INTRODUCTION

Staelia Cham. & Schldl. belongs to the tribe Spermacoceae which comprises 19 genera. The most accepted classification of Rubiaceae family was provided by Robbrecht (1988). In this work the tribe Spermacoceae was included in the subfamily Rubioideae with 17 other tribes. A molecular study done by Andersson & Rova (1999), confirmed the monophyly of the tribe, but with the inclusion of members of the Hedyotideae tribe. However, Bremer (1996) proposes to extend the definition of the tribe, including in addition to Hedyotideae, the tribes Manetieae and Knoxiaceae. In this work we follow the traditional definition of Spermacoceae proposed by Robbrecht (1988).

According to different authors the number of genera in America ranges between 16 and 19. The difference is mainly due to the recent changes realized in the Borreiria-Diodia-Spermacoce complex (Bacigalupo & Cabral 1999, 2006, Cabral & Bacigalupo 1997, 2001, Dessein 2003). Some authors, such as De Candolle (1830) and Schumann (1888) have used the type of fruit dehiscence as a diagnostic character to establish the generic limit. Nevertheless, recent studies grant greater relevance to other characters like heterostylous or isostylous flowers, inflorescence pattern, chromosome number, pollen morphology, growth form and/or molecular data (Bacigalupo & Cabral 1999, 2006, Cabral & Bacigalupo 1997, 2001, Dessein et al. 2002, Dessein 2003). The genus Staelia can be distinguished from the remaining genera of the tribe on the basis of its fruit dehiscence. The dehiscence is longitudinal and septifragal, it starts from the apex to halfway, the fruit base and septum remaining on the short pedicle (Fig. 1e, f, 2a, b).

According to Dessein (2003) Staelia is a somewhat trouble-some genus. Two different groups can be recognized: the Staelia thyoides group with very small leaves without distinct secondary veins, an ericoid habit, small seeds and small pollen grains with long colpi and the Staelia capitata group with larger leaves, impressed venation, a taller habit, larger ruminate seeds, and larger pollen grains with short colpi. The only character in common is the type of fruit dehiscence. The new species described here, S. nelidae, is similar to the S. thyoides group. No taxonomic revisions are available for the genus Staelia. Almost all the information is restricted to the protologues of the species and their treatment in some regional floras (Bacigalupo 1974, 1993, Kirkbride 1997, Cabral & Salas 2005, Salas & Cabral 2006a, b).

The genus Staelia (Rubiaceae, Spermacoceae) is distributed exclusively in South America and comprises 17 species that inhabit in Brazil (10 species, 8 of which are endemic), Argentina (3 species, 1 endemic), Paraguay (3 species, 1 endemic), Bolivia (4 species, 2 endemics) and Uruguay (2 species, 1 endemic) (De Souza & De Sales 2004, Cabral & Salas 2005, Salas & Cabral 2006a, b). The Staelia species grow in tropical and subtropical areas, from northern Brazil (Pará state) to Uruguay (Artigas) and north of Argentina (Entre Ríos), from approximately 1° to 32° S. Staelia was described by Chamisso & Schlechtendal in 1828 on the basis of one specimen from S Brazil: S. thyoides. Later, two new species from Goiás (Brazil) were described by De Candolle (1830): S. galioideae DC. and S. reflexa DC. In that work also Tessiera DC. is described, a genus very close to Staelia. For this new genus he describes two new species: T. lanigera DC. (Brazil) and T. lithospermoideae DC. (Mexico). Schumann (1888) does not accept the genus Tessiera including it under the synonymy of Staelia. In the same work, ten species of Staelia are recognized for the Brazilian flora, four of them are new to science (S. aurea K.Schum., S. capitata K.Schum., S. catechosperma K.Schum., S. vestita K.Schum.) and three are new combinations (S. lanigera (DC.) K.Schum., S. thymbroides (Mart. ex Mart. & Zucc.) K.Schum., S. virgata (Willd. ex Roem. & Schult.) K.Schum.). According to Schumann (1888) the species of Staelia can be grouped in three sections: Tessiera, Anthospermopsis and Staelia, with two, one and seven species, respectively. Chodat & Hassler (1904) recognized four species for Paraguay: Staelia filifolia Chodat & Hassl., S. thymbroides, S. thyoides and S. virgata. In this treatment, S. filifolia is described as a new species, however, that specific epithet was previously used by Rusby (1895) to designate a species from Bolivia. For this reason Standley (1931) proposed the new name S. hassleri for S. filifolia Chodat & Hassl. A morphological analysis of three isotypes of S. hassleri deposited at K, P and W, revealed that S. hassleri is a new synonym of the widespread S. thyoides. Finally, the fourth species cited by Chodat & Hassler (1904), S. thymbroides...
is an erroneous identification of one specimen collected by Hassler in the Cordillera department (Hassler 6126, K), which corresponds to *S. thymoides*.

During the study of the *Rubiaceae* family in Paraguay, we found some specimens collected in the Boquerón department (Paraguay), which represents a new species endemic to this area. The present paper provides the description and illustration of the new species, *Staelia nelidae* and a key to distinguish the Paraguayan species. The pollen and seed morphology are also analysed and its relevance is discussed.
Staelia

Staelia Cham. & Schtdl. (1828) 346. — Typus: Staelia thymoides Cham. & Schtdl.

Small shrubs, subshrubs or perennial herbs. Stipules filbricate, connected to the petioles. Leaves linear or narrowly elliptical, more rarely ovate or narrowly ovate, herbaceous or coriaceous, leaf base gradually narrowed or attenuate. Inflorescence multi-
flowered, congested, terminal or axillary. Flowers sessile or pedicellate, isoscytous. Calyx tube reduced, calyx lobes 2 or 4. Corolla funnel-shaped, white, 4-lobed, inside with moniliform hairs above the middle of the tube, rarely with dispersed hairs, outside glabrous or pubescent. Stamens and style exserted, stigmas bident, biloba or capitate. Ovary 2-locular with a single ovule per locule, nectary disc entire or parted. Capsules septi-
fragal dehiscent in three parts, two caducous pieces and one basilar persistent piece. Seeds ellipsoid, obvoid or dorsiventrally flattened, ventral groove shallow and wide or narrow and deep, seed coat surface finely reticulate-foveate, reticulate-areolate, rarely ruminate.

Distribution — Approximately 17 species in South America: Argentina, Bolivia, Brazil, Paraguay, Uruguay (Cabral & Salas 2005).

KEY TO THE SPECIES OCCURRING IN PARAGUAY

1. Herb or subshrub 10–30 cm tall. Inflorescences apical and 1 or 2 axillary. Necteriferous disk 2-lobed. 2. S. thymoides
3. Stipular sheath with 3 (or 5) bristles, each 4–6 (or 8) mm long. Corollas 3.5–5 mm long. Calyx lobes 2.5–3 (or 4) mm long, larger than the corolla tube. 1. S. nelidae
4. Stipular sheath with 3–5 (or 9) bristles, each 2–3 mm long. Corollas 5.5–6.5 (or 7) mm long. Calyx lobes 1.5–2 (≈2.5) mm long, smaller than corolla tube. 3. S. virgata

1. Staelia nelidae R.M.Salas & E.L.Cabral, sp. nov. — Fig. 1

Affinis S. thymoides et S. virgata. Sed ab S. thymoides, a quo imprimis differt folis (10–)25–30 (≈38) mm longis, usque ad 1 (≈1.3) cm latis versus 5–8 (≈10) mm longis, 3–(3.5) mm latis, lacinias 4–6 (≈8) mm longis, versus lacinias 0.8–1.4 mm longis, glomeruli florales 7–16 in ramis florigeris 10–15 mm latis versus glomeruli florales 3–6 (≈8) in ramis florigeris 5–8 (≈10) mm latis. Ab S. virgata calycis segmentis differt, glabris versus pubescentibus, 2.5–3 (≈4) mm longis versus 1.5–2.5 mm longis, corolla 3.5–5 mm longis versus 5.5–7 mm longis. Calyx lobes 4–6 (≈8) mm longis versus lacinias 2–3 mm longis. — Typus: Mereles 2663 (hola CETES; iso FOQ, SI), Paraguay, Departamento Boquerón, 4 de mayo y Capitán Lagarenza, suelo arenoso, borde de ruta, 1 Mar. 1989.

Subshrub 35–50 cm tall. Stem subcylindrical to terete, hollow, pubescent. Stipular sheath 1.5–2 mm long, puberulous to pubescent with, 3 (≈5) bristles, 4–6 (≈8) mm long. Leaves opposite, (8–)10–30 (≈38) by 0.5–2 (≈2.5) mm, linear or narrowly elliptic, apex acute to acuminate, both sides glabrous. Inflorescence multiform, congested, axillary, 7–16, 10–15 mm wide; bracts 2 (or 3). Flowers sessile, hypanthium 0.6–0.7 mm long; calyx lobes linear-subulate, erect, glabrous, 2.5–3 (≈4) mm long, with conspicuous intercalar teeth; corolla 3.5–5 mm long, outside glabrous, inside with moniliform hairs above the middle of the tube; stamens exerted, 1.5–1.7 mm long; style 4.5–5 mm long, stigma bifid; nectary disc entire. Fruit capsule with puberulous to pubescent valves; seed subellipsoid, 1–1.2 mm long, reticulate-foveate, ventral furrow with strophiole.

Distribution — The new species is only known for the Boque-
rón department in north-western Paraguay.

Habitat & Ecology — Frequent in sandy grounds, way edges, opened forest of Schinopsis balansae Eng. and Ceiba insignis (Kunth) P.E.Gibbs & Semir. Flowering and fructifying: February to April.

Note — Staelia nelidae is dedicated to Prof. Nélida María Bacaipalo, an important specialist in American Rubiaceae, by her countless contributions to floras of Argentina, Bolivia, Brazil and Paraguay. The differences between S. nelidae and its related species, S. thymoides and S. virgata, are the width and length of its leaves, the bristles size, the number of glonerules per flowering branch and the calyx/corolla ratio.


2. Staelia thymoides Cham. & Schtdl.

Staelia thymoides Cham. & Schtdl. (1828) 346. — Type: Sellow s.n. (holo BT; iso K, W), Brasilia megaloniellus.


Distribution — Southern Brazil (Rio Grande do Sul), north-eastern Argentina (Misiones, Corrientes and Entre Ríos), W Uruguay and S Oriental Paraguay (Cabral & Salas 2005).

Habitat & Ecology — It grows in ‘campo cerrado’, savan-
as with Pseudobombax and Acrocomia and grasslands of Elyonurus muticus Kuntze. Flowering and fructifying: November to May.

Note — Staelia thymoides is the name most used in the identification of plants belonging to this genus. Therefore, it is very common to find erroneously identified specimens. Staelia thymoides displays a great variation of leaf width and length. Chodat & Hassler (1904) described Staelia filifolia (= Staelia hassleri), on the base of its filiform leaves, graceful aspect and thin branches. After the morphological analysis of three isotypes of S. hassleri deposited at K, P and W, we have concluded that this species and S. thymoides are conspecific.


Staelia virgata (Wild. ex Roem. & Schult.) K.Schum. (1888) 76. — Sperma-
coeca virgata Wild. ex Roem. & Schult. (1818) 281. — Mitracarpum virgatum (Roem. & Schult.) Cham. & Schtdl. (1828) 363. — Type: Hoffmannsegg s.n. (B-WILD 2634, iso BR), Brazil.

Staelia caespitosa Griseb. (1789) 159. — Lectotype (here designated): Lorentz & Henryonius 390 (hola K; iso F photo, G, L n.v.), Argentina, Provincia de Salta, La Florida en el Río del Tala, Nov. 1877.

Borreria finitima S.Moore (1922) 27. — Type: Herzog 1028 (hola BM), Ar-
terina, between Embarracar and Mirafloraes, Nov. 1910.


Distribution — Argentina, Bolivia, almost all Brazil (except the Southern states) and Peru (De Souza & De Sales 2004). In Paraguay it has been found in Alto Paraguay, Concepción, Cordillera, Boquerón, Presidente Hayes, Ñeembucú and Paraguaui departments.

Habitat & Ecology — It grows in sandy-argillaceous grounds, stony grasslands, river margins, in grasslands of Elyonurus muticus Kuntze with Astronium balansae Eng. and Schinopsis balansae Engs., edges of forest or ways, occasionally wees, between 500–1100 m. Flowering and fructifying: October to May.

Note — Staelia virgata grows in diverse habitats throughout its distribution area, and consequently displays a wide variation in the number of bristles of stipular sheath, stem hair-covering, leaf shape and hairs and height (35–110 cm tall).
Pollen grains of *Staelia* are prolate spheroidal, isopolar and radially symmetric. Medium sized (25–33 µm), 7–10-colporate, with ectocolpi long and endoapertures lolongate. Exine 2.2–3.5 µm thick, the sexine equal or thicker than the nexine, tectate-perforate, uniformly scabrate. Perforations circular to elongate. Scabrae 0.2 µm, distributed over the entire surface of the grain.

*Staelia nelidae* — pollen grains 7- or 8-colporate, ectocolpi 14–16 µm long, endoapertures lolongate, 4–4.5 µm long. Medium sized, P = 25 µm and E = 24 µm. Exine 1.6–2 µm thick, sexine and nexine equally thick. Perforations irregular, 0.2–0.5 µm. Scabrae 0.1–0.2 µm, uniformly distributed (Fig. 2a–d).

*Staelia thymoides* — pollen grains 8-colporate, rarely 7-colporate, ectocolpi 16–21 µm long, endoapertures lolongate, 4.5–5.5 µm long. Medium sized, P = 29 µm and E = 27.5 µm. Exine 1.4–1.6 µm thick, sexine equally thick or thicker than nexine. Perforations subcircular or irregular, 0.2–1.2 µm. Scabrae 0.1–0.2 µm, uniformly distributed (Fig. 2e–h).

*Staelia virgata* — pollen grains 9-colporate, rarely 10-colporate, ectocolpi 14.7–17.5 µm long, endoapertures lolongate, 4.5–5.5 µm long. Medium sized, P = 27.8 µm and E = 27.2 µm. Exine 1.4–1.6 µm thick, sexine equally thick or thicker than nexine. Perforations subcircular or irregular, 0.2–0.6 µm. Scabrae 0.1–0.2 µm, uniformly distributed (Fig. 2i–k).

The pollen morphology of *Staelia* sect. *Staelia* K.Schum. is rather uniform. Significant differences do not exist between

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**POLLEN MORPHOLOGY**

Fig. 2 Pollen grains of *Staelia* species. a–d. *Staelia nelidae* R.M.Salas & E.L.Cabral. a. Equatorial view of pollen grain; b. polar view of pollen grain; c. detail of apocolpium; d. detail of mesocolpium. — e–h. *Staelia virgata* (Wild. ex Roem. & Schult.) K.Schum. e. Equatorial view of pollen grain; f. polar view of pollen grain; g. detail of apocolpium; h. detail of mesocolpium (from Mereles 5881). — i–k. *Staelia thymoides* Cham. & Schltdl. i. Equatorial view of pollen grain; j. detail of apocolpium; k. detail of mesocolpium (a–d: Mereles 2663; e–h: Mereles 5881; i–k: Krapovickas 45169). — Scale bars: a, b, e, f, i = 10 µm; c, d, g, h, j, k = 2 µm.
the species of Paraguay. However, some differences may be noticed in the size, number of colpi and sculpture. *Staelia ne-
clidae* has relatively small pollen grains (P = 25 µm and E = 24 µm), *S. virgata* has 9- or 10-colporate grains and *S. thymoides* displays relatively large perforations (0.2–1.2 µm wide).

*Staelia* pollen was analyzed by Schumann (1888). He studied a single species and described the pollen grains size, shape and the number of apertures, without mentioning the aperture type and the species name.

The pollen of *S. thymoides* was studied by Galati (1988). She described it as 10-colporate, with long colpi and a perforate tectum. Some characters were also observed in other genera of the tribe, such as the number of colpi, the long colpi and the tectate-perforate exine. Galati (1988) concludes that the pollen of *Staelia thymoides* is very close to that of two species of *Mitracarpus* Zucc. ex. Schult. & Schult.f. (*M. hirtus* (Sw.) DC. and *M. megapotamicus* (Spreng.) O.Kuntze). Both present the same morphology and the colpi are often united at the poles. However, *M. hirtus* has 5-colporate grains ((3–)7(–9)-colporate according to Melhem et al. 2003) and *M. megapotamicus* has 8-colporate pollen grains (Galati 1988).

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**Fig. 3** Fruit and seed morphology of *Staelia* species. a–f. *S. neilidae* R.M. Salas & E.L.Cabral. a. Lateral view of dehiscing fruit; b. persistent portion of fruit; c. dorsal view of mature seed; d. ventral view of mature seed; e. detail of the exotesta cells; f. ventral view of seed under binocular microscope. — g, h. *S. thymoides* Cham. & Schltld. g. Ventral view of seed; h. dorsal view of seed. — i, j. *S. virgata* (Willd. ex Roem. & Schult.) K.Schum. i. Ventral view of seed; j. dorsal view of seed (a–f: Mereles 2663; g, h: Krapovickas 45168; i, j: Mereles 5881). — Scale bars: a = 1 mm; b–d = 500 µm; e = 100 µm; f–j = 500 µm.
SEED MORPHOLOGY

Seeds of *Staelia* are light brown or dark brown, ellipsoid, subellipsoid or obvoid. The seed coat surface is reticulate-foveate, the exotesta cells are elongate, subcircular or polygonal and depressed, 22–50 µm long. At the ventral side, there are two narrow longitudinal furrows and between them rests of the placenta with numerous raphides (visible under a binocular microscope). The seeds are released by septifragal dehiscence, the fruit base and septum remaining on the short pedicle.

Seeds of *Staelia nelidae* are light brown, subellipsoid or obvoid, 0.9–1 by 0.5–0.6 mm (Fig. 3c–f), the seed coat surface is reticulate-foveate, the exotesta cells are elongate or subcircular and depressed (Fig. 3e), 22–50 µm long. The seeds of *S. thymoides* are ellipsoid and dark brown, 1.3–1.5 by 0.9–1 mm (Fig. 3g, h). *Staelia virgata* seeds are obvoid and light brown, 0.8–1 by 0.5–0.6 mm (Fig. 3i, j).

The seeds of *Staelia* species from Paraguay are uniform in seed morphology. Under binocular microscope they look very similar. The seeds of three species differ only in size and shape.

The pollen morphology of *Staelia* is similar to some species of genus *Mitracarpus* (Galati 1988), but the seed characters are very different. In *Mitracarpus* species the seeds are obvoid or spheroid, rarely ellipsoid or subellipsoid, at the dorsal side with or without cross-shaped depressions, at the ventral side with quadrateangular, X- or Y-shaped inversed depressions (De Souza & De Sales 2001, Bacigalupo & Cabral 2005).

In *Staelia* both seeds are always developed, however, in some genera, as in *Diacrodon* Sprague, only one seed per fruit is developed (Sprague 1928).

REFERENCES


IDENTIFICATION LIST

1 = *S. nelidae* 2 = *S. thymoides* 3 = *S. virgata*

Arbo 1685: 3 – Arenas 1717: 3; 1165: 3 – August 440: 3.

Balansa 1762: 2, 1783: 2 – Bordas 3603: 2; 4064: 2; 4398: 3.

Caballero 1599: 3.

Hassler 4032: 2; 6126: 2; 8158: 3; 12409: 2 – Herzog 1028: 3, 1896a: 3.

Krapovicka 45168: 2, 45476: 3.

Lorentz & Hieronymus 390: 3.

Mereles 2663: 1, 2919: 1, 5881: 3, 6352: 3, 6684: 3, 8053: 3.

Pedersen 9331: 2 – Pérez 2550: 3, 9285: 3, 9305: 3.

Ramella 482–486.

Schinini 1340: 2, 2351: 3; 2704: 2, 2814: 2, 4353: 3, 14816: 3, 15100: 1.

Vanni 2057: 3.

Zardini 29335: 2, 37253: 3, 54348: 3.