Palynology of species in the Astereae and Heliantheae tribes occurring in the region of Campos Gerais, Paraná State, Brazil

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ABSTRACT – We analyzed the pollen morphology of twelve species belonging to five genera of the Asteraceae family; four species belonging to the Astereae tribe [Aster haplopappus (Remy) Kuntze, Baccharis axillaris DC, Baccharis semiserrata DC and Baccharis trimerus (Less.) DC.], and eight to the Heliantheae tribe [Aspilia monteviendas (Spreng) Kuntze, Bidens alba (L) DC, Bidens pilosa L, Calea cymosa Less, Calea hispida (DC) Baker, Calea parvifolia (DC) Baker and Calea pinnatifida (R. Br.) Less] occurring in the region of Campos Gerais, Paraná State, Brazil. We used acetolysis to carry out the palynological analysis and pollen grains were studied under light and scanning electron microscopy. The pollen grains of the two tribes had common morphological features such as 3-colpores, lalongate endoapertures, echinate exine type, a sexine of one stratum and with cavea, however, they differed regarding the structure size and appearance of the spine. The two tribes were considered stenopalynous.

Key words: grassland, palynotaxonomy, pollen grain, stenopalynous

INTRODUCTION

The Asteraceae family is the most numerous group within the Angiosperms, with about 23,000 species and 17 tribes. According to APG III (2009), the Asteraceae family is classified in the Asterideas clade and Asterales order. In Brazil, there are 14 tribes, and Heliantheae is in third position featuring 41 genera, while the Astereae tribe comprises 18 genera (Mondin, 2006).

Plants in the Asteraceae family vary greatly in appearance, mainly including herbs or shrubs, though rarely trees. The family has a cosmopolitan distribution and in Brazil, is common in open areas, mainly in the Cerrado and grasslands (Souza & Lorenzi, 2005).
The asterological flora of southern Brazil is considered dense, with high species diversity and better represented by the tribes Astereae, Inuleae, Heleneae, and Mutisieae with microthermal species, especially in cold temperate climate (Matzenbacher, 2003). The high density in this region may be attributed to the evolutionary history of the family being linked to the southern portion of South America, south of latitude 30° (Bremer & Gustafsson, 1997).

According to the Brazilian vegetation classification system (IBGE, 1992), the Campos Gerais region, in southern Brazil, is called a grassland ecosystem, also known as native fields (Leite & Klein, 1990). The Asteraceae family in the Campos Gerais region, Ponta Grossa, Paraná State is among the richest families in species and individuals. According to Kozera et al. (2008), a floristic survey of the grassland determined 49 taxa belonging to the Asteraceae family. Dalazoana (2010), on the other hand, identified 91 taxa in the same vegetation.

Some pollen grains of Asteraceae (Astereae and Heliantheae tribes) studied here were previously described by Cancelli (2008) and Cancelli et al. (2005, 2007, 2010) from specimens collected in the state of Rio Grande do Sul (Brazil) (including Aspilia monteviensis (Spreng.) Kuntze, Baccharis trimera (Less.) DC., Bidens alba (L.) DC., Bidens pilosa L., and Calea pinnatifida (R. Br.) Less.). The pollen grains of Bidens pilosa were also described by Ikuse (1956) for the flora of Japan, Huang (1972) for the flora of Taiwan, Galvão et al. (2009) in their study on medicinal plants of Ilha Grande in Rio de Janeiro (Brazil), Sanchez & Lupo (2009) in their study on Asteraceae for apiculture in Argentina, and Melhem et al. (1979) in their study on pollen morphology of allergogens Asteraceae of Brazil. Melhem et al. (2003) studied the pollen grains of Baccharis trimera and Calea pinnatifida of Campos do Jordão in São Paulo State, Brazil. Felippe & Salgado-Labouriau (1964) studied pollen of the Heliantheae tribe of the Cerrado and described Aspilia reflexa. Souza et al. (2008) studied the pollen grains of nine other species of Baccharis from southern Brazil, and Gonçalves (1977) studied other Aspilia species from Brazil.

The present study aims to characterize the pollen morphology of twelve species within the Asteraceae family, Astereae and Heliantheae tribes, occurring in the region of Campos Gerais, Paraná State, Brazil, contributing to palynological, ecological, and paleoecological studies.

**MATERIALS AND METHODS**

The plant material used was obtained from flower buds removed from mounted specimens in the herbarium of the Universidade Estadual de Ponta Grossa (HUPG), Paraná State. The species most representative of the Campos Gerais region were selected based on a list carried out by the HUPG herbarium and floristic survey of the region. For each species pollen was removed from at least three flower buds to standardize size variations (Salgado-Labouriau, 1973).

Pollen grains were acetolyzed following Erdtman (1952), with modifications proposed by Melhem et al. (2003) for light microscopy observation. Measurements were conducted using an OLYMPUS OSM micrometer drum coupled to the microscope eyepiece of an OLYMPUS BX 50. Mean pollen dimension were derived from measurements of 25 pollen grains per sample. Measurements of morphological structures were based upon ten pollen grains per sample. Subsequently, a statistical analysis was performed by calculating the arithmetic mean (x), standard deviation (s), sample standard deviation (s), coefficient of variation (CV), with the significance interval at 95 % and variation range.

To better define the ornamentation aspect of pollen grains, we measured the base width and spine height yielding indices that define classes which vary between species as in Coutinho & Dinis (2007) for Asteraceae species and Barth et al. (2005) for Cucurbitaceae species. An index below 1.03 was obtained for spines with a base width proportional to the height; an index equal to 1.11 for spines slightly longer than wide at the base, and from 1.16 to 1.22 for spines longer than wide at the base, i.e., long spines. We also characterized the apex/tip appearance (straight or curved) as well as the columella and cavities at the spine bases, mainly under scanning electron microscopy (SEM), differing in number and height between the species.

The terminology used for the palynological descriptions followed Barth & Melhem (1988) based on updates by Punt et al. (2007) and Punt & Hoen (2009) for the Asteraceae pollen grains. The species and their respective authors were consulted on the botanical site (Tropicos®) of the Missouri Botanical Garden.
The acetolysed pollen grains prepared for light microscopy were digitally photographed with the photomicroscope LEICA DM 2500 coupled to a video camera and a computer using the LAS EZ 1.6.0. software. For the analysis under scanning electronic microscopy, non-acetolysed pollen grains were spread on the surface of double-sided carbon tape wrapped on aluminum brackets (“stubs”), properly numbered. The samples were transferred to a vacuum pump and coated with a thin layer of gold palladium (ca. 150 angstroms thick) and were subsequently analyzed under Shimadzu SSX-550 model belonging to the Laboratory of Scanning Electron Microscopy, Department of Material Engineering at the Universidade Estadual de Ponta Grossa.

RESULTS

Following are the pollen morphology descriptions of the twelve tribes of two grassland species of Asteraceae occurring in the Campos Gerais, Paraná State, Brazil. The general palynological characteristics that each tribe shares are presented under the tribe name. They were omitted from specific descriptions to avoid duplication of information.

The general morphological characterization and measurements of pollen grains of the species are shown in Tables 1-3.

Astereae tribe
(Figs. 1-12)

Pollen grains of small size, isopolar, radial symmetry, oblate spheroidal or prolate spheroidal, amb subcircular, 3-zonocolporate, echinate. 

Aperture: longiaperturate colpi, broad colpi at the equator or very narrow colpi, colpi with acute ends or obtuse ends, no central constriction. Endoaperture lalongate, regular type (convex sides, straight and identical ends), with acute ends, with or without central constriction.

Exine: two distinct layers (sexine and nexine) with cavea (indistinct or well delimited). Simplicolumellate exine with sexine 1 (columellae), sexine 2 (tectum) and sexine 3 (spines, sculpture elements). The structure of the spines is of columellar and tegillum type, meaning they have a perforation at the base. The spinular columellae are longer than the inter-spinular columellae. Spines are slightly longer than wide at the base or as long as wide at the base, conical or dome shaped (swollen at the base) and usually with acute and straight spine apex. Basis of echinae distinctly filled with at least 4 columellae. Sexine thicker than the nexine.

Aster Linnaeus
Aster haplopopappus (Remy) Kuntze (Figs. 1-3)
Prolate spheroidal pollen grains. 

Aperture: narrow colpi with acute ends, endoaperture without central constriction.

Exine: well-delimited cavea, spines as long as wide at the base (index 0,94), spines dome shaped. Around eighteen spines in polar view. Both sexines 1 and 2 are thicker than the nexine.

Baccharis Linnaeus
Baccharis axillaris DC. (Figs. 4-6)
Oblate spheroidal pollen grains. 

Aperture: very narrow colpi with obtuse ends, endoaperture with central constriction.

Exine: well-delimited cavea, spines slightly longer than wide at the base (index 1,11), spines conical shaped. Around twelve spines in polar view. Both sexines 1 and 2 are twice as thick as the nexine.

Baccharis semisserrata DC. (Figs. 7-9)
Oblate spheroidal pollen grains.

Aperture: narrow colpi with acute ends, endoaperture with central constriction.

Exine: well-delimited cavea, spines as long as wide at the base (index 0,97), spines conical shaped. Around twelve spines in polar view. Both sexines 1 and 2 are twice as thick as the nexine.

Baccharis trimera (Less.) DC. (Figs.10-12)
Prolate spheroidal pollen grains.

Aperture: broad colpi at the equator with acute ends, endoaperture with central constriction.

Exine: indistinct cavea, spines as long as wide at the base (index 1,03), spines conical shaped. Around twelve spines in polar view. Sexines 1 and 2 are thicker than the nexine.

Heliantheae tribe
(Figs. 13-15)

Pollen grains of small to medium size, isopolar, radial symmetry, oblate spheroidal or prolate spheroidal, amb subcircular, amb subtriangular or with square amb, 3-4-zonocolporate, echinate. 

Aperture: medium size to longiaperturate colpi, broad colpi at the equator, slightly sunken colpi or very narrow colpi, colpi with acute or obtuse ends, central constriction. Endoaperture lalongate, presenting two forms: regular type (convex sides, straight and identical ends) or sigmoid type (double curved in opposite directions like an S), with acute ends, with or without central constriction.

Exine: two distinct layers (sexine and nexine) with cavea (indistinct or well-delimited). Simplicolumellate exine with sexine 1 (columellae), sexine 2 (tectum) and sexine 3 (spines, sculpture elements). The structure of the spines is columellar and tegillum type, meaning they have a perforation at the base. The spinular columellae are longer than the inter-spinular columellae. Spines slightly longer than wide at the base or as long as wide at the base, conical shaped, slightly dome shaped (swollen at the base), with acute and straight spine apex or with curved spine apex. Basis of echinae distinctly filled with at least 4 columellae. The sexine is thicker than the nexine or it is the same thickness of the nexine.

**Aspilia** Thouars

**Aspilia montevidensis** (Spreng.) Kuntze

(Figs. 13-15)

Pollen grains of small size, oblate spheroidal, amb subcircular.

**Aperture:** 3-colporate, longiaperturate, very narrow colpi, with acute ends. Endoaperture of regular type, with or without central constriction.

**Exine:** indistinct cavea, spines longer than wide at the base (index 1.16), spines conical shaped, with acute and straight apex or with curved apex. Around fifteen spines in polar view. Sexines 1 and 2 are twice as thick as the nexine.

**Aspilia reflexa** Baker

(Figs. 16-18)

Pollen grains of medium size, oblate spheroidal, amb subcircular.

**Aperture:** 3-colporate, longiaperturate, broad colpi at the equator, with acute ends. Endoaperture of regular type, with central constriction.

**Exine:** indistinct cavea, spines longer than wide at the base (index 1.22), spines slightly dome shaped, with acute and straight apex or with curved apex. Around fifteen spines in polar view. Sexines 1 and 2 are thicker than the nexine.

**Bidens** Linnaeus

**Bidens alba** (L.) DC.

(Figs. 19-21)

Pollen grains of small size, prolate spheroidal, amb subcircular.

**Aperture:** 3-colporate, longiaperturate, very narrow colpi, with obtuse ends. Endoaperture of regular type (40 %) or sigmoid type (60 %), with central constriction (50 %) or without central constriction (50 %).

**Exine:** well delimited cavea, spines longer than wide at the base (index 0.96), spines conical shaped, with acute and straight apex. Around fifteen spines in polar view. Sexines 1 and 2 are as thick as the nexine.

**Bidens pilosa** L.

(Figs. 22-24)

Pollen grains of small size, prolate spheroidal, square amb or rarely amb subtriangular.

**Aperture:** 3-4 colporate (90 % of 4-colporate), longiaperturate, very narrow colpi, with acute ends. Endoaperture of sigmoid type, with central constriction (50 %) or without central constriction (50 %).

**Exine:** well-delimited cavea, spines longer than wide at the base (index 0.97), spines conical shaped, with acute and straight apex or with curved spine apex. Around eighteen spines in polar view. Sexines 1 and 2 are as thick as the nexine.

**Calea** Linnaeus

**Calea cymosa** Less

(Figs. 25-27)

Pollen grains of medium size, oblate spheroidal, amb subcircular.

**Aperture:** 3-colporate, medium size aperture, slightly sunken colpi, with acute ends. Endoaperture of regular type (80 %) or sigmoid type (20 %), with central constriction (90 %) or without central constriction (10 %).

**Exine:** indistinct cavea, spines longer than wide at the base (index 0.98), spines dome shaped, with acute and straight apex. Around twelve spines in polar view. Sexines 1 and 2 are thicker than the nexine.

**Calea hispida** (DC) Baker

(Figs. 28-30)

Pollen grains of small size, prolate spheroidal, amb subcircular.

**Aperture:** 3-colporate, medium size aperture, slightly sunken colpi, with acute ends. Endoaperture of regular type (50 %) or sigmoid type (50 %), with central constriction (40 %) or without central constriction (60 %).

**Exine:** indistinct cavea, spines longer than wide at the base (index 1.01), spines conical shaped, with acute and straight apex. Around twelve spines in polar view. Sexines 1 and 2 are slightly thicker than nexine.

**Calea parvifolia** (DC) Baker

(Figs. 31-33)

Pollen grains of small to medium size, prolate spheroidal, amb subcircular.

**Aperture:** 3-colporate, medium size aperture, slightly sunken colpi, with acute ends. Endoaperture of regular type (50 %) or sigmoid type (50 %), with central constriction (40 %) or without central constriction (60 %).

**Exine:** indistinct cavea, spines longer than wide at the base (index 1.01), spines conical shaped, with acute and straight apex. Around twelve spines in polar view. Sexines 1 and 2 are slightly thicker than nexine.

**Calea parvifolia** (DC) Baker

(Figs. 31-33)

Pollen grains of small to medium size, prolate spheroidal, amb subcircular.
**Exine**: well-delimited cavea, spines longer than wide at the base (index 0.94), spines dome shaped, with acute and straight apex. Around twelve spines in polar view. Sexines 1 and 2 are thicker than the nexine.

**Calea pinnatifida** (R. Br.) Less.  
(Figs. 34-36)  
Pollen grains of small size, oblate spheroidal, amb subcircular.

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**Figs. 13-24.** Pollen grains of *Asteraceae*, tribe Heliantheae.  

Aperture: 3-colporate, medium size aperture, slightly sunken colpi, with acute ends. Endoaperture of regular type, with central constriction (30%) or without central constriction (70%).

Exine: indistinct cavea, spines longer than wide at the base (index 0.94), spines slightly dome shaped, with acute and straight apex. Around fifteen spines in polar view. Sexines 1 and 2 are thicker than the nexine.

Table 1. General morphological characterization of pollen grains of the Asteraceae family in the Astereae and Heliantheae tribes occurring in the region of Campos Gerais, Paraná state, Brazil.

<table>
<thead>
<tr>
<th>Species</th>
<th>Pollen size</th>
<th>Aperture</th>
<th>Colpus</th>
<th>Endoaperture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aster haplopappus</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, narrow</td>
<td>regular type</td>
</tr>
<tr>
<td>Baccharis axillaris</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, very narrow</td>
<td>regular type</td>
</tr>
<tr>
<td>Baccharis semiserrata</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, narrow</td>
<td>regular type</td>
</tr>
<tr>
<td>Baccharis trimera</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, broad</td>
<td>regular type</td>
</tr>
<tr>
<td>Aspilia montevidensis</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, very narrow</td>
<td>regular type</td>
</tr>
<tr>
<td>Aspilia reflexa</td>
<td>medium</td>
<td>3-zonocolporate</td>
<td>long size, broad</td>
<td>regular type</td>
</tr>
<tr>
<td>Bidens alba</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>long size, very narrow</td>
<td>regular/sigmoid types</td>
</tr>
<tr>
<td>Bidens pilosa</td>
<td>small</td>
<td>(3)4-zonocolporate</td>
<td>long size, very narrow</td>
<td>sigmoid type</td>
</tr>
<tr>
<td>Calea cymosa</td>
<td>medium</td>
<td>3-zonocolporate</td>
<td>medium size, narrow</td>
<td>regular/sigmoid types</td>
</tr>
<tr>
<td>Calea hispida</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>medium size, narrow</td>
<td>regular/sigmoid types</td>
</tr>
<tr>
<td>Calea parvifolia</td>
<td>small-medium</td>
<td>3-zonocolporate</td>
<td>medium size, narrow</td>
<td>regular type</td>
</tr>
<tr>
<td>Calea pinnatifida</td>
<td>small</td>
<td>3-zonocolporate</td>
<td>medium size, narrow</td>
<td>regular type</td>
</tr>
</tbody>
</table>

Table 2. Measurements (μm) in equatorial view of the diameters (n=25) and arithmetic means of measurements of apertures (n=10) of pollen grains of the Asteraceae family in the Astereae and Heliantheae tribes occurring in the region of Campos Gerais, Paraná State, Brazil. P – Polar axis; E – Equatorial axis; x – arithmetic mean; s – sample standard deviation; sx – mean standard deviation; CI- confidence interval 95%; L - length; W – width.

<table>
<thead>
<tr>
<th>Species</th>
<th>P</th>
<th>E</th>
<th>P/E</th>
<th>Shape</th>
<th>Colpus</th>
<th>Endoaperture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>x±s</td>
<td>CI 95%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspilia montevidensis</td>
<td>1.3</td>
<td>23.4±0.3</td>
<td>22.9-24.0</td>
<td>1.5</td>
<td>24.1±0.3</td>
<td>23.5-24.8</td>
</tr>
<tr>
<td>Aspilia reflexa</td>
<td>1.9</td>
<td>27.8±0.4</td>
<td>27.0-28.5</td>
<td>1.9</td>
<td>28.9±0.4</td>
<td>28.1-29.7</td>
</tr>
<tr>
<td>Aster haplopappus</td>
<td>1.2</td>
<td>14.6±0.2</td>
<td>14.2-15.0</td>
<td>2.5</td>
<td>14.3±0.4</td>
<td>13.5-15.2</td>
</tr>
<tr>
<td>Baccharis axillaris</td>
<td>1.3</td>
<td>17.0±0.4</td>
<td>16.5-17.5</td>
<td>1.2</td>
<td>18.2±0.2</td>
<td>17.7-18.7</td>
</tr>
<tr>
<td>Baccharis semiserrata</td>
<td>1.6</td>
<td>17.6±0.3</td>
<td>17.0-18.3</td>
<td>1.8</td>
<td>18.6±0.4</td>
<td>17.8-19.3</td>
</tr>
<tr>
<td>Baccharis trimera</td>
<td>1.0</td>
<td>15.6±0.2</td>
<td>15.2-16.0</td>
<td>1.0</td>
<td>15.2±0.2</td>
<td>14.8-15.6</td>
</tr>
<tr>
<td>Bidens alba</td>
<td>1.5</td>
<td>21.4±0.3</td>
<td>20.7-22.0</td>
<td>1.4</td>
<td>21.2±0.3</td>
<td>20.6-21.8</td>
</tr>
<tr>
<td>Bidens pilosa</td>
<td>8.3</td>
<td>22.6±1.7</td>
<td>19.9-26.0</td>
<td>1.9</td>
<td>24.2±0.4</td>
<td>23.4-25.0</td>
</tr>
<tr>
<td>Calea cymosa</td>
<td>1.2</td>
<td>26.3±0.2</td>
<td>25.8-26.8</td>
<td>2.2</td>
<td>28.3±0.4</td>
<td>27.4-29.2</td>
</tr>
<tr>
<td>Calea hispida</td>
<td>1.6</td>
<td>24.5±0.3</td>
<td>23.4-24.7</td>
<td>1.6</td>
<td>23.8±0.3</td>
<td>23.2-24.5</td>
</tr>
<tr>
<td>Calea parvifolia</td>
<td>1.5</td>
<td>24.6±0.3</td>
<td>23.8-27.0</td>
<td>1.4</td>
<td>25.5±0.3</td>
<td>24.9-26.0</td>
</tr>
<tr>
<td>Calea pinnatifida</td>
<td>1.0</td>
<td>21.8±0.2</td>
<td>21.4-22.2</td>
<td>1.5</td>
<td>22.9±0.3</td>
<td>22.2-23.5</td>
</tr>
</tbody>
</table>
DISCUSSION

Several authors have reported that the exine structure of *Asteraceae* is valuable for understanding the evolution, systematics, and ecology of this group. In the Heliantheae tribe, the pollen grains show a structural pattern called a Heliantoide (Skvarla & Larson, 1965a, 1965b; Skvarla & Turner, 1966, 1969; Skvarla et al., 1977). This pattern is also found in the Astereae tribe, as well as in others, and is characterized by a cavea and internal foramina (perforation) in the sexine. The cavea presence and a simple sexine (i.e., composed of only one extract of columellae) are synapomorphies of the Asteroidae subfamily to which Astereae and Heliantheae tribes belong (Bolick, 1991; Cancelli et al., 2010). However, the cavea is part of the harmomegathic system and therefore, largely varying, dependent on the imbibition of liquid (Blackmore et al., 1984), which prevents separation of the species into pollen types based only on its thickness.

As for the material presented here, the species *Aster haplopappus* had not yet been palynologically studied. Barth (1989) referred to pollen of the *Aster* genus as a similar type to Compositae S (*Senecio* (Stix, 1960)), which was corroborated by Cancelli (2008) for *A. squamatus* Hieron of Rio Grande do Sul State, Brazil. The morphological diagnosis presented here showed its correspondence to the *Senecio* pollen type.

The three species of *Baccharis* Linnaeus (*B. axillaris,* *B. semiserrata* and *B. trimera*) analyzed here had very similar pollen grains, differing only in shape, aperture dimensions, endoapertures, and exine thickness. We classified them to the *Baccharis* pollen type (Stix, 1960) according to the pollen morphology diagnosis of these species, which had already been attributed to other *Baccharis* species in southern Brazil by Souza et al. (2008) and to *B. trimera* by Cancelli (2008) and Cancelli et al. (2005). The Compositae B pollen type presented by Barth (1989) for *Baccharis* pollen grains found in Brazilian honeys does not fit any of our species, because the author described it as not showing cavea and circular endoaperture. The description of *B. trimera* pollen presented by Melhem et al. (2003), however, was similar to our material.

The two species of *Aspilia* treated in this study have been palynologically studied by Felippe & Salgado-Labouriau (1964), who studied *A. reflexa* of the Cerrado, and by Cancelli (2008) and Cancelli et al. (2005, 2010), who studied *A. montevidensis* in southern Brazil. The descriptions given by these authors were similar to ours, differing only in structure dimensions.

Gonçalves (1977) studied other *Aspilia* species from Brazil classifying most species as *Helianthus* type (Stix, 1960), however separating two species by the presence of a hollow tegillum and double layer of infratectum columellae, different features of *Helianthus* pollen types. The two species studied here differ among them in pollen grain size, colporus width, and the presence or absence of endoaperture constriction, but both fit the *Helianthus* pollen type (Stix, 1960), which has already been highlighted by Felippe & Salgado-Labouriau (1964), Cancelli (2008), and Cancelli et al. (2010).

The *Bidens* species (*B. alba* and *B. pilosa*) analyzed here differ in the number of apertures, spine apex type, spine number in polar view, and endoaperture types. *B. pilosa* was palynologically analyzed...
The great morphopalynological similarity allowed characterizing the species of the Astereae and Heliantheae tribes in the region of Campos Gerais, Paraná State, as stenopalynous. However, details of pollen morphology allowed separating species into three groups of related pollen types Baccharis, Helianthus, and Senecio, previously defined in literature.

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