Pollen morphology of the Amacayacu Forest dynamics plot, Western Amazon, Colombia

Daiana Fontes, Carlos Jaramillo and J. Enrique Moreno

Smithsonian Tropical Research Institute (STRI), Panama, Republic of Panama

ABSTRACT

Amacayacu Forest Dynamics Plot (AFDP) is a 25-ha (500 m × 500 m) site located at Amacayacu National Natural Park (ANNP), Colombian Amazonia. The flora of AFDP is represented by terra firme Forest, the phytophysiognomic unit of the Amazon region with the greatest richness of plant species. However, high-resolution pollen images and morphological descriptions from the Amazon North-west are still rare. This study presents detailed information about pollen grains that will benefit future palynological analyses, particularly of Quaternary material. Herein we describe 255 tree species, comprising 72 families and 192 genera. Those species were grouped into 236 morphotypes. Six species revealed morphological variations among the pollen types within the same species and 36 species were impossible to differentiate from each other. Overall morphology shows apertures with a dominance of tricolporate (61%), inaperturate (5.8%), monocolpate (5.5%), and triporate (4.7%), and variation of sexine sculptures, with dominance of reticulate (66%), scabrate (11.3%), echinate (7.05%) and rugulate (4.3%). With respect to size, the equatorial diameter has a median of 29 μm (SD = 15.5), while the polar diameter has median of 32 μm (SD = 14.7).

KEYWORDS

Amacayacu Park; Western Amazon; pollen; morphology; terra firme Forest

1. Introduction

Amazonian rainforests play an important role in the regional climate of South America, and in the global carbon and hydrological cycles (Tian et al. 1998; Saatchi et al. 2007, 2011; Bustamante et al. 2016; Zuleta et al. 2017). The flora of Amazonia is the richest in the world and includes a large variety of environments such as terra firme forests, rainforests, floodplain forests, seasonal forests and even savannas. However, its floristic composition is not yet fully understood (Pitman et al. 2001; Steege et al. 2013; Pimm et al. 2014; Slik et al. 2015; Cardoso et al. 2017). terra firme forests in the north-western Amazon are among the most species-rich forests in the world (Valencia et al. 1994; Steege et al. 2003; Lleras et al. 2005; Duque et al. 2017), including not only trees but also lianas (Duivenvoorden 1996; Burn et al. 2010). Western Amazonia has more nutrient-rich soils, a shorter dry season, and a different taxonomic and functional composition of tree species than central and eastern Amazonia (Phillips et al. 1994; Steege et al. 2006).

Amazonian trees show a large disparity in species abundance, with only 227 species accounting for ~50% of the number of trees while 11,000 species represent less than 0.12% of the total number of trees (Steege et al. 2013, 2016). Already other taxonomic studies in the lowland Amazon rainforest, including periodically flooded terra firme forests and white-sand forests, have shown 6727 tree species among a total of 14,003 plant species (Cardoso et al. 2017).

Of the 227 most abundant species (Steege et al. 2013), almost half (102) occur in the Amacayacu National Natural Park (ANNP) (south-east of Colombia). Most plant families from ANNP originated in Gondwana, with a centre of endemism influenced by the northern Andes (Prance 1978; Gentry 1982; Rudas and Prieto 1998).

While the floristic composition of Amazonia remains poorly understood, the pollen flora is even less studied. There are relatively few palynological works based upon western Amazonian floras; most have focused on Colombian Amazonia or on the floras near Manaus, Brazil (Carvalho 1971; Carreira and Barth 1986, 2003; Carreira et al. 1996, 2005; Herrera and Urrego 1996; Jimenez 1996; Jimenez and Rangel 1997; Coliniaux et al. 1999; Jimenez et al. 1999, 2008; Rangel et al. 2001; Gurgel et al. 2004; Moura et al. 2004; Bush and Weng 2007; Ferreira et al. 2012; Absy and Rodrigues 2013; Rodrigues et al. 2016).

Here, we describe and illustrate pollen from 255 tree species from a forest plot in the western Amazonia of Colombia (Amacayacu), and describe general trends of pollen morphology within these species.

2. Materials and methods

2.1. Study area

The Forest Global Earth Observatory (ForestGEO) is a global network of scientists and forest research sites dedicated to advancing the long-term study of the world’s forests.
(Anderson-Teixeira et al. 2015). The network has more than 60 forest plots that were established and are monitored following the same protocols (Condit 1998). One of these is the Amacayacu Forest Dynamics Plot (AFDP), located within ANNP, Colombian Amazonia (lat. –3.80917°, long. –70.2679°; elev. 100 m above sea level; Figure 1). This 25-ha plot (500 m × 500 m) was established on terra firme forest that grows on Neogene sedimentary bedrock (the Pebas Formation), and it is characterised by a hilly and moderately dissected topography. Amacayacu soils are generally lower in nutrients and have high acidity and low base saturation due to the dominance of kaolinite and quartz (Chamorro 1989).

The mean annual temperature is 25.8 °C, mean annual precipitation is 3.2 m and the relative humidity is ~86% (Prieto 1994; Rudas 1996; Rudas and Prieto 2005; Barreto-Silva et al. 2014; Duque et al. 2017; Zuleta et al. 2017). According to Köppen (1936), the climate is classified as tropical wet (Af). The entire Amacayacu Park occupies 2930 km² at the southern end of the Amazon Basin (‘Amazon trapezium’). The study area is situated between the Amazon River (between Matamata Creek and the Amacayacu River) in the south and the Cotuhe River (between Pamaté Creek and Lorena Channel) in the north, and from Cabimas creek in the west to the Puritá River in the eastern (Lleras et al. 2005).

All plants with diameter at breast height (dbh) > 1 cm were identified, mapped, tagged, and measured following standard protocols (Condit 1998; Anderson-Teixeira et al. 2015). The census of AFDP, comprising 123,714 individuals, identified 1230 species, with an average diversity of 597.5 species per hectare (Duque et al. 2017), one of the largest in the world.

2.2. Description and illustration of modern pollen grains

We aspire to describe the pollen morphology of all 1230 species identified in the AFDP, a major task that will take years of work. In this first work, we describe 255 species. We used the extensive palynological collection housed at the Smithsonian Tropical Institute (STRI; Moreno et al. 2014), which holds the palynological slides for 28,000 mostly Neotropical species. The STRI collection includes the Alan Graham pollen collection, Barro Colorado Island pollen collection and Amazonia collection, among others (Moreno et al. 2014). We searched in our palynological collections for each of the 255 species listed in AFDP and found 133 of them. For the remaining 122 species, we used another species within the same genus as a surrogate for the species in the plot. We chose species that were geographically as close as possible to species from AFDP (Table 1). We analysed all slides available for a given species including the same species from different geographical areas. Descriptions of pollen grains were made using a Nikon Eclipse 80i microscope, following the standard terminology (Punt et al. 2007). Photographs with magnification 40× and 100× were captured using DIC M/N2 system (Difference Interference Contrast Illumination), with a Nikon Digital Camera Dxm 1200 F and Nikon ACT-1 version 2.63 image-capturing software. Measurements of the morphological structures of each species were made using ImageJ 1.51n software. There are 1999 pictures, each displaying individual bars representing 10 μm, arranged into 17 plates. The collection information on all botanical species, as well as the England Finder (EF) location coordinates of photographed grains, is included as Supplementary material.

The complete description and illustration of all 255 species were also added to the STRI palynological database (Jaramillo and Rueda 2018), where most pollen morphological characteristics are tabulated, making polytomous searches possible. This database is public and can be accessed over the Internet.

3. Results

Anacardiaceae R. Brown
Anacardium excelsum (Bertero & Balb. ex Kunth) Skeels
(Plate 1, figures 1–3, 8–9)
Table 1. List of species whose pollen grains are impossible to differentiate from each other under light microscopy.

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
<th>Morphotypes</th>
<th>Plates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piptocoma discolor</td>
<td>Asteraceae</td>
<td>Asteraceae</td>
<td>II</td>
</tr>
<tr>
<td>Vernonanthura puberula</td>
<td>Asteraceae</td>
<td>Asteraceae</td>
<td>II</td>
</tr>
<tr>
<td>Dussia tessmannii</td>
<td>Fabaceae</td>
<td>Leguminosae Type A</td>
<td>IV V</td>
</tr>
<tr>
<td>Hymenolobium nitidum</td>
<td>Fabaceae</td>
<td>Leguminosae Type A</td>
<td>V</td>
</tr>
<tr>
<td>Vatairea erythocarpa</td>
<td>Fabaceae</td>
<td>Leguminosae Type B</td>
<td>VI</td>
</tr>
<tr>
<td>Vataireopsis speciosa</td>
<td>Fabaceae</td>
<td>Leguminosae Type B</td>
<td>VI</td>
</tr>
<tr>
<td>Abarea auriculata</td>
<td>Fabaceae, Mimosoideae</td>
<td>Mimosoaceae Type A</td>
<td>VII VII</td>
</tr>
<tr>
<td>Inga umbelifera</td>
<td>Fabaceae, Mimosoideae</td>
<td>Mimosoaceae Type A</td>
<td>VIII</td>
</tr>
<tr>
<td>Abarea barbouriana</td>
<td>Fabaceae, Mimosoideae</td>
<td>Mimosoaceae Type B</td>
<td>VIII</td>
</tr>
<tr>
<td>Inga nobilis</td>
<td>Fabaceae, Mimosoideae</td>
<td>Mimosoaceae Type B</td>
<td>VIII</td>
</tr>
<tr>
<td>Endopleura uchi</td>
<td>Humiriaceae</td>
<td>Humiriaceae</td>
<td>IX</td>
</tr>
<tr>
<td>Sacogloottis trochygna</td>
<td>Humiriaceae</td>
<td>Humiriaceae</td>
<td>IX</td>
</tr>
<tr>
<td>Aegiphila integrifolia</td>
<td>Lamiaceae</td>
<td>Aegiphila</td>
<td>IX</td>
</tr>
<tr>
<td>Aegiphila panamensis</td>
<td>Lamiaceae</td>
<td>Aegiphila</td>
<td>IX</td>
</tr>
<tr>
<td>Aniba puchury-minor</td>
<td>Lauraceae</td>
<td>Lauraceae</td>
<td>X</td>
</tr>
<tr>
<td>Endlicheria paniculata</td>
<td>Lauraceae</td>
<td>Lauraceae</td>
<td>X</td>
</tr>
<tr>
<td>Theobroma glaucum</td>
<td>Malvaceae</td>
<td>Theobroma</td>
<td>XI</td>
</tr>
<tr>
<td>Theobroma abovatum</td>
<td>Malvaceae</td>
<td>Theobroma</td>
<td>XI</td>
</tr>
<tr>
<td>Adelobrotys ascendens</td>
<td>Malastomataceae</td>
<td>Adelobrotys Type B</td>
<td>XI</td>
</tr>
<tr>
<td>Adelobrotys tessmannii</td>
<td>Malastomataceae</td>
<td>Adelobrotys Type B</td>
<td>XI</td>
</tr>
<tr>
<td>Clidemia quinquenervia</td>
<td>Malastomataceae</td>
<td>Malastomataceae</td>
<td>XI</td>
</tr>
<tr>
<td>Tococa caquetana</td>
<td>Malastomataceae</td>
<td>Malastomataceae</td>
<td>XI</td>
</tr>
<tr>
<td>Compsonoea capitellata</td>
<td>Myristicaceae</td>
<td>Myristicaceae</td>
<td>XII</td>
</tr>
<tr>
<td>Compsonoea spnucei</td>
<td>Myristicaceae</td>
<td>Myristicaceae</td>
<td>XII</td>
</tr>
<tr>
<td>Piper arbororum</td>
<td>Piperaceae</td>
<td>Piper</td>
<td>XIII</td>
</tr>
<tr>
<td>Piper obliquum</td>
<td>Piperaceae</td>
<td>Piper</td>
<td>XIII</td>
</tr>
<tr>
<td>Triplaris americana</td>
<td>Polygonaceae</td>
<td>Triplaris Type A</td>
<td>XIII</td>
</tr>
<tr>
<td>Triplaris cumingiana</td>
<td>Polygonaceae</td>
<td>Triplaris Type C</td>
<td>XIII</td>
</tr>
<tr>
<td>Paullinia cupana</td>
<td>Sapindaceae</td>
<td>Paullinia Type B</td>
<td>XV</td>
</tr>
<tr>
<td>Paullinia rugosa</td>
<td>Sapindaceae</td>
<td>Paullinia Type B</td>
<td>XV</td>
</tr>
<tr>
<td>Chrysophyllum africanum</td>
<td>Sapotaceae</td>
<td>Chrysophyllum Type A</td>
<td>XV</td>
</tr>
<tr>
<td>Chrysophyllum cainito</td>
<td>Sapotaceae</td>
<td>Chrysophyllum Type A</td>
<td>XV</td>
</tr>
<tr>
<td>Chrysophyllum argenteum Type 1</td>
<td>Sapotaceae</td>
<td>Chrysophyllum Type C</td>
<td>XV</td>
</tr>
<tr>
<td>Chrysophyllum argenteum Type 2</td>
<td>Sapotaceae</td>
<td>Chrysophyllum Type D</td>
<td>XV</td>
</tr>
<tr>
<td>Cestrum nocturnum</td>
<td>Solanaceae</td>
<td>Cestrum</td>
<td>XVI</td>
</tr>
<tr>
<td>Cestrum schlechtendalii</td>
<td>Solanaceae</td>
<td>Cestrum</td>
<td>XVI</td>
</tr>
<tr>
<td>Cecropia peltata</td>
<td>Urticaceae</td>
<td>Urticaceae</td>
<td>XVI</td>
</tr>
<tr>
<td>Pourouma bicolor</td>
<td>Urticaceae</td>
<td>Urticaceae</td>
<td>XVI</td>
</tr>
<tr>
<td>Cecropia obtusifolia</td>
<td>Urticaceae</td>
<td>Cecropia Type B</td>
<td>XVI</td>
</tr>
<tr>
<td>Cecropia pachystachya</td>
<td>Urticaceae</td>
<td>Cecropia Type B</td>
<td>XVI</td>
</tr>
</tbody>
</table>

Monad; prolate spheroidal, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pores lalongate; colpi thin; exine tectate; striatoreticulate; columellae smaller than 1 μm; equatorial view length 34.5 μm (29–41, n = 10); equatorial view width 29 μm (26–32, n = 10); polar view length 27.8 μm (27–29, n = 4); colpi length 28.2 μm (18.9–34.2, n = 5); pore length 9.4 μm (8.9–10.5, n = 5); pore width 6.9 μm (4.8–8.6, n = 5).

**Tupirira guianensis** Aubl. (Plate 1, figures 4–7,14–15)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine tectate; columellae indistinct; striate. There are inconspicuous reticula; equatorial view length 27.1 μm (24–33, n = 11); equatorial view width 19.9 μm (18–23, n = 11); polar view length 22.1 μm (18–28, n = 9); colpi length 22.4 μm (20–29, n = 7); pore length 7.8 μm (5.8–10.3, n = 6); pore width 4.4 μm (2.8–5, n = 6).

**Annonaceae** Juss.

**Annona cacans** Warm. (Plate 1, figures 11–13)

Tetrad tetragonal; isolated grains asymmetric; inaperturate; exine semitectate; columellae conspicuous and greater than 1 μm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 44.5 μm (36–56, n = 10); equatorial view width 47.2 μm (42–57, n = 10).

**Cremastosperma novogranatense** R.E. Fr. (Plate 1, figures 10, 20)

Tetrad tetragonal; isolated grains asymmetric; inaperturate; exine tectate; columellae indistinct, smaller than 1 μm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 72.7 μm (63–83, n = 9); equatorial view width 87 μm (78–104, n = 9).

**Rollinia salicifolia** Schltdl. (Plate 1, figures 21–22)

Monad; spherical; amb circular; symmetry radial; inaperturate; exine semitectate; columellae conspicuous and greater than 1 μm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 44.5 μm (36–56, n = 10); equatorial view width 47.2 μm (42–57, n = 10).

**Apocynaceae** Juss.

**Aspidosperma megalocarpon** Müll. Arg. (Plate 1, figures 16–19)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; stephanocolporate; pore lalongate; 12-colpori; with margin and apex obtuse; exine tectate; columellae indistinct; scabrate; equatorial view length 64.3 μm (58–69, n = 9); equatorial view width 53.3 μm (51–59, n = 9); polar...
view length 66 µm (61–70, n = 9); colpi length 39.2 µm (34.4–46.6, n = 5); pore length 8.7 µm (8.7–8.7, n = 1); pore width 7.6 µm (7.6–7.6, n = 1).

*Lacmellea gracilis* (Müll. Arg.) Markgr. (Plate 1, figures 23–24, 32)

Monad; suboblate; amb circular; isopol; symmetry bilateral; dicolporate and tetracolporate, brevicolporate; exine tectate; columellae indistinct; scabrate; equatorial view length 21 µm (20–22, n = 2); equatorial view width 26.5 µm (26–27, n = 2); polar view length 26.2 µm (21–29, n = 9).

*Tabernaemontana longipes* Donn. Sm. (Plate 1, figures 31, 33–34, 40–41, 48)

Monad; subprolate, prolate spheroidal; amb circular; isopol; symmetry radial; tricolporate; pores lalongate; brevicolporate, with costa endocolpi and apex obtuse; exine tectate; columellae indistinct. Nexine thicker in equatorial region; reticulate; homobrochate; lumina smaller than 1 µm; exine tectate; equatorial view length 32.7 µm (31–34, n = 10); equatorial view width 29.1 µm (27–30, n = 10); polar view length 29.3 µm (29–30, n = 3); colpi length 15.5 µm (15.5–15.5, n = 1); pore length 20.2 µm (20.2–20.2, n = 1); pore width 6.2 µm (6.2–6.2, n = 1).

*Aquifoliaceae* Bercht. & J. Presl

*Ilex intermedia* reisset (Plate 1, figures 26–29, 36, 43)

Monad; subprolate, prolate; amb circular; isopol; symmetry radial; tricolporate; pores lalongate; colpus with constriction; exine tectate; clavate, clavae with different sizes; equatorial view length 42.8 µm (40–46, n = 10); equatorial view width 32.5 µm (30–35, n = 10); polar view length 42.2 µm (39–48, n = 8); colpi length 28.4 µm (24.7–33.1, n = 8).

*Araliaceae* Juss.

*Dendropanax monogynus* (Vell.) Seem. (Plate 1, figures 30, 39, 46–47, 52)

Monad; subprolate and prolate spheroidal; amb circular; isopol; symmetry radial; tricolporate; pores lalongate; apex acute; exine tectate; columellae conspicuous and smaller than 1 µm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 46.6 µm (42–49, n = 8); equatorial view width 41.6 µm (37–46, n = 8); polar view length 45.6 µm (44–47, n = 5); colpi length 32.4 µm (28.4–34.3, n = 7); pore length 7.4 µm (7.4–7.4, n = 2); pore width 4.9 µm (4.8–5, n = 2).

*Schefflera bangii* Harms (Plate 1, figures 25, 35, 42, 49, 55–56)

Monad; prolate, subprolate; amb circular; isopol; symmetry radial; tricolporate; pores lalongate; colpus with margin, costa endocolpi, apex acute; exine tectate; columellae conspicuous and smaller than 1 µm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; colpi length 24.3 µm (22.1–28, n = 9); colpi width 1 µm (1–1, n = 2); pore length 7.3 µm (6.2–8.5, n = 6); pore width 3.8 µm (3.4–4.2, n = 6).

*Arecales* Bercht. & J. Presl

*Astrocaryum acaule* Mart. (Plate 1, figures 37–38, 44–45, 50–51)

Monad; anisopolar; two types, symmetry bilateral, radial; monosulcate (monocolporate), and symmetry radial when trichotomosulcate; exine tectate; columellae conspicuous and smaller than 1 µm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 43 µm (41–45, n = 2); equatorial view width 61.5 µm (59–64, n = 2); polar view length 50.7 µm (43–56, n = 7).

*Attalea anisitsiana* (Barb. Rodr.) Zona (Plate 1, figures 57–59)

Monad; anisopolar; symmetry bilateral; monosulcate (monocolporate); with margin (1.347–1.629 µm), apex obtuse; exine tectate; baculate, baculae smaller than 1 µm; equatorial view length 26.5 µm (20–31, n = 10); equatorial view width 52.5 µm (45–63, n = 10); colpi length 44.8 µm (37.6–50.9, n = 8); colpi width 3 µm (2.4–3.9, n = 5).

*Bactris concinna* Mart. (Plate 1, figures 63–64; Plate 2, figures 1–3)

Monad; anisopolar; two types, symmetry bilateral, monosulcate (monocolporate), and symmetry radial when trichotomosulcate; apex obtuse; exine tectate; columellae indistinct; micropitted; equatorial view length 20.3 µm (14–25, n = 9); equatorial view width 38.8 µm (35–42, n = 9); colpi length 25.4 µm (12.3–33.2, n = 6).

*Chamaedorea tepejilote* Liebm. (Plate 1, figures 53–54)

Monad; anisopolar; symmetry bilateral; monosulcate (monocolporate); colpus irregular and as long as grain; exine tectate; columellae indistinct; psilate; equatorial view length 24.3 µm (22–27, n = 10); equatorial view width 28.4 µm (26–33, n = 10).

*Desmoncus polyacanthos* Mart. (Plate 1, figures 60, 65–66)

Monad; anisopolar; symmetry bilateral; monosulcate (monocolporate), colpus as long as grain; exine tectate; columellae conspicuous and smaller than 1 µm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 26.3 µm (23–30, n = 10); equatorial view width 38.8 µm (35–42, n = 10); colpi length 34.3 µm (33.2–35.4, n = 2); colpi width 1.3 µm (1.3–1.3, n = 1).

---

*Plate 1.* The scale bars represent 10 µm. Photographs were taken at 100× magnification, with the exception of figure 3 (40× magnification). Ev = equatorial view; Pv = polar view; Gv = general view. *Anacardiaceae:* *Anacardium excelsum* (Ev: 1–3; Pv: 8–9); *Tapiria quianensis* (Ev: 4–6; Pv: 7, 14–15). *Annonaceae:* *Annona cacans* (Isolated Grain 11–12, Tetrad: 13); *Cremastospermum novogranatense* (Gv: 10, 20); *Rollinia salicifolia* (Gv: 21–22). *Apocynaceae:* *Aspidosperma megalocarpum* (Ev: 16–17; Pv: 18–19); *Lacmellea gracilis* (4-colporate PV: 23–24; 2-colporate EV: 32); *Tabernaemontana longipes* (Ev: 34, 40–41, 48; Pv: 31, 33); *Aquifoliaceae:* *Ilex intermedia* (Ev: 27–29; Pv: 26, 36, 43). *Araliaceae:* *Dendropanax monogynus* (30, 39; Pv: 46–47, 52); *Schefflera bangii* (25, 35, 42; Pv: 49, 53–56). *Arecales:* *Astrocaryum acaule* Type 1 (Ev: 37, 44, 50); *Astrocaryum acaule* Type 2 (Ev: 38, 45, 51); *Attalea anisitsiana* (Ev: 57–59); *Bactris concinna* Type 1 (Ev: 63–64); *Chamaedorea tepejilote* (Ev: 53–54); *Desmoncus polyacanthos* (Ev: 60, 65–66); *Geonoma elegans* (Ev: 61–62).
Geonoma elegans Mart. (Plate 1, figures 61–62)
Monad; anisopolar; symmetry bilateral; monosulcate (monocolpate), colpus as long as grain, apex obtuse; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 27.8 μm (23–30, n = 9); equatorial view width 37.7 μm (36–41, n = 9); colpi length 32.1 μm (31.8–32.4, n = 2).

Hyospathe elegans (Ev: 40–46; Pv: 56, 69, 78); Monad; anisopolar; two types, symmetry bilateral, monosulcate (monocolpate), and symmetry radial when trichotomy-sulcate; apex obtuse; exine tectate; columellae indistinct, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 23.6 μm (19–29, n = 11); equatorial view width 35 μm (30–38, n = 11); colpi length 34 μm (31.2–36.5, n = 6).

Oenocarpus circumtextus Mart. (Plate 2, figures 7–9)
Monad; anisopolar; symmetry bilateral; monosulcate (monocolpate); apex obtuse, with margin (2.012–2.281 μm); exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 42.4 μm (38–53, n = 10); equatorial view width 56.3 μm (12–66, n = 10); colpi length 48.5 μm (38.3–56, n = 5); colpi width 13.5 μm (10–18.6, n = 5).

Socrates exorrhiza (Mart.) H. Wendl. (Plate 2, figures 10–12)
Monad; anisopolar; symmetry bilateral; monosulcate (monocolpate); as long as grain; exine intectate; echinate; echinae conical, with sharp and base broad (2.064 μm); equatorial view length 52.9 μm (45–64, n = 10); equatorial view width 58.3 μm (50–69, n = 10).

Asteraceae Bercht. & J. Presl
Piptocoma discolor (Kunth) Pruski (Plate 2, figures 15–19)
Monad; oblate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; colpus as long as grain; exine tectate; columellae indistinct; echinate; echinae conical and sharp (10.326–13.253 μm); equatorial view length 60 μm (54–68, n = 4); equatorial view width 51.5 μm (45–63, n = 4); polar view length 54 μm (51–61, n = 6); colpi length 34.1 μm (34.1–34.1, n = 1).

Vernonanthura puberula (Less.) H. Rob. (Plate 2, figures 20–21, 28–29)
Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate; exine tectate; columellae conspicuous and digitate; echinate; echinae sharp and conical (8.112–10.377 μm); equatorial view length 54.3 μm (50–62, n = 3); equatorial view width 49 μm (46–53, n = 3); polar view length 50.1 μm (44–55, n = 10).

Bignonaceae Juss.
Jacaranda copaia (Aubl.) D. Don (Plate 2, figures 13, 22, 30, 39, 48)
Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus with constriction, margin (1.321 μm) and apex obtuse; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 45.9 μm (43–50, n = 9); equatorial view width 34.2 μm (31–37, n = 9); polar view length 45.9 μm (40–52, n = 10); colpi length 29.3 μm (26–40.3, n = 4); colpi width 2 μm (1.3–2.6, n = 3); pore length 5.6 μm (5.6–5.6, n = 1); pore width 2.8 μm (2.8–2.8, n = 1).

Boraginaceae Juss.
Cordia nodosa Lam. (Plate 2, figures 23–27, 37)
Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 42 μm (41–43, n = 2); equatorial view width 40.5 μm (40–41, n = 2); polar view length 48 μm (42–53, n = 8); colpi length 23.5 μm (18.6–28.4, n = 2); pore length 6 μm (6–6, n = 1); pore width 3.7 μm (3.7–3.7, n = 1).

Cordia spinescens L. (Plate 2, figures 31–33)
Monad; spherical; isopolar; symmetry radial; triporate; pore circular; exine tectate; columellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate; muri width 0.747–2.012 μm and lumina width 2.017–5.867 μm; equatorial view length 50 μm (41–61, n = 10); equatorial view width 50.1 μm (40–62, n = 10).

Burseraceae Kunth
Crepidospermum goudotianum (Tul.) Triana & Planch. (Plate 2, figures 43–44, 51–52)
Monad; prolate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, apex acute; exine tectate; columellae indistinct; nexine thicker in equatorial region (1.088–3.120 μm); psilate; equatorial view length 39.3 μm (35–45, n = 9); equatorial view width 27.7 μm (23–31, n = 9); polar view length 26.5 μm (23–30, n = 6); colpi length 27.3 μm (23.6–29.4, n = 5); pore length 8.8 μm (6.2–11.6, n = 5); pore width 9.1 μm (2.8–29.4, n = 5).

Plate 2. The scale bars represent 10 μm. Photographs were taken at 100× magnification. Ev = equatorial view; Pv = polar view; Gv = general view. Arecaceae: Bactris concinna Type 2 (Ev: 1–3); Hyospathe elegans Type 1 (Ev: 4–5), Hyospathe elegans Type 2 (Ev: 6, 14); Oenocarpus circumtextus (Ev: 7–9); Socrates exorrhiza (Ev: 10–12). Asteraeae: Piptocoma discolor (Ev: 15–16; Pv: 17–19); Vernonanthura puberula (Ev: 20, 28; Pv: 21, 29). Bignonaceae: Jacaranda copaia (Ev: 13, 22, 30; Pv: 39, 48). Boraginaceae: Cordia nodosa (Ev: 26–27, 37; Pv: 23–25); Cordia spinescens (Ev: 31–33). Burseraceae: Crepidospermum goudotianum (Ev: 43–44; Pv: 51–52); Dacryodes acutipyrena (Ev: 40–41); Dacryodes excelsa (Ev: 53–55; Pv: 59–60); Dacryodes gabara (Ev: 34–36; Pv: 45–46); Protium acipiculatum (Ev: 38, 47, 68; Pv: 56, 69, 78); Protium brasiliense (Ev: 61–62; Pv: 57–58); Tetragastris panamensis (Ev: 76–77, 85; Pv: 66–67, 70); Trattinnickia aspera (Ev: 64–65; Pv: 63,72). Calophyllaceae: Carapa densiflora (Ev: 74, 83–84; Pv: 73, 82); Mahurea extipulata (Ev: 86–87, 96; Pv: 94–95); Manila laxiflora (Ev: 70–71, 79; Pv: 80–81). Cannabaceae: Celtis iguanae (Pv: 88–90); Celtis schippii (Ev: 91–93).
Protium apiculatum Swart (Plate 2, figures 38, 47, 56, 68–69, 78)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 38.7 μm (33–45, n = 10); equatorial view width 33.3 μm (27–43, n = 10); polar view length 39.8 μm (35–44, n = 10); colpi length 22.2 μm (19.4–23.8, n = 5); pore length 7.2 μm (6.3–7.9, n = 5); pore width 5.3 μm (4.3–6.2, n = 5).

Protium brasiliense (Spreng.) Engl. (Plate 2, figures 57–58, 61–62)

Monad; subprolate, prolate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 27.2 μm (24–30, n = 8); equatorial view width 22.1 μm (17–26, n = 8); polar view length 23.2 μm (18–26, n = 9); colpi length 21.5 μm (17.3–23.7, n = 4); pore length 7.3 μm (7.3–7.4, n = 2); pore width 4.4 μm (4.1–4.8, n = 2).

Marila laxiflora Rusby (Plate 2, figures 70–71, 79–81)

Monad; prolate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate;
columellae indistinct; verrucate; colpi length 26.3 µm (22.4–28.8, n = 6).

Cannabaceae Martinov

Celtis iguanae (Jacq.) Sarg. (Plate 2, figures 88–90)

Monad; oblate spheroidal; amb circular; isopolar; symmetry radial; triporate; exine tectate; columellae conspicuous, type pilum, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 28.4 µm (21–32, n = 5); equatorial view width 29.4 µm (21–33, n = 5); polar view length 28 µm (25–33, n = 3); pore length 3 µm (2.2–3.5, n = 5); pore width 2.7 µm (1.7–3.7, n = 5).

Celtis schippii Standl. (Plate 2, figures 91–93; Plate 3, figures 1–3)

Monad; oblate; circular; isopolar; symmetry radial; stephanocporate (4-porate); pores lolongate; exine tectate; columellae indistinct; scabrate; equatorial view length 18.4 µm (17–20, n = 5); equatorial view width 21.2 µm (20–22, n = 5); polar view length 22 µm (21–23, n = 5); pore length 2.1 µm (1.9–2.4, n = 2); pore width 3.8 µm (3.3–4.3, n = 2).

Trema micrantha (L.) Blume (Plate 3, figures 4–5)

Monad; elliptic; isopolar; symmetry bilateral; diporate; exine tectate; columellae indistinct; scabrate, there are some granula; equatorial view length 27.1 µm (25–32, n = 10); equatorial view width 28.9 µm (25–35, n = 10).

Cardiopetideae Blume

Citronella incarum (J.F. Macbr.) R.A. Howard (Plate 3, figures 11–14)

Monad; subprolate and prolatae; amb circular; isopolar; symmetry radial; tricolporate; pore lolongate; colpi with apex acute; exine tectate; columellae conspicuous, type pilum, simplicolumellate; reticulate; homobrochate; equatorial view length 31.6 µm (20–37, n = 10); equatorial view width 23.6 µm (22–28, n = 10); polar view length 24.9 µm (21–35, n = 10); colpi length 21.8 µm (20–23.7, n = 5).

Dendrobangia multinervia Ducke (Plate 3, figures 6–8, 15–17)

Monad; subprolate and prolatae; amb circular; amb isopolar; symmetry radial; tricolporate; pore lolongate; colpus with constriction and margin; apex acute; exine tectate; columellae conspicuous smaller than 1 µm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 30.5 µm (29–32, n = 10); equatorial view width 26.3 µm (24–30, n = 10); polar view length 29.8 µm (26–33, n = 10); colpi length 21.9 µm (18.7–24.7, n = 3).

Celastraceae R. Br.

Maytenus cassineformis Reissek (Plate 3, figures 9–10, 18–19, 25)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; exine tectate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 38.7 µm (35–44, n = 10); equatorial view width 31 µm (28–35, n = 10); polar view length 35 µm (33–37, n = 3); colpi length 24.4 µm (21–29, n = 6); pore length 6.5 µm (3.9–8.6, n = 5); pore width 5.6 µm (1.1–10.3, n = 5).

Salacia pyriformis (Sabine) Steud. (Plate 3, figures 26, 36, 45, 54, 63)

Monad; subprolate, prolatae; amb circular; isopolar; symmetry radial; tricolporate; pore lolongate; colpus with margin and apex acute; exine tectate; columellae conspicuous and smaller than 1 µm; simplicolumellate and duplicolumellate; reticulate; heterobrochate; lumina width 1.040–2.055 µm; equatorial view length 34.7 µm (31–40, n = 9); equatorial view width 29.4 µm (27–34, n = 9); polar view length 32.9 µm (28–37, n = 8); colpi length 26.9 µm (24.7–32.2, n = 7); pore length 5.2 µm (4.9–5.4, n = 2); pore width 4.2 µm (3.9–4.5, n = 2).

Clusiaceae Lindl.

Caloplyphium longifolium Willd. (Plate 3, figures 27–33)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lolongate; colpi with margin, apex acute; exine tectate; columellae conspicuous and smaller than 1 µm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 38.7 µm (34–42, n = 10); equatorial view width 35.3 µm (32–38, n = 10); polar view length 36.1 µm (33–41, n = 9); colpi length 22.7 µm (8.8–29.3, n = 10); colpi width 2.7 µm (1.5–3.4, n = 9); pore length 9.6 µm (8.8–10, n = 3); pore width 5.8 µm (3.2–7.9, n = 3).

Chrysochlamys dependens Planch. & Triana (Plate 3, figures 34–35, 43–44, 52–53)

Monad; spherical; circular; isopolar; symmetry radial; tricolporate; pore circular; brevicolporate; exine intectate; echinate; echinae smaller than 1 µm; equatorial view length 20 µm (20–20, n = 1); equatorial view width 21 µm (21–21, n = 1); polar view length 19.2 µm (16–22, n = 9).

Clusia alata Planch. & Triana (Plate 3, figures 61–62, 71–72, 81, 84)

Monad; spherical, subprolate, prolatae; amb spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lolongate; colpus with constriction and margin (1.143–1.868 µm); exine tectate; columellae conspicuous and smaller than 1 µm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 53 µm (43–57, n = 8); equatorial view width 47.2 µm (42–51, n = 8); polar view length 51.8 µm (45–58, n = 10); colpi length 40.9 µm (36.8–44, n = 5).

Garcinia binucua (Blanco) Choisy (Plate 3, figures 37–39, 46–47)

Monad; amb circular; isopolar; symmetry radial; tricolporate, stephanocporate; pore circular; 3–4 colpi; exine intectate; columellae conspicuous and smaller than 1 µm; clavate; polar view length 28.3 µm (26–30, n = 9).

Garcinia multiflora Champ. ex Benth. (Plate 3, figures 40–42, 49–51)

Monad; subprolate and prolatae; amb circular; isopolar; symmetry radial; tricolporate; pore lolongate; colpus with margin...
Plate 4. The scale bars represent 10 µm. Photographs were taken at 100× magnification. Ev = equatorial view; Pv = polar view; Gv = general view. **Euphorbiaceae:** *Hevea brasiliensis* (Pv: 1–2); *Pera pulchrolia* (Ev: 3–4; Pv: 5–6); *Sapium glandulosum* (Ev: 7–9; Pv: 17–18). **Fabaceae – Faboideae:** *Acosmium bijugum* (Ev: 10–13; Pv: 19–20); *Acosmium dasycarpum* (Ev: 14–16; Pv: 23–24); *Andira inermis* (Ev: 28–30; Pv: 21–22); *Bobgunnia madagascariensis* (Ev: 25–27; Pv: 34–35); *Clathrotropis brachypetala* (Ev: 31–33; Pv: 41–42); *Clitoria javitensis* var. *portobellensis* (Ev: 36–38; Pv: 39–40); *Dalbergia hupeana* (Ev: 49–51; Pv: 43–44); *Deguelia scandens* (Ev: 45–48; Pv: 52–54); *Dioclea violacea* (Pv: 55–57); *Diplotropis martusii* (Ev: 61–62, 68; Pv: 63–64, 69); *Dipteryx oleifera* (Ev: 58–60, 65; Pv: 66–67); *Dussia tessmannii* (Ev: 70–71).
(1.152–2.429 μm), apex acute; exine tectate; columella inconspicuous; scabrate; equatorial view length 40.4 μm (37–48; n = 10); equatorial view width 29.7 μm (25–35; n = 10); polar view length 31.8 μm (29–37; n = 4); colpi length 30.6 μm (28.8–34.3; n = 6); pore length 6.3 μm (6.3–6.3; n = 2); pore width 3.5 μm (3.2–3.8; n = 2).

_Tovomita stylosa_ Hemsli. (Plate 3, figures 58–60, 67–68, 70)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain; exine semitectate; columellae conspicuous and smaller than 1 μm, pluricolumellate; reticulate; homobrochate; equatorial view length 28.1 μm (25–33; n = 10); equatorial view width 25.7 μm (23–30; n = 10); polar view length 29.6 μm (26–32; n = 9); colpi length 20.6 μm (18.4–23.8; n = 8); pore length 9.1 μm (8–10.9; n = 8); pore width 3.5 μm (2.2–5.1; n = 8).

_Connارaceae_ R. Br.

_Connarус panамensis_ Griseb. (Plate 3, figures 48, 55–57, 66)

Monad; oblate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 17.8 μm (16–20; n = 10); equatorial view width 19 μm (17–20; n = 10); polar view length 19.8 μm (18–21; n = 6); colpi length 10.6 μm (9.3–13.1; n = 5); pore length 7.5 μm (6.6–9; n = 3); pore width 5 μm (3.3–6.5; n = 3).

_Rourea glabra_ Kunth (Plate 3, figures 64–65, 73–75)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; colpi 2/3 as long as grain, with margin and apex acute; exine semitectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 28.1 μm (26–30; n = 10); equatorial view width 22.9 μm (21–25; n = 10); polar view length 24.7 μm (21–29; n = 7); colpi length 18.4 μm (15.4–22.3; n = 8).

_Dichapetalaceae_ Baill.

_Dichapetalum axillare_ Woodson (Plate 3, figures 90–91)

Monad; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 20.6 μm (19–22; n = 8).

_Ebenaceae_ Gürke

_Diospyros virginiana_ Linnaeus (Plate 3, figures 69, 76–80)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, marginate (1.7–2.1 μm); exine tectate; columellae indistinct; scabrate; equatorial view length 64.4 μm (58–72; n = 10); equatorial view width 46.5 μm (41–53; n = 10); polar view length 55.2 μm (50–63; n = 10); colpi length 57.9 μm (52.8–62.3; n = 3); colpi width 2 μm (2–2; n = 1); pore length 9.2 μm (5.6–16.3; n = 3); pore width 5 μm (4.3–6.5; n = 3).

_Erythroxylaceae_ Kunth

_Erythroxylum panamense_ Turcz. (Plate 3, figures 85–89, 95–96)

Monad; equatorial shape subprolate; polar shape circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with margin that varies 1.596 and 2.363 μm (with exitus digitatus), apex acute; syncolporate; exine semitectate; columellae conspicuous and smaller than 1 μm; sexine thinner at the poles; simplicolumellate; reticulate; homobrochate; lumina vary between 0.714 and 1.878 μm; equatorial view length 55.8 μm (51.6–59.9; n = 20); equatorial view width 46.7 μm (40–53.5; n = 20); polar view length 52.6 μm (51–55.8; n = 18); colpi length 39.7 μm (32.7–45.4; n = 12).

_Euphorbiaceae_ Juss.

_Conceveiba guianensis_ Aubl. (Plate 3, figures 82–83, 92–93, 100–102)

Monad; prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin, costa endocolpi, apex obtuse; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 25.2 μm (23–27; n = 10); equatorial view width 24.1 μm (22–26; n = 10); polar view length 25.1 μm (21–28; n = 9); colpi length 16.3 μm (15.6–16.8; n = 3); colpi width 1.4 μm (1.4–1.5; n = 2); pore length 7.4 μm (6.6–8.4; n = 3); pore width 2.1 μm (1.9–2.3; n = 3).

_Croton ortholobus_ Müll.Arg. (Plate 3, figures 97–99)

Monad; spherical; amb circular; symmetry radial; inaperturate; exine intectate; clavate; clavae displaying croton pattern; equatorial view length 81.1 μm (66–92; n = 9); equatorial view width 90.9 μm (77–107; n = 9).

_Hevea brasiliensis_ (Willd. ex A. Juss.) Müll. Arg. (Plate 3, figures 94, 103; Plate 4, figures 1–2)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; colpi 2/3 as long as grain, with operculum (11.066–14.405 μm); exine intectate; baculae conspicuous and smaller than 1 μm; equatorial view length 48.1 μm (45–50; n = 9); equatorial view width 40.9 μm (37–46; n = 9); polar view length 50.1 μm (46–53; n = 10); colpi length 36.5 μm (36.5–36.5; n = 1).

_Pera pulchrolifia_ Ducke (Plate 4, figures 3–6)
Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grains, with margin and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; simplicicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 29.5 μm (29–31, n = 10); equatorial view width 24.6 μm (22–26, n = 10); polar view length 27.4 μm (26–31, n = 8); colpi length 19.6 μm (18.1–21.1, n = 9); pore length 5.2 μm (4.4–6, n = 9); pore width 2.7 μm (2.5–3.1, n = 9).

Sapindus glandulosus (L.) morong (Plate 4, figures 7–9, 17–18)

Monad; prololate; amb triangular-obtuse-convex; isopolar; symmetry radical; tricolporate; pore lalongate; colpi as long as grain, with margin and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicicolumellate; micro-pitted; homobrochate; lumina smaller than 1 μm; equatorial view length 70.6 μm (64–76, n = 10); equatorial view width 48.1 μm (43–51, n = 10); polar view length 49.2 μm (44–56, n = 8); colpi length 54.4 μm (50.7–58.8, n = 7); pore length 18.7 μm (16–23.5, n = 7); pore width 9.3 μm (7.2–11.6, n = 7).

Fabaceae-Faboideae Lindl.

Acosmium bijugum (Vogel) Yakovlev (Plate 4, figures 10–13, 19–20)

Monad; subprolate, prololate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (0.808–1.597 μm), apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 31.8 μm (27–36, n = 10); equatorial view width 22.1 μm (19–25, n = 10); polar view length 24.1 μm (21–29, n = 9); colpi length 20.9 μm (17.3–25.2, n = 6); colpi width 1 μm (0.7–1.2, n = 4).

Acosmium dasycarpum (Vogel) Yakovlev (Plate 4, figures 14–16, 23–24)

Monad; subprolate, prololate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi with constriction and margin (1.040–1.495 μm), apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 27.8 μm (25–31, n = 10); equatorial view width 19.8 μm (15–23, n = 10); polar view length 23.3 μm (20–27, n = 10); colpi length 18.5 μm (15.3–20.5, n = 3); colpi width 0.8 μm (0.6–1, n = 2).

Andira inermis (W. Wright) Kunth ex DC. (Plate 4, figures 21–22, 28–30)

Monad; oblitate spheroidal, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 26.9 μm (25–28, n = 9); equatorial view width 22.6 μm (18–27, n = 9); polar view length 25.7 μm (22–29, n = 10); colpi length 16.3 μm (15.1–18.5, n = 5); pore length 4.4 μm (3.8–5, n = 2); pore width 2.9 μm (2.9–2.9, n = 1).

Bobgunnia madagascariensis (Desv.) J.H. Kirkbr. & Wiersema (Plate 4, figures 25–27, 34–35)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, apex acute, syncolporate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 33.3 μm (31–35, n = 10); equatorial view length 25.8 μm (24–28, n = 10); polar view length 31.6 μm (29–34, n = 9); colpi length 26.4 μm (24.6–27.4, n = 4); colpi width 1.9 μm (1.4–2.5, n = 3).

Clathropis brachypetala (Tul.) kleinhoonte (Plate 4, figures 31–33, 41–42)

Monad; prololate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi with apex acute; exine tectate; columellae indistinct and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 32.6 μm (30–37, n = 9); equatorial view width 28.3 μm (24–33, n = 9); polar view length 32.7 μm (28–37, n = 9); colpi length 19 μm (14–25.4, n = 9); colpi width 1.4 μm (1.2–1.7, n = 2); pore length 11.5 μm (7.7–15, n = 5); pore width 8.6 μm (7.7–9.5, n = 5).

Clitoria javitensis var. portobellensis (Beurl.) Fantz (Plate 4, figures 36–40)

Monad; prololate spheroidal; amb circular; isopolar; symmetry radial; stephanocolpate; 5 colpi, with irregular margins with free ectexinic elements; exine semitectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 66.4 μm (60–72, n = 5); equatorial view width 62.6 μm (58–67, n = 5); polar view length 73.2 μm (66–83, n = 10); colpi length 22.9 μm (20.4–29.4, n = 4).

Dalbergia hupeana Hance (Plate 4, figures 43–44, 49–51)

Monad; subprolate, prololate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus apex acute; exine tectate; columellae conspicuous; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 23.1 μm (21–26, n = 10); equatorial view width 19.7 μm (15–22, n = 10); polar view length 21.7 μm (19–23, n = 6); colpi length 16.1 μm (15–17.2, n = 6); pore length 6.2 μm (4.7–7, n = 6); pore width 5.2 μm (3.1–6.1, n = 6).

Deguelia scandens Aubl. (Plate 4, figures 45–48, 52–54)
Plate 7. The scale bars represent 10 μm. Photographs were taken at 100× magnification, with the exception of figure 36 (40× magnification). Ev = equatorial view; Pv = polar view; Gv = general view. Fabaceae-Caesalpinioideae: Crudia amazonica (Ev: 6, 11–12; Pv: 4–5); Dicorynia paraensis (Ev: 1–3; Pv: 7); Hymenaea stigonocarpa (Ev: 8–9; Pv: 14–15, 17); Macrollobium angustifolium (Ev: 10, 19–20, 28); Senna macranthera (Ev: 18, 24, 27; Pv: 13, 16, 22); Tachigali paniculata (Ev: 23, 25–26, 30–31; Pv: 32–35). Fabaceae-Mimosoideae: Abarema auriculata (Isolated Grain: 29; Polyad: 21, 36–38).
Monad; spherical, subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 26.8 μm (23–28, n = 9); equatorial view width 26.8 μm (23–30, n = 9); polar view length 28.1 μm (25–35, n = 10); colpi length 19.4 μm (16.1–22.5, n = 5); colpi width 2.5 μm (2.2–2.8, n = 2); pore length 8.9 μm (5.7–11.2, n = 5); pore width 4.1 μm (2.5–5.4, n = 5).

*Dioecia violacea* Benth. (*Plate 4*, figures 55–57)

Monad; oblate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; tectum thicker than sexine and nexine; columellae indistinct; psilate; polar view length 85.4 μm (73–97, n = 9).

*Diplotropis martii* Benth. (*Plate 4*, figures 61–64, 68–69)

Monad; suboblate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 21.2 μm (19–22, n = 10); equatorial view width 24.8 μm (23–26, n = 10); polar view length 25.2 μm (23–29, n = 10); colpi length 16.1 μm (12.7–19.9, n = 9); pore length 10.1 μm (8.8–11.5, n = 9); pore width 5.8 μm (4.5–7.5, n = 9).

*Dipteryx oleifera* Benth. (*Plate 4*, figures 58–60, 65–67)

Monad; prolate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, apex acute; exine tectate; columellae conspicuous, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 45.5 μm (44–47, n = 2); equatorial view width 41.5 μm (41–42, n = 2); polar view length 41.2 μm (39–45, n = 9); colpi length 34.6 μm (34.6–34.6, n = 1); colpi width 3.5 μm (3.5–3.5, n = 1); pore length 7.3 μm (7.3–7.3, n = 1); pore width 4.3 μm (4.3–4.3, n = 1).

*Dussia tessmannii* Harms (*Plate 4*, figures 70–71; *Plate 5*, figures 1–4)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 26.4 μm (25–28, n = 10); equatorial view width 22.7 μm (20–25, n = 10); polar view length 22.6 μm (20–25, n = 11); colpi length 22.2 μm (19–25.5, n = 9); colpi width 2.3 μm (1.3–6.7, n = 9); pore length 7 μm (5.6–8.5, n = 7); pore width 6.3 μm (5.3–7.2, n = 7).

*Hymenolobium heterocarpum* Ducke (*Plate 5*, figures 5–7, 14)

Monad; suboblate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore circular; colpi with apex acute; exine tectate; columellae indistinct; psilate; equatorial view length 24.5 μm (22–30, n = 10); equatorial view width 19.9 μm (18–23, n = 10); polar view length 22 μm (21–23, n = 3); colpi length 18.3 μm (16.2–19.7, n = 3); pore length 5.2 μm (5.2–5.2, n = 1); pore width 5.9 μm (5.9–5.9, n = 1).

*Hymenolobium nitidum* Benth. (*Plate 5*, figures 8–13)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi as long as grain, with constriction; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 28.9 μm (24–33, n = 9); equatorial view width 25 μm (22–28, n = 9); polar view length 25.2 μm (22–28, n = 10); colpi length 19.4 μm (18.6–20.4, n = 5); colpi width 2.8 μm (2.8–2.8, n = 1); pore length 4.1 μm (4.1–4.1, n = 1); pore width 4.3 μm (4.3–4.3, n = 1).

Lecointea amazonica* Ducke (*Plate 5*, figures 15–18)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi with constriction and margin (0.639–1.010 μm); apex acute; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 28 μm (26–32, n = 10); equatorial view width 21.1 μm (18–24, n = 10); polar view length 22.7 μm (22–24, n = 3); colpi length 19.8 μm (17.7–21.9, n = 7); colpi width 0.5 μm (0.5–0.5, n = 1); pore length 6.9 μm (6.9–6.9, n = 1); pore width 4.7 μm (4.7–4.7, n = 1).

*Lonchocarpus araripensis* Benth. (*Plate 5*, figures 19–21)

Monad; subprolate, prolate; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 53.3 μm (40.6–59, n = 10); equatorial view width 42.2 μm (38.7–46.6, n = 10); colpi length 34.4 μm (31.3–38.3, n = 4); colpi width 12.9 μm (12.6–13.4, n = 3); pore width 8.9 μm (7.4–10.4, n = 3).

*Machaerium biovulatum* Micheli (*Plate 5*, figures 22–28)

Monad; subprolate, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 27.3 μm (23–32, n = 10); equatorial view width 22.8 μm (20–28, n = 10); polar view length 24.4 μm (21–28, n = 10); colpi length 19.9 μm (14.9–24.8, n = 7); colpi width 3 μm (2.1–3.8, n = 2); pore length 6 μm (3–7.8, n = 4); pore width 3.6 μm (2.8–5.2, n = 3).

*Machaerium floribundum* Benth. (*Plate 5*, figures 29–34)

Monad; subprolate, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 22.3 μm (20–25, n = 9); equatorial view width 20.8 μm (19–23, n = 9); polar view length 21.3 μm (20–23, n = 10); colpi length 16.8 μm (14.1–18.6, n = 5); pore length 7.4 μm (5.9–8.4, n = 5); pore width 5.2 μm (3.6–6.1, n = 5).
Monad; subprolate, prolate spheroidal; isopolar; symmetry radial; tricolporate; pore circular; colpus apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 47 μm (40–54, n = 2); equatorial view width 42 μm (38–46, n = 2).

*Ormosia cocinea* (Aubl.) Jacks. ([Plate 5](#), figures 35, 42, 50, 58)

Monad; prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpus with margin (2.020–3.162 μm) and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 48 μm (45–51, n = 10); equatorial view width 42.6 μm (38–48, n = 10); polar view length 48.5 μm (48–49, n = 2); colpi length 26 μm (13.6–30.9, n = 7); pore length 8.8 μm (6.8–10.9, n = 2); pore width 8.7 μm (6.6–10.8, n = 2).

*Ormosia macrocalyx* Ducke ([Plate 5](#), figures 39–41, 48–49)

Monad; prolate spheroidal; circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 52.8 μm (37–60, n = 10); equatorial view width 45.1 μm (34–51, n = 10); polar view length 50.7 μm (42–59, n = 10); colpi length 31 μm (22.8–34.4, n = 4); pore length 6.5 μm (6.5–6.5, n = 1); pore width 4.9 μm (4.9–4.9, n = 1).

*Platymiscium pinnatum* (Jacq.) Dugand ([Plate 5](#), figures 43–45, 51–53)

Monad; subprolate, prolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 14.3 μm (13–16, n = 10); equatorial view width 12.2 μm (9–14, n = 10); polar view length 12.7 μm (11–14, n = 7); colpi length 10.7 μm (9.5–11.8, n = 2); pore length 4 μm (3.9–4.1, n = 2); pore width 2.8 μm (2.4–3.3, n = 2).

*Pterocarpus rohrii* Vahl ([Plate 5](#), figures 62–67)

Monad; prolate, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpus with constriction and margin; apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; colpi length 15.7 μm (14.3–17, n = 9); pore length 6.2 μm (5.2–7.6, n = 8); pore width 6.5 μm (4.2–7.5, n = 8).

*Swartzia arborescens* (Aubl.) pittier ([Plate 5](#), figures 46–47, 55–57)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 31.9 μm (27–36, n = 10); equatorial view width 28.5 μm (23–33, n = 10); polar view length 28 μm (25–30, n = 10); colpi length 22.1 μm (18.1–24.9, n = 5); colpi width 2.6 μm (1.3–3.3, n = 5); pore length 5.7 μm (3.7–8, n = 5); pore width 3.5 μm (2.6–5.2, n = 5).

*Swartzia leptopetala* Benth. ([Plate 5](#), figures 54, 59, 68–70)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, apex acute; exine tectate; columellae indistinct; scabrate; equatorial view length 30.6 μm (27–37, n = 10); equatorial view width 27 μm (25–30, n = 10); polar view length 27.4 μm (25–32, n = 10); colpi length 23.1 μm (20.5–24.4, n = 4); colpi width 2 μm (1.9–2.2, n = 2); pore length 8 μm (7.3–8.9, n = 3); pore width 3.8 μm (2.9–5, n = 3).

*Swartzia panamensis* Benth. ([Plate 5](#), figures 60–61, 71–72; [Plate 6](#) figure 1)

Monad; spherical, subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (1.010–1.471 μm), apex acute. Parasyncolporate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 25.2 μm (23–26, n = 9); equatorial view width 23 μm (21–25, n = 9); polar view length 25.4 μm (22–28, n = 8); colpi length 20.4 μm (18–22.1, n = 6); colpi width 1 μm (0.9–1.1, n = 4).

*Swartzia pendula* Spruce ex Benth. ([Plate 6](#), figures 2–6, 13)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus apex acute; exine tectate; columellae indistinct, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 36.8 μm (33–40, n = 6); equatorial view width 34.7 μm (28–38, n = 6); polar view length 34.1 μm (31–42, n = 8); colpi length 31.1 μm (27.9–33.5, n = 4); colpi width 3.3 μm (3–3.6, n = 4); pore length 6.3 μm (3.6–7.6, n = 4); pore width 3.5 μm (2.8–5.2, n = 4).

*Swartzia simplex* var. *continentalis* Urb. ([Plate 6](#), figures 7–12)

Monad; suboblate, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, margin (1.857–2.055 μm) and some granula. Colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 38.6 μm (32–43, n = 8); equatorial view width 30.8 μm (26–35, n = 8); polar view length 35.3 μm (31–40, n = 10); colpi length

---

*Plate 8.* The scale bars represent 10 μm. Photographs were taken at 40× magnification, with the exception of figures 2–3, 7, 11, 15–19 (100× magnification). Ev = equatorial view; Pv = polar view; Gv = general view. *Fabaceae-Mimosoidae:* *Abarema auriculata* (Polyad: 1); *Abarema barbouriana* (Polyad: 5–7, 11); *Calliandra tinervia* (Polyad: 2–4, 8); *Cedrelinga cateniformis* (Polyad: 9–10, 13); *Enterolobium cyclocarpum* (Polyad: 12; 15–16); *Inga nobilis* (Polyad: 14; 17–19); *Inga pezizifera* (Polyad: 21–23); *Inga umbelifera* (Polyad: 20, 24).
Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; lumina smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 49.1 μm (43–58, n = 11); equatorial view width 41.1 μm (37–44, n = 11); polar view length 44.1 μm (39–49, n = 9); colpi length 42.3 μm (38.7–47.1, n = 5); colpi width 3.5 μm (3.1–4.3, n = 5); pore length 9.8 μm (9.7–9.8, n = 2); pore width 6 μm (5.7–7.1, n = 2).

*Vatairea erythrocarpa* (Ducke) Ducke (Plate 6, figures 18–22)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolpate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 24.6 μm (23–26, n = 10); equatorial view width 17.8 μm (15–19, n = 10); polar view length 17.4 μm (14–21, n = 9); colpi length 13.8 μm (12.3–14.8, n = 4).

*Vataireopsis speciosa* Ducke (Plate 6, figures 23, 28–30, 37–38)

Monad; prolate spheroidal, prolate, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; colpi length 20.2 μm (17.5–23.6, n = 6); pore length 5.7 μm (5.7–5.7, n = 1); pore width 5.1 μm (5.1–5.1, n = 1).

*Fabaceae-Caesalpinioideae* Lindl.

*Bauhinia guianensis* Pule (Plate 6, figures 26–27, 35)

Monad; subprolate; isopolar; symmetry radial; tricolporate; amb circular; colpi with constriction, apex acute; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 71.4 μm (60–79, n = 10); equatorial view width 58 μm (50–62, n = 10); colpi length 41.6 μm (33.4–47.9, n = 8); colpi width 2.8 μm (2.1–3.3, n = 8); pore length 7.3 μm (5.2–8.9, n = 8); pore width 7 μm (5.9–8.3, n = 8).

*Campsiandra angustifolia* Benth. (Plate 6, figures 31, 34, 43)

Monad; oblate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore circular; colpi with margin (1.196–1.857 μm), apex acute; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 44.1 μm (42–48, n = 10).

Equatorial view width 44.2 μm (37–48, n = 10); polar view length 45 μm (42–49, n = 11); colpi length 35.8 μm (33.1–38, n = 6); colpi width 3.4 μm (2.4–4.6, n = 6); pore length 5.1 μm (3.8–6.4, n = 6); pore width 6.4 μm (5.2–8.2, n = 6).

*Campsiandra comosa* Benth. (Plate 6, figures 36, 39–42, 47–48)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin (1.545–2.281 μm) and apex acute; costa endocolpi become thinner when it approaches the annulus and porus (this characteristic gives the impression of 3 pores). Parasyncolporate in polar view; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 60.9 μm (58–65, n = 10); equatorial view width 50 μm (46–56, n = 10); polar view length 58.2 μm (55–62, n = 8); colpi length 45 μm (39.1–51.2, n = 5); colpi width 2.3 μm (1.7–3.2, n = 5); pore length 3 μm (1.5–4.9, n = 3); pore width 9.4 μm (8.3–10.1, n = 3).

*Cenostigma gardnerianum* Tul. (Plate 6, figures 44–46)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin and costa endocolpi. Colpus is covered by fine layer of sexina (tectum) and with sculpture microreticulate; apex obtuse. There is a dark mark contouring the colpus in polar view; exine semitectate; columellae conspicuous, duplicolumellate; lumina width 1.196–5.031 μm and muri width 1.196–1.868 μm; reticulate; homobrochate; equatorial view length 79.5 μm (76–85, n = 10); equatorial view width 72.8 μm (67–78, n = 10); polar view length 81.8 μm (78–87, n = 10); colpi length 62.2 μm (47.7–72.9, n = 5); colpi width 26.6 μm (17.9–37.1, n = 4); pore length 3 μm (2.7–3.4, n = 2); pore width 11.1 μm (10.7–11.6, n = 2).

*Crudia amazonica* Benth. (Plate 7, figures 4–6, 11–12)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction; exine tectate; columellae conspicuous; striatoreticulate; homobrochate; equatorial view length 58 μm (53–61, n = 10); equatorial view width 40.8 μm (36–49, n = 10); polar view length 52.5 μm (45–55, n = 6); colpi length 49.8 μm (45–54.2, n = 5); colpi width 3.5 μm (2.4–4.7, n = 2).

*Dicorynia paraensis* Benth. (Plate 7, figures 1–3, 7)

Monad; subprolate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (0.857–1.720 μm), apex acute; parasyncolporate in polar view; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate;
homobrochate; lumina smaller than 1 μm; equatorial view length 30.8 μm (29–34, n = 9); equatorial view width 24.3 μm (22–26, n = 9); polar view length 27.4 μm (22–34, n = 9); colpi length 23.6 μm (20.8–26.6, n = 9); colpi width 1.5 μm (1–1.7, n = 4).

Hymenaea stigonocarpa Mart. ex Hayne (Plate 7, figures 8–9, 14–15, 17)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 54.8 μm (51–58, n = 10); equatorial view width 41.1 μm (38–44, n = 10); polar view length 48.4 μm (46–56, n = 11); colpi length 43.6 μm (39.6–48.6, n = 6); colpi width 3.9 μm (2–4.9, n = 4); pore length 7.4 μm (4.5–10.8, n = 3); pore width 7.1 μm (5.5–9.2, n = 3).

Macrolobium angustifolium (Benth.) Cowan (Plate 7, figures 8, 19–20, 28)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore elongate; exine tectate; columellae conspicuous and smaller than 1 μm. Thick tectum; striatoreticulate; homobrochate. There are multiple lumina in each stria. Equatorial view length 56.1 μm (49–62, n = 9); equatorial view width 37.1 μm (30–42, n = 9); colpi length 48.5 μm (39.4–54.2, n = 5); colpi width 4.3 μm (3.6–5.2, n = 3); pore length 4.8 μm (4.3–5.4, n = 2); pore width 8.4 μm (7.2–9.7, n = 2).

Senna macranthera (DC. ex Collad.) H.S. Irwin & Barneby (Plate 7, figures 13, 18, 16, 22, 24, 27)

Monad; prolate, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore elongate; colpi with margin (2.089–2.490 μm) and with constriction, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simple-columellate; reticulate; homobrochate; lumina smaller than 1 μm; colpi length 53.8 μm (47.3–58.5, n = 7); colpi width 3.1 μm (1.9–4.2, n = 6).

Tachigali paniculata Aubl. (Plate 7, figures 23, 25–26, 30, 35)

Monad; suboblate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore circular; exine tectate; columellae conspicuous and smaller than 1 μm, simple-columellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 28.2 μm (26–32, n = 10); equatorial view width 32.8 μm (31–39, n = 10); polar view length 32.8 μm (27–36, n = 10); colpi length 16.1 μm (13.2–18.7, n = 4); colpi width 5.2 μm (3.1–7.3, n = 3); pore length 7.4 μm (7.2–7.6, n = 4); pore width 7.4 μm (6.6–8.1, n = 4).

Fabaceae-Mimosoideae Lindl.

Abarella auriculata (Benth.) Barneby & J.W. Grimes (Plate 7, figures 21, 29, 36–38; Plate 8, figure 1)

Polyad; isolated grains anisopolar; symmetry asymmetric; pantoporate; exine semitectate; rugulate. The swollen apical part of columellae connects with each other, forming a semicontinuous tectum and appearance of rugulae. Equatorial view length 33.8 μm (28–39, n = 5); equatorial view width 43.2 μm (39–47, n = 5).

Abarella barbouriana (Standl.) Barneby & J.W. Grimes (Plate 8, figures 5–7, 11)

Polyad; isolated grains anisopolar; symmetry asymmetric; staphanoporate; exine semitectate; columellae indistinct. Exine is thicker in the distal region; reguluate. The swollen apical part of columellae connects with each other, forming a semicontinuous tectum and appearance of rugulae. Equatorial view length 31.5 μm (29–34, n = 2); equatorial view width 41 μm (38–44, n = 2).

Calliandra trinervia Benth. (Plate 8, figures 2–4, 8)

Polyad; rectangular; isolated grains anisopolar; symmetry asymmetric; pantoporate; pore circular; exine semitectate; columellae conspicuous and smaller than 1 μm; rugulate. The swollen apical part connects with each other, forming a semicontinuous tectum and appearance of rugulae. Equatorial view length 37.8 μm (34–40, n = 4); equatorial view width 60.5 μm (52–65, n = 4).

Cedrelina cateniformis (Ducke) Ducke (Plate 8, figures 9–10, 13)

Polyad; isolated grains anisopolar; symmetry asymmetric; pantoporate; exine semitectate thicker in the distal region and rugulate. The swollen apical parts of the columellae connect with each other, forming a semicontinuous tectum and appearance of rugulae. Equatorial view length 24 μm (22–25, n = 3); equatorial view width 29 μm (24–35, n = 3).

Enterolobium cyclocarpum (Jacq.) Griseb (Plate 8, figures 12, 15–16)

Polyad; isolated grains anisopolar; symmetry asymmetric; pantoporate; exine tectate; columellae indistinct; psilate; equatorial view length 20 μm (17–25, n = 9); equatorial view width 29.7 μm (27–34, n = 9).

Inga nobilis Wild (Plate 8, figures 14, 17–19)

Polyad; isolated grains anisopolar; symmetry asymmetric; exine semitectate; columellae indistinct. Exine is thicker in the distal region; rugulate. The swollen apical part of columellae connects with each other, forming a semicontinuous tectum and appearance of rugulae Equatorial view length 33 μm (31–35, n = 2); equatorial view width 39.5 μm (39–40, n = 2).
Inga pezizifera Benth. (Plate 8, figures 21–23)

Polyad; isolated grains anisopolar; symmetry asymmetric; pantoporate; semiexine tectate; columnellae indistinct, type pilum. Exine is thicker in the distal region; rugulate; the swollen apical part of columnellae connects with each other, forming a semicontinuous tectum and appearance of rugulae.
Equatorial view length 19.2 μm (16–22, n = 10); equatorial view width 24.3 μm (20–30, n = 10).

**Inga umbellifera** Steud. ex DC. (Plate 8, figures 20, 24; Plate 9, figures 1–3)

Polyad; isolated grains anisopolar; symmetry asymmetric; pantoporate; semiiexine tectate; columellae indistinct and type pilum. Exine is thicker in the distal region; rugulate. The swollen apical part of columellae connects with each other, forming a semicontinuous tectum and appearance of rugulae. Equatorial view length 28 μm (27–29, n = 2); equatorial view width 32.5 μm (29–36, n = 2).

**Parkia multiijuga** Benth. (Plate 9, figures 4, 7–8)

Polyad; isolated grains anisopolar; symmetry asymmetric; triporate; exine tectate; columellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 37 μm (33–41, n = 2); equatorial view width 56 μm (49–63, n = 2).

**Strephnodendron microstachyum** Poepp. (Plate 9, figures 5–6)

Polyad; circular; isolated grains anisopolar; symmetry asymmetric; pantoporate; exine tectate; columellae indistinct; scabrate; 4 pores; equatorial view length 10.9 μm (10–12, n = 7); equatorial view width 13.1 μm (12–14, n = 7).

**Gentianaceae** Juss.

**Potalia amara** Aubl. (Plate 9, figures 9–12, 16)

Monad; spherical; amb circular; isopolar; symmetry radial; triporate; pore circular; exine tectate; columellae indistinct; psilate; with granules; equatorial view length 43.7 μm (38–49, n = 10); equatorial view width 50 μm (35–59, n = 10); pore length 6.1 μm (4.8–8.3, n = 8); pore width 5.9 μm (4.4–8.5, n = 8).


**Drymonia serulata** (Jacq.) Mart. (Plate 9, figures 17–20, 28)

Monad; subprolate, prolute spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain. Colpi with granules and with costa-endocolpi. Apex obtuse; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 38.6 μm (36–42, n = 9); equatorial view width 31.6 μm (28–36, n = 9); polar view length 38.2 μm (35–45, n = 11); colpi length 25.3 μm (22.1–31.1, n = 6).

**Humiriaceae** A. Juss.

**Endopleura uchi** (Huber) Cuatrec. (Plate 9, figures 24–27, 35–36)

Monad; subprolate, prolute spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi 2/3 as long as grain, with margin (1.221–1.818 μm) and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 42.7 μm (38–50, n = 10); equatorial view width 39.2 μm (34–44, n = 10); polar view length 42.3 μm (39–45, n = 10); colpi length 23.9 μm (21–27.8, n = 7); colpi width 1.4 μm (0.8–1.8, n = 3); pore length 7.2 μm (5.3–9.1, n = 2); pore width 4.8 μm (4.5–5.1, n = 2).

**Sacoglottis trichogyra** Cuatrec. (Plate 9, figures 13–15, 21–23, 29)

Monad; subprolate, prolute spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, with constriction and margin (2.343–3.899 μm), apex obtuse; exine tectate; columellae conspicuous, smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 56.6 μm (48–61, n = 10); equatorial view width 50.5 μm (45–53, n = 10); polar view length 53.8 μm (50–60, n = 9); colpi length 38.8 μm (35.3–45.9, n = 5); colpi width 1.8 μm (1.5–2.2, n = 4).

**Hypericaceae** Juss.

**Visnia baccifera** (L.) Triana & Planch. (Plate 9, figures 30–34, 42)

Monad; prolute spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore circular; colpi with margin (3.172–4.546 μm), apex acute; exine semitectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 23 μm (16–26, n = 7); equatorial view width 21.3 μm (14–26, n = 7); polar view length 26.4 μm (25–29, n = 9); colpi length 16.5 μm (12.6–18.8, n = 5); colpi width 2.5 μm (2.1–2.9, n = 2); pore length 5.4 μm (4.7–6.1, n = 2); pore width 3.8 μm (3.2–4.5, n = 2).

**Visnia latifolia** (Aubl.) Choisy (Plate 9, figures 37–41, 49–50)

Monad; oblate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 19.7 μm (18–21, n = 9); equatorial view length 19.8 μm (18–21, n = 9); polar view length 21.4 μm (18–24, n = 7); colpi length 15.4 μm (14.1–16.5, n = 4); colpi width 1.7 μm (1.7–1.7, n = 1); pore length 3.8 μm (3.7–4, n = 3); pore width 2.6 μm (2.4–2.7, n = 3).

**Visnia macrophylla** Kunth (Plate 9, figures 43–44, 51–52, 59–60)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate, colpi with constriction, apex acute; exine semitectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina width 1.317–2.378 μm and muri width 0.319–0.904 μm; equatorial view length 42.5 μm (38–46, n = 6); equatorial view length 39 μm (36–42, n = 6); polar view length 40.7 μm (36–48, n = 10); colpi length 31.9 μm (27.4–37.4, n = 5).

**Icacinaceae** Miers

**Calotela costaricensis** Standl. (Plate 9, figures 45–47)

Monad; amb circular; symmetry radial; tricolporate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 25.8 μm (24–29, n = 10).

**Poraqueiba sericea** Tul. (Plate 9, figures 48, 55–58, 65)
Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (2.020 μm); exine intectate; columellae conspicuous and smaller than 1 μm; clavate; equatorial view length 53 μm (48–59, n = 10); equatorial view width 43.8 μm (41–47, n = 10); polar view length 44.7 μm (39–51, n = 9); colpi length 34.1 μm (31.6–36.2, n = 4); pore length 15 μm (11.6–17.5, n = 5); pore width 5 μm (2.6–6.4, n = 4).

**Lacistemataceae** Mart.

*Lacistema aggregatum* (P.J. Bergius) Rusby (Plate 9, figures 53–54, 61–64)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (0.589 μm); apex acute; exine tectate; columellae conspicuous and smaller than 1 μm; equatorial view length 16.6 μm (16–17, n = 10); equatorial view width 11.3 μm (10–13, n = 10); colpi length 11.9 μm (10.5–13.4, n = 6); pore length 3.4 μm (2.9–4.2, n = 3); pore width 1.6 μm (0.9–2.1, n = 3).

**Lamiaceae** Martinov

*Aegiphila integrifolia* (Jacq.) B.D. Jacks. (Plate 9, figures 66–69)

Monad; spherical, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; colpi with apex acute; exine tectate; columellae indistinct; echinate; echinae sharp, conical and smaller than 1 μm; equatorial view length 58.4 μm (56–61, n = 10); equatorial view width 57.4 μm (53-64, n = 10); polar view length 60.1 μm (55–65, n = 10); colpi length 18.1 μm (13.4–26.6, n = 6).

*Aegiphila panamensis* Moldenke (Plate 10, figures 1–4)

Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate; colpi with margin; exine tectate; columellae indistinct; echinate; echinae sharp, conical and smaller than 1 μm; equatorial view length 64 μm (56–71, n = 8); equatorial view width 57.6 μm (45–64, n = 8); polar view length 64 μm (52–76, n = 10); colpi length 31.4 μm (14.5–42.4, n = 3).

*Vitex masoniana* Pittier (Plate 10, figures 5–8, 16)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; colpi as long as grains, with constriction, margin and apex acute. The margin edges are more prominent and reticulate (with small lumina); exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; heterobrochate; equatorial view length 35.1 μm (33–38, n = 10); equatorial view width 31.7 μm (30–36, n = 10); polar view length 35.1 μm (32–38, n = 10); colpi length 30.4 μm (28.8–32.7, n = 6); colpi width 3.6 μm (3.6–3.6, n = 1).

**Lauraceae** Juss.

*Aniba puchury-minor* (Mart.) Mez (Plate 10, figures 9–11)

Monad; spherical; symmetry radial; inaperturate; exine tectate; echinate; echinae smaller than 1 μm; faintly discernible and scattered; equatorial view length 26 μm (23–27, n = 10); equatorial view width 26.9 μm (25–28, n = 10).

*Endlicheria paniculata* (Spreng.) J.F. Macbr. (Plate 10, figures 12–13)

Monad; spherical; amb circular; symmetry radial; inaperturate; exine tectate and echinate. Echinae smaller than 1 μm; equatorial view length 17.9 μm (15–19, n = 10); equatorial view width 20.7 μm (18–25, n = 10).

*Ocotea oblonga* (Meisn.) Mez (Plate 10, figures 14–15, 24)

Monad; spherical; symmetry radial; inaperturate; exine intectate; echinate. Echinae sharp, conical and smaller than 1 μm; equatorial view length 27 μm (23–28, n = 10); equatorial view width 28.8 μm (23–33, n = 10).

*Pleurothryrum maximum* O.C. Schmidt (Plate 10, figures 25, 32–33)

Monad; spherical; symmetry radial; inaperturate; exine intectate; echinate. Echinae sharp, conical and smaller than 1 μm; equatorial view length 44.1 μm (39–53, n = 10); equatorial view width 46.3 μm (39–54, n = 10).

**Lecythidaceae** A. Rich.

*Eschweilera albiflora* (DC.) Miers (Plate 10, figures 17–20)

Monad; subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (1.143–1.407 μm) and apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; micropitted; homobrochate; Lumina smaller than 1 μm; equatorial view length 25.1 μm (24–28, n = 9); equatorial view width 19.8 μm (18–21, n = 9); polar view length 24.8 μm (23–27, n = 9); colpi length 16.8 μm (15.5–18.2, n = 5); colpi width 1.1 μm (0.8–1.5, n = 3).

*Leyzithis zabucajo* Aubl. (Plate 10, figures 21–23, 29–31)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; colpi as long as grain and with constriction; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; Lumina smaller than 1 μm; equatorial view length 29.8 μm (28–32, n = 9); equatorial view width 21.7 μm (19–23, n = 9); polar view length 29 μm (27–31, n = 10); colpi length 20.3 μm (16.4–23, n = 6).

---

Plate 12. The scale bars represent 10 μm. Photographs were taken at 100× magnification. Ev = equatorial view; Pv = polar view; Gv = general view. **Meliaeaceae:** Carapa guianensis (3-colporate Ev: 1–3; Pv: 4–5; 4-colporate Ev: 6, 11–12; Pv: 9–10); Guarea magertha (Ev: 7–8; Pv: 13–14); Trichilia cipo (Ev: 15–17; Pv: 18–19, 28). **Monimiaceae:** Mollinedia elliptica (Gv: 20–22). **Moraceae:** Ficus insipida (Gv: 23–25); Naucleopsis oblongifolia (Pv: 31–33); Soroea affinis (Gv: 26, 34). **Myristicaceae:** Componea capitellata (Ev: 29–30, 42); Componea sprucei (Gv: 36, 41, 48); Iryanthera coriacea (Gv: 27, 35); Osteophloeum platyspermum (Gv: 37–39); Otoba latifolia (Ev: 40, 47; Pv: 46); Vriona peruviana (Ev: 43–45). **Nyctaginaceae:** Neea amplifolia (Ev: 50–52; Pv: 49, 55, 65). **Ochnaceae:** Lucania crenata (Ev: 56–58; Pv: 53, 59, 62); Lacunaria jenomani (Ev: 66–68); Quina caubambensis (Ev: 61, 64, 71; Pv: 54, 60, 63). **Opiliaceae:** Agonandra obusifolia (Ev: 69–70).
Loganiaceae  R. Br. ex Mart.

Strychnos brachistantha  Standl.  (Plate 10, figures 26–28, 34–36)

Monad; spherical, prolate, prolate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore longate; colpi with constriction; exine tectate; columnellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 37.5 μm (44.0–40, n = 10); equatorial view width 34.2 μm (30–38, n = 10); polar view length 39.3 μm (34–48, n = 10); colpi length 23.6 μm (22.8–24.5, n = 2); pore length 7.5 μm (7–7.9, n = 2); pore width 3.5 μm (3.5–3.6, n = 2).

Strychnos toxifera  R.H. Schomb. ex Lindl.  (Plate 10, figures 37–39)

Monad; circular; symmetry radial; tricolporate; exine tectate; columnellae indistinct, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 34 μm (34–34, n = 1).

Magnoliaceae  Juss.

Magnolia sororum  Seibert  (Plate 10, figures 40–41, 47)

Monad; spherical; inaperturate; exine tectate; columnellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 97.6 μm (83–115, n = 11).

Malpighiaceae  Juss.

Hiraea faginea  (Sw.) Nied.  (Plate 10, figures 42, 48, 58)

Monad; spherical; amb circular; pantoporate; pore circular; exine semitectate; columnellae conspicuous, micropitted; equatorial view length 59.8 μm (49–71, n = 8); equatorial view width 61.9 μm (51–72, n = 8); pore length 6.4 μm (5.4–7.2, n = 5); pore width 5.8 μm (4.3–8, n = 5).

Malvaceae  Juss.

Apeiba membranacea  Spruce ex Benth.  (Plate 10, figures 43, 46, 52)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore longate; brevicolpate and apex acute; exine semitectate; columnellae conspicuous and smaller than 1 μm, simplicolumellate, lumina width 0.904–1.863 μm and muri width 0.286–0.591 μm; reticulate; homobrochate; equatorial view length 61.7 μm (57–70, n = 3); equatorial view width 51.3 μm (48–53, n = 3); polar view length 57 μm (48–61, n = 6); colpi length 16.1 μm (16.1–16.1, n = 1); pore length 9 μm (9–9, n = 1); pore width 2.1 μm (2.1–2.1, n = 1).

Apeiba tibbourbou  Aubl.  (Plate 10, figures 49–51, 53–56)

Monad; oblate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore longate; brevicolpate, colpus with exitus digitatus  (Kremp, 1965); exine tectate; columnellae conspicuous and smaller than 1 μm, simplicolumellate; lumina width 0.639–1.116 μm and muri width 0.202–0.429 μm; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 42.6 μm (38–47, n = 10); equatorial view width 42.6 μm (36–48, n = 10); polar view length 45.1 μm (42–52, n = 10); colpi length 14.5 μm (11.8–17.4, n = 6); pore length 8.7 μm (6.8–10.7, n = 5); pore width 6.1 μm (5.2–6.7, n = 5).

Abrona augusta  (L.) L.f.  (Plate 10, figures 59–62)

Monad; subprolate, prolate, amb circular; isopolar; symmetry radial; tricolporate; pore longate; colpi with margin (1.212 μm), apex obtuse; exine semitectate; columnellae conspicuous, simplicolumellate, lumina width 0.904–2.045 μm and muri width 0.286–0.452 μm; reticulate; Homobrochate; equatorial view length 38.8 μm (36–42, n = 10); equatorial view width 30 μm (28–34, n = 10); polar view length 33.7 μm (31–38, n = 10); colpi length 25.4 μm (22.1–30, n = 5).

Quararibea spatulata  Dooke  (Plate 10, figures 57, 63–64; Plate 11, figures 1–3)

Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate; pore longate; 3–4 colpore, brevicolpate and apex obtuse; exine semitectate; columnellae conspicuous and greater than 1 μm, pluricolumellate; reticulate; homobrochate; equatorial view length 87.8 μm (75–101, n = 9); equatorial view width 93.1 μm (80–103, n = 9); polar view length 92 μm (81–103, n = 2); pore length 9.2 μm (7–11.3, n = 7); pore width 10.2 μm (7.1–12.9, n = 7).

Sterculia apetala  (Jacq.) H. Karst.  (Plate 11, figures 4–6, 9–12)

Monad; subprolate, prolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore longate; exine semitectate; columnellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 35.9 μm (32–41, n = 10); equatorial view width 29.9 μm (24–36, n = 10); polar view length 34.1 μm (30–37, n = 9); colpi length 25.9 μm (19–29.4, n = 7); colpi width 1.6 μm (1.5–1.7, n = 3); pore length 7 μm (6.3–8, n = 6); pore width 2.2 μm (1.7–2.4, n = 6).

Theobroma glaucum  H. Karst.  (Plate 11, figures 16–18, 24–26)

Monad; oblate spheroidal, spherical; circular; isopolar; symmetry radial; tricolporate; pore longate; colpi 2/3 as long as grain; exine semitectate; columnellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate;
Adelobotrys adscendens
Melastomataceae

Monad; oblate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine tectate; columella conspicuous and smaller than 1 µm, simple-columellate; reticulate; homobrochate; lumina width 0.869–1.578 µm and muri width 0.202–0.606 µm; equatorial view length 26.9 µm (25–29, n = 9); equatorial view width 26.7 µm (23–28, n = 9); polar view length 28.3 µm (26–31, n = 9); colpi length 12.8 µm (11–16.2, n = 7); pore length 3.8 µm (3–4.4, n = 3); pore width 2.2 µm (1.9–2.7, n = 3).

Marcgraviaeae Bercht. & J. Presl

Marcgravia polyantha Delpino (Plate 11, figures 29–31, 39–40)

Monad; prolate spheroidal, amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpus apex obtusum; exine tectate; columella conspicuous and smaller than 1 µm; reticulate; homobrochate; lumina smaller than 1 µm; colpi length 16 µm (13.2–17.2, n = 5); pore length 4.8 µm (4.8–4.8, n = 1); pore width 1.2 µm (1.2–1.2, n = 1).

Melastomataceae Juss.

Adelobotrys adscendens (Sw.) Triana (Plate 11, figures 19–23)

Monad; subprolate, prolate; amb triangular-obtuse-concave; isopolar; symmetry radial; heterocolpate; pores lalongate; 3 colpori alternating with 3 pseudocolpols; apex acute, syncolporate; exine tectate; columella indistinct; scabrate; equatorial view length 13.5 µm (13–15, n = 10); equatorial view width 9.8 µm (8–11, n = 10); polar view length 10.8 µm (9–13, n = 10); colpi length 9.3 µm (7.9–11.1, n = 4); pore length 1.7 µm (1.7–1.7, n = 1); pore width 1.1 µm (1.1–1, n = 1).

Adelobotrys tessmannii Markgr. (Plate 11, figures 34–36, 46)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi with constriction and apex acute; syncolporate in polar view; exine tectate; columellae indistinct; scabrate; equatorial view length 17 µm (15–19, n = 6); equatorial view width 13 µm (12–15, n = 6); colpi length 14.6 µm (11–18, n = 9); colpi length 13.4 µm (13.1–13.8, n = 2).

Bellucia pentamera Naudin (Plate 11, figures 32–33, 41–42, 52)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; heterocolpate; pores lalongate; 3 colpori alternating with 3 pseudocolpols; with margin (1.010–1.152 µm), apex acute; exine tectate; columella conspicuous and smaller than 1 µm; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 27.7 µm (26–30, n = 9); equatorial view width 20.9 µm (19–23, n = 9); polar view length 24.9 µm (22–33, n = 10); colpi length 17.6 µm (16.5–19.5, n = 8); colpi width 0.7 µm (0.7–0.7, n = 1); pore length 5.5 µm (4.3–7.3, n = 4); pore width 3.2 µm (2.8–3.4, n = 4).

Clidemia hirta (L.) D. Don (Plate 11, figures 70, 78–81)

Monad; subprolate; amb circular; isopolar; symmetry radial; heterocolpate; pore lalongate; 3 colpori alternating with 3 pseudocolpols; apex acute; exine tectate; columella indistinct; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 27.6 µm (22–30, n = 10); equatorial view width 21.3 µm (17–24, n = 10); polar view length 23.5 µm (19–29, n = 10); colpi length 19.2 µm (15.9–21.8, n = 4); pore length 3.7 µm (3.7–3.7, n = 1); pore width 2.1 µm (2.1–2.1, n = 1).

Clidemia quinquenervia (Mill.) Almeda (Plate 11, figures 64–66)

Monad; subprolate, prolate; isopolar; symmetry radial; heterocolpate; pore lalongate; 3 colpori alternating with 3 pseudocolpols; apex acute; exine tectate; columella indistinct; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 18.3 µm (17–20, n = 9); equatorial view width 13.9 µm (13–16, n = 9); colpi length 11.4 µm (10.4–13.4, n = 7); pore length 3.5 µm (3.5–3.5, n = 1); pore width 1.8 µm (1.8–1.8, n = 1).

Henriettea tuberculosa (Donn. Sm.) L.O. Williams (Plate 11, figures 27–28, 37–38, 47–48)

Monad; prolate; amb circular; isopolar; symmetry radial; heterocolpate; pores lalongate; 3 colpori alternating with 3 pseudocolpols; apex acute; exine tectate; columella conspicuous and smaller than 1 µm; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 19.3 µm (17–21, n = 10); equatorial view width 13.1 µm (12–14, n = 10); polar view length 15 µm (13–17, n = 6); colpi length 12.4 µm (11.5–12.9, n = 5); pore length 3.2 µm (3.2–3.2, n = 1); pore width 2.1 µm (2.1–2.1, n = 1).

Miconia lamprophylla Triana (Plate 11, figures 49–51, 62–63)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; reticulate; homobrochate; lumina smaller than 1 µm; equatorial view length 16.1 µm (15–18, n = 10); equatorial view width 14.2 µm (13–17, n = 10); polar view length 15.6 µm (15–16, n = 10); colpi length 9.9 µm (8.4–11.4, n = 5); pore length 3.8 µm (3.7–3.9, n = 2); pore width 2.4 µm (2.2–2.7, n = 2).
Miconia serrulata (DC.) Naudin (Plate 11, figures 59–61, 71–72)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; heterocolepate; 3 colpors alternating with 3 pseudocolp; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 28.1 μm (26–30, n = 9); equatorial view width 19.9 μm (16–22, n = 9); polar view length 30.6 μm (29–32, n = 9); colpi length 21.1 μm (19.6–23.9, n = 4).

Mouriri acutiflora Naudin (Plate 11, figures 73–77)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; heterocolepate; pore lalongate; 3 colpors alternating with 3 pseudocolp; exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 20.9 μm (19–22, n = 10); equatorial view width 19.5 μm (18–22, n = 10); polar view length 19.4 μm (16–21, n = 9); colpi length 15.2 μm (14.1–16, n = 3); pore length 6.3 μm (5.8–6.8, n = 4); pore width 3.7 μm (3.3–4.4, n = 4).

Mouriri myrtilloides var. parvifolia (Benth.) Morley (Plate 11, figures 43–45, 53–55)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; heterocolepate; pore lalongate; 3 colpors alternating with 3 pseudocolp. Colpus with constriction and apex obtuse. Exine tectate; columellae conspicuous and smaller than 1 μm; regulate. Equatorial view length 40.3 μm (36–45, n = 10); equatorial view width 32.5 μm (28–45, n = 10); polar view length 37.7 μm (36–43, n = 10); colpi length 26.5 μm (23.6–30.2, n = 6); pore length 7.1 μm (6.2–7.9, n = 2); pore width 4.4 μm (3.6–5.2, n = 2).

Tococa caquetana Sprague (Plate 11, figures 56–58, 67–69)

Monad; subprolate, prolate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; heterocolepate; pore lalongate; exine tectate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 18 μm (16–21, n = 10); equatorial view width 15 μm (14–17, n = 10); polar view length 17.1 μm (16–19, n = 8); colpi length 12.8 μm (10.2–15.4, n = 6); pore length 4.5 μm (3.7–5.3, n = 6); pore width 1.8 μm (1.3–2.7, n = 6).

Meliaceae Juss.

Carapa guianensis Aubl. (Plate 12, figures 1–6, 9–12)

Monad; spherical, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate and tetracolporate; pore circular; colpi with constriction and margin, apex obsolete; exine tectate; columellae indistinct; reticulate; lumina smaller than 1 μm; equatorial view length 35.9 μm (30–43, n = 10); equatorial view length 36 μm (33–40, n = 10); polar view length 39.6 μm (35–55, n = 7); colpi length 15.1 μm (11.8–20.3, n = 8); pore length 4.5 μm (3.9–5.3, n = 7); pore width 3.9 μm (3.1–4.9, n = 7).

Guarea megantha A. Juss. (Plate 12, figures 7–8, 13–14)

Monad; spherical; amb circular; isopolar; symmetry radial; stellphanocolporate; pore circular; 4 colpors, loxocolporate; brevicolpate; exine tectate; columellae indistinct; scabrate; equatorial view length 44 μm (39–47, n = 6); equatorial view width 45.5 μm (43–48, n = 6); polar view length 47.4 μm (43–52, n = 9); colpi length 19.9 μm (19.9–19.9, n = 1); pore length 4.1 μm (4.1–4.1, n = 1); pore width 6.4 μm (6.4–6.4, n = 1).

Trichilia cipo (A.Juss.) C.DC. (Plate 12, figures 15–19, 28)

Monad; prolate; amb triangular-acute-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with costa endocolp (2.060–2.973 μm) and apex acute; exine tectate; columellae indistinct; reticulate; lumina smaller than 1 μm; equatorial view length 44.3 μm (38–53, n = 10); equatorial view width 29.5 μm (25–32, n = 10); polar view length 27.3 μm (25–29, n = 6); colpi length 29.1 μm (24.7–35, n = 7); pore length 8.3 μm (4.7–10.5, n = 7); pore width 3.9 μm (1.6–4.9, n = 7).

Monimiaceae Juss.

Mollinedia elliptica (Gardner) A. DC. (Plate 12, figures 20–22)

Monad; spherical; symmetry radial; inaperturate; exine tectate; columellae conspicuous and smaller than 1 μm, simple-columellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 24.1 μm (21–28, n = 8); equatorial view width 23.9 μm (18–28, n = 8).

Moraceae Gaudich.

Ficus insipida Willd. (Plate 12, figures 23–25)

Monad; suboblate; elliptic; isopolar; symmetry bilateral; diporate; pore circular; exine tectate; columellae indistinct; scabrate; equatorial view length 12.2 μm (11–13, n = 10); equatorial view width 15.4 μm (14–17, n = 10).

Naucleopsis oblongifolia (Kuhl.) Carauta (Plate 12, figures 31–33)

Monad; circular; isopolar; symmetry radial; triporate; exine tectate; columellae indistinct; echinate; echinae smaller than 1 μm; polar view length 18.1 μm (16–20, n = 10).

Sorocea affinis Hemsl. (Plate 12, figures 26, 34)

Monad; suboblate, oblate spheroidal; isopolar; symmetry bilateral; diporate; circular; exine tectate; columellae indistinct; echinate. Echinae smaller than 1 μm; equatorial view

Plate 15. The scale bars represent 10 μm. Photographs were taken at 100× magnification. Ev = equatorial view; Pv = polar view; Gv = general view. Sapindaceae: Matayba opaca (Ev: 1–3; Pv: 4–6); Paulinia bracteosa (Pv: 7, 14); Paulinia cupana (Pv: 8–10); Paulinia rugosa (Pv: 11–12); Talisia acutifolia (Ev: 13, 20–21; Pv: 17–19); Vourana guianensis (Pv: 15–16, 22). Sapotaceae: Chrysophyllum africanum (Ev: 28–30; Pv: 26–27); Chrysophyllum amazonicum (Ev: 24–25, 33; Pv: 23, 32); Chrysophyllum argenteum Type 1 (Ev: 34–36; Pv: 44–45); Chrysophyllum argenteum Type 2 (Ev: 37–39, 46); Chrysophyllum argenteum subsp. panamense (Ev: 31, 40–41, 50); Chrysophyllum cainito Type 1 (Ev: 47–48, 59); Chrysophyllum cainito Type 2 (Ev: 57–58, 66); Chrysophyllum.marginatum (Ev: 42–43, 51–52; Pv: 53–55); Chrysophyllum mexicanum (Ev: 49, 60, 78; Pv: 61, 69, 79); Chrysophyllum oliviforme (Ev: 56, 64–65); Chrysophyllum splendens (Ev: 62–63); Manilkara bidentata (Ev: 70, 72–73); Micropholis guianensis (Ev: 67–68, 76–77); Micropholis venulosa (Ev: 74–75); Pouteria cladantha (Ev: 84–86; Pv: 82–83); Sarcaulus brasiliensis (Ev: 81; Pv: 71, 80).
length 16.3 μm (14–18, n = 10); equatorial view width 17.8 μm (16–19, n = 10).

**Myristicaceae** R. Br.

*Compsoneura capitellata* (A. DC.) Warb. *(Plate 12, figures 29–30, 42)*

Monad; symmetry bilateral; monosulcate (monocolpate); exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 29.5 μm (25–35, n = 10); equatorial view width 36.9 μm (32–40, n = 10); colpi length 24.4 μm (21.7–28.2, n = 4).

*Compsoneura sprucei* (A. DC.) Warb. *(Plate 12, figures 36, 41, 48)*

Monad; spherical; symmetry radial; inaperturate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 29.1 μm (24–34, n = 9); equatorial view width 35.1 μm (34–38, n = 9).

*Iryanthera coriacea* Ducke *(Plate 12, figures 27, 35)*

Monad; spherical; symmetry asymmetric; inaperturate; exine tectate; columellae conspicuous, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 34.3 μm (28–44, n = 10); equatorial view width 39.1 μm (33–47, n = 10).

*Osteophloeum platyspermum* (Spruce ex A. DC.) Warb. *(Plate 12, figures 37–39)*

Monad; inaperturate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 24.7 μm (22–28, n = 10); equatorial view width 33.4 μm (29–38, n = 10).

*Otoba latialata* (Pittier) A.H. Gentry *(Plate 12, figures 40, 46–47)*

Monad; subprolate, prolate; circular; monosulcate; symmetry radial; tricolpate; exine tectate; lumina smaller than 1 μm; simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 24.1 μm (22–27, n = 9); equatorial view width 17.8 μm (17–19, n = 9); polar view length 24.2 μm (21–30, n = 10); colpi length 18.5 μm (17.6–19.4, n = 2).

*Virola peruviana* (A. DC.) Warb. *(Plate 12, figures 43–45)*

Monad; anisopolar; symmetry bilateral; monosulcate (monocolpate); exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 24.3 μm (21–29, n = 6); equatorial view width 33.2 μm (31–35, n = 6); colpi length 24.8 μm (24.8–24.8, n = 1); colpi width 2.5 μm (2.5–2.5, n = 1).

**Nyctaginaceae** Juss.

*Nea amplifolia* Donn. Sm. *(Plate 12, figures 49–52, 55, 65)*

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolpate; colpi with margin and apex acute; exine semitectate; columellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 48.7 μm (45–51, n = 6); equatorial view width 42.3 μm (38–45, n = 6); polar view length 54.3 μm (42–60, n = 10); colpi length 35.3 μm (33.6–38.3, n = 3).

**Ochnaceae** DC.

*Lucania renata* (Tul.) A.C. Sm. *(Plate 12, figures 53, 56–59, 62)*

Monad; subprolate, prolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (1.714–2.290 μm), apex obtuse; exine tectate; lumina smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 36.1 μm (32–39, n = 10); equatorial view width 28.3 μm (27–31, n = 10); polar view length 31.4 μm (27–37, n = 10); colpi length 25.9 μm (21–29, n = 7); colpi width 1.6 μm (1.1–1.9, n = 3); pore length 7 μm (5.6–7.9, n = 5); pore width 3.7 μm (3–4.6, n = 5).

*Lucania jenmanii* (Oliv.) Ducke *(Plate 12, figures 66–68)*

Monad; subprolate, prolate, prolate spheroidal; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction and margin (1.286–3.014 μm), apex obtuse; exine tectate; lumina smaller than 1 μm, simplicolumellate; reticulate; homobrochate. Equatorial view length 47.4 μm (42–52, n = 8); equatorial view width 37.6 μm (34–41, n = 8); colpi length 32 μm (31–33.6, n = 5); colpi width 2.8 μm (2.2–3.3, n = 2).

*Quina cajambrensis* Cuatrec. *(Plate 12, figures 54, 60–61, 63–64, 71)*

Monad; spherical; amb circular; symmetry radial; pantoporate; pore circular; exine tectate; lumina smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 25.3 μm (20–28, n = 7); equatorial view width 26.6 μm (24–29, n = 7); polar view length 25.7 μm (22–31, n = 10); pore length 3.1 μm (2.1–3.8, n = 4); pore width 2.5 μm (2.2–2.7, n = 4).

---

**Opiliaceae** Valeton

*Agonandra obtusifolia* Standl. (Plate 12, figures 69–70; Plate 13, figures 1–4)

Monad; prolate spheroidal, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, apex acute, colpi with constriction; exine tectate; columellae indistinct; echinate; echinae smaller than 1 μm. Equatorial view length 21.5 μm (21–22, n = 10); equatorial view width 17.4 μm (16–20, n = 10); polar view length 21.9 μm (20–23, n = 10); colpi length 13.8 μm (13–15, n = 4); colpi width 2 μm (1.7–2.2, n = 2).

**Picramniaceae** Fernando & Quinn

*Picramnia latifolia* Tul. (Plate 13, figures 5–9, 19)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction; exine tectate; columellae indistinct; striate. Equatorial view length 23.1 μm (18–26, n = 10); equatorial view width 16 μm (15–17, n = 10); polar view length 18 μm (16–21, n = 10); colpi length 19.9 μm (17–22, n = 8); colpi width 1.4 μm (0.7–2.2, n = 5).

**Piperaceae** Giseke

*Piper arboreum* Aubl. (Plate 13, figures 10–11)

Monad; symmetry bilateral; monosulcate (monocolpate); exine tectate; columellae indistinct; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 9.2 μm (8–10, n = 8); equatorial view width 10.8 μm (9–12, n = 8).

*Piper obliquum* Ruiz & Pav. (Plate 13, figures 12–13)

Monad; symmetry bilateral; monosulcate (monocolpate); exine tectate; columellae indistinct, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 11.7 μm (9–14, n = 10); equatorial view width 14.9 μm (14–16, n = 10).

**Polygalaceae** Hoffmanns. & Link

*Moutabea excoriata* Mart. ex Miq. (Plate 13, figures 14–18, 29, 33–34)

Monad; subprolate, prolate, prolate spheroidal; amb circular; isopolar; symmetry radial; stephanocolporate; pore circular; 13–14 colpori, colpi with apex acute; exine tectate; columellae indistinct; scabrate. Equatorial view length 46 μm (36–55,
Triplaris americana L. (Plate 13, figures 36–38, 45–47, 53)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 53.3 μm (47–63, n = 10); equatorial view width 44.8 μm (38–50, n = 10); polar view length 48.5 μm (41–55, n = 10); colpi length 45.3 μm (38.6–55.5, n = 7); pore length 4.5 μm (3.9–5.5, n = 3); pore width 5.9 μm (5.1–6.4, n = 3).

Triplaris caracasana Cham. (Plate 13, figures 48–50, 54–56)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; equatorial view length 28.9 μm (25–36, n = 10); equatorial view width 22.4 μm (18–28, n = 10); polar view length 24.7 μm (18–30, n = 6); colpi length 22.1 μm (15.6–27.7, n = 3); colpi width 2.4 μm (2.4–2.4, n = 1); pore length 2.3 μm (2.3–2.3, n = 1); pore width 3.7 μm (3.7–3.7, n = 1).


Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin (1.720–2.607 μm), apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate. Equatorial view length 54.9 μm (51–59, n = 9); equatorial view width 41.6 μm (38–45, n = 9); polar view length 50.3 μm (44–55, n = 10); colpi length 35 μm (33.6–36.9, n = 5); colpi width 1.3 μm (1.3–1.3, n = 1); pore length 6.2 μm (5.9–6.4, n = 2); pore width 8.2 μm (7.7–8.6, n = 2).

Primulaceae Batsch ex Borkh.

Ardisia guianensis (Aubl.) Mez (Plate 13, figures 63–65, 72–74)

Monad; subprolate, prolate spheroidal; circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, apex acute; exine semitectate; columellae indistinct; reticulate; homobrochate; circular lumina and thin muri. Equatorial view length 21.8 μm (18–25, n = 10); equatorial view length 17.7 μm (15–20, n = 10); polar view length 17.1 μm (15–19, n = 7); colpi length 12.6 μm (8.6–16.8, n = 4); pore length 12.5 μm (6.8–16.3, n = 3); pore width 3.3 μm (3.3–3.3, n = 1).
simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 29.7 μm (23–35, n = 10); equatorial view width 25.5 μm (22–29, n = 10); polar view length 29.1 μm (25–33, n = 9); colpi length 21.9 μm (17.1–27, n = 7); pore length 5.5 μm (4.4–8.2, n = 6); pore width 3 μm (2–4.5, n = 6).

**Rhhamnaceae** Juss.

*Ziziphus itacaiunensis* Frôes (Plate 13, figures 79–80, 84, 91–92, 98)

Monad; suboblate; amb triangular-obtuse-concave; isopolar; symmetry radial; tricolporate; pore circular; colpi wider and with apex obtuse; exine tectate; columellae indistinct, simplisimplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 23.4 μm (21–28, n = 8); equatorial view width 28.2 μm (26–31, n = 8); polar view length 27 μm (24–32, n = 7); colpi length 17.8 μm (16.8–19.1, n = 3); colpi width 8.6 μm (2.5–11.8, n = 3); pore length 5.2 μm (3.9–6.1, n = 3); pore width 5.8 μm (5.3–6.1, n = 3).

**Rhizophoraceae** Pers.

*Cassipourea peruviana* Alston (Plate 13, figures 81–82, 85–86, 94, 101)

Monad; prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin (0.869 μm) and costa endocolpi, colpi with apex acute; exine tectate; columellae conspicuous, simplisimplicolumellate, reticulate; homobrochate. Equatorial view length 20.6 μm (17–23, n = 10); equatorial view width 13.4 μm (12–15, n = 10); polar view length 15.5 μm (14–17, n = 4); colpi length 14.8 μm (12.3–17.8, n = 9); pore length 5.2 μm (3.5–6.9, n = 7); pore width 2.6 μm (1.9–3.6, n = 7).

**Rosaceae** Juss.

*Prunus reflexa* (Gardner) Walp. (Plate 14, figures 1–3)

Monad; prolate, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; Colpi thin, with margin, apex acute; exine tectate; columellae indistinct; striatoreticulate; with inconspicuous reticulum. Colpi length 25.7 μm (23.1–28.8, n = 4); pore length 7.2 μm (7.2–7.2, n = 2); pore width 5.5 μm (5.5–5.5, n = 2).

**Rubiaceae** Juss.

*Alibertia longiflora* K. Schum. (Plate 14, figures 4–8, 16)

Monad; prolate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction; margin with exitus digitatus, with costa ectocolpi; exine semitectate; columellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate. Equatorial view length 35.3 μm (31–40, n = 10); equatorial view width 34.5 μm (30–38, n = 10); polar view length 37.1 μm (34–39, n = 8); colpi length 24.1 μm (20–26.2, n = 7); pore length 4.4 μm (4.4–4.4, n = 1); pore width 1.8 μm (1.8–1.8, n = 1).

*Faramea anisocalyx* Poepp. (Plate 14, figures 9–15)

Monad; outline circular; isopolar; symmetry bilateral; diporate; pore circular; exine tectate; columellae conspicuous and greater than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 49.3 μm (39–58, n = 10). Equatorial view width 46.6 μm (38–54, n = 10); polar view length 43.2 μm (34–50, n = 9); colpi length 28.7 μm (28.7–28.7, n = 1).

*Ixora coccinea* L. (Plate 14, figures 17–22)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with margin (with costa endocolpi), apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 30.8 μm (28–33, n = 10); equatorial view width 21.2 μm (19–26, n = 10); polar view length 27.5 μm (24–31, n = 8); colpi length 24.4 μm (22.4–26.5, n = 6); colpi width 0.9 μm (0.9–1, n = 3); pore length 6.6 μm (6.3–7.1, n = 3); pore width 4.4 μm (4.4–4.6, n = 3).

**Psychotria calophylla** Standl. (Plate 14, figures 26–27, 33–35)

Monad; oblate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain; exine semitectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate. Equatorial view length 47 μm (47–47, n = 1); equatorial view width 67 μm (67–67, n = 1); polar view length 61.5 μm (50–70, n = 8); colpi length 28.6 μm (28.6–28.6, n = 1); colpi width 4.9 μm (4.9–4.9, n = 1); pore length 6.1 μm (6.1–6.1, n = 1); pore width 4.4 μm (4.4–4.4, n = 1).

**Rutaceae** Juss.

*Amyris breneesii* Standl. (Plate 14, figures 36, 42–43, 48–49)

Monad; prolate spheroidal, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, with constriction and apex acute; exine tectate; columellae indistinct; striatoreticulate; with inconspicuous reticulum. Equatorial view length 21.9 μm (21–23, n = 10); equatorial view width 17.4 μm (15–20, n = 10); polar view length 20.6 μm (19–22, n = 7); colpi length 13.9 μm (12.1–15.1, n = 6); pore length 3.5 μm (2.9–4.1, n = 3); pore width 2.5 μm (1.7–3, n = 3).

**Conchocarpus nicaraguensis** (Standl. & L.O.Williams) Kallunki & Pirani (Plate 14, figures 28–29, 37)

Monad; prolate; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, apex acute; semiexine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; equatorial view length 75.2 μm (68.5–87.7, n = 5); equatorial view width 57.6 μm (50.5–64.3,
$n = 5$; colpi length $48.5 \mu m$ ($43.8–50.8$, $n = 4$); pore length $11.4 \mu m$ ($9.4–16.4$, $n = 4$); pore width $3.6 \mu m$ ($3.4–3.9$, $n = 4$).

*Zanthoxylum juniperinum* Poepp. (Plate 14, figures 30–31, 38–40, 46–47)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain; exine tectate; columellae conspicuous and greater than $1 \mu m$, simplicolumellate; reticulate; homobrochate; equatorial view length $27.1 \mu m$ ($25–29$, $n = 10$); equatorial view width $20.5 \mu m$ ($18–22$, $n = 10$); polar view length $20.4 \mu m$ ($18–23$, $n = 9$); colpi length $19.6 \mu m$ ($18–22.1$, $n = 8$); pore length $4.6 \mu m$ ($3.4–5.7$, $n = 8$); pore width $2 \mu m$ ($1–2.9$, $n = 8$).

*Sabiaceae* Blume

*Ophiocaryon heterophyllum* (Benth.) Urb. (Plate 14, figures 44–45, 50–52, 58)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine tectate; columellae conspicuous, smaller than $1 \mu m$, simplicolumellate; reticulate; homobrochate; lumina smaller than $1 \mu m$; equatorial view length $25.1 \mu m$ ($22–28$, $n = 10$); equatorial view width $18.4 \mu m$ ($15–24$, $n = 10$); polar view length $25 \mu m$ ($20–27$, $n = 6$); colpi length $21.8 \mu m$ ($19–24.4$, $n = 8$); colpi width $1.2 \mu m$ ($1–1.5$, $n = 3$); pore length $6.3 \mu m$ ($5.5–7.6$, $n = 4$); pore width $4 \mu m$ ($3.3–4.6$, $n = 4$).

*Meliosma glabrata* (Liebm.) Urb. (Plate 14, figures 41, 53–56, 63)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; apex acute; exine semitectate; columellae conspicuous and smaller than $1 \mu m$, simplicolumellate; reticulate; homobrochate. Equatorial view length $31.1 \mu m$ ($29–33$, $n = 11$); equatorial view width $22.5 \mu m$ ($21–27$, $n = 11$); polar view length $22.5 \mu m$ ($22–23$, $n = 2$); colpi length $22.2 \mu m$ ($19.8–25$, $n = 6$); pore length $8.3 \mu m$ ($7.4–10.1$, $n = 3$); pore width $4.9 \mu m$ ($4.8–5$, $n = 2$).

*Salicaceae* Mirb.
Casearia arborea (Rich.) Urb. (Plate 14, figures 59–60)

Monad; subprolate, prolate spheroidal; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grains, margin with exitus digitatus, apex obtuse; exine tectate; columellae inconspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 45 μm (37–49.1, n = 10); equatorial view width 38.6 μm (32.2–42.7, n = 10); colpi length 29.8 μm (26.4–34.1, n = 8); colpi width 1.7 μm (1.7–1.7, n = 1); pore length 8.8 μm (7.9–10.7, n = 10); pore width 3.6 μm (1.1–5.1, n = 10).

Sapindaceae Juss.

Allophylus floribundus (Poepp.) Radlk. (Plate 14, figures 62, 69–70)

Monad; amb triangular-obtuse-convex; isopolar; symmetry radial; triporate; exine tectate; columellae conspicuous, type pilum; rugulate; polar view length 32.7 μm (27–41, n = 6).

Cupania latifolia Kunth (Plate 14, figures 57, 64–67)

Monad; subprolate; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; parasyncolporate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 38 μm (37–39, n = 2); equatorial view width 33 μm (32–34, n = 2); polar view length 29.8 μm (24–34, n = 10).

Cupania scrobiculata Rich. (Plate 14, figures 61, 68)

Monad; amb triangular-obtuse-concave; symmetry radial; tricolporate; syncolporate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 20.9 μm (19–23, n = 10).

Matayba opaca Radlk. (Plate 15, figures 1–6)

Monad; subprolate, prolate spheroidal, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; colpi with margin; exine tectate; columellae conspicuous and smaller than 1 μm, reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 26.9 μm (22–30, n = 9); equatorial view width 22.2 μm (17–24, n = 9); polar view length 27.8 μm (26–31, n = 10); colpi length 19.6 μm (15.6–21.8, n = 4); pore length 3.3 μm (3.3–3.3, n = 1); pore width 2.6 μm (2.6–2.6, n = 1).

Paullinia bracteosa Radlk. (Plate 15, figures 7, 14)

Monad; amb triangular-obtuse-straight; symmetry radial; triporate; exine tectate; columellae indistinct; psilate; polar view length 36.6 μm (29.3–43.4, n = 10).

Paullinia cupana Kunth (Plate 15, figures 8–10)

Monad; amb triangular-obtuse-straight; symmetry radial; triporate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 62.8 μm (58–67, n = 10).

Paullinia rugosa Benth. ex Radlk. (Plate 15, figures 11–12)

Monad; amb triangular-obtuse-convex; symmetry radial; triporate; exine tectate; columellae conspicuous and smaller than 1 μm; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 42.8 μm (38–48, n = 10).

Talisia acutifolia Radlk. (Plate 15, figures 13, 17–21)

Monad; oblate spheroidal, spherical; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with margin (1.355 μm), apex acute, parasyncolporate; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 31.7 μm (31–32, n = 3); equatorial view width 30 μm (28–32, n = 3); polar view length 33.4 μm (31–36, n = 10); colpi length 20 μm (20–20, n = 1); colpi width
Figure 6. Distribution of ornamentation types among the 255 described species for the Amacayacu Forest Dynamics Plot (AFDP), by family.

1.3 μm (1.3–1.3, n = 1); pore length 11 μm (3.4–25.3, n = 3); pore width 8.4 μm (8–8.8, n = 2).

Vouarana guianensis Aubl. (Plate 15, figures 15–16, 22)

Monad; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; syncolporate in polar view; exine tectate; columellae indistinct and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 24.1 μm (21–27, n = 10).

Sapotaceae Juss.

Chrysophyllum africanum A. DC. (Plate 15, figures 26–30)

Monad; prolate; amb triangular-acute-straight; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with costa endocolpi and apex acute; exine tectate; columellae indistinct; nexine is thicker in equatorial region (1.863–2.718 μm); scabrate. Equatorial view length 34 μm (32–35, n = 10); equatorial view width 21.4 μm (20–22, n = 10); colpi length 20.3 μm (17.8–22, n = 7); colpi width 1.7 μm (1.7–1.7, n = 1); pore length 6.4 μm (5.6–7, n = 7); pore width 1.9 μm (1.3–2.4, n = 7).

Chrysophyllum amazonicum T.D. Penn. (Plate 15, figures 23–25, 32–33)

Monad; prolate; amb triangular-obtuse-straight; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae indistinct; nexine is thicker (1.629–2.326 μm) in equatorial region; psilate; equatorial view length 29.8 μm (28–34, n = 10); equatorial view width 17.2 μm (15–19, n = 10); polar view length 19 μm (19–19, n = 4); colpi length 21.1 μm (18.3–24.1, n = 6); colpi width 1.3 μm (1.3–1.3, n = 1); pore length 4.1 μm (3.1–5.5, n = 6); pore width 2.2 μm (1.1–2.9, n = 6).

Chrysophyllum argenteum Jacq. Type 1 (Plate 15, figures 34–36, 44–45)

Monad; perprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with costa endocolpi, apex acute; exine tectate; columellae indistinct, simplicolumellate; nexine thicker in equatorial region (1.212–2.231 μm); reticulate; homobrochate; muri are wider in equatorial region, lumina smaller than 1 μm. Equatorial view length 31.8 μm (28–36, n = 10); equatorial view width 19 μm (17–25, n = 10); colpi length 20.7 μm (19.1–23.3, n = 5); pore length 5.7 μm (3.6–7.6, n = 5); pore width 2 μm (1.1–2.5, n = 5).

Chrysophyllum argenteum subsp. panamense (Pittier) T.D. Penn. (Plate 15, figures 31, 40–41, 50)

Monad; prolate; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with costa endocolpi and apex acute; exine tectate; columellae indistinct, simplicolumellate; nexine thicker in equatorial region (1.121–1.879 μm) in equatorial region; scabrate; equatorial view length 30.1 μm (28–32, n = 10); equatorial view width 19 μm (17–21, n = 10); colpi length 21.2 μm (20.5–23.2, n = 6); colpi width 1 μm (0.9–1, n = 3); pore length 4.7 μm (4.4–5.4, n = 7); pore width 1.6 μm (1.3–2, n = 7).

Chrysophyllum cainito L. Type 1 (Plate 15, figures 47–48, 59)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi thin, with costa
endocolpi and apex acute; exine tectate; columellae indistinct; scabrate; equatorial view length 40.5 μm (36–43, n = 10); equatorial view width 30 μm (26–32, n = 10); colpi length 25.6 μm (22.6–28.8, n = 6); pore length 4.3 μm (3.5–5.4, n = 6); pore width 1.6 μm (1.3–2.1, n = 6).

**Chrysophyllum cainito** L. Type 2 (Plate 15, figures 57–58, 66)
Monad; prolate; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with costa endocolpi; exine tectate; columellae indistinct; nexine is thicker in equatorial region (1.040–1.767 μm); scabrate. Equatorial view length 30 μm (28–32, n = 9); equatorial view width 19.4 μm (18–21, n = 9); colpi length 19.7 μm (17.2–22.5, n = 6); pore length 5.5 μm (4.7–7.4, n = 6); pore width 1.7 μm (1.3–2, n = 6).

**Chrysophyllum marginatum** (Hook. & Arn.) Radlk. (Plate 15, Chrysophyllum marginatum
Monad; prolate; subprolate, prolate spheroidal; isopolar; symmetry radial; tricolporate; pore lalongate; 4 colpori; colpi thin, 2/3 as long as grain, with margin, apex acute; exine tectate; columellae conspicuous, digitate, larger than 1 μm, simplicomulcated; nexine thinner in equatorial region (0.515–1.212 μm); reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 32.6 μm (29–35, n = 10); equatorial view width 20.5 μm (18–22, n = 10); polar view length 18.4 μm (16–20, n = 5); colpi length 19.6 μm (18.4–20.4, n = 5); pore length 4.8 μm (3.9–5.6, n = 5); pore width 2.7 μm (2.5–3.2, n = 5).

**Chrysophyllum mexicanum** Brandegee ex Standl. (Plate 15, figures 49, 60–61, 69, 78–79)
Monad; prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, with constriction and costa endocolpi; exine tectate; columellae indistinct, nexine thinner in equatorial region (1.457–1.629 μm); scabrate; equatorial view length 33 μm (30–36, n = 9); equatorial view width 21.4 μm (17–25, n = 9); polar view length 22 μm (18–27, n = 5); colpi length 21.4 μm (19.9–22.7, n = 5); pore length 5 μm (4.3–6.4, n = 5); pore width 1.8 μm (1.5–2.1, n = 5).

**Chrysophyllum oliviforme** L. (Plate 15, figures 56, 64–65)
Monad; subprolate, prolate; isopolar; symmetry radial; stephanocolporate; pore lalongate; 4 colpori; colpi with costa endocolpi, apex acute; exine tectate; columellae indistinct, simplicomulcated, nexine thinner in equatorial region (1.116–1.317 μm); reticulate; homobrochate; muri are wider in the equatorial region; lumina smaller than 1 μm. Equatorial view length 37.1 μm (32–40, n = 10); equatorial view width 28.2 μm (25–32, n = 10); colpi length 22.1 μm (18.6–25.4, n = 6); pore length 5.1 μm (3.5–7.6, n = 6); pore width 2.1 μm (1.2–2.8, n = 6).

**Chrysophyllum splendidens** Spreng. (Plate 15, figures 62–63)
Monad; subprolate, prolate spheroidal; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, with costa endocolpi and apex acute; exine tectate; columellae indistinct; nexine thicker in equatorial region; scabrate. Equatorial view length 39.8 μm (35–46, n = 11); equatorial view width 34.1 μm (30–38, n = 11); colpi length 20.1 μm (16.4–25.2, n = 6); pore length 6.2 μm (3.4–9.3, n = 6); pore width 2.4 μm (1.3–3.3, n = 6).

**Manilkara bidentata** R.O. Williams (Plate 15, figures 70, 72–73)
Monad; prolate spheroidal, prolate, subprolate; isopolar; symmetry radial; stephanocolporate; pore lalongate; 5 colpori, colpi 2/3 as long as grain, apex acute, margin with 1.010 μm; exine tectate; columellae indistinct; scabrate; colpi length 26.5 μm (19.7–29.1, n = 8); pore length 5 μm (4.1–6.4, n = 8); pore width 3 μm (2.2–3.4, n = 8).

**Micropholis guyanensis** (A. DC.) Pierre (Plate 15, figures 67–68, 76–77)
Monad; prolate; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain; exine tectate; columellae indistinct, nexina is differentiated in the equatorial region; nexine is thicker than sexine; scabrate; colpi length 21.7 μm (16.1–26.4, n = 7); pore length 4 μm (3.1–5.2, n = 6); pore width 1.7 μm (1.5–1.8, n = 6).

**Micropholis venulosa** (Mart. & Eichler) Pierre (Plate 15, figures 74–75)
Monad; subprolate; isopolar; symmetry radial; tricolporate; pore lalongate; exine tectate; columellae indistinct and with costa endocolpi; sexina is differentiated in the equatorial region; scabrate; colpi length 27.6 μm (26.9–28, n = 3); pore length 2.9 μm (2.9–2.9, n = 1); pore width 1 μm (1–1, n = 1).

**Pouteria cladantha** Sandwith (Plate 15, figures 82–86)
Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain; exine tectate; columellae indistinct, simplicomulcated; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 15.9 μm (14–17, n = 10); equatorial view width 12 μm (10–13, n = 10); polar view length 12.9 μm (12–14, n = 9); colpi length 11.9 μm (10.1–14.2, n = 5); pore length 2.3 μm (1.6–3.1, n = 5); pore width 1.4 μm (1–1.6, n = 5).

**Sarcaulus brasiliensis** (A. DC.) Eyema (Plate 15, figures 71, 80–81; Plate 16, figures 1–2)
Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore circular; exine tectate; columellae indistinct, simplicomulcated; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 17.1 μm (15–19, n = 10); equatorial view width 15.7 μm (14–17, n = 10); polar view length 16.2 μm (15–18, n = 9); colpi length 9.2 μm (7.6–10.9, n = 2); pore length 2.9 μm (2.3–3.3, n = 7); pore width 2.6 μm (2.1–3.5, n = 7).

**Simaroubaceae** DC.

**Picrolemma sprucei** Hook. F. (Plate 16, figures 3–5)
Monad; subprolate, prolate spheroidal; isopolar; symmetry radial; stephanocolporate; pore lalongate; 4 colpori; colpi 2/3 as long as grain; exine tectate; cyclorolcates; convex smaller than 1 μm, simplicomulcated; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length
34.6 μm (33–37, n = 10). Equatorial view width 30.9 μm (29–34, n = 10); colpi length 20.8 μm (19.2–24.2, n = 6); pore length 6.8 μm (6.1–7.7, n = 6); pore width 4.1 μm (3.6–4.3, n = 6).

**Simarouba glabra** Engl. (Plate 16, figures 6–8, 13–16)

Monad; prolate spheroidal, subprolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 20.9 μm (17–24, n = 11); equatorial view width 18.7 μm (14–23, n = 11); polar view length 17.4 μm (15–20, n = 8); colpi length 16.8 μm (15.8–17.5, n = 5); pore length 5.8 μm (5–6.7, n = 2); pore width 2.5 μm (2.4–2.5, n = 2).

**Simarouba amara** Aubl. (Plate 16, figures 9–12, 17–18)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain; exine semitectate; columellae indistinct; echinate; sexine with small lumina. There are echinae (with less than 1 μm) in the muri. Equatorial view length 19 μm (15–22, n = 9); equatorial view width 17.1 μm (14–19, n = 9); polar view length 17.3 μm (15–19, n = 9); colpi length 14.5 μm (11.6–16.5, n = 5); pore length 4.6 μm (4.2–5, n = 4); pore width 1.5 μm (1.1–1.7, n = 4).

**Siparuna guianensis** Aubl. (Plate 16, figures 21–25)

Monad; prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 32.3 μm (28–38, n = 9); equatorial view width 29.7 μm (23–35, n = 9); polar view length 29.4 μm (24–34, n = 9); colpi length 21.5 μm (19.6–24.2, n = 5); colpi width 1.8 μm (1.8–1.8, n = 1); pore length 8.8 μm (7.9–9.7, n = 4); pore width 3.4 μm (1.5–4.5, n = 4).

**Siparuna parciflora** (Beurl.) A. DC. (Plate 16, figures 19–20)

Monad; spherical; outline circular; symmetry radial; inaperturate; exine intectate; echinate; echinae smaller than 1 μm; equatorial view length 16.7 μm (14–20, n = 9); equatorial view width 17.4 μm (14–20, n = 9).

**Solanaceae** Juss.

**Brunfelsia grandiflora** D. Don (Plate 16, figures 34–36, 41–43)

Monad; oblate spheroidal; amb circular; isopolar; symmetry radial; stephanocolporate; pores lalongate; 4-colpori; colpi with margin; exine semitectate; columellae conspicuous and smaller than 1 μm; regulate. Equatorial view length 61 μm (61–61, n = 1); equatorial view width 68 μm (68–68, n = 1); polar view length 48.3 μm (40–60, n = 6); colpi length 28.6 μm (28.6–28.6, n = 1).

**Cestrum nocturnum** L. (Plate 16, figures 32–33, 37–40, 44–45)

Monad; subprolate, prolate; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction and margin (1.692 μm); apex obtuse; exine tectate; columellae indistinct; micropitted; like perforate. Equatorial view length 52.2 μm (41–66, n = 9); equatorial view width 46.9 μm (36–55, n = 9); polar view length 51.6 μm (43–58, n = 10); colpi length 44.3 μm (40–46.5, n = 4); colpi width 1.4 μm (1.1–1.7, n = 2); pore length 17 μm (14.3–22.1, n = 4); pore width 6.9 μm (5.6–8, n = 4).

**Cestrum schlechtendalii** G. Don (Plate 16, figures 26–31)

Monad; oblate spheroidal, subprolate, prolate spheroidal; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with constriction; exine tectate; columellae inconspicuous, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 46.2 μm (37.5–52.6, n = 11); equatorial view width 43.7 μm (36.3–51.4, n = 11); polar view length 42.1 μm (38.7–51.5, n = 10); colpi length 35.7 μm (28–43.9, n = 4); pore length 18 μm (17.4–18.6, n = 2); pore width 4.7 μm (3.7–5.6, n = 2).

**Solanum diversifolium** Schltdl. (Plate 16, figures 46–47, 53–56)

Monad; prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi 2/3 as long as grain, with constriction, margin (1.495 μm), apex obtuse; exine tectate; reticulate; homobrochate; lumina smaller than 1 μm; equatorial view length 40.3 μm (36–45, n = 11); equatorial view width 38.6 μm (33–42, n = 11); polar view length 39.9 μm (38–43, n = 9); colpi length 29.9 μm (24.9–33.3, n = 10); colpi width 2.2 μm (1.4–3, n = 5); pore length 11.6 μm (7.9–15.5, n = 7); pore width 4.6 μm (3.4–6.5, n = 7).

**Stemonuraceae** Kárehed

**Discophora guianensis** miers (Plate 16, figures 48–52)

Monad; spherical; amb circular; isopolar; symmetry radial; two types: tricolporate and stephanocolporate; pore circular; 3–5 colpori; brevicolpate; exine tectate; columellae indistinct; echinate; echinae smaller than 1 μm. Equatorial view length 21.8 μm (20–23, n = 6); equatorial view width 22.2 μm (21–24, n = 6); polar view length 22.5 μm (21–24, n = 4); colpi length 2.7 μm (2.2–3.2, n = 2); pore length 3 μm (2.2–3.5, n = 6); pore width 1.6 μm (1–2.1, n = 6).

**Styracaceae** DC. & Spreng.

**Styrax grandifolius** Griff (Plate 16, figures 57–63, 67–70, 74)

Monad; subprolate, prolate, prolate spheroidal; amb circular; isopolar; symmetry radial; two types: stephanocolporate; pore lalongate; colpi 2/3 as long as grains, with margin (1.460–2.750 μm) and constriction, apex acute. 3–4 colpori; and parasympocolporate (with 3 apertures); exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 45.7 μm (39.6–50.7, n = 9); equatorial view width 37 μm (30.2–40.4, n = 9); polar view length 46.4 μm (41.6–50.7, n = 10); colpi length 35 μm (30.2–40.7,
Thymelaeaceae  Juss.

*Schoenobiblus daphnoides* Mart. (Plate 16, figures 64–66, 73)

Monad; spherical; amb circular; symmetry radial; pantoporate; pore circular; exine tectate; columellae indistinct; scabrate; with granules; equatorial view length 12.4 μm (6.2–6.3, n = 2); pore width 3.3 μm (3.2–3.4, n = 2).

Trigoniaceae  A. Juss.

*Trigonia laevis* Aubl. (Plate 16, figures 71–72)

Monad; circular, rectangular; isopolar; symmetry radial; steplanoporate; exine tectate; columellae inconspicuous, type baculum and digitate; reticulate; homobrochate; lumina smaller than 1 μm; polar view length 8.9 μm (7–10, n = 5); pore width 6.3 μm (5–8, n = 5).

Ulmaceae  Mirb.

*Ampelocera cubensis* Griseb. (Plate 16, figures 75–78)

Monad; oblate; amb circular; isopolar; symmetry radial; steplanoporate; exine tectate; columellae indistinct; scabrate. Equatorial view length 9.2 μm (8–11, n = 8); equatorial view width 6.8 μm (5–8, n = 8).

Cecropia longipes* Pittier (Plate 16, figures 79–81)

Monad; symmetry bilateral; diporate; pore circular; exine tectate; columellae indistinct; scabrate; with granula; equatorial view length 9.2 μm (8–11, n = 8); equatorial view width 6.8 μm (5–8, n = 8).

*Cecropia obtusifolia* Bertol. (Plate 16, figures 82–83)

Monad; symmetry bilateral; diporate; pore circular; exine tectate; columellae indistinct; scabrate; with granula; equatorial view length 8 μm (7–10, n = 5); equatorial view width 6.2 μm (5–8, n = 5).

*Cecropia pachystachya* Trécul (Plate 16, figures 82–83)

Monad; symmetry bilateral; diporate; pore circular; exine tectate; columellae indistinct; scabrate; with some granules; equatorial view length 12.4 μm (11–14, n = 10); equatorial view width 9.3 μm (8–10, n = 10).

*Cecropia peltata* L. (Plate 16, figures 90–91)

Monad; symmetry bilateral; diporate; pore circular; exine tectate; columellae indistinct; echinate; echinae smaller than 1 μm; equatorial view length 12.2 μm (10–15, n = 9); equatorial view width 9.9 μm (8–12, n = 9).

*Pourouma bicolor* Mart. (Plate 16, figure 84, 92)

Monad; symmetry bilateral; diporate; pore circular; echinae smaller than 1 μm; exine tectate; columellae indistinct; echinate; equatorial view length 15.7 μm (14–18, n = 10); equatorial view width 14.6 μm (13–16, n = 10).

Urera baccifera* (L.) Gaudich. ex Wedd. (Plate 16, figures 85–86, 93)

Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate and stephanocolporate; pore lalongate; 3–4 colpore, with granula around the apertures; brevicolpate, but the colpi are not oriented symmetrically; exine tectate; columellae indistinct; scabrate. Equatorial view length 38.8 μm (35–46, n = 5); equatorial view width 37.6 μm (33–45, n = 5); polar view length 37.4 μm (33–42, n = 9); colpi length 15.8 μm (13.3–19.5, n = 4); pore length 4.7 μm (3.9–5.9, n = 5); pore width 3.5 μm (2.7–4.7, n = 5).

Petrea volubilis* L. (Plate 17, figures 7–8)

Monad; amb triangular-obtuse-convex; isopolar; symmetry radial; tricolporate; exine tectate; columellae conspicuous and smaller than 1 μm; scabrate; polar view length 60.1 μm (54–68, n = 9).

Violaceae  Batsch

*Gloeospermum sphaerocarpum* Triana & Planch. (Plate 17, figures 9–10)

Monad; spherical; amb circular; isopolar; symmetry radial; tricolporate; exine tectate; columellae conspicuous and smaller than 1 μm; scabrate; polar view length 28, n = 45; equatorial view width 3.2 μm (13–19.5, n = 4); colpi length 15.8 μm (13.3–19.5, n = 4); pore length 4.7 μm (3.9–5.9, n = 5); pore width 3.5 μm (2.7–4.7, n = 5).

Leonia cymosa  Mart. (Plate 17, figures 11–12, 17–20)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi with constriction; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm; exine tectate; columellae indistinct; scabrate. Equatorial view length 26.6 μm (22–34, n = 5); equatorial view width 22.6 μm (19–26, n = 5); polar view length 22.9 μm (20–27, n = 9); colpi length 16.4 μm (16–16.8, n = 2).

Rinorea guianensis* Aubl. (Plate 17, figures 15–16, 25–26, 35)

Monad; oblate spheroidal, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with margin; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 26.4 μm (25–28, n = 7); equatorial view width 27.4 μm (23–31, n = 7); polar view length 29.6 μm (26–33, n = 7); colpi length 19.5 μm (19.3–19.9, n = 4); pore length 9.2 μm (8–11, n = 4); pore width 5.8 μm (3.1–7.3, n = 4).
**Vochysiaceae** A. St.-Hil.

**Erisma calcareatum** (Link) Warn. (Plate 17, figures 27–30, 39–40)

Monad; subprolate, prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; with margin, apex acute; exine reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view width 26.6 μm (21–33, n = 9); equatorial view length 23.2 μm (20–29, n = 9); polar view length 25.3 μm (22–31, n = 9); colpi length 17.2 μm (13.3–19.8, n = 3).

**Vochysia ferruginea** Mart. (Plate 17, figures 36–38, 45–46)

Monad; oblate spheroidal; amb triangular-obtuse-concave; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with margin, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 28 μm (24–31, n = 7); equatorial view width 24.9 μm (21–28, n = 7); polar view length 27.2 μm (24–30, n = 10); colpi length 21.3 μm (19.8–23.1, n = 4); colpi width 1.1 μm (1.1–1.1, n = 1); pore length 8.1 μm (7.7–8.5, n = 3); pore width 1.8 μm (1.8–1.9, n = 3).

**Ruizterania cassiquiarensis** (Spruce ex Warn.) Marc.-Berti (Plate 17, figures 31–32, 41–43)

Monad; prolate spheroidal; amb circular; isopolar; symmetry radial; tricolporate; pore lalongate; colpi as long as grain, with margin, apex acute; exine tectate; columellae conspicuous and smaller than 1 μm, simplicolumellate; reticulate; homobrochate; lumina smaller than 1 μm. Equatorial view length 39.4 μm (37–43, n = 9); equatorial view width 37.1 μm (34–40, n = 9); polar view length 40 μm (38–43, n = 4); colpi length 29.2 μm (26.7–33.8, n = 7).

**4. Discussion**

The 255 species described from AFDP correspond to 197 genera and 72 families. Overall pollen morphology is composed of 13 types of apertures dominated by tricolporate (61%), inaperturate (5.8%), monocolporate (5.5%), and triporate (4.7%) (Figure 2). Sexine ornamentation constitutes 11 major types dominated by reticulate (66%), scabrate (11.3%), echinate (7.05%) and rugulate (4.3%) (Figure 3). Overall pollen size distribution is right-skewed for both equatorial and polar diameters (Figure 4). Equatorial diameter has a median of 29 μm (SD = 15.5), while polar diameter has a median of 32 μm (SD = 14.7). Most families have one or two aperture types, and only four (Myristicaceae, Euphorbiaceae, Mimosoideae, Rubiaceae) have three aperture types (Figure 5). Most families also have only one or two ornamentation types, although 10 families have three or more types (Arecaceae, Fabaceae, Mimosoideae, Annonaceae, Burseraceae, Clusiaceae, Euphorbiaceae, Sapindaceae, Melastomataceae, and Sapotaceae) (Figure 6).

Several species had morphologically variable pollen types. *Astrocaryum acaule*, *Bactris concinna* and *Hypospathe elegans* each had two pollen types that varied in the shape of the grains and colpi (Plates 1 and 2). *Chrysophyllum argenteum* also had two pollen types, which showed variation in the grain shape as well as in thickness of the nexine in the equatorial region and in the shape of the apex of the colpi (Plate 15). The two pollen types of *Chrysophyllum cainito* revealed variation in grain shape and size of colpi, in the thickness of the nexine and muri in the equatorial region, and in presence/absence of margo bypassing the colpi (Plate 15). *Roupala montana*, also with two pollen types, showed different shapes of grains and pores and variation in the size of the lumina of the reticulum (Plate 13).

In addition, several species have very similar pollen morphologies even though they are not related (e.g. *Abarema auriculata* and *Inga umbelifera*). Therefore, for this group of species we also add the descriptive category morphotype, which indicates how a palynologist might name the grain if the pollen were found free in the sediment or soils, or in the body of animals (in the case of *Abarema auriculata* and *Inga umbelifera* we used the morphotype Mimosaceae Type A) (Table 1). This descriptive term, we think, could be useful as all individuals within the AFDP plot are identified. For example, if dispersed pollen were found in the soil of the plot and were assigned to the morphotype Mimosaceae Type A, the distance to individual trees of *Abarema auriculata* and *Vernonanthura puberula* could be calculated, and therefore the probability of the grain being produced by either *Abarema* or *Vernonanthura* could be calculated.

The 255 species have been grouped into 236 morphotypes (see Supplementary material), underscoring that at the plot level, the morphological diversity of the pollen grains captures the plant diversity of the plot. There are about 40 species which under light microscopy are impossible to differentiate from each other (Table 1). Higher-resolution techniques [e.g. scanning electron microscopy (SEM) and con-focal microscopy] might reveal characters that would distinguish them from each other. That group of species includes *Piptocoma discolor* (Plate 2) and *Vernonanthura puberula* (Plate 2), both being spheroidal in shape, tricolporate, with inconspicuous endoaperture (pore) masked by sculpture, sexine tectate and with spines that are conical and sharp. *Dussia tesselmannii* (Plates 4 and 5) and *Hymenolobium nitidum* (Plate 5) both are subprolate in shape, tricolporate with pores circular, tectate with conspicuous columellae, and reticulate (lumina smaller than 1 μm). *Vatairea erythrocarpa* (Plate 6) and *Vataireopsis speciosa* (Plate 6) both have prolate and subprolate shape, are tricolporate with circular pores, have colpi with acute apex, are tectate with conspicuous columellae, and are reticulate (with lumina smaller than 1 μm). *Abarema auriculata* (Plates 7 and 8) and *Inga umbelifera* (Plates 8 and 9) both are polyads with 16 pollen grains and circular shape, and periporate with five pores (*I. umbelifera* can have up to nine pores). *Abarema barbouriana* (Plate 8) and *Inga nobilis*
contrast to the majority of families, which have only one or two types of ornamentation, 10 families have three, four or five types (Arecales, Fabaceae, Mimosoideae, Annonaceae, Burseraceae, Clusiaceae, Euphorbiaceae, Sapindaceae, Melastomataceae, and Sapotaceae). The pollen morphologies of the 255 species can be grouped into 236 morphotypes, indicating that pollen morphology captures a large amount of the plant diversity of the plot.

Acknowledgements

The authors acknowledge support from the ‘Conselho Nacional de Desenvolvimento Científico e Tecnológico’ (CNPq-Brasil) process: 232360/2014-6 conducted by the programme ‘Ciencia sem Fronteiras’ (CSF – Brasil), the Smithsonian Tropical Institute, SIGEO, the Anders Foundation, Gregory D. and Jennifer Walston Johnson, and the 1923 Fund. We thank Alvaro Duque and Dairon Cárdenas for providing the species list of the AFDP plot, and Alan Graham for building up the most complete palynological collection of Neotropical plants now housed at the Smithsonian.

Thanks to the herbariums COAH (SINCHI) and COL (Instituto Ciencias Naturales Universidad Nacional – Colombia) for access to their material.

Notes on contributors

DAIANA FONTES is a palynologist that worked at Center of Tropical Paleoecology and Archaeology (Smithsonian Tropical Research Institute) in the area of pollen morphology of Amazonian vegetation. She works in the fields of Paleontology and Palynology, with emphasis on Quaternary studies, descriptions of current pollen morphology and reconstructions of palaeoenvironments and paleoclimates.

CARLOS A. JARAMILLO is a staff scientist in the Smithsonian Tropical Research Institute in Panama. His research investigates the causes, patterns, and processes of tropical biodiversity at diverse scales in time and space. Carlos is also interested in Mesozoic and Cenozoic biostatigraphy of low latitudes, developing methods for high-resolution biostatigraphy and the palaeobiogeography of Tethys.

J. ENRIQUE MORENO is a palynologist at Center for Tropical Paleoecology and Archaeology (Smithsonian Tropical Research Institute) that investigates the fields of entomology (bees), Quaternary climatic changes, paleoecology of the Miocene (in Panama) and collaborates in the paleontological and archaeological studies of the Isthmus. He is co-author of the “Pollen and Spores of Barro Colorado Island” and “Amazon Pollen Manual and Atlas” books and of pioneering palynological compilations of tropical American pollen of international repercussion. He is currently involved in the project on the “dynamics of pollen dispersal in tropical forests”.

5. Conclusion

In this study we described pollen from 255 tree species belonging to 72 angiosperm families that occur in the 25-ha AFDP of Amacayacu National Natural Park in western Amazonia.

Most of the species are characterised by tricolporate (61%), inaperturate (5.8%), monocolporate (5.5%), or triporate (4.7%) apertures. Only four families (Myristicaceae, Euphorbiaceae, Mimosoideae, Rubiaceae) have three aperture types (monocolporate, inaperturate and tricolporate). There are four main patterns of grain ornamentation: reticulate (66%), scabrate (11.3%), echinate (7%) and rugulate (4.3%). In contrast to the majority of families, which have only one or two types of ornamentation, 10 families have three, four or five types (Arecales, Fabaceae, Mimosoideae, Annonaceae, Burseraceae, Clusiaceae, Euphorbiaceae, Sapindaceae, Melastomataceae, and Sapotaceae). The pollen morphologies of the 255 species can be grouped into 236 morphotypes, indicating that pollen morphology captures a large amount of the plant diversity of the plot.

ORCID

Daiana Fontes http://orcid.org/0000-0001-9726-8473
Carlos Jaramillo http://orcid.org/0000-0002-2616-5079
J. Enrique Moreno http://orcid.org/0000-0002-9767-7522

References

Anderson-Teixeira KJ, Davies SJ, Bennett AC, Gonzalez-Akre EB, Muller-Landau HC, Joseph Wright S, Abu Salim K, Almeida ZAM, Alonso A,


