Pollen morphology of Vochysiaceae tree species in the State of Santa Catarina, Southern Brazil

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Abstract: Tropical Vochysiaceae includes mainly trees, and also shrubs and subshrubs. Three genera and seven species are present in the Brazilian state of Santa Catarina. The pollen morphology of six species of trees, belonging to three genera of the Vochysiaceae A. St-Hil. family, was studied. Herbaria samples were obtained, processed and treated by standard methods. The pollen grain morphology of *Callisthene*, *Qualea* and *Vochysia* is distinct. Medium sized pollen grains occur in *Vochysia* species, and small ones in *Callisthene* and *Qualea*. Specific characteristics were considered at species level [*C. castellanosii* H. F. Martins, *C. kuhlmannii* H. F.Martins, *Qualea cordata* Spreng var. *cordata*, *Q. cryptantha* (Spreng) Warm. var. *cryptantha*, *Vochysia magnifica* Warm. and *V. tucanorum* Mart.]. The presence of a fastigium (vestibulum) and a thin space devoid of nexine fixing the boundary of the apertural area is characteristic of *Qualea* and *Vochysia* species only. Rev. Biol. Trop. 62 (3): 1209-1215. Epub 2014 September 01.

Key words: pollen grains, morphology, *Callisthene, Qualea, Vochysia.*

The family of Vochysiaceae includes mainly trees, and also shrubs and subshrubs, being mainly tropical. It presents six genera and about 200 species. In the state of Santa Catarina three genera and seven species are present. The two species of *Callisthene* Mart. and *Vochysia bifalcata* Warm. are preferentially found in lowland areas near the coast, while the species of *Qualea* Aubl., *Vochysia magnifica* Warm. and *V. tucanorum* Mart. are found in higher regions above 500m (Vianna & Martins, 2001).

Trees of *Callisthene* and *Qualea* have very restricted distribution in the State of Santa Catarina, as well as *Vochysia magnifica* and *V. bifalcata*. According to Vianna and Martins (2001), excicata of *V. tucanorum* have not yet been collected in the state of Santa Catarina, but occur throughout the neighboring state of Paraná.

The species of the lowlands are part of the Rain Forest in the Atlantic hill side, and can occur up to an altitude of 400m, while in higher regions, up to 1 500m, they reach the "Matinha Nebular" (fog forest), and *Q. cryptantha* (Spreng.) Warm. may go down to 250m.

The pollen grain morphology of 20 Brazilian species of the genus *Vochysia* Aubl. was described by Vianna, Mendonça, Franklin, Pereira, and Gonçalves-Esteves (2002), including excicata occurring from Paraíba to Paraná States. Previously, Watanabe (1995) examined two species of *Qualea* from the "Reserva do Parque Estadual das Fontes do Ipiranga", São Paulo. The other species from Southern Brazil were considered in the present paper.

MATERIAL AND METHODS

The list of species presented in the present paper was taken from Vianna and Martins (2001). The pollen material was obtained from herbarium specimens deposited in the

Herbarium Alberto Castellanos of the State Environmental SEAPLI (GUA), Rio de Janeiro, consisting of the following species: *Callisthene castellanosii* H.F. Martins - Brasil. São Paulo: Votorantin, H.F. Martins 562 (GUA 20828). *Callisthene kuhlmannii* H.F. Martins – Brasil. Santa Catarina: Mina Velha, Guaruva, São Francisco do Sul, Reitz & Klein 5610 (GUA 10643). *Qualea cordata* Spreng var. *cordata* – Brasil. Minas Gerais: Mendanha, Couto Magalhaes, G. Hatschbach 49820 (GUA 31032). *Qualea cryptantha* (Spreng) Warm. var. *cryptantha* – Brasil. Santa Catarina: Morro da Fazenda, Itajaí, R.M. Klein 1035 (GUA 10637). *Vochysia magnifica* Warm. – Brasil. Santa Catarina: Doutor Benedito, Benedito Novo, R. Reitz 7958 (GUA 46315). *Vochysia tucanorum* Mart. – Brasil. Paraná: São Jerônimo da Serra, Reitz & Klein 12045 (GUA 10632).

Vochysia bifalcata Warm occurs in the state of Santa Catarina also. The pollen grain morphology of the specimen available (Brazil. Paraná: Paranaguá, G. Hatschbach 6627, GUA 10649) was formerly described and illustrated in Vianna et al. (2002).

Pollen material of the previously cited species was submitted to acetolysis (Erdtman 1952, 1960) and embedded in glycerin jelly. Light micrographs (LM) were obtained using a Zeiss Axiophot microscope coupled to a digital AxioCam camera, and were digitally processed in the AxioVision 4.6.3 Zeiss program. Measurements were performed using n=25 for the polar and equatorial diameters, and n=10 for sexine and nexine measured at the mesocolpium. The terminology used follows Barth and Melhem (1988) and Punt, Hoen, Blackmore, Nilsson, and Le Thomas (2007).

RESULTS

The descriptions of the pollen morphology of six tree species occurring in the state of Santa Catarina, Brazil are presented. Morphometric data of pollen grains, comprising the polar and equatorial axis and the exine layer thickness, are shown in table 1.

Callisthene castellanosii

Fig. 1, Fig. 2, Fig. 3, Fig. 4 and Fig. 5

Pollen grains small, isopolar, spheroidal, ambitus subtriangular, 3-colporate, longicolpate, psilate, sexine of variable thickness, nexine thin.

The colpi are narrow and invaginate, however prominent over the endoapertures. These are narrow and lalongate, slightly evident and covered with small granules. The sexine is thicker in the mesocolpi area, presenting a tectum. Columella are indistinct.

Callisthene kuhlmannii

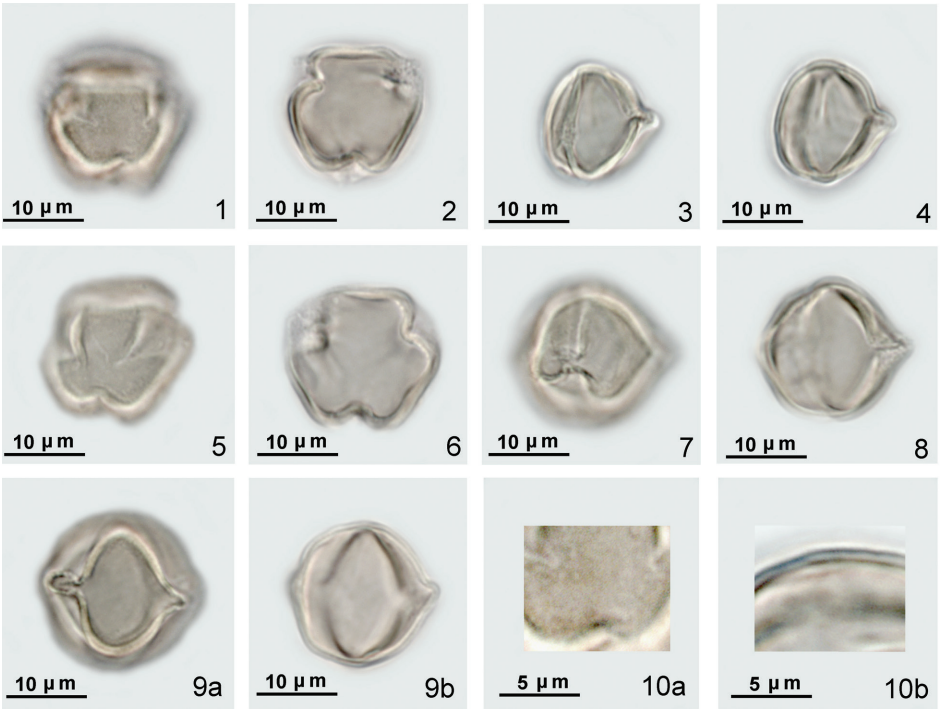
Fig. 6, Fig. 7, Fig. 8, Fig. 9 and Fig. 10

Pollen grains small, isopolar, oblate spheroidal, ambitus subtriangular, 3-colporate,

TABLE 1
Morphometric data of pollen grains (µm). Arithmetric average and standard deviation are presented in P and E. Amplitude is presented between parentheses

Species	P	E	P/E	S	N
Callisthene castellanosii	13.6±0.2 (12.4 – 16.0)	13.6±0.2 (11.0 – 15.8)	1.00	0.8	0.5
Callisthene kuhlmannii	15.0±0.1 (14.0 – 16.4)	16.7±0,1 (15.8 – 18.2)	0.90	0.9	0.5
Qualea cordata	17.2±0.2 (15.6 – 20.0)	19.7±0.2 (17.6 – 21.6)	0.87	1.7	0.6
Qualea crypytantha	19.5±0.1 (17.2 – 22.4)	22.4±0.1 (20.8 – 24.4)	0.87	1.1	0.5
Vochysia magnifica	40.4±0.2 (36.8 – 44.2)	40.7±0.2 (35.9 – 46.0)	0.99	1.8	0.6
Vochysia tucanorum	36.1±0.2 (32.7 – 43.7)	38.2±0.2 (35.4 – 41.4)	0.95	1.9	0.6

E=equatorial axis (equatorial view), **P**=polar axis (equatorial view), **P/E**=ratio between polar axis and equatorial axis, **S**=thickness of sexine, **N**=thickness of nexine.



Figs. 1-10. Pollen grains of species of *Callysthene*. 1-5. *Callysthene castellanosii* H.F. Martins. 1-3. Polar view. 1. Surface. 2. Optical section. 3. Granulations over the endoaperture (arrow). 4-5. Equatorial view. 4. Colpus and granulations over the endoaperture (arrow). 5. Optical section. 6-10. *Callysthene kuhlmannii* H.F. Martins. 6-7. Polar view. 6. Surface. 7. Optical section. 8-10. Equatorial view. 8. Granulations over the endoaperture (arrow). 9. Optical section. 10. Mesocolpium, optical section (tectum psilate, columellae indistinct). Figures 1-9: bar = 10µm. Figure 10: bar = 5µm.

longicolpate, psilate, sexine of variable thickness, nexine thin.

The colpi are narrow and invaginate, however prominent over the endoapertures. These are narrow and lalongate, slightly evident and covered with small granules. The sexine is thicker in the mesocolpi area, presenting a tectum. Columella are indistinct.

Qualea cordata var. ***cordata***

Fig. 11, Fig. 12, Fig. 13, Fig. 14, Fig. 15 and Fig. 16

Pollen grains small, isopolar, suboblate to oblate spheroidal, ambitus subtriangular, 3-colporate, longicolpate, surface finely ornamentated, sexine with about three times the thickness of the nexine.

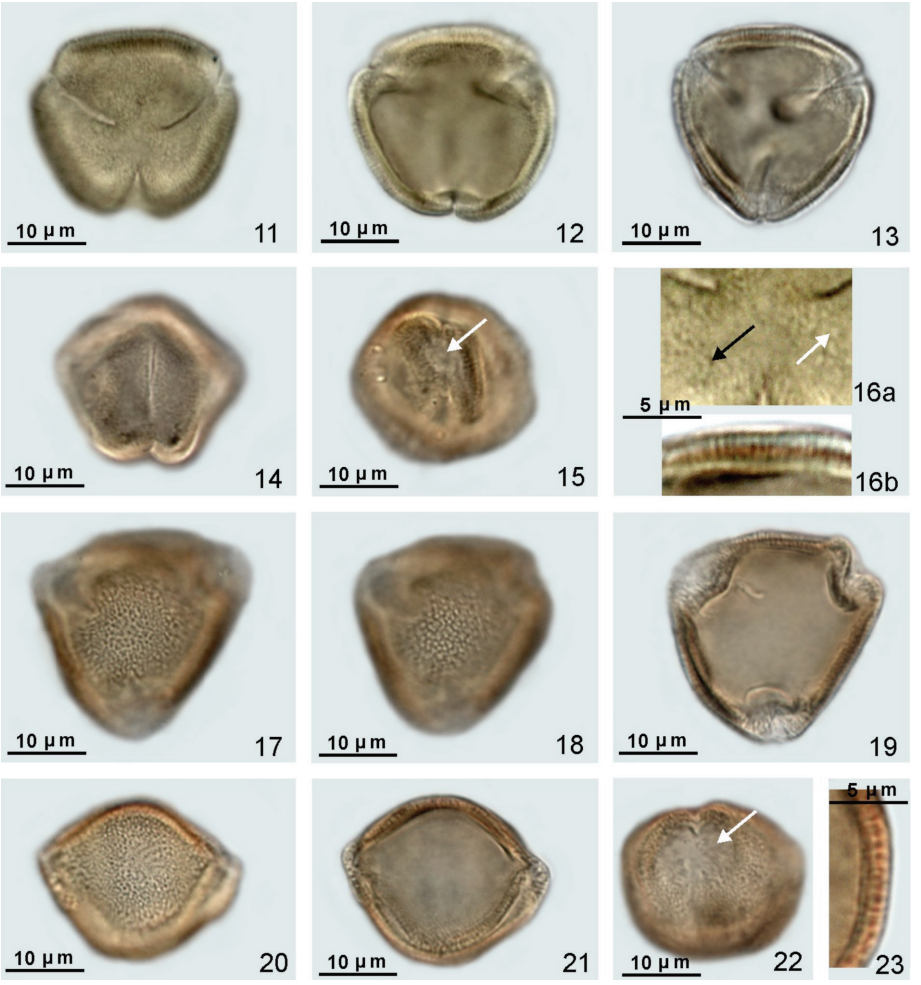
The colpi are narrow and invaginate, however prominent over the endoapertures and with smooth margins. The endoapertures are lalongate, large, variable-sized. There is a small fastigium. The tectum of the sexine is slightly thicker than the nexine, perforate and present small protrusions of columellae over the tectum, giving an ornate surface appearance.

Qualea cryptantha var. ***cryptantha***

Fig. 17, Fig. 18, Fig. 19, Fig. 20, Fig. 21, Fig. 22 and Fig. 23

Pollen grains small, isopolar, suboblate to oblate spheroidal, ambitus triangular with rounded corners, 3-colporate, surface microreticulate, sexine about twice the thickness of the nexine.

The colpi are short and not invaginate. The endoapertures are lalongate, large, variable-sized. There is a fastigium. The tectum of the sexine is as thick as the nexine. The



Figs. 11-23. Pollen grains of species of *Qualea*. 11-16. *Qualea cordata* Spreng var. *cordata*. 11-13. Polar view. 11-12. Pollen grain of circular ambitus. 11. Apocolpium, surface. 12. Optical section. 13. Pollen grain of subtriangular ambitus, optical sextion. 14-15. Approximately equatorial view. 14. Surface and part of a colpus. 15. Endoaperture (arrow). 16. Structural details. 16a. Surface of an apocolpium presenting perforations (black arrow) and granulations (top of the columellae, white arrow). 16b. Optical section showing the nexine, several columellae and the tectum. 17-23. *Qualea cryptantha* (Spreng) Warm. var. *cryptantha*. 17-19. Polar view. 17. Surface, high focus. 18. Surface, low focus. 19. Optical section. 20-22. Equatorial view. 20. Mesocolpium, surface. 21. Mesocolpium, optical section. 22. Endoaperture (arrow). 23. Optical section showing the nexine, several columellae and the tectum. Figures 11-15 and 17-22: bar = 10µm. Figures 16 and 23: bar = 5µm.

perforations in the tectum look like a micro-reticulate surface.

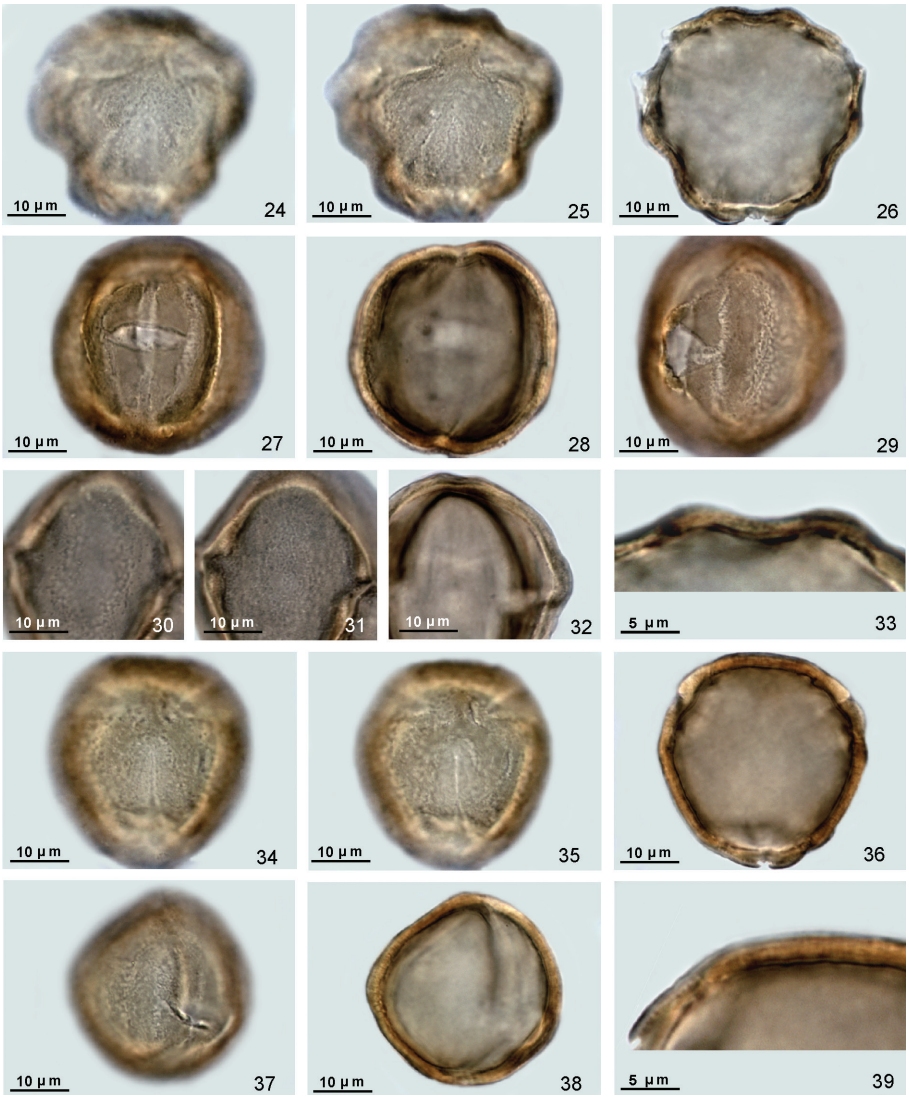
Vochysia bifalcata

The description and illustration of pollen morphology of the specimen was presented in Vianna et al. (2002). In summary: pollen grains medium sized, isopolar, oblate spheroidal, longicolpate, margins psilate, ambitus triangular, presenting conspicuous rugulae and perforations on the mesocolpium surfaces, apocolpium psilate with perforations. P = 38.7 (40.4) 42.5µm; E = 41.2 (43.5) 46.2µm; sexine = 0.9µm, nexine = 1.1µm.

Vochysia magnifica

Fig. 24, Fig. 25, Fig. 25, Fig. 26, Fig. 27, Fig. 28, Fig. 29, Fig. 30, Fig. 31, Fig. 32 and Fig. 33

Pollen grains of medium size, isopolar, spheroidal to oblate spheroidal, ambitus undulating, 3-colporate, 3-pseudocolpate, longicolpate, surface irregularly microreticulate



Figs. 24-39. Pollen grains of species of *Vochysia*. 24-33. *Vochysia magnifica* Warm. 24-26. Polar view. 24. Surface, high focus. 25. Surface, low focus. 26. Optical section. 27-32. Equatorial view. 27. Surface, apocolpium, colpus, endoaperture and striae (absence of nexine) limiting a great apertural area. 28. Optical section. 29. Mesocolpium with pseudocolpus (arrow) and part of an apertural area at the left side. 30. Mesolcolpium, surface, high focus. 31. Mesocolpium, surface, low focus. 32. Optical section of an apocolpium and apertural area. 33. Optical section, pseudocolpus. 34-39. *Vochysia tucanorum* Mart. 34-36. Polar view. 34. Surface, high focus. 35. Surface, low focus. 36. Optical section. 37-38. Equatorial view. 37. Colpus, endoaperture, surface of one side of the apertural area showing stria (absence of nexine) (arrow). 38. Optical section. 39. Optical section of a mesocolpium and part of an apertural area at the left side. Figures 24-32 and 34-38: bar = 10µm. Figures 33 and 39: bar = 5µm.

or foveolate, sexine thickness variable and a thin nexine.

Size and shape of pollen grains are quite variable, since nexine offers little rigidity leading to wrinkling of the pollen grains. The colpi are not invaginate and are partially covered by sexine, except over the endoapertures. These are lalongate with pointed ends and well defined. The apertural area is highlighted by narrow longitudinal lines (tracks) parallel to the colpi, and defined by the absence of nexine. There is a wide-ranging fastigium. The sexine of pseudocolpi is less thick than of mesocolpia, presenting a granular ornamentation

Vochysia tucanorum

Fig. 34, Fig. 35, Fig. 36, Fig. 37, Fig. 38 and Fig. 39

Pollen grains of medium size, isopolar, oblate spheroidal to spheroidal, ambitus subcircular, 3-colporate, longicolpate, surface irregularly microreticulate or foveolate, sexine with about three times the thickness of the nexine.

Size and shape of pollen grains are quite variable, since nexine offers little rigidity leading to wrinkling of the pollen grains. The colpi are narrow and not invaginate. The endoapertures are narrow and lalongate. There is evidence of the formation of an apertural area bounded by tracks of lack of nexine in some parts of the pollen grains, as well as pseudocolpi, though not always observable. There is a small fastigium.

DISCUSSION

Each one of the three genera of Vochysiaceae (*Callisthene*, *Qualea*, *Vochysia*) examined in the present paper showed a distinct pollen morphology.

The pollen grains of the two species of *Callisthene* examined are very similar, with no morphological distinct features, conferring with the description of *C. fasciculata* (Salgado-Labouriau, 1973). All of them showed small sized pollen grains, subtriangular, with invaginated colpi and protruding over the endoapertures, psilate ornamentation, thus characterizing the pollen type *Callisthene*.

Significant variation of pollen grain morphology was observed in *Qualea*. Ambitus subcircular to circular, invaginated long colpi, and a very delicate ornamentation characterize *Q. cordata*. The most striking feature of the pollen grains of the *Q. cryptantha* sample studied was well defined microreticulate ornamentation. Erdtman (1952) and Carreira (1976) examined respectively pollen grains of *Q. pilosa* and *Q. retusa*, establishing the *Qualea* pollen type, characterized by the presence of a small fastigium in the equatorial part of the apertures and large, lalongate and hardly defined endoapertures, which was corroborated here. The largest variation of the morphological characteristics was found in the genus *Vochysia*.

The strongest variation in pollen grain morphology was observed in *Vochysia magnifica*, presenting distinct pseudocolpi and large apertural areas with significant demarcation of their boundaries through the tracks devoid of nexine. In *V. bifalcata* (Vianna et al., 2002) and *V. tucanorum* these features were more attenuated. The detailed study of 20 species of *Vochysia*, richly illustrated and including a literature review (Vianna et al., 2002), reflects the variability of pollen morphology within this genus.

The pollen grains of the genus *Qualea*, corresponding to the two species described in this paper, present a morphological approach to the genus *Callisthene*, on another side to the genus *Vochysia*. The similarities with *Callisthene* comprise the small, narrow and invaginate colpi and surfaces tending to be psilate in *Q. cordata*. They approach to *Vochysia* while presenting a fastigium, distinct perforations in the tectum, and small prominences of columella mainly in *Q. cordata*

Erdtman (1952) studied the pollen morphology of some Brazilian species of three genera of Vochysiaceae addressed in this work, as *Callisthene fasciculata*, *Qualea pilosa, Vochysia chapadensis*, *V. maxima* and *V. petraea*, none occurring in Southern Brazil. Regarding morphological characteristics they

are in agreement regarding trends in the formation of oblate spheroidal pollen grains and delicate ornamentation of the surfaces.

Some morphological characteristics of pollen grains of *Vochysia magnifica* are similar to species of *Aspidosperma* Mart. & Zucc., Apocynaceae (Barth & Luz, 2008), in particular by the presence of pseudocolpi and apertural areas bounded by narrow tracks devoid of nexine. Similar pseudocolpi and tracks devoid of nexine were observed in Verbenaceae species also (Punt & Langewis, 1988). Further studies of pollen grain morphology of Vochysiaceae species from other countries may improve additional informations.

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RESUMEN

Morfología del polen de las especies de árboles de Vochysiaceae en el estado de Santa Catarina, sur de Brasil. Las Vochysiaceae tropicales incluyen principalmente árboles, arbustos y subarbustos. Tres géneros y siete especies están presentes en el estado brasileño de Santa Catarina. La morfología del polen de las seis especies de árboles, pertenecientes a tres géneros de la Vochysiaceae A. St.- Hil . familia, fue considerado en el presente trabajo. La morfología de los granos de polen de *Callisthene* Mart., *Qualea* Aubl. y *Vochysia* (Aubl.) Juss. es distinta. Los granos de polen de tamaño medio se producen en las especies de *Vochysia* y pequeños en *Callisthene* y *Qualea*. Características particulares fueron considerados a nivel de especie [*C. castellanosii* H.F. Martins, *C. kuhlmannii* H.F. Martins, *Qualea cordata* Spreng var. *cordata*, *Q. cryptantha* (Spreng) Warm. var. *cryptantha*, *Vochysia magnifica* Warm. and *V. tucanorum* Mart.]. La presencia de un fastigium (vestibulum) y de un espacio delgado que carece de nexina limita la zona apertural y es característica solo de las especies de *Qualea* y *Vochysia*.

Palabras clave: granos de polen, morfología, *Callisthene*, *Qualea*, *Vochysia.*

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