada (1964), Smith (1964), Palácios-Chávez (1970), Larsen (1975), Schmitz (1977), Ferguson (1986), Gamerro & Fortunato (2001) and Novaes (2005). The genus *Bauhinia* has pollen grains in monads, rarely in tetrads (Larsen 1975, Fergunson & Banks 1994), with a very wide range of characters such as shape, exine ornamentation, type and number of apertures; i.e., the genus is eurypalynous (Palacios-Chávez 1970; Salgado-Labouriau 1973; Ferguson 1987; Gamerro & Fortunato 2001). The study of pollen grains of *Bauhinia* has proved an important aid in elucidating the taxonomy of the genus, confirming the classification of the tribes (Schmitz 1973), and can also be used to help determine subgenera (Smith 1964).

Few other studies have examined the pollen grains of the species of *Bauhinia*, especially the native Brazilian taxa. Vaz (2001) noted that the pollen morphology is known for only a few species of section *Pauletia* and emphasized the need for studies on the external morphology of pollen.

In the present study, we analyzed the pollen of 30 tree and shrub species of *Bauhinia*, subg. *Bauhinia* sect. *Pauletia* series *Aculeatae*, *Acuminatae*, *Cansenia*, *Pentandrae* and *Perlebia* occurring in Brazil, in order to support an eventual revision

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of the genus in the neotropics. Our objective was to expand knowledge of the attributes of the pollen of this group.

Material and methods

Pollen grains of 30 *Bauhinia* species were examined. The samples were obtained from the anthers of flower buds of specimens held in the following Brazilian herbaria: the Herbarium of the Ecological Reserve of the Brazilian Institute of Geography and Statistics (code, IBGE); the Herbarium of the Botany Department of the National Museum in Rio de Janeiro (code, R); and the Herbarium of the Rio de Janeiro Botanical Garden (code, RB). Acronyms are according to Thiers (continuously updated).

Whenever possible, four specimens of each species were analyzed and compared in order to obtain accurate results (Appendix 1). The permanent slides from this study are stored in the Álvaro Xavier Moreira Laboratory of Palynology of the Botany Department at the Federal University of Rio de Janeiro/National Museum.

Pollen grains were prepared by acetolysis with the method developed by Erdtman (1952), as modified by Melhem *et al.* (2003) for light microscopy. Pollen grains for scanning electron microscopy were placed on stubs covered with carbon tape and sputter-coated with gold. Samples were then examined using a scanning electron microscope (JSM-5310; JEOL, Tokyo, Japan) in the Hertha Meyer Laboratory of Cell Ultrastructure at the Biophysics Institute of the Federal University of Rio de Janeiro.

One specimen of each species was chosen for statistical treatment and illustrations, and is indicated by an asterisk (*) after the collector's name (Appendix 1). Measurements in equatorial view (polar diameter and equatorial diameter) were taken for 25 pollen grains per sample. Means, standard deviations, and 95% confidence intervals (CIs) were calculated. For measurements of equatorial diameter in polar view (EDPV), apocolpium side, apertures and exine thickness, the arithmetic means of 10 measurements were used. Ten similar measurements of pollen grains were made on additional material, from another collection, to check the stability of the data (treated further as comparison material).

The number of supratectal elements was established from a 50 μm² area on the surface of the pollen in polar view.

The terminology used for pollen descriptions follows Punt *et al.* (2007), which takes into consideration elements of size, shape, number of apertures, and sexine ornamentation. The descriptions of the polar area and aperture size were made according to the classification system established by Faegri & Iversen (1966) for the polar area index.

Results

We evaluated the pollen of 30 tree and shrub species of *Bauhinia* L. sect. *Pauletia*, within five series:

- *Aculeatae*—*B. acreana* (Fig. 1-3); *B. aculeata* (Fig. 4-5); *B. affinis* (Fig. 6-7); *B. albicans* (Fig. 8-12); *B. catingae* (Fig. 13-14); *B. forficata* and *B. mollis* (Fig. 15-17); *B. ovata* (Fig. 18-21); and *B. platypetala* (Fig. 22-24)
- *Acuminatae*—*B. acuminata* (Fig. 25-27)
- *Cansenia*—*B. acuruana* (Fig. 28,29); *B. angulicaulis* (Fig. 30-32); *B. brevipes* (Fig. 33-34); *B. cheilantha*; *B. cupulata* (Fig. 35-37); *B. curvula* (Fig. 38-40); *B. dubia* (Fig. 41-44); *B. dumosa* (Fig. 45-48); *B. goyazensis* (Fig. 49); *B. holophylla* (Fig. 50); *B. longicuspis* (Fig. 51); *B. longifolia* (Fig. 52-55); *B. membranacea* (Fig. 56); *B. rufa* (Fig. 57-58); *B. subclavata* (Fig. 59-60); *B. ungulata* (Fig. 61-63); and *B. viscidula* (Fig. 64-65)
- *Pentandrae*—*B. pentandra* (Fig. 66-68); and *B. vespertilio* (Fig. 69-73)
- *Perlebia*—*B. bauhinioides* (Fig. 74-77)

The palynological descriptions are arranged according to the following pollen features: size; polarity; dispersal unit; shape, number, and type of apertures; and exine sculpture. The results are presented in Tab. 1-4.

Size and polarity

In the group evaluated, the pollen grains were classified as very large in polar view (Tab. 2): 77.5-137.5 μm in polar diameter; and 102.5-170.0 μm in equatorial diameter. Isopolar pollen grains were found in members of the series *Aculeatae*, *Cansenia*, *Pentandrae*, and *Perlebia*. Apolar pollen grains were found only in the series *Acuminatae* (*B. acuminata*).

Dispersal unit and shape

All species examined had pollen grains arranged in monads (Tab. 2). Oblate pollen grains were found in *B. aculeata* (ser. *Aculeatae*), *B. acuruana*, *B. brevipes*, *B. cheilantha*, *B. curvula*, *B. longifolia*, *B. rufa*, *B. subclavata* (ser. *Cansenia*) and *B. bauhinioides* (ser. *Perlebia*). Suboblate pollen grains were found in *B. albicans*, *B. catingae*, *B. platypetala* (ser. *Aculeatae*), *B. cupulata*, *B. dubia*, *B. dumosa*, *B. goyazensis*, *B. holophylla*, *B. longicuspis*, *B. ungulata*, *B. viscidula* (ser. *Cansenia*), *B. pentandra* and *B. vespergilio* (ser. *Pentandrae*). Oblate spheroidal pollen grains were found in *B. acreana*, *B. affinis*, *B. forficata*, *B. mollis*, *B. ovata*, *B. platypetala* (ser. *Aculeatae*) and *B. angulicaulis* (ser. *Cansenia*). *B. acuminata* (ser. *Acuminatae*) and *B. angulicaulis* (ser. *Cansenia*) had spheroidal and prolate spheroidal pollen grains, respectively. In *B. membranacea*, the form could not be established, because the pollen grains were found only in polar view.

Polar area and apertures

A small polar area was found in all species of the series *Aculeatae*, *Pentandrae*, and *Perlebia*, and in *B. angulicaulis* (ser. *Cansenia*). The polar area was large in most of the species of the series *Cansenia* (Tab. 1).

Table 1. Measurements (μm), in polar view, of isopolar pollen grains of *Bauhinia* species (n = 25).

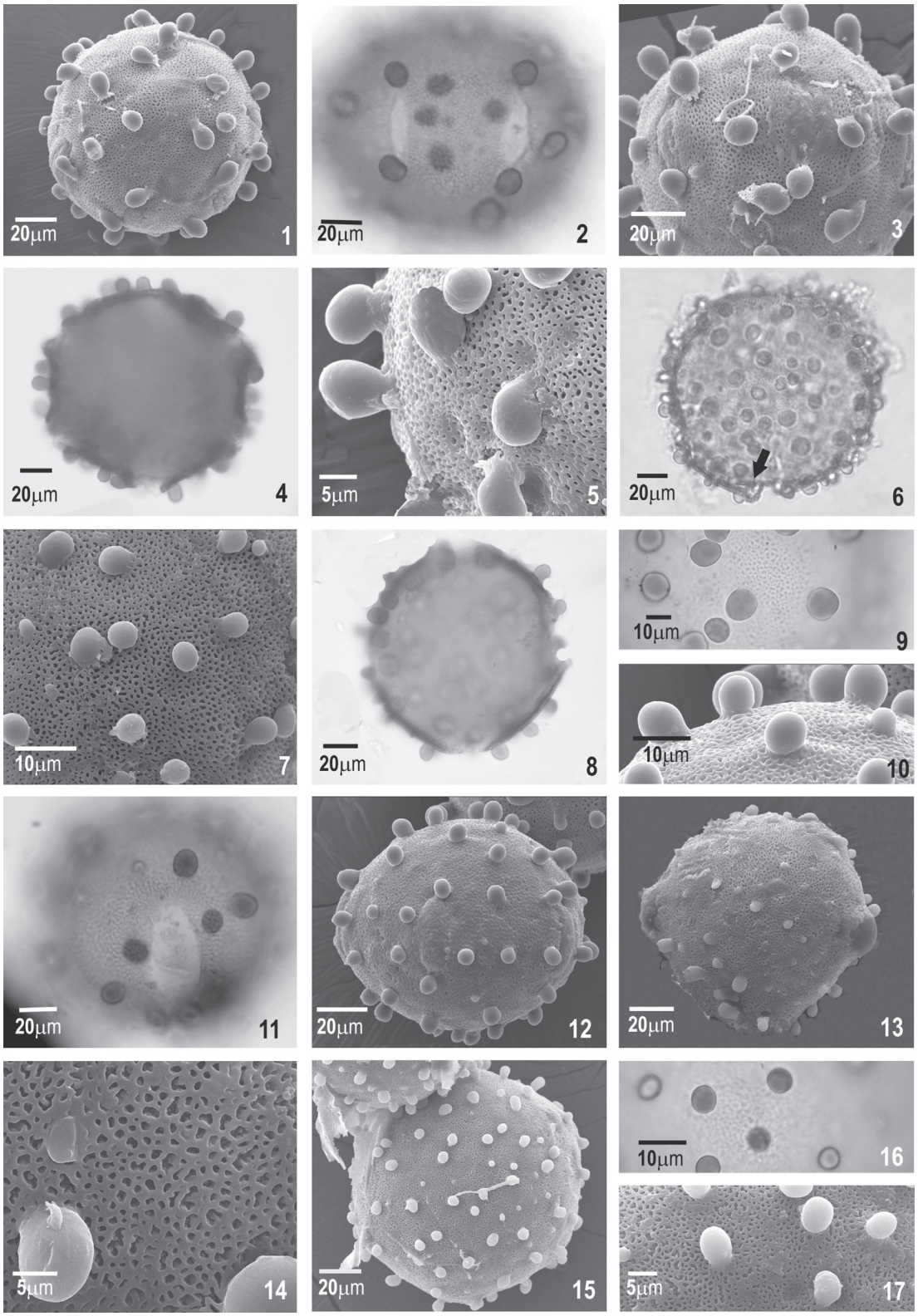
Species	Equatorial diameter			Apocolpium side			PAI
	Range	Mean±SD	95% CI	Range	Mean±SD	95% CI	
Series *Aculeatae*							
B. acreana	145.0-157.5	151.8±0.7	150.4-153.2	50.0-60.0	54.3±0.5	53.2-55.3	0.35
B. aculeata	137.5-150.0	145.9±0.8	144.3-147.5	45.0-52.5	48.5±0.5	47.5-49.5	0.33
B. affinis	100.0-112.5	105.7±0.7	104.3-107.1	37.5-57.5	46.4±1.1	44.1-48.7	0.43
B. albicans	120.0-142.5	133.9±0.9	132.1-135.7	50.0-60.0	55.7±0.6	54.5-56.9	0.41
B. catingae	135.0-152.5	142.5±0.9	140.7-144.3	40.0-55.0	46.5±0.7	45.1-47.9	0.32
B. forficata	135.0-157.5	147.2±1.2	144.8-149.6	42.5-57.5	46.9±0.8	45.3-48.5	0.31
B. mollis	107.5-122.5	114.9±0.8	113.3-116.5	30.0-40.0	35.4±0.6	34.2-36.6	0.30
B. ovata	132.5-140.0	135.4±0.5	134.4-136.4	42.5-50.0	46.6±0.4	45.8-47.4	0.34
B. platypetala	110.0-130.0	117.9±1.0	115.8-120.0	40.0-50.0	46.6±0.6	45.4-47.8	0.39
Series *Cansenia*							
B. acuruana	147.5-160.0	153.8±0.7	152.4-155.2	80.0-90.0	86.5±0.5	85.2-87.8	0.56
B. angulicaulis	157.5-170.0	164.1±0.6	162.9-165.3	75.0-85.0	79.1±0.5	78.1-80.1	0.48
B. brevipes	137.5-157.5	146.4±0.9	144.6-148.2	70.0-87.5	76.7±0.7	75.3-78.1	0.52
B. cheilantha	125.0-137.5	127.5±0.7	126.1-128.9	70.0-82.5	76.8±0.6	75.6-78.0	0.60
B. cupulata	145.0-162.5	152.3±0.8	150.7-153.9	82.5-95.0	87.9±0.6	86.7-89.1	0.57
B. curvula	125.0-145.0	137.1±1.2	134.6-139.6	62.5-75.0	70.6±0.8	69.0-72.2	0.51
B. dubia	150.0-157.5	151.7±0.5	150.4-153.0	95.0-100.0	98.7±0.6	97.5-99.9	0.65
B. dumosa	152.5-172.5	162.1±1.0	159.0-163.2	77.5-90.0	84.3±0.7	82.9-85.7	0.52
B. goyazensis	150.0-162.5	155.8±0.6	154.6-157.0	75.0-82.5	78.2±0.5	77.2-79.2	0.50
B. holophylla	150.0-162.5	154.2±0.8	152.6-155.8	80.0-95.0	89.2±0.6	88.0-90.4	0.57
B. longicuspis	165.0-200.0	175.3±1.3	172.6-178.0	80.0-112.5	97.1±1.2	94.6-99.6	0.55
B. longifolia	150.0-165.0	157.5±1.0	155.4-159.6	75.0-100.0	90.4±1.1	88.1-92.7	0.57
B. membranacea	125.0-135.0	129.8±0.6	128.6-131.0	75.0-87.5	80.2±0.9	78.4-82.0	0.61
B. rufa	145.0-167.5	156.3±1.1	154.0-158.6	77.5-95.0	86.0±0.9	84.2-87.8	0.55
B. subclavata	137.5-152.5	144.5±0.8	142.9-146.1	75.0-90.0	82.3±0.9	80.5-84.1	0.56
B. ungulata	162.5-167.5	165.3±0.4	164.5-166.1	87.5-95.0	90.3±0.4	89.5-91.1	0.54
B. viscidula	150.0-167.5	158.0±1.0	155.9-160.1	75.0-87.5	82.4±0.6	81.2-83.6	0.52
Series *Pentandrae*							
B. pentandra	125.0-132.5	126.6±0.5	125.6-127.6	47.5-60.0	52.6±0.6	51.4-53.8	0.41
B. vespertilio	140.0-152.5	147.6±0.6	146.4-148.8	47.5-55.0	50.7±0.5	49.7-51.7	0.34
Series *Perlebia*							
B. bauhinioides	137.5-162.5	148.2±0.9	146.4-150.0	32.5-55.0	50.6±0.9	48.8-52.4	0.34

CI – confidence interval; PAI – polar area index.

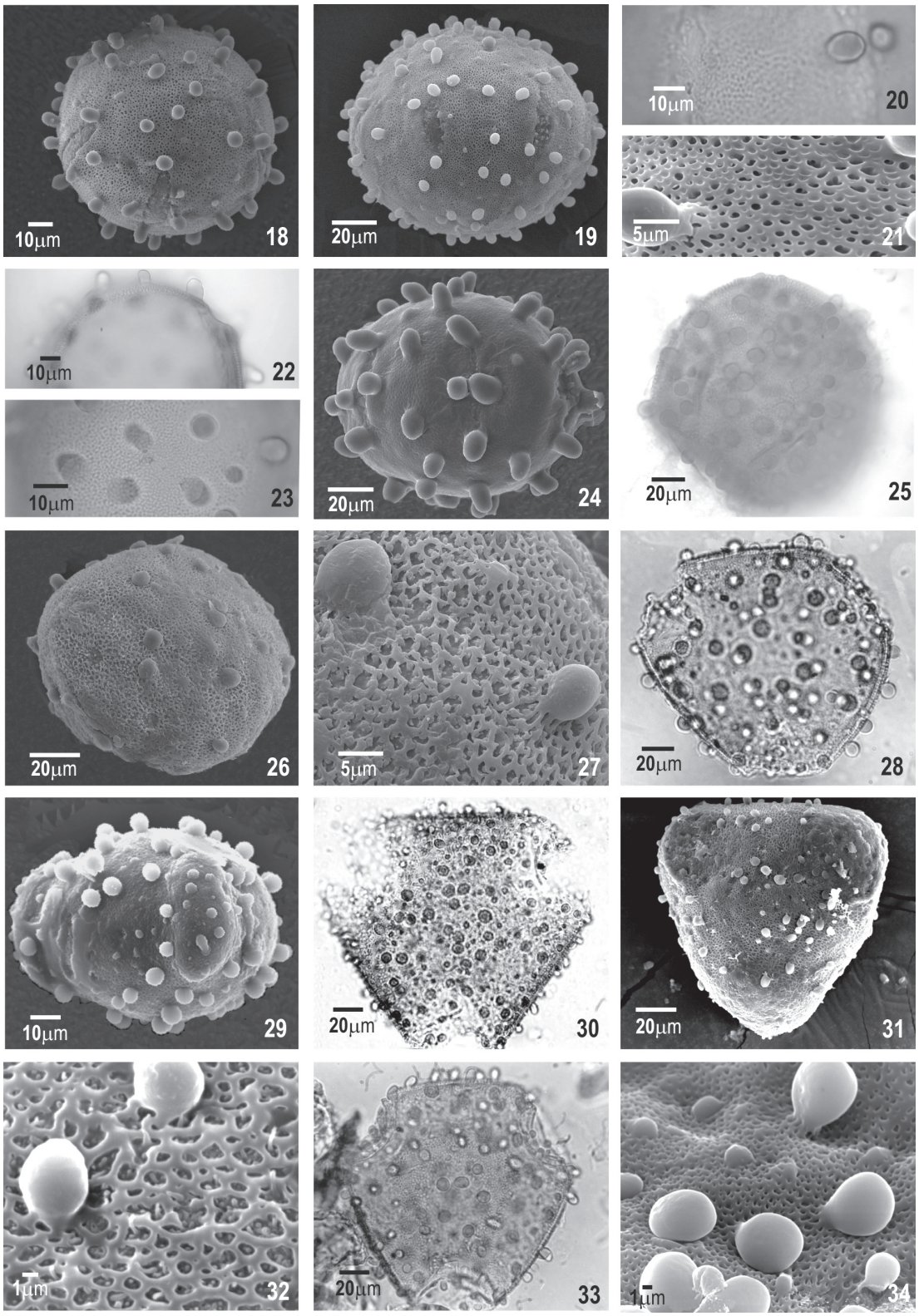
Inaperturate pollen grains were found in *B. acuminata* (ser. *Acuminatae*) (Fig. 25, 26). Aperturate pollen grains occurred as follows: 3-porate in *B. cheilantha* (ser. *Cansenia*); 3-colpate in most species of the series *Cansenia*; 3(4)-colpate in *B. dubia* (ser. *Cansenia*); 5-colpate in *B. vespertilio* (ser. *Pentandrae*); 4(5)-colpate in *B. albicans* (ser. *Aculeatae*) and *B. bauhinioides* (ser. *Perlebia*); 5(6)-colpate in *B. pentandra* (ser. *Pentandrae*), 6-colpate in most of the species of series *Aculeatae*, and 6(7)-colpate in *B. mollis* (ser. *Aculeatae*).

In the series *Aculeatae*, the colpi were long and covered by a thin, transparent, ornamented membrane. Colpi were granulated in *B. albicans* (Fig. 12) and *B. platypetala* (Fig. 24) and smooth in *B. catingae* (Fig. 13); the apex was acute in most species and rounded in *B. albicans* (Fig. 11), with costae only in *B. affinis* (Fig. 6).

In most species within the series *Cansenia*, the colpi were short, the margo being pronounced only in *B. cupulata* (Fig. 35, 36) and long only in *B. angulicaulis*. The apex was rounded in most species and acute in *B. curvula*, covered by a thin membrane, transparent, with gemmae and/or verrucae, and rarely granulate. *Bauhinia cheilantha* (Fig. 33) was the only species to show slightly elongated pores (Tab. 3). The longest colpus was found in *B. ungulata* (ca. 110.2 μm) and in *B. curvula* (ca. 58.8 μm). The colpus was widest in *B. rufa* (ca. 55.0 μm) and narrowest in *B. angulicaulis* (ca. 26.8 μm) (Tab. 3).



Figures. 1-17. Photomicrographs and electron photomicrographs of pollen grains of the *Bauhinia*. Fig. 1-3. *Bauhinia acreana* Harms.: 1. general aspect under scanning electron microscopy (SEM); 2. aperture in equatorial view (EV); 3. aperture/ornamentation (EV, SEM)—Fig. 4, 5. *Bauhinia aculeata* Vell.: 4. optical section in polar view (PV); 5. ornamentation (PV, SEM)—Fig. 6, 7. *Bauhinia affinis* Vog.: 6. optical section (PV); 7 ornamentation (PV, SEM)—Fig. 8-12. *Bauhinia albicans* Vog., polar view: 8. optical section (PV); 9. ornamentation detail (PV); 10. ornamentation (PV, SEM); 11. aperture (EV); 12. general aspect and aperture (EV, SEM)—Fig. 13, 14. *Bauhinia catingae* Harms.: 13. general aspect (PV, SEM); 14. ornamentation (PV, SEM)—Fig. 15-17. *Bauhinia mollis* (Bong) D. Dietr.: 15. general aspect (PV, SEM); 16. ornamentation detail (PV); 17. ornamentation detail (PV, SEM).



Figures. 18-34. Photomicrographs and electron photomicrographs of pollen grains of the *Bauhinia*. Fig. 18-21. *Bauhinia ovata* Vog.: 18. general aspect, in polar view (PV), under scanning electron microscopy (SEM); 19. general aspect/aperture in equatorial view (EV, SEM); 20. ornamentation detail (EV); 21. ornamentation (EV, SEM)—Fig. 22-24. *Bauhinia. platypetala* Burch. ex Benth.: 22. ornamentation detail; 23. ornamentation (SEM); 24. general aspect and aperture (EV, SEM)—Fig. 25-27. *Bauhinia acuminata* Vell.: 25. general aspect; 26. general aspect (SEM); 27. ornamentation (SEM)—Fig. 28, 29. *Bauhinia acuruana* Moric.: 28. general aspect (PV); 29. aperture (EV, SEM)—Fig. 30-32. *Bauhinia angulicaulis* Harms., polar view: 30. optical section (PV); 31. general aspect (PV, SEM); 32. ornamentation (PV, SEM)—Fig. 33, 34. *Bauhinia brevipes* Vogel: 33. optical section (PV); 34. ornamentation (PV, SEM).

Table 2. Measurements (μm), in equatorial view, of isopolar pollen grains of *Bauhinia* species (n = 25).

Species	Polar diameter		Equatorial diameter		P/E
	Range	Mean	Range	Mean	
Series *Aculeatae*					
B. acreana	117.5-127.5	121.4	127.5-135.0	129.3	0.94
B aculeata	102.5-110.0	105.8	140.0-147.5	145.0	0.73
B. affinis	90.0-105.0	97.8	102.5-115.0	106.5	0.92
B. albicans	122.5-130.0	126.8	140.0-147.50	142.9	0.79
B. catingae	112.5-127.5	121.5	135.0-150.0	140.2	0.87
B. forficata	117.5-137.5	131.0	132.5-152.5	143.8	0.91
B. mollis	102.5-107.5	104.8	112.5-125.0	117.2	0.90
B. ovata	120.0-130.0	126.0	132.5-142.5	135.2	0.93
B. platypetala	92.5-100.0	97.0	107.5-115.0	110.0	0.88
Series *Cansenia*					
B. acuruana	102.5-107.5	105.8	137.5-150.0	147.8	0.72
B. angulicaulis	112.5-122.5	118.8	115.0-125.0	119.2	1.01
B. brevipes	95.0-107.5	100.5	140.0-150.0	144.5	0.70
B. cheilantha	77.5-82.5	79.8	130.0-135.0	132.2	0.60
B. cupulata	120.0-137.5	128.2	145.0-160. 0	151.0	0.85
B. curvula	82.5-90.0	86.8	110.0-125.0	117.0	0.74
B. dubia	122.5-127.5	124.0	150.0-160.0	152.5	0.81
B. dumosa	107,5-117,5	111,5	125,0-142,5	136,5	0,82
B. goyazensis	127,5-140,5	133,6	152,5-162,5	157,5	0,85
B. holophylla	120,0-127,5	123,8	150,0-155,0	152,5	0,81
B. longicuspis	127,5-132,5	129,5	160,0-170,0	164,0	0,78
B. longifolia	105,0-117,5	110,8	150,0-155,0	152,0	0,73
B. membranacea	-----	-----	-----	-----	-----
B. rufa	95,0-117,5	108,2	145,0-162,5	154,0	0,70
B. subclavata	85,0-97,5	89,2	125,0-140,0	131,2	0,68
B. ungulata	125,0-137,5	131,8	152,5-170,0	164,2	0,80
B. viscidula	102,5-112,5	110,0	125,0142,50	133,8	0,82
Series *Pentandrae*					
B. pentandra	100.0-105.0	101.0	130.0-137.5	132.5	0.76
B. vespertilio	127.5-137.5	130.7	150.0-160.0	153.5	0.85
Series *Perlebia*					
B. bauhinioides	82.5-100.0	93.2	125.0-145.0	140.2	0.66

P/E – polar/equatorial (ratio).

In the series *Pentandrae*, the colpi were long with a slightly rounded apex, covered by a thin membrane, transparent, and ornamented (Fig. 71). The colpus was longest and widest in *B. vespertilio* (ca. 78.0 × 8.8 μm) (Tab. 3). In *B. bauhinioides* (ser. *Perlebia*) the colpi were long and covered by a thin membrane, transparent, and lightly ornamented (Fig. 76, 77), with a rounded apex (Fig. 75) (Tab. 3).

Ornamentation and stratification of exine

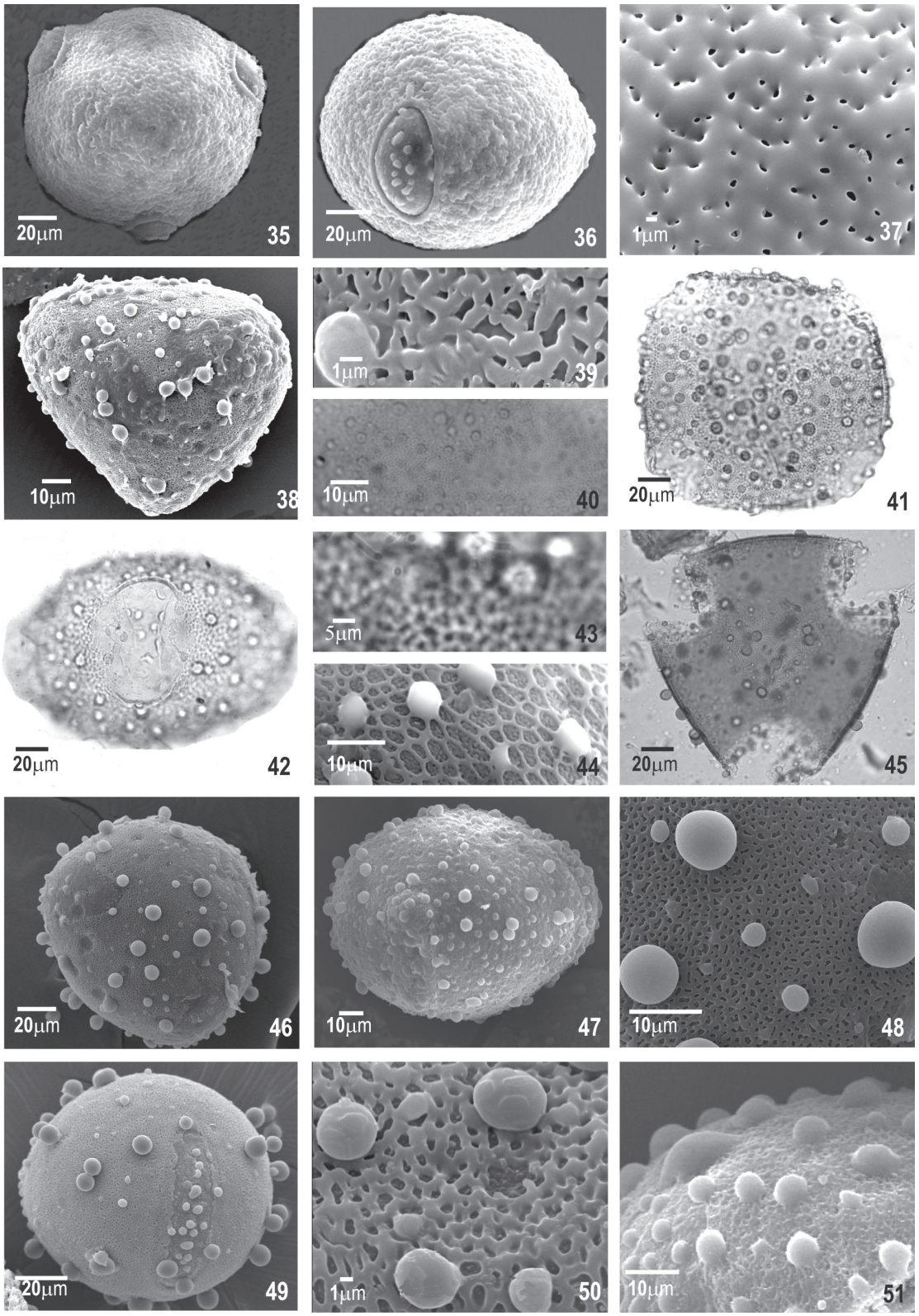
In the species of the series *Aculeatae*, the sexine was reticulate or microreticulate, with supratectal elements in the shape of gemmae, bacula or clavae. Reticulate sexine was present in *B. acreana* (Fig. 3), *B. aculeata* (Fig. 5), *B. catingae* (Fig. 14), *B. mollis* (Fig. 17) and *B. ovata* (Fig. 21). The sexine was microreticulate in *B. affinis* (Fig. 7), *B. albicans* (Fig. 9, 10),

Table 3. Mean (µm) of the measurements of aperture, exine layers and ornamentation elements of pollen grains of *Bauhinia* species (n = 10).

Species	Colpus		Pore		Exine thickness			Gemmae		Clavae		Bacula		Verrucae	
	length	width	length	width	exine	sexine	nexine	length	width	length	width	length	width	length	width
Series *Aculeatae*															
B. acreana	23.2	9.0	---	---	3.5	2.0	1.5	8.6	8.4	11.9	7.7	---	---	---	---
B. aculeata	47.2	13.5	---	---	2.2	1.3	0.9	---	---	12.3	6.9	---	---	---	---
B. affinis	38.8	5.2	---	---	3.3	1.1	2.2	7.6	7.6	10.9	7.9	---	---	---	---
B. albicans	38.4	11.8	---	---	4.0	2.7	1.3	9.2	9.3	13.0	9.6	---	---	---	---
B. catingae	31.8	9.0	---	---	4.2	2.4	1.8	9.9	10.0	15.2	10.0	---	---	---	---
B. forficata	41.0	11.0	---	---	4.3	2.5	1.8	7.9	7.9	10.2	6.1	---	---	---	---
B. mollis	28.9	7.8	---	---	3.3	1.5	1.8	5.4	5.1	9.5	5.3	---	---	---	---
B. ovata	38.0	9.2	---	---	3.5	2.1	1.4	7.8	7.8	12.2	7.2	19.8	9.3	---	---
B. platypetala	32.2	7.5	---	---	4.1	2.0	2.1	14.3	14.3	---	---	14.3	7.5	---	---
Series *Acuminatae*															
B. acuminata	---	---	---	---	4.1	2.0	2.1	7.2	7.2	---	---	---	---	---	---
Series *Cansenia*															
B. acuruana	71.5	40.0	---	---	4.2	3.0	1.2	7.3	7.4	---	---	---	---	---	---
B. angulicaulis	93.2	26.8	---	---	3.3	1.6	1.7	6.2	6.3	9.2	5.2	---	---	---	---
B. brevipes	72.0	29.5	---	---	3.7	1.3	2.4	7.7	7.8	10.3	6.4	10.0	5.0	---	---
B. cheilantha	---	---	58.3	57.5	3.9	1.4	2.5	9.4	9.4	13.8	8.1	---	---	---	---
B. cupulata	77.5	40.0	---	---	5.4	3.4	2.0	---	---	---	---	---	---	---	---
B. curvula	58.8	28.2	---	---	3.4	1.1	2.3	8.5	8.5	---	---	---	---	2.6	3.0
B. dubia	75.0	23.0	---	---	2.3	1.2	1.1	5.0	5.0	---	---	---	---	---	---
B. dumosa	77.8	33.5	---	---	2.2	0.8	1.4	5.5	5.4	---	---	---	---	2.9	3.4
B. goyazensis	73.0	32.5	---	---	3.4	1.2	2.2	9.0	8.8	---	---	---	---	---	---
B. holophylla	71.0	33.0	---	---	3.0	1.1	1.9	9.4	9.4	---	---	---	---	---	---
B. longicuspis	62.0	30.0	---	---	3.6	1.5	2.1	8.4	8.5	---	---	---	---	---	---
B. longifolia	63.5	41.5	---	---	3.5	1.5	2,0	8.2	8.2	---	---	---	---	---	---
B. membranacea	---	---	---	---	3.4	1.3	2.1	8.6	8.5	---	---	---	---	---	---
B. rufa	69.0	55.0	---	---	3.8	1.7	2.1	5.2	5.2	---	---	---	---	---	---
B. subclavata	62.8	30.5	---	---	3.3	1.1	2.1	7.8	7.8	12.2	7.2	11.8	5.7	---	---
B. ungulata	110.2	45.5	---	---	4.6	1.3	3.3	8.8	8.8	12.6	8.2	---	---	---	---
B. viscidula	82.5	25.0	---	---	3.9	1.2	2.7	7.8	7.8	---	---	---	---	---	---
Series *Pentandrae*															
B. pentandra	60.8	4.8	---	---	3.3	1.2	2.1	6.7	6.8	---	---	---	---	---	---
B. vespertilio	78.0	8.8	---	---	2.8	1.0	1.8	7.4	7.0	---	---	---	---	---	---
Series *Perlebia*															
B. bauhinioides	55.8	7.5	---	---	3.8	1.3	2.5	8.3	7.5	---	---	---	---	---	---

B. forficata and *B. platypetala* (Fig. 23). The muri were straight, smooth and simplicolumellate, with supratectal elements in the shape of clavae (Fig. 1, 5), gemmae (Fig. 10) or bacula (Fig. 24). The occurrence of the three types of supratectal elements was variable among the taxa; although there was a predominance of a given type in most species. There was no predominance in *B. mollis*, which had a the highest number of supratectal elements (ca. 25). The lowest number (ca. 6) was observed in *B. aculeata* and *B. acreana* (Tab. 4). The sexine was thicker than the nexine in *B. acreana*, *B. aculeata*, *B. albicans*, *B. catingae* and *B. ovata*; as thick as the nexine in *B. platypetala*; and thinner than the nexine in *B. affinis*, *B. forficata* and *B. mollis* (Tab. 3).

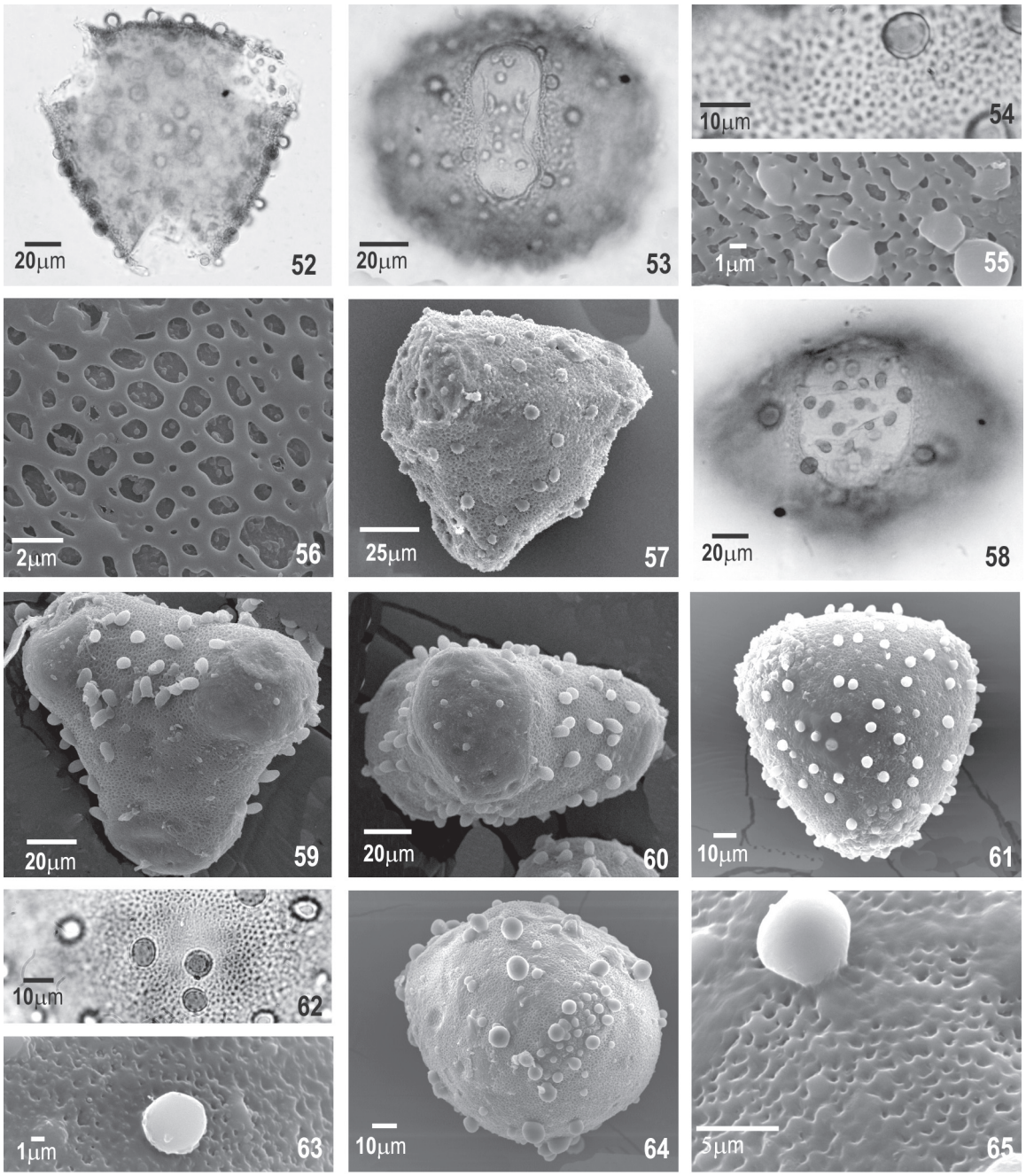
In *B. acuminata* (ser. *Acuminatae*), the sexine was reticulate; muri sinuous, smooth and simplicolumellate (Fig. 26); supratectal elements in the shape of gemmae and bacula



Figures. 35-51. Photomicrographs and electron photomicrographs of pollen grains of the *Bauhinia*. Fig. 35-37. *Bauhinia cupulata* Benth.: 35. general aspect, in polar view (PV), under scanning electron microscopy (SEM); 36. aperture in equatorial view (EV, SEM); 37. ornamentation (EV, SEM)—Fig. 38-40. *Bauhinia curvula* Benth.: 38. general aspect (PV, SEM); 39. ornamentation (PV, SEM); 40. ornamentation detail (PV)—Fig. 41-44. *Bauhinia dubia* G. Don.: 41. general aspect (PV); 42. general aspect/aperture (EV); 43. ornamentation detail (EV); 44. ornamentation (EV, SEM)—Fig. 45-48. *Bauhinia dumosa* Benth.: 45. optical section (PV); 46. general aspect (PV, SEM); 47. general aspect and aperture (EV, SEM); 48. ornamentation (EV, SEM)—Fig. 49. *Bauhinia goyazensis* Harms.: general aspect and aperture (EV, SEM)—Fig. 50. *Bauhinia holophylla* (Bong.) Steud.: ornamentation (SEM)—Fig. 51. *Bauhinia longicuspis* Benth.: ornamentation (SEM).

Table 4. Number of elements in an area of 50 μm² of the surface of the pollen grains in polar view and sexine ornamentation of *Bauhinia* species, by series.

Species	N of elements	Sexine ornamentation
Series *Aculeatae*		
B. acreana	6	Reticulate, supratectal elements: clavae (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. aculeata	6	Reticulate, supratectal elements: clavae (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. affinis	21	Microreticulate, supratectal elements: clavae (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. albicans	7	Microreticulate, supratectal elements: clavae (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. catingae	8	Reticulate, supratectal elements: bacula (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. forficata	17	Microreticulate, supratectal elements: clavae (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
B. mollis	25	Reticulate, supratectal elements: clavae and gemmae. Muri straight, smooth. Lumina not ornamented
B. ovata	9	Reticulate, supratectal elements: clavae (in most) and gemmae and bacula. Muri straight, smooth. Lumina not ornamented
B. platypetala	9	Microreticulate, supratectal elements: bacula (in most) and gemmae. Muri straight, smooth. Lumina not ornamented
Series *Acuminatae*		
B. acuminata	9	Reticulate, supratectal elements: gemmae. Muri sinuous and straight. Lumina ornamented
Series *Cansenia*		
B. acuruana	38	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina not ornamented
B. angulicaulis	32	Reticulate, supratectal elements: clavae (in most). scabrae and gemmae. Muri straight, smooth, with perforate. Lumina not ornamented. Small lumina surrounding the larger lumina
B. brevipes	35	Reticulate, supratectal elements: bacula (in most), scabrae, clavae and gemmae. Muri straight, smooth, with perforate. Lumina ornamented. Small lumina surrounding the larger lumina
B. cheilantha	35	Microreticulate, supratectal elements: scabrae, clavae and gemmae. Muri straight, smooth. Lumina not ornamented
B. cupulata	--------	Perforate, without supratectal elements. Mesocolpium with sexine conspicuously undulate, suggestive of rugulae, and slightly undulate at the pole
B. curvula	35	Reticulate, supratectal elements: scabrae, verrucae and gemmae. Muri sinuous and smooth with perforation. Lumina not ornamented
B. dubia	53	Reticulate, supratectal elements: verrucae. Muri low, straight and smooth. Lumina ornamented. Small lumina surrounding the larger lumina
B. dumosa	103	Reticulate, supratectal elements: scabrae. gemmae (in most) and verrucae. Muri straight, smooth. Lumina not ornamented
B. goyazensis	17	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina not ornamented
B. holophylla	28	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina ornamented
B. longicuspis	52	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina ornamented
B. longifolia	51	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth with perforation. Lumina not ornamented
B. membranacea	19	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth with perforation. Lumina ornamented. Small lumina surrounding the larger lumina
B. rufa	29	Reticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth with perforation. Lumina ornamented
B. subclavata	26	Reticulate, supratectal elements: scabrae. clavae (in most), gemmae and bacula. Muri straight, smooth. Lumina not ornamented
B. ungulata	26	Microreticulate, supratectal elements: scabrae, clavae and gemmae. Muri with elevations at intersections. Lumina not ornamented
B. viscidula	30	Reticulate, supratectal elements: scabrae and gemmae. Muri sinuous and smooth with interruptions in some areas but not closing the lacunae. Lumina not ornamented
Series *Pentandrae*		
B. pentandra	25	Microreticulate. Mesocolpial regions undulate from pole to pole. Supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina not ornamented
B. vespertilio	28	Microreticulate. Mesocolpial regions undulate from pole to pole. Supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina not ornamented
Series *Perlebi*a		
B. bauhinioides	1l	Microreticulate, supratectal elements: scabrae and gemmae. Muri straight, smooth. Lumina not ornamented



Figures. 52-65. Photomicrographs and electron photomicrographs of pollen grains of the *Bauhinia.* Fig. 52-55. *Bauhinia longifolia* (Bong) Steud.: 52. optical section in polar view (PV); 53. general aspect and aperture in equatorial view (EV); 54. ornamentation detail (EV). 55. ornamentation in EV under scanning electron microscopy (SEM)—Fig. 56. *Bauhinia membranacea* Benth.: ornamentation (SEM)—Fig. 57, 58. *Bauhinia rufa* (Bong) Steud.: 57. general aspect (PV, SEM); 58. general aspect and aperture (EV)—Fig. 59, 60. *Bauhinia subclavata* Benth.: 59. general aspect (PV, SEM); 60. general aspect and aperture (EV, SEM)—Fig. 61-63. *Bauhinia ungulata* Jacq.: 61. general aspect (PV, SEM); 62. ornamentation detail (PV); 63. ornamentation (PV, SEM)—Fig. 64, 65. *Bauhinia viscidula* Harms.: 64. general aspect (PV, SEM); 65. ornamentation (PV, SEM).

(Fig. 27); and lumina ornamented (Tab. 4). The sexine was as thick as the nexine (Tab. 3).

In the series *Cansenia*, the sexine was reticulate in most species, microreticulate in *B. cheilantha* (Fig. 34) and *B. ungulata* (Fig. 62, 63); and perforate in *B. cupulata* (Fig. 87), in which the mesocolpium was conspicuously undulate, resembling rugulae, and the apocolpium was slightly undulate. The muri of the sexine were simplicolumellate in all species; reticulate in most species (Figs. 32, 39, 44, 50, 56, 59, 65); microreticulate in *B. cheilantha* (Fig. 34) and *B. ungulata* (Fig. 62, 63); and perforate with the surface in the mesocolpium, conspicuously undulate, resembling rugulae, and slightly undulate in the apocolpium only in *B. cupulata* (Fig. 35, 36). The muri were straight or sinuous,

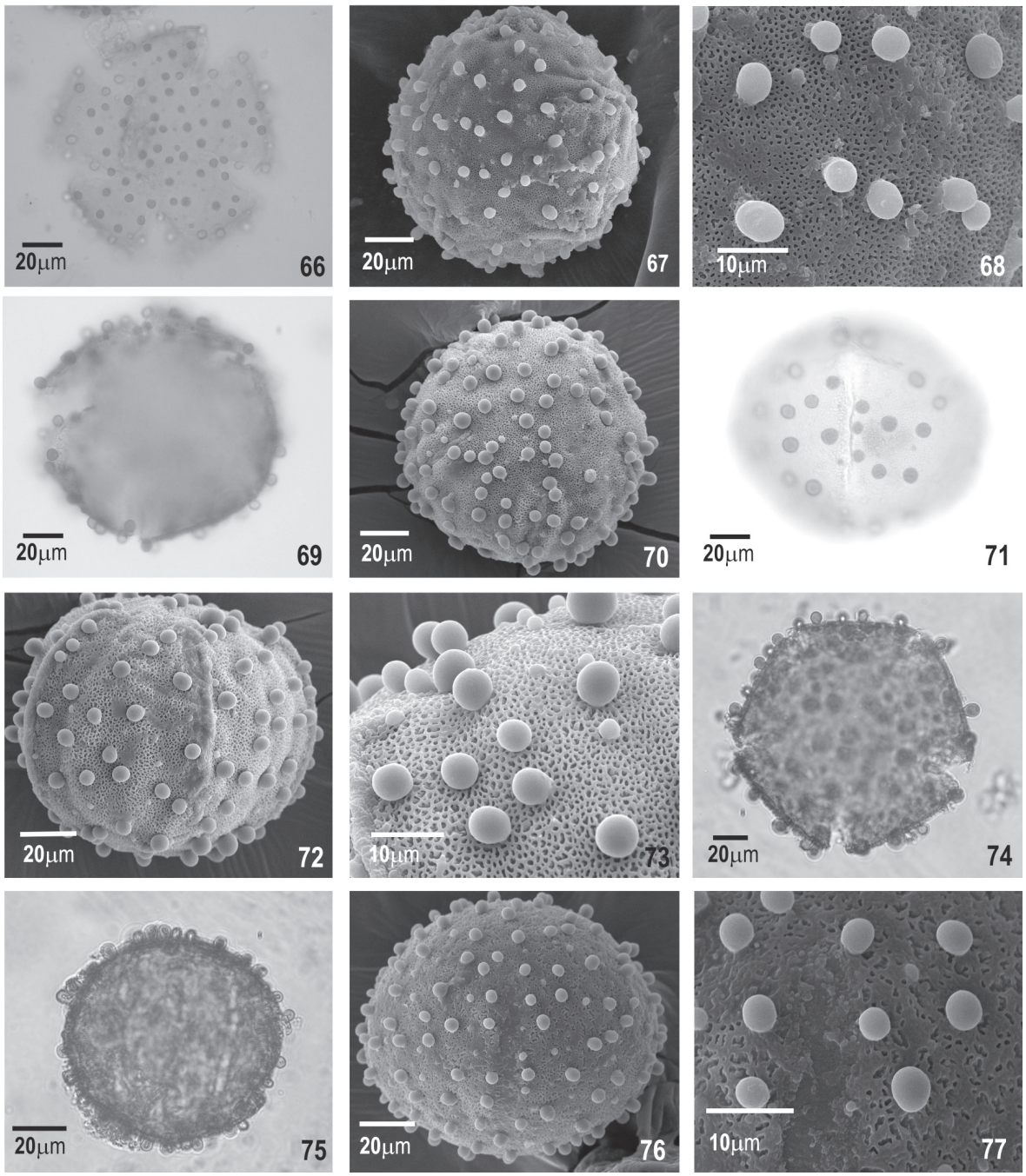


Fig. 66-77. Photomicrographs and electron photomicrographs of pollen grains of the *Bauhinia.* Fig. 66-68. *Bauhinia pentandra* (Bong) Steud.: 66. optical section in polar view (PV); 67. general aspect in PV under scanning electron microscopy (SEM); 68. ornamentation (PV, SEM)—Fig. 69-73. *Bauhinia vespertilio* S. Moore- polar view: 69. optical section; 70. general aspect (SEM); 71. aperture in equatorial view (EV); 72. general aspect (EV, SEM); 73. ornamentation (EV, SEM)—Fig. 74-77. *Bauhinia bauhinioides* Macbride: 74. optical section (PV); 75. general aspect and aperture (EV, SEM); 76. general aspect (EV, SEM); 77. ornamentation (EV, SEM).

low or high in the intersections, with or without perforations, some species showing interruptions in some areas that nevertheless did not close the lacunae; the lumina were ornamented or not, with small lumina surrounding the larger lumina. In most species, there were five types of supratectal elements (scabrae, gemmae, clavae, bacula and verrucae) with or without a predominance of any given type (Tab. 4). The nexine was thicker than the sexine in most species; approximately the same thickness as the sexine in *B. angulicaulis* and *B. dubia*; and thinner than the sexine of *B. cupulata* (Tab. 3).

In the series *Pentandrae*, the sexine was microreticulate, with supratectal elements in the shape of scabrae and gemmae (Fig. 69, 73) the muri were straight, smooth and

simplicolumellate. scanning electron microscopy analysis showed the mesocolpial regions undulate from pole to pole (Fig. 67, 72). *Bauhinia vespertilio* was the species with the highest number of supratectal elements (ca. 28) (Tab. 4). The sexine was thinner than the nexine (Tab. 3).

In *B. bauhinioides* (ser. *Perlebia*), the sexine was microreticulate (Fig. 77), with muri that were straight, smooth and simplicolumellate, with approximately 11 supratectal elements (scabrae and gemmae) (Tab. 4). The nexine was thicker than the sexine (Tab. 3).

Dichotomous key to *Bauhinia* species, based on pollen characters

1. Inaperturate pollen grains.....*B. acuminata*
1. Aperturate pollen grains
2. Porate pollen grains.....*B. cheilantha*
2. Colpate pollen grains
3. Perforate sexine..... *B. cupulata*
3. Microreticulate or reticulate sexine
4. Microreticulate sexine
5. Mesocolpium with undulate regions from pole to pole.....*B. pentandra* and *B. vespertilio*
5. Mesocolpium without undulate regions
6. Muri with elevations at the intersections of the lumina.....*B. ungulata*
6. Muri straight and smooth
7. Pollen grain 4(5)-colpate
8. Colpus length ca. 38.4 µm.....*B. albicans*
8. Colpus length ca. 55.8 µm.....*B. bauhinioides*
7. Pollen grains 6-colpate
9. Supratectal elements mostly shaped as bacula and numbering ca. 9.....*B. platypetala*
9. Supratectal elements mostly shaped as clavae and numbering > 15
10. Colpus with costa, ca. 38.8 µm long.....*B. affinis*
10. Colpus with costa, ca. 41.0 µm long.....*B. forficata*
4. Reticulate sexine
11. Pollen grains 6(7)-colpate
12. Colpus length ≥ 38.0 µm
13. Pollen grains oblate spheroidal, colpus length ca. 38.0 µm.....*B. ovata*
13. Pollen grains oblate, colpus length ca. 47.2 µm.....*B. aculeata*
12. Colpus length < 38.0 µm
14. Pollen grains suboblate, colpus length ca. 31.8 µm…….....*B. catingae*
14. Pollen grains oblate spheroidal, colpus length ca. < 30.0 µm
15. Colpus length ca. 23.2 µm; supratectal elements numbering ca. 6.....*B. acreana*
15. Colpus length ca. 28.9 µm; supratectal elements numbering ca. 25.....*B. mollis*
11. Pollen grains 3(4)-colpate
16. Sexine with sinuous muri
17. Pollen grains oblate, colpus length ca. 58.8 µm, muri of the reticulum without interruption .....*B. curvula*
17. Pollen grains suboblate, colpus length ca. 82.5 µm, muri of the reticulum with interruptions .....*B. viscidula*
16. Sexine with straight muri
18. Reticulum formed by the small lumina surrounding the larger lumina
19. Sexine with low muri, supratectal elements only of the verruca type, and numbering ca. 53 .....*B. dubia*
19. Sexine without low muri, supratectal elements of the scabra, gemma, clava, verruca or baculum type, numbering ≤ 35
20. Supratectal elements numbering ca. 19, 95% CI EDPV = 129.8 µm.....*B. membranacea*
20. Supratectal elements numbering > 30, 95% CI, EDPV > 140.0 µm
21. Pollen grains oblate, colpus length ca. 720 µm, 95% CI, EDPV = 146.4 µm .....*B. brevipes*
21. Pollen grains oblate spheroidal, colpus length ca. 93.2 µm, 95% CI, EDPV = 164.1 µm ..... *B. angulicaulis*
18. Reticulum without small lumina surrounding the larger lumina
22. Reticulum lumina without ornamentation

23. Pollen grains suboblate, supratectal elements numbering ca. 103.....*B. dumosa*
23. Pollen grains oblate, supratectal elements numbering ≤ 55
24. Supratectal elements numbering ca. 26, clava type predominating, 95% CI = 144.5 µm.....*B. subclavata*
24. Supratectal elements numbering > 35, gemma and scabra types predominating, 95% CI > 150.0 µm
25. Supratectal elements ca. 38, 95% CI > 153.8 µm, muri without perforation .....*B. acuruana*
25. Supratectal elements ca. 51, 95% CI = 157.5 µm, muri with perforation .....*B. longifolia*

22. Reticulum lumina with ornamentation
26. 95% CI > 160.0 µm, supratectal elements ca. 52, colpus length ca. 62.0 µm..... .....*B. longicuspis*
26. 95% CI < 160.0 µm, supratectal elements < 30, colpus length ≥ 69.0 µm
27. Pollen grains oblate, colpus length ca. 69.0 µm, sexine with muri perforate .....*B. rufa*
27. Pollen grains suboblate, colpus length ≥ 71.0 µm, sexine with muri without perforation
28. Supratectal elements numbering ca. 17.....*B. goyazensis*
28. Supratectal elements numbering ca. 28.....*B. holophylla*

Discussion

Bauhinia acuminata (ser. *Acuminatae*) differs from all other species by presenting inaperturate pollen grains separated in the key based on this characteristic. The species *B. bauhinioides* was the only one belonging to the series *Perlebia* and had pollen grains 4(5)-colpate with a microreticulate sexine. These features placed it next to *B. albicans* (ser. *Aculeatae*) in the pollen key. The species of the series *Pentandrae* could not be separated in the key because their pollen was similar. The series *Aculeatae* formed two groups in the key, based on the type of sexine, which was microreticulate (*B. affinis*, *B. forficata*, and *B. platypetala*) or reticulate (*B. acreana*, *B. aculeata*, *B. catingae*, *B. mollis*, and *B. ovata*). Other features such as the number and type of supratectal elements were similar among the species of this series; i.e., some heterogeneity exists within this group. The taxa *B. cheilantha* and *B. ungulata* fell rather far from each other in the key, closer to representatives of other series. A large part of the species of the series *Cansenia* were united in the pollen key, based on the number and type of aperture (3(4)-colpate).

The species studied here all showed very large pollen grains. However, they differed primarily with respect to shape; amb; polar area; presence or absence of aperture (number and type); and sexine ornamentation. The members of the genus *Bauhinia* analyzed here showed predominantly reticulate pollen grains; only one species (*B. cupulata*) differed from the pattern, with the sexine perforate, although the mesocolpium was conspicuously undulate, with rugulae, and the apocolpium was slightly undulate. Some species differed from the others in the type of muri, which were low in *B. dubia*; with a smaller lumina around the larger lumina in *B. angulicaulis*, *B. brevipes*, and *B. membranacea*; sinuous in *B. curvula* and *B. viscidula*; and with elevations at the intersections in *B. holophylla* and *B. ungulata*. Other features were also important, and the key effectively differentiated the species by the shape of the pollen grain; aperture dimensions; and number and type of supratectal elements (scabrae, gemmae, clavae or bacula).

According to Salgado-Labouriau (1973), all Caesalpinioideae have pollen grains in monads. However, pollen grains in tetrads were found in representatives of the subgenus *Bauhinia* by Wunderlin *et al*. (1987), although those authors did not mention which species have this characteristic. In the present study, we found pollen grains only in monads, in agreement with Salgado-Labouriau (1973).

Melhem & Salgado-Labouriau (1963) described the pollen grains of species of the Leguminosae of the Cerrado. Among the taxa studied, the authors analyzed two of the species discussed in the present study: *B. holophylla* and *B. rufa*. Our results corroborate those described for *B. rufa* and differ with respect to *B. holophylla* in terms of the shape (oblate) and the sexine/nexine ratio.

Barth & Bousada (1964) studied the pollen grains of three species of *Bauhinia*, including *B. forficata*, which was analyzed here. The authors described the pollen grains of *B. forficata* as having a pore-type aperture and supratectal elements of the spine type, differing from our observation that this species has supratectal elements of the clava type and aperture of the colpus type.

The variability of supratectal elements has been demonstrated by various authors, showing that *Bauhinia* species can have supratectal elements ranging from scabrae to bacula. The presence of verrucae, bacula, gemmae and scabrae was previously reported by Palacios-Chávez (1970).

This wide variation was observed in our study; the absence of supratectal elements of the scabra type was characteristic of the pollen grains of the representatives of the series *Aculeatae*. The similarity between some supratectal elements might explain the lack of specificity in the descriptions of pollen grains in certain studies.

Schmitz (1973) examined the pollen of 100 species of *Bauhinia*, with simplified descriptions based mainly on the number and type of aperture, shape and sexine ornamentation. Among the species treated by that author and also studied here are the following: *Perlebia acuminata* (= *B. acuminata*), *Pauletia acuruana* (= *B. acuruana*), *P. affinis* (= *B. affinis*), *P. angulicaulis* (= *B. angulicaulis*), *P. bauhinioides* (= *B. bauhinioides*), *P. curvula* (= *B. curvula*), *P. forficata* (= *B. forficata*), *P. holophylla* (= *B. holophylla*), *P. longifolia* (= *B. longifolia*), *P. rufa* (= *B. rufa*), *P. ungulata* (= *B. ungulata*) and *P. viscidula* (= *B. viscidula*). Comparing the results of Schmitz (1973) with those of our study, the pollen descriptions generally agree for the species *B. acuruana*, *B. curvula*, *B. rufa*, *B. ungulata* and *B. viscidula*. Note that *Bauhinia curvula* was characterized by Schmitz (1973) as having pollen grains with supratectal processes in the form of verrucae. This characteristic corroborates our results, albeit found only in three of the taxa studied here. Our observations regarding *B. acuminata* diverged from those of Schmitz (1973), who classified the pollen as 3-4(5)-aperturate, whereas we classified it as inaperturate. The variations in the number of apertures indicated by Schmitz (1973) for *B. bauhinioides* and *B. longifolia* were not observed in this study. Schmitz (1973) classified *B. platypetala* as 3-colporate, rugulate to striated; whereas we observed six colpi and a reticulate sexine. The classification of the number of apertures of *B. forficata* (3(4)-colpate), does not agree with our observation of 6-colpate pollen grains.

Wunderlin (1976) considered *B. affinis* a synonym of *B. aculeata*, along with numerous other binomials, including *B. catingae* and *B. albicans*. The proximity of the species mentioned by Wunderlin (1976) was confirmed by the pollen characters observed in this study. These taxa belong to the series *Aculeatae* and have pollen grains with supratectal processes such as clavae or bacula. This type of ornamentation, together with other characters, places these species in the series *Aculeatae* with regard to pollen characters.

Guinet (1981) reported that the vast majority of the representatives of the subfamily Caesalpinioideae have 3-colporate pollen grains, with some colpate and a few porate. Despite that author's assertion regarding the predominance of colpori in the subfamily, our results for the pollen grains of species of the genus *Bauhinia* showed that practically all taxa had colpate pollen, which probably indicates that the section *Pauletia* does not follow the aperture type pattern found in Caesalpinioideae. The only exception, *B. cheilantha*, had a pore-type aperture. Porate pollen grains were observed in the genus *Bauhinia*, in *B. seleriana*, by Palacios-Chávez (1970). The species *B. acuminata* showed no apertures, differing from all other species examined here. Inaperturate pollen grains were observed in *B. tomentosa* by Vishnu-Mitre & Sharma (1962).

Wunderlin *et al.* (1987) established five series under the section *Pauletia*: *Acuminatae*, *Ariaria*, *Cansenia*, *Pentandrae* and *Perlebia*, making use of macro- and micromorphological characters, including those of pollen. Of those series, only *Ariaria* was not analyzed here. The palynological characters used by the authors in the formulation of the series were as follows: for the series *Cansenia*, including ca. 50 species—pollen grains (3-7)-colpate or (3-7)-colporoidate, sexine reticulate, usually with supratectal processes; for the series *Perlebia*, with only one species—pollen grains 3-7-colpate, sexine reticulate with supratectal processes; and for the series *Pentandrae*, comprising ca. seven species—pollen grains 3-7 colporate, sexine reticulate with supratectal processes. Comparing the results obtained here with those of Wunderlin *et al.* (1987), the observations for the series *Cansenia* and *Perlebia* were similar. However, descriptions for the series *Pentandra* differ, because Wunderlin *et al*. (1987) reported colporate pollen grains, whereas we found that the species *B. pentandra* and *B. vespertilio* both have apertures of the colpus type.

Vaz (2001) carried out a taxonomic study of 58 species of *Bauhinia* sect. *Pauletia*, native to or cultivated in Brazil. Among those taxa, the author analyzed the pollen grains of seven species, six of which were also analyzed here. The author divided the species into five pollen types (type *B. acuminata*, type *B. catingae*, type *B. pentandra*, type *B. ungulata*, and type *B. tarapotensis*). Vaz (2001) defined the pollen types mainly on the basis of the classification of the aperture, amb and shape of pollen grains. Unfortunately, we could not accept the pollen types established by Vaz (2001), due to the presence of important characters related to muri that were not examined by those authors.

Vaz & Tozzi (2003) considered the series *Cansenia* to be well-defined and recognizable by the type of terminal aphyllous inflorescence, called pseudo-raceme with foliaceous bracts, as well as the floral bracts and bracteoles associated with pollen grains of type 3-(4)-colpate, angulaperturate. The pollen morphology described in the present study differs significantly for some species, especially as regards the type of supratectal elements, shape of the reticulum, and type of the muri. We note that those authors included *B. cheilantha* in the series *Cansenia*, although that species was previously assigned to another group by Bentham (1870). Our results show that the pollen of *B. cheilantha* shares many features with other species of the series *Cansenia*, although it was the only member of the series that had apertures of the pore type. Also according to Vaz & Tozzi (2003), *B. cupulata* is often confused with *B. longifolia*, especially when they occur sympatrically. Our results show a large difference between those two taxa in terms of the pollen morphology. *Bauhinia cupulata* has, among other characters, pollen grains with a perforate sexine and without supratectal

elements; whereas *B. longifolia* has reticulate pollen grains with supratectal elements of the scabra and gemma types. These respective differences in pollen were also observed by Ferguson (1986). We believe that these characters can help discriminate between the two species.

Santos *et al.* (2012) examined the pollen grains of 15 species of *Bauhinia* occurring in Caatinga areas of Bahia, some of them also analyzed here: *B. aculeata*, *B. acuruana*, *B. bauhinioides*, *B. brevipes*, *B. cheilantha*, *B. dumosa*, *B. forficata*, *B. pentandra* and *B. subclavata*. Comparing their results with our own, we found differences in the size of pollen grains of *B. acuruana*, *B. bauhinioides*, *B. cheilantha* and *B. dumosa* which those authors described as large and we classified as very large. The differences in the size of pollen grains might be related to the technique of preparation for light microscopy (10% KOH) used by Santos *et al.* (2012). The exine measurements, as well as the shape of the muri, also showed a large discrepancy because that author described the species with sinuous muri and the exine thicker than or the same as the nexine; whereas we observed that the pollen grains of the same species have straight muri, with the sexine thicker than the nexine only in *B. aculeata*. According to Santos *et al.* (2012), the number of apertures varies among *B. aculeata*, *B. bauhinioides* and *B. brevipes*. Although we did not observe such variation among those species, we did see similar variations among other species. This heteromorphism in the number of apertures in *Bauhinia* species has been reported by other investigators (Schmitz 1973; Gamerro & Fortunato 2001). Also according to Santos *et al.* (2012), the pollen grains of *B. cheilantha*, *B. dumosa* and *B. subclavata* have microreticulate exine, whereas we found the exines to be reticulate in those species. We obtained similar results in the classification of supratectal elements (gemmae, clavae and verrucae), although Santos *et al.* (2012) made no mention of the presence of bacula in any species, which were observed here in *B. brevipes* and *B. subclavata*. Regarding the type of aperture of the latter species, Santos *et al.* (2012) considered it to be the pore type but did not provide measurements.

Vaz & Tozzi (2005), in making a synopsis of *Bauhinia* sect. *Pauletia* in Brazil, used palynological characters for the composition of key species. Our results differ from theirs for the series *Cansenia*, because we found no colpori in the species examined here. These authors indicated that *B. acreana* belongs to the *B. forficata* complex and is accepted by some authors as a synonym of this. Considering our observations of pollen reported here, we can conclude that these taxa are actually quite similar, confirming the taxonomic observations. The species can be separated, mainly by the fact that the sexine is microreticulate in *B. forficata* and reticulate in *B. acreana*, although they share other characters. In their taxonomic analysis of populations of *B. affinis*, *B. catingae*, *B. albicans* and *B. aculeata*, considering that these species occur in geographical areas that are not connected, Vaz & Tozzi (2005) decided to retain these as separate species, based on the characters of leaves and branches. Although the palynological characters indicate a close similarity between these species, it was possible to separate them based mainly on the shape, aperture number and sexine ornamentation. Vaz & Tozzi (2005) considered *B. mollis* a distinct species, isolated in the series *Aculeatae* by the shape of the bud, which has a clavate outline and a median-region constriction that divides the calyx into two parts. However, considering the pollen characters, the species is located well within the series *Aculeatae* in that it shares many characters with the other representatives, differing mainly with respect to heteromorphism of the number of apertures (6(7)-colpate).

Across palynological studies of *B. forficata*, there are discrepancies regarding the classification of the type of aperture: Leonhardt & Lorscheitter (2008) termed the aperture of *B. forficata* a colporus, whereas Barth & Bouzada (1964) stated that *B. forficata* has apertures of the pore type. The observations made in the present study indicate that the apertures of *B. forficata* should be classified as colpi.

Various investigators have used pollen characters to aid in formulating taxonomic arrangements, including Melhem & Salgado-Labouriau (1963), Smith (1964), Palacios-Chavez (1970), Schmitz (1973), Larsen (1975), Larsen & Larsen (1983), Ferguson & Pearse (1986) and Ferguson (1990). Vishnu-Mitre & Sharma (1962) observed that a system of plant taxonomy based only on the pollen morphology can hardly be regarded as natural, although the authors recognized the importance of pollen grains as an aid to taxonomic studies.

The present study has established that representatives of the series *Aculeatae*, *Cansenia*, *Pentandrae* and *Perlebia* differ from those of the series *Acuminatae* mainly in that *Acuminatae* representatives are inaperturate, whereas the taxa within the series *Cansenia* were heterogeneous (*B. cheilantha* was the only species that had apertures of the pore type). Knowledge of pollen characters is important to improving the taxonomic organization of the genus *Bauhinia*.

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Apendix 1 - Specimens examinated

Bauhinia acreana Harms.: **BRAZIL. Acre**: Acrelândia. BR-364, Km 85; Faz. do SR. Natalícia Gomes Silva, 12/II/2000, *I.S. Riveiro 274* (RB); **Ceará**: Guaramiranga. Serra de Baturité, 13/II/1966, *Andrade Lima, A.D 66-4437* (RB); **Pará**: Serra de Santarém, 20/III/1926, *A. Ducke s/nº* (RB20320); Mun. Altamira. km 74 da estr. Transamazônica, no rumo de Itaituba, 26/VII/1971, **P. Cavalcante 2802* (RB).

Bauhinia aculeata Vell.: **BRAZIL. Rio de Janeiro**: Jardim Botânico do Rio de Janeiro, cultivada no arboreto, 06/XII/2005, **A.C.L.N Rodrigues s/nº* (RB); Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, 01/XI/1996, *A. Vaz et al. 1179* (RB); cultivada no canteiro 1E, 19/XI/1999, *A. Vaz 1183* (RB).

Bauhinia acuminata Vell.: Brazil. **Bahia**: Santa Cruz de Cabrália, Estação Ecol. do Pau Brasil, km 16 a W de Porto Seguro. rod. BR 367. Elev.: 40, s/data, **Santos, F.S. s/nº* (RB).

Bauhinia acuruana Moric.: BRAZIL. **Bahia**: Mun. Macaúbas, Estrada para Canatiba, próximo ao alto, 18/I/1997, *G. Hatschbach et al. 65926* (RB); **Minas Gerais**: Várzea de Palma, Estrada Várzea de Palma a Serra do Cabral, 16/I/1996, *G. & M. Hatschbach 64192 et J. M. Silva* (RB); Manga, Gleba A, DIJ, 13/II/1990, *M.B. Horta et al. s/nº* (RB309579); Jaíba, 18/XII/1996, **E. Tameirão Neto 2264* (RB).

Bauhinia affinis Vog.: **BRAZIL**. **Paraná**: Guaraniaçu, Guarani, 07/XI/1963, *E. Pereira 7758* (RB); **Santa Catarina**: Luiz Alves. 16 Km em direção a Massaranduba, s/data, **R.L.C. Bortoluzzi, 1285* (RB).

Bauhinia albicans Vog.: **BRAZIL. Espírito Santo**: Venda Nova do Imigrante. Alto Bananal. Elev.: 1000M, 15/I/1995, *G. Hatschbach 61505* (RB); **Rio de Janeiro**: Mun. Cabo Frio. Estrada do Guriri, antiga estrada que liga Búzios à Cabo Frio, 22/II/2006 **C.L.N. Rodrigues 165* (RB); Estr. do Guriri, após a entrada para as dunas do Peró (beira de estrada), 15/XII/1996, *P.R. do C. Farág 297* (RB).

Bauhinia angulicaulis Harms.: BRAZIL. **Brasília**: Bacia do Rio São Bartolomeu, 04/VIII/1981 *E.P. Heringer et al. 7309* (IBGE); adjacências da mata após o córrego cachoeirinha, afluente margem esquerda do Rio Paranoá, 26/V/1982, *B.A.S. Pereira 263* (IBGE); Bacia do Rio São Bartolomeu, Adjacências do córrego Forquilha, 07/V/1981 **E.P. Heringer et al. 6921* (IBGE).

Bauhinia bauhinioides Macbride: BRAZIL. **Brasília**: Campus da UnB em frente ao IBAMA, 24/VI/1989, **V.F. Ferreira 4110* (RB); **Mato Grosso do Sul**: Corumbá. Vazante (próx. a divisa da invernada Canjiqueiral) Faz. Azurizal; Nabileque; Pantanal. Elev.: 90m, 28/IX/1987, *A. Pott 3476* (RB); Porto Murtinho. Rio Apa, Faz. Santa Cruz, 24/III/1998, *H.C. de Lima 5558* (RB).

Bauhinia brevipes Vogel: **BRAZIL. Bahia**: Mun. Barreiras. Coleta efetuada no km 30 da BR-242, Rod. Barreiras/Ibotirama, 04/VI/1991, *H.S. Brito 338* (RB); Mun. Caetité, Rodovia para Guanambi, caatinga, 13/VI/2004, **G. Hatschbach 77808* (RB); **Minas Gerais**: Brasilândia de Minas. Fazenda Brejão. Adjacências de vereda próxima ao Rio Paracatu, 11/VII/2000, *J.A. Lombardi 3965* (RB); **Tocantins**: Conceição do Tocantins. Rod. TO-050, Km 375, Fazenda São José. próximo do Rio Santa Isabel. Elev.: 400 m. 11/V/2000, *G. Hatschbach 70881* (RB).

Bauhinia catingae Harms.: **BRAZIL. Bahia**: Mun. Feira de Santana Estrada Federal de Terra, Serra do Tambor, 30Km antes de Morro do Chapéu, s/data, *I. & C. Geettsberger 14-2273* (RB); Santa Inês; propriedade Pedrão, 09/III/1958, *A.D. de Andrade Lima 58-2913* (RB); Mun. Maracás. estr. para Contendas do Sincorá, 6 km sw de Maracás, afloramentos graníticos, 15/III/1980, *G. Martinelli 6658* (RB); Mun. Jacobina, Margem da Estrada (Saída), 20/II/2000, * *F.S. Cavalcanti et al. 629* (RB).

Bauhinia cheilantha (Bong.) Steud: BRAZIL. **Mato Grosso**: Mun. Poconé, rodovia Transpantaneira (MT 060) que liga Poconé a Porto Jofre, a aproximadamente 45km de Poconé, 28/I/1989, *A. Vaz 597* (RB); **Minas Gerais**: CD 03, 14/VI/1983, *Teixeira & Carvalho s/nº* (RB309577); **Pernambuco**: Serra do Cruzeiro, na estrada Triunfo - Sítio dos Nunes, 28/III/1970, **Andrade-Lima 70-5845*(RB); **Rio de Janeiro**: Jardim Botânico do Rio de Janeiro, 17/VIII/1937, *J. G. Kuhlmam s/nº* (RB35780).

Bauhinia cupulata Benth.: **BRAZIL. Goiás**: Mun. de Colinas do Sul, Minacu/Niquelândia, Fazenda Saracura, estrada de manutenção das torres, 08/IV/1999, *Walter et al. 13* (RB); Mun. de Teresina de Goiás Km 14 da estrada Teresina de Goiás/Nova Roma, entroncamento que vai para Campos Belos, aproximadamente 13º 30' S 47º 30' W. Gr,. 03/VIII/ 1996, **B.A.S. Pereira & D. Alvarenga 3115* (RB); **Mato Grosso**: Mun. dos Guimarães, Salgadeira, *12/III/1997*, *G. Hatschbach et al. 16740* (RB); **Tocantins**: Mun. Lagoa da Confusão, fazenda Formosa da Javaós, na margem direita do Rio Formoso. Latitude 51º 39' e longitude W 49º 51', 17/VIII/1998, *V.L. Gomes Klein et P. Delprete 3448* (RB).

Bauhinia curvula Benth.: **BRAZIL. Brasília**: Bacia do Rio São Bartolomeu, 11/III/1981, *E.P. Heringer et al. 6417* (BGE); Bacia do Rio São Bartolomeu, 14/V/1980, **E.P. Heringer et al. 4786* (IBGE); **Goiás**: Mun. Niquelândia ca 4km de Muquem Altitude 495m 14º31'14"S & 48º0910811W, Folha Uruaçu SD 22-Z-B, 08/V/1998, *M.L. Fonseca et al. 1824* (RB); Plantas do planalto do Brasil, serra dos cristais, 17ºS, 48ºW, 07/III/1966, *H.S. Irwin et al. s/nº* (R162112).

Bauhinia dubia G. Don.: BRAZIL. **Maranhão**: Mun. Santa Luzia, margens da estrada da Fazenda Cacique, já próximo a ferrovia Carajás, mata de terra firme com relevo ondulado, 27/III/1983, *M.G. Lobo et al. 310* (RB); **Pará**: Tomé Açu, margem da estrada que vai para a fazenda Curiman próximo ao Igarapé Ipiranga, floresta virgem, solo argiloso, 03/I/1977, *O.C. Nascimento 409* (RB); **Paraná**: 10km a leste pela Rodovia para Campos Belos, Tocantins, 10/XI/1991, **G. & M. Hatschbach 56043* (RB); **Piauí**: Bocaina. Prox. a estaca 44 Alto do Sangradouro, elev.: 285 m., 14/XII/1999, *M.R.A. Mendes 163* (RB).

Bauhinia dumosa Benth.: **BRAZIL. Brasília**: Reserva Biológica do IBGE 16º56'41"S & 47º53'07"W. Altitude 1100m. Córrego Taquara, 31/VIII/1995, **F.C.A. Oliveira & D. Alvarenga 442* (RB); **Goiás**: Mun. Alto Paraíso, Chapada dos Veadeiros PARNA, estrada para a sede, solo argiloso pedregoso. Relevo: Plano 1120m, 14º09'41"S & 47º46'30"W, 15/VIII/1995, *R. Marquete et al. 2288-A* (RB); Mun. Niquelândia, próximo ao povoado de Macedo, ca 07km da Mina de Níquel Tocantins, coord: 14º 26' 43"S 48º 25' 51"W, 18/IX/1996, *M. Aparecida da Silva & C.C.S. Ferreira 3113* (RB); Mun. de Niquelândia morro à esquerda entre Niquelândia e a companhia de Níquel Tocantins (CNT), ca de 4km da CNT, coord. 14º23'26"S & 48º26'13"W. 15/VIII/1996, *R.C. Mendonça et al. 2572* (RB).

Bauhinia forficata Link.: BRAZIL. **Rio de Janeiro**: Mun. de Piraí, estação ecológica de Piraí, 21/II/1984 *I.M. Silva et al. 195* (RB); Mun. Rio de Janeiro, estrada Vista Chinesa, 02/II/1996, *C. Garcia 08 et al.* (RB); Mun. Rio de Janeiro, cultivada atrás da Sistemática do JBRJ, 19/I/1994, **A.M.S. da F. Vaz 1010* (RB); Mun. Rio de Janeiro "cultivado" no JBRJ. xi-g, placa 450, s/data, *s/coletor* (RB385295).

Bauhinia goyazensis Harms.: **BRAZIL. Goiás**: Niquelândia. km 31 em direção a Muquem, próximo ao Córrego Dois Irmãos. Elev. 470, s/data, **Fonseca, M.L. 1837* (RB); Campinorte, Fazenda Barro Vermelho, Elev.

535, s/data, *M.A. Silva 3834* (RB); Niquelândia. Km 4 de Muquem, Elev.: 495, s/data, *M.L. Fonseca 1816* (RB).

Bauhinia holophylla (Bong.) Steud.: **BRAZIL. Brasília**: Área da Marinha próximo à BR 040, campo cerrado com solo úmido, 16/XII/1991, *R.C. Mendonça et al. 1992* (IBGE); BR - 251 -Km 1, 5/IX/1978, *E.P. Heringer et al. 2001* (IBGE); Reserva Ecológica do IBGE. Coord. 15º56'41"S 47º58'07"W alt. ca 1100m, entre a sede e a chácara, 06/II/1995, *M. Aparecida da Silva 2482* (IBGE); Reserva ecológica do IBGE,15º57'42"S & 47º 52'51"W, 28/X/1997, **R. Marquete & R.C. Mendonça 2830* (RB).

Bauhinia longicuspis Benth.: **BRAZIL. Amazonas**: BR 319, rod. Manaus-Porto Velho, a 15km de alt., mun. de Humaitá, 10/IV/1985, **C.A. Cid Ferreira 5393* (RB); **Mato Grosso**: Km 274 Xavantina - Cachimbo road. Dry Forest roadside, 18/XI/1967, *D. Philcox et al. 3127* (RB); **Pará**: Porto Trombetas, Oriximiná, Estrada para Igarapé das Pedras, 10/III/2001, *S.M. de Faria et al. 2377* (RB); Porto Trombetas, Oriximiná, Estrada para Igarapé das Pedras, 10/III/2001, *S.M. de Faria et al. 2376* (RB).

Bauhinia longifolia (Bong) Steud.: **BRAZIL. Mato Grosso**: Mun. Nova Xavantina, Reserva Biológica Mario Vianna, s/data, **B.S. Marimom BS-286* (RB); **Mato Grosso do Sul**: Bonito. Rod. Guia Lopes da Laguna a Bonito, 09/III/2003, *G. Hatschbach 74424* (RB); Mun. Aquidauana, Serra de Maracaju, Rodovia Ecológica 19/III/2003, *G. Hatschbach et al. 74934* (RB); **Rio de Janeiro**: Teresópolis, Campo Limpo, Granja. 28/V/1977, *Lucia Freire Carvalho 532* (RB).

Bauhinia membranacea Benth.: BRAZIL. **Goiás**: Guarani de Goiás. Fazenda Forquilha, Elev. 450m, 05/III/2001, *M.L. Fonseca 2412* (RB); **Bahia**: Correntina, 28/I/1967, *G.K. Gottsberger 11-28167* (RB); **Minas Gerais**: Juramento, Rio Piedosa, III/2005, **A.A. Miranda-Melo s/nº* (RB 425589).

Bauhinia mollis (Bong) D.Dietr.: **BRAZIL. Goiás**: Mun. Hidrolândia, Faz. Nova Fátima a 2km da BR. 153, 19/X/1983, *M.H. Rezende 06* (RB); **Mato Grosso do Sul**: Mun. Bonito, Estrada Bonito, Fazenda São Geraldo, 10,5km Lat. 21º13'29.8"S Long. 56º31'29.5"W. Alt 300m, 11/II/2002, *V.J. Pott. 5945 et al.* (RB); Rio Formoso, 01/II/1998, **O. S. Ribas & L.B.S. Pereira 2406* (RB); Mun. Bodoquena Rod. - MS - 178, 20km S de Bodoquena, 08/II/1998, *O.S. Ribas & L.B.S. Pereira 2596* (RB).

Bauhinia ovata Vog.: BRAZIL. **Espírito Santo**: Mun. Linhares, Reserva Florestal de Linhares, Estrada Mantegueira km1188, mata de Tabuleiro, 22/XI/1985, *D. A. Folli 559* (RB); Reserva Florestal de Linhares – CVRD Próximo estrada 154 Talhão 507, 02/X/1972, *A. M. Lino 116* (RB); **Minas Gerais**: Aimorés, Mata do Varejão, Borda de mata, 20/X/1997, *M.F. de Vasconcelos s/nº* (RB343802); Braúnas, 27/IX/1997, **E. Tameirão Neto 2552* (RB).

Bauhinia pentandra (Bong) Steud.: BRAZIL. **Mato Grosso do Sul**: Bonito. Projeto Guaicurus, cerca de 4-5km N. 09/XI/2002, *G. Hatschbach 73977* (RB); **Mato Grosso**: Cáceres. Gleba Facão, Rodovia para o Rio Jacobina, 05/V/1995, *G. Hatschbach 62293* (RB); Rod. BR-163, Próximo de km 699, Torre da Embratel (Mun. Rio Verde), 06/XI/1996, *G. Hatschbach 65361* (RB); Mato Grosso, 10/XI/1977, **C. Almeida 379* (RB).

Bauhinia platypetala Burch. ex Benth.: **BRAZIL. Distrito Federal**: Res. Ecol. do IBGE, 11/III/1992, *B.A.S. Pereira 2045* (RB); **Maranhão**: Mun. Buriti Bravo, IX/1984, *F.M.D. Hora & S.B. Silva 03* (RB); Carroxo BR-226, prox. Pousada do Cacique Barra do "corda", s/data, *P. Martins & E. Nunes s/nº* (RB); **Piauí**: Teresina, Larg. 60m, próximo ao Surrear, 10/IV/2001, **F.A.R. Soares 134* (RB).

Bauhinia rufa (Bong) Steud.: **BRAZIL. Brasília**: Córrego Landim, ca 20km N.E., D.F. Elevation 900m, 04/V/1966, *H.S. Irwin et al. s/nº* (R161556); Universidade de Brasília 12/IV/1963, *E. Santos 1704 & J. Sacco 1937* (R); **Minas Gerais**: Mun. Diamantina, estrada para São Gonçalo Rio das Pedras, 1161 ms.m., campo rupestre 18º10'18"S e 43º42'24"W, 07/X/2003, *M.G. Bovini & L.C.Giordano 2379* (RB); Mun. de Niquelândia, CNT. ca 5,5km a direita da Mina de Níquel. Coord.14º24'02"S & 48º25'20"W, 28/XI/1996, **M.L.M. Azevedo et al. 1076* (RB).

Bauhinia subclavata Benth.: **BRAZIL. Ceará**: Crato. Chapada do Araripe, 31/III/1985, **A.G. Fernandes s/nº* (RB287906); **Maranhão**: São João dos Patos, Buriti Largo, 14/IV/1980, *A.G. Fernandes s/nº* (RB287904).

Bauhinia ungulata Jacq.: **BRAZIL. Mato Grosso do Sul**: Mun. Ladário; Logradouro- Fazenda Vale do Paraíso - Morro Sta. Cruz, 17/V/2001, *Damasceno Junior et al. 2405* (RB); Campo grande, Rita Vieira, 24/IX/1993, *C.A.C. 2878* (RB); Mun. Sonora, Rod. BR-163, Km 811, 03/V/1995, *G. Hatschbach et al. 62202* (RB); Campo Grande, Reserva de cerrado, 24/VIII/2000, **A.L. Barros s/nº* (RB375092).

Bauhinia vespertilio S. Moore: **BRAZIL. Mato Grosso**: Mun. Cárceres, Mt-343, Rio Pirapatonga, 24/X/1995, **G. Hatschbach et al. 63842* (RB); Mun. Carceres, BR-070 Serra do Manguezal, 07/XI/1996, *G. Hatschbach et al. 65377* (RB).

Bauhinia viscidula Harms.: **BRAZIL. Brasília**: Taguatinga, Confluência córregos cana do Reino / Vicente Pires, 25/VIII/1981, *E.P. Heringer 7352* (IBGE); Reserva Ecológica do IBGE, cerrado. Ponto 32 s/data, *M.L.M. Azevedo & Rogério D. Lopes 790* (IBGE26454); Reserva Ecológica do IBGE, Foto: 953, Faixa 21, Ponto 33, 23/VII/1990, **M.L.M. Azevedo & F.C.A. Oliveira s/nº* (IBGE).