

# Flower vascularisation in Solanaceae: a particular pattern in *Metternichia* J.G.Mikan

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## ABSTRACT

The delimitation and relationship of several genera of Solanaceae are not resolved yet. The systematic position of *Metternichia principis* J.G.Mikan has long been discussed; recently it was split from *Cestreae* G.Don to a monotypic tribe *Metternichieae* Miers. The last proposal was supported mainly by the particular chromosome number of *Metternichia*. In addition, some pollen, anther and seed characters were used to separate *Metternichia* from *Sessea* Ruiz & Pav., the genus morphologically most closely related. An anatomical and vascular analysis of the flower was conducted to look for characters that contribute to its systematic position. The placental tissue placed in the base of the septum has never been described before in other Solanaceae species. Moreover, the process of formation of the middle petals, staminal bundles and the two vascular arcs placed on the base of the ovary, are particularities that have not been reported before in the family. The presence of two vascular arcs on the base of the ovary seems to be primitive features in the family as it happens in *Humbertia madagascariensis* Lam. (Convolvulaceae). The vascular characters in addition to chromosomal, pollen, anther and seed characters, postulated by other authors, support the independence of *M. principis* from *Cestreae*. Results are discussed and compared with previous reports on the family.

## KEY WORDS

Solanaceae,  
*Metternichia*,  
anatomy,  
flower vascularisation.

## RÉSUMÉ

*Vascularisation florale des Solanaceae: le modèle particulier de Metternichia J.G.Mikan.*

La délimitation et la relation entre les divers genres de Solanaceae ne sont pas encore résolues. La position systématique de *Metternichia principis* J.G.Mikan a été longuement débattue; récemment elle a été passée des Cestree G.Don vers la tribu monotypique des Metternichieae Miers. La dernière proposition a été principalement appuyée par le nombre chromosomique particulier de *Metternichia*. De plus, certains caractères du pollen, de l'anthère et des semences ont contribué à séparer *Metternichia* de *Sessea* Ruiz & Pav., morphologiquement le genre le plus étroitement lié. Une analyse anatomique et vasculaire de la fleur a été effectuée pour chercher les caractères qui contribuent à sa position systématique. Les résultats montrent des caractéristiques supplémentaires qui contribuent à la délimitation systématique de *Metternichia*. Le tissu placentaire situé à la base de la cloison (septum) n'a jamais été décrit pour d'autres espèces de Solanaceae. Et de plus le processus de formation des pétales moyens, de l'androcée et des deux arcs vasculaires à la base de l'ovaire sont des particularités qui n'ont jamais été rapportées auparavant dans cette famille. La présence des deux arcs vasculaires à la base de l'ovaire paraît être un caractère primitif dans la famille du fait de son occurrence chez *Humbertia madagascariensis* Lam. (Convolvulaceae). Les caractères vasculaires ajoutés aux caractères chromosomiques du pollen, de l'anthère et des semences postulés par d'autres auteurs pourraient appuyer l'indépendance de *Metternichia principis* des Cestree. Les résultats sont discutés et comparés avec les rapports antérieurs sur la famille.

## MOTS CLÉS

Solanaceae,  
*Metternichia*,  
anatomie,  
vascularisation  
de la fleur.

## INTRODUCTION

Solanaceae comprise *c.* 92 genera and over 2300 species (Hunziker 2001). This family includes many plants of economic importance. Some of them are sources of food, or cultivated as ornamental plants. Several species are toxic or are used as drugs or stimulants (Hunziker 2001), others have insecticide or nematocidal effects (Insunza *et al.* 2001).

Studies on floral anatomy have been argued since De Candolle's time (Schneider 1976), and a central issue is the validity of its application in the taxonomic problems. Anatomy could be used as one of several interpretations (Mosely 1972), and the variety of flower anatomy could be applied to systematic and phylogenetic interpretations in Solanaceae (Armstrong 1986).

The delimitation and relationships of several genera within Solanaceae are still no resolved (D'Arcy

1979). Recently, some vascular studies have contributed to delimit different taxonomic levels (Eyde 1975) in the Solanaceae family (Murray 1945; Moscone 1986; Bernardello 1986, 1987; Carrizo García 1998; Rodriguez 1998, 2000b; Barboza & Hunziker 2000) and in other families (Mehta & Moseley 1981; Hang-Xing & Tucker 1990; Cosa 1995; Di Fulvio *et al.* 1999; Gonzalez 2001; Derooin 2002, 2004). In spite of the usefulness of vascular studies, they are not abundant in relation to other aspects on flower anatomy in Solanaceae.

*Metternichia principis* J.G.Mikan is an endemic tree from Brazil (Hunziker 2001); its common names are "cambará" or "café do mato" (Castro de Olivera & Carvalho 1985). The systematic position of the monotypic genus *Metternichia* J.G.Mikan has long been discussed. Miers (1846) placed *Metternichia* and *Sessea* Ruiz & Pav. in the tribe Metternichieae Miers (subfamily Cestroideae Schtdl.)

based on the shape of the embryo; in a similar way, Dunal (1852) proposed the inclusion of both genera in Metternichieae adding fruit characters. After that, other proposals have been made. D'Arcy (1979) suggested placing *Metternichia* tentatively into Solanoideae subfamily considering floral and fruit characters. Later, Benitez de Rojas & D'Arcy (1998) agreed with Hunziker's proposal (1979) in which *Metternichia* had been considered a member of tribe Cestreae G. Don. In the most recent morphological revision of Solanaceae, Hunziker (2001) excluded *Metternichia* from Cestreae placing it in the monotypic tribe Metternichieae Miers, based on its peculiar chromosome number,  $x = 13$  (Moscone *et al.* 2005) and some other features of seeds, anthers and pollen. Cladistic analysis based on molecular data set shows a close relationship among *Metternichia* with *Duckeodendron* Kuhl., *Goetzea* Wydler (Fay *et al.* 1998), *Coeloneurum* Radlk., *Henoonia* Griseb. and *Espadaea* A. Rich. (Santiago-Valentín & Olmstead 2003). The position of the five latter genera is different in the traditional morphological Hunziker's system (2001) because the fruit, seed and embryo features are incompatible with those of the remaining Solanaceae genera; on account of this, Hunziker (2001) segregated the five genera into the Duckeodendraceae Kuhl. (*Duckeodendron*) and Goetzeaceae Miers (*Coeloneurum*, *Henoonia*, *Espadaea* and *Goetzea*) families. However, Fay *et al.* (1998) stated that the unusual fruit of *Duckeodendron* is uninformative because it does not suggest relationships with other families. Other controversial character of *Metternichia* is the pollen with echinate exine (Gentry 1986); this feature is uncommon in Solanaceae (Stafford & Knapp 2006) and it is present in Goetzeaceae and *Duckeodendron* (Gentry 1986; Moncada & Fuentes 1991; Stafford & Knapp 2006), although surface ornamentation in the pollen requires careful analysis of homology of underlying structures (Stafford & Knapp 2006). On its part, in the tribe Cestreae (*sensu* Hunziker 2001) or the *Cestrum* + *Sesaea* + *Vestia* clade (*sensu* Santiago-Valentín & Olmstead 2003) revealed a well supported monophyly (Stafford & Knapp 2006) by molecular (Olmstead *et al.* 1999; Montero-Castro *et al.* 2006), chemical (Gemeinholzer & Wink 2001), morphological

(Hunziker 2001) and cytological studies (Sykorova *et al.* 2003; Las Peñas *et al.* 2006).

The few known works on *Metternichia* are focused on the exomorphology or anatomy of vegetative organs or the development of seeds (Araujo & Sonkin 1984; Castro Oliveira & Carvalho 1985; Carvalho 1986), but the flower anatomy of the genus is still unknown. This is a limitation to estimate the contribution of this aspect to its systematic position in the family.

The present work was undertaken to analyse the flower anatomy of *Metternichia principis* with emphasis on the vascularisation, with two objectives: 1) to contribute to a more complete knowledge of the genus; and 2) to evaluate the importance of these aspects on its systematic position in the family.

## MATERIALS AND METHODS

Material examined: *Metternichia principis* J.G. Mikan. Brazil, Mun. Rio de Janeiro, Jacarepaguá, 20.XI.1969, *Sucre 6304*, RB. — Mata Atlântica, Jardim Botânico do Rio de Janeiro, 16.XI.1999, *Carvalho s/n*, Fco. CORD 4019 (the herbarium specimen was deposited under *Schnoor 88*, 14.IV.1998, RB).

Flowers were fixed in FAA, dehydrated through an ethyl alcohol/xylol serial, and then embedded in histoplast. Cross and longitudinal sections were cut at 10 µm using a rotative microtome. Histological serial sections were mounted, and stained with activate haematoxylin-safranin and fast green (Conn *et al.* 1960).

Observations were made with a Kyowa LSCB-VC-2B-L (LVV) microscope. Photographs were taken with a Nikon digital camera added to the Kyowa microscope and to a Zeiss stereomicroscope. Drawings were made using a camera lucida attached to a Kyowa microscope.

## RESULTS

### GENERAL CHARACTERS

Flowers are hypogynous and pentamerous (Fig. 1E). Calyx is five-lobed and persistent. Corolla is actinomorphic, gamopetalous and shortly five-lobed

(Fig. 1A, E). The five stamens are adnate to the corolla tube near its base; the filaments are unequal (2+3) (Fig. 1D); anthers are basifixed (Fig. 1B, C), dithecal, tetrasporangiate (Fig. 2D, E), with longitudinal dehiscence (Fig. 1G). The ovary is bicarpellate and bilocular (Fig. 2A), with axile placentation; the placenta is placed near the base of the septum; the ovules are erect in relation to the longitudinal axis of the ovary (Fig. 2A). The annular nectary is at the base of the ovary (Fig. 1F) and shows five swellings (Fig. 2A). The style is terminal (Fig. 1F) and solid with a central portion occupied by transmission tissue (Fig. 2E); the stigma is two-lobed and deeply deflected (Fig. 2B, C). The compitum arises approximately between the half and the third upper ovary length (Fig. 3S, T).

The anthers wall consists of a simple epidermis, three cell layers with fibrous thickenings (the external is the endothecium and the other two the middle layers), and a secretory tapetum in the innermost layer. A noticeable placentoid is developed into the locule (Fig. 2F). Crystals are observed in the stomium.

#### VASCULARISATION OF THE FLOWER

The pedicel shows an amphiphloic siphonostele (Fig. 3B). In the receptacle, five vascular bundles are extended toward the periphery of the flower (Fig. 3E), the median sepal bundles (mk). Each lateral sepal bundle (lk) gives rise from lateral ramifications of the median sepal bundle and from the external zone of the petal trace (Fig. 3G). The five central remaining vascular bundles become in V-shaped with the branches toward the centre of the flower (Fig. 3D, E). Each V-shaped structure diverges in three bundles; the central and largest bundle is the main petal bundle (mc) which gradually takes an external position (Fig. 3F); the other two are the smaller lateral bundles which arise from the internal branches of the V-shaped structure. In the centre of the flower, the ten small lateral branches join in pairs between adjacent bundles (Fig. 3F, G); so, the five resulting bundles arise from contiguous bundles. These five central bundles again form a V-shape (Fig. 3H), being the greater central bundle the staminal bundle (s), and alternating with the main petal bundles (Fig. 3I). The two smaller

and remaining bundles follow the same development pattern described above, resulting in 10 free bundles. At the base of the ovary, these 10 lateral bundles arrange again in five bundles, where each one is the result of joining between two adjacent bundles (Fig. 3I, J). The resulting five bundles produce two arcs, one with two and the other with three bundles (Fig. 3K). The extremes of these two arcs converge toward the centre of the ovary (Fig. 3L); they are the four ventral bundles (v), two of each carpel. These bundles gradually anastomose, originating two heterocarpellar ventral bundles (Fig. 3M, N). The rest of the arcs split simultaneously, the dorsal bundles are not different in size or shape from the lateral bundles (Fig. 3L). The ovules are supplied through divergences from the ventral bundles (Fig. 3O). Before the compitum, each ventral bundle progressively splits into two bundles, one for each carpel; then, in the uppermost portion of the ovary four ventral bundles supply this zone (Figs 3R-T; 4B). At the top of the ovary, the ventral and the lateral bundles are less conspicuous. Dorsal and its nearest lateral bundles give rise to two greater bundles in the dorsal zone (Fig. 4D); these greater bundles supply the stigma (Fig. 4E-K), while ventral and the rest of lateral bundles finish in the top of the ovary.

In the corolla, the median bundles split into three bundles (Fig. 4F); the central bundle (mc) is greater than the lateral ones (lc). The lateral bundles give rise to several lateral ramifications (Fig. 4H-M). The androecium (Fig. 4H, I) has single bundles (s).

#### DISCUSSION

Differences between morphological and phylogenetic classifications have been reported for other groups in the family (Witt Smith & Baum 2006). In the introduction were stated the different placement and relationships that *Metternichia* has in the morphological Hunziker's system (2001) and in the Santiago-Valentin & Olmstead's (1999) phylogenetic approach. In this section, the novel morphological information (vascularisation) as well as other flower features are discussed in the context of both proposals.

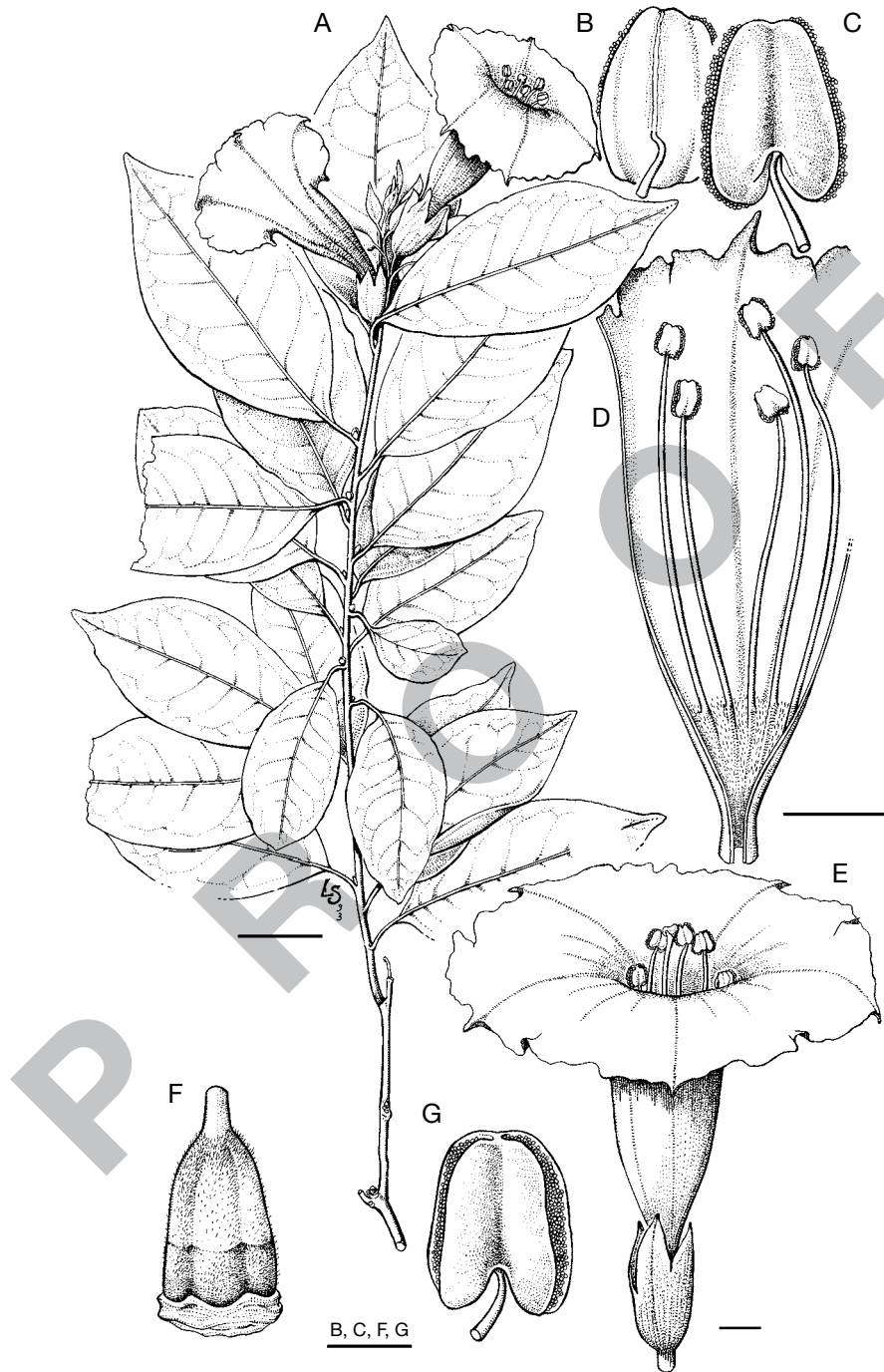


FIG. 1. — *Metternichia principis* J.G.Mikan, Sucre 6304: **A**, apical sector of a flowering branch; **B**, **C**, **G**, dehiscent anther; **B**, section of anther to show the basal insertion of the filament; **C**, **G**, ventral and dorsal views respectively; **D**, inside view of an opened out corolla; **E**, flower; **F**, ovary, lateral view. Modified after Hunziker (2001). Scale bars: **A**, 2 cm; **B**, **C**, **F**, **G**, 1.3 mm; **D**, 1 cm; **E**, 0.5 cm.

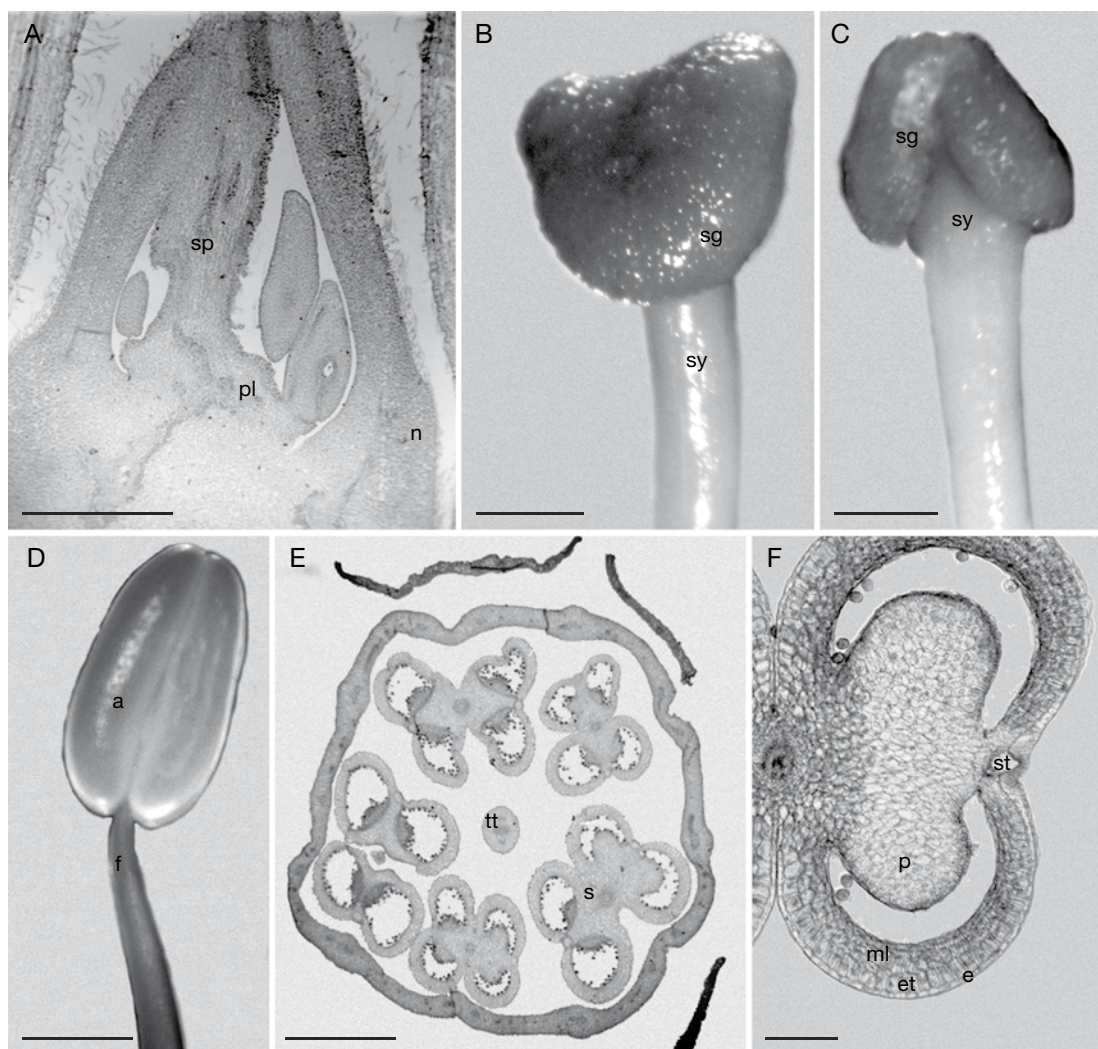


FIG. 2. — *Metternichia principis* J.G.Mikan, *Carvalho s/n*: **A-C**, gynoecium; **A**, longitudinal section of ovary to show placenta on the basal quarter of septum; **B, C**, stigma showing the lobes deflected; **D-F**, androecium; **D**, undehiscent anther to show basal insertion of filament, dorsal view; **E**, cross section of the flower to the anther level; **F**, cross section of anther showing the wall and the placentoid. Abbreviations: **a**, anther; **e**, epidermis; **et**, endothecium; **f**, filament; **ml**, middle layer; **n**, nectary; **o**, ovule; **p**, placentoid; **pl**, placenta; **s**, staminal bundle; **sg**, stigma; **sp**, septum; **st**, stomium; **sy**, style; **tt**, transmitting tissue.

The placentation in *Metternichia* is axile, as it was seen in other Solanaceae's species (Murray 1945; Nee 1986). Some variations in the size and shape of placenta and in the thickness of the septum and elaboration of "false septum" have been reported to the ovary (Rodríguez 1998, 2000b; Garzón-Venegas & Orozco 2006) and to the fruit (Nee 1986) in the family, but nothing about this

was observed in this work. However, the origin of the placental tissue in *Metternichia* is uncommon because it develops near the basal quarter of the septum, instead of the middle zone as it occurs in the remaining genera of tribe Cestree (Liscovsky 2007) and in the family in general (Nee 1986).

In Solanaceae, the ovules can be hemicampylotropous, anatropous, anacampylotropous or

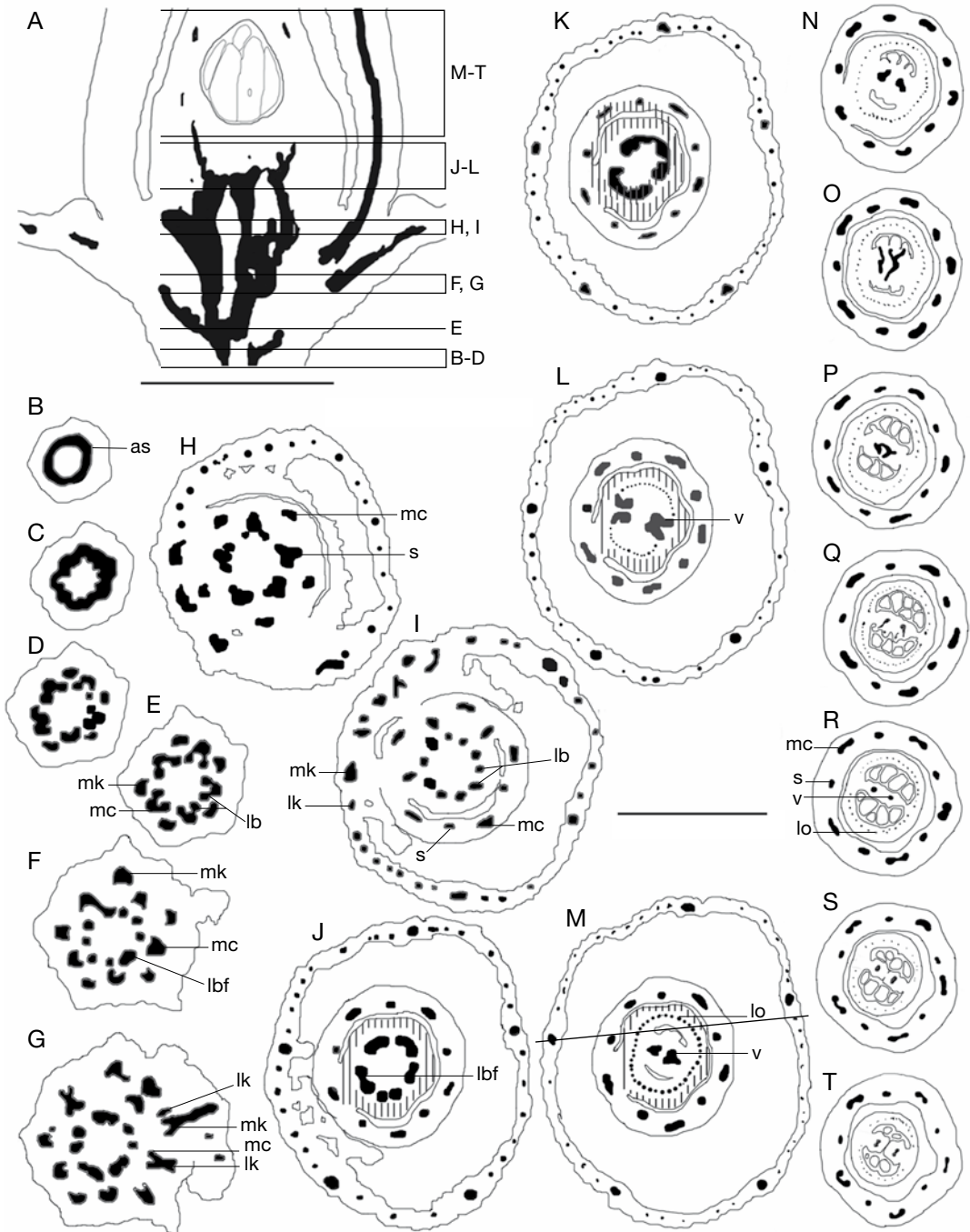


FIG. 3. — *Metternichia principis* J.G.Mikan, *Carvalho s/n*, flower vascularisation: **A**, longitudinal section in immature bud, along plane indicated in M; **B-L**, cross section from peduncle to ovarian apex, as indicated in A; **N-T**, drawn without sepals. Symbols: blackened areas, vascular tissue; gray areas, transmitting tissue; hatching, nectary. Abbreviations: **as**, amphiphloic siphonostele; **lb**, lateral bundles; **lbf**, fusion of lateral bundles; **lk**, lateral sepal bundle; **lo**, lateral ovarian bundle; **mc**, median petal bundle; **mk**, median sepal bundle; **s**, staminal bundle; **v**, ventral bundle.

hemitropous (Hunziker 2001). In *Metternichia*, the ovules are anatropous and they are joined to the placental tissue at the base of the septum. The type of ovule is different of that of tribe Cestreae (*sensu* Hunziker 2001), where *Cestrum*, *Sessea* and *Vestia* have hemitropous ovules (Hunziker 2001; Liscovsky 2007), while the anatropous one is present in *Duckeodendron* (Nee 2004). The place where the ovules are joined to the placenta is apparently uncommon in the family; only *Melananthus* exhibits a single ovule arising near the base of its unicarpelate ovary (Hunziker 2001); the position of this latter genus is very far from *Metternichia* in the morphological (subfamily Cestroideae, tribe Schwenckieae) and phylogenetic systems (subfamily “Schwenckioideae”). To date, the position of the placenta in the basal septum and consequently the place where the ovules arise, as occurs in *Metternichia*, are a particular condition in Solanaceae (*sensu* Hunziker 2001). However, this is a common characteristic in the genera placed in Goetzeaceae (Fuentes Fiallo 2005).

Terminal styles, as in *Metternichia*, are also present in other Solanaceae species (Hunziker 2001) which differs from the subterminal styles observed in Cestreae (Hunziker 2001). None is known in Goetzeaceae or Duckeodendraceae to this respect.

In the family the shape of the stigma can be more or less variable at generic (Bernardello 1986; Rodriguez 2000a, b) or specific levels (Moscone 1986); nevertheless, its position has not been used for taxonomic purposes. The stigma can be erect or deflected, i.e. bent through different angles in relation to the style (*pers. obs.*). Then, the position of the stigma as taxonomic character could be useful when the shape is variable within a group. For example, in Cestreae tribe (*sensu* Hunziker 2001) the stigma exhibits several shapes (Hunziker 2001), but the position is always erected (Liscovsky 2007), while in *Metternichia* it is deflected. This feature is not a particular character of *Metternichia*, because other species exhibit the same pattern (see drawings in Hunziker 2001 and photographs in Carrizo García 2002), such as *Petunia axillaris* (Lam.) Britton, Stern & Poggenb. (subfamily Cestroideae), *Duboisia hopwoodii* F.Muell., and *Grammosolen dixonii* (F.Muell. & R.Tate) Haegi (subfamily Anthocercidoideae) among others. So, this character

could be useful in the delimitation of some groups but in other ones does not reveal any significant association.

The filament insertion level is variable and this character has been used to distinguish some genera (Hunziker 2001). Unlike tribe Cestreae (Hunziker 2001; Liscovsky 2007), *Duckeodendron* (*Barboza pers. obs.*) and the genera of Goetzeaceae (Fuentes Fiallo 2005), where the stamen insertion is dorsal, *Metternichia* has clearly a basal insertion. The available information about the presence of placentoid and crystals is still scarce in the family and at the moment the systematic value of these features is uncertain (Weberling 1992; D’Arcy *et al.* 1996). *Metternichia* develops a noticeable placentoid and crystals in the stomium which are absent in *Cestrum* (D’Arcy *et al.* 1996; Carrizo García 2002), *Sessea* and *Vestia* (Liscovsky 2007) but nothing is known about *Duckeodendron* or the genera of Goetzeaceae to establish a possible relation.

The most striking feature in the floral anatomy of *Metternichia* is its vascularisation pattern. In Solanaceae, the flower vascularisation has been examined in 42 genera (Murray 1945; Armstrong 1986; Bernardello 1986, 1987; Moscone 1986; Rodriguez 1998, 2000a, b; D’Arcy *et al.* 2001; Hamed & Mourad 2004), comprising species of all subfamilies (*sensu* Hunziker 2001). However, some peculiarities are exclusive of *Metternichia*. The process, in which the middle petal bundles, the staminal bundles and the vascular arcs at the base of ovary are developed, has not been reported for any other species of the family. The particularities in this process are: 1) the formation of five vascular V-shaped bundles after the middle sepal bundles divergence; 2) the origin of the median petal and the staminal bundles from the greater bundle of each V-shaped structure; 3) the fusion in pairs of the smaller lateral bundles from adjacent V-shaped structure; and 4) the organization into two opposite arcs at the base of the ovary. *Duckeodendron* and the species of Goetzeaceae have not been included in any vascular analysis of the flower, which could add new evidences to a better understanding of the systematic position of *Metternichia*.

In relation to the other vascularisation features observed in *Metternichia*, this genus shares a common



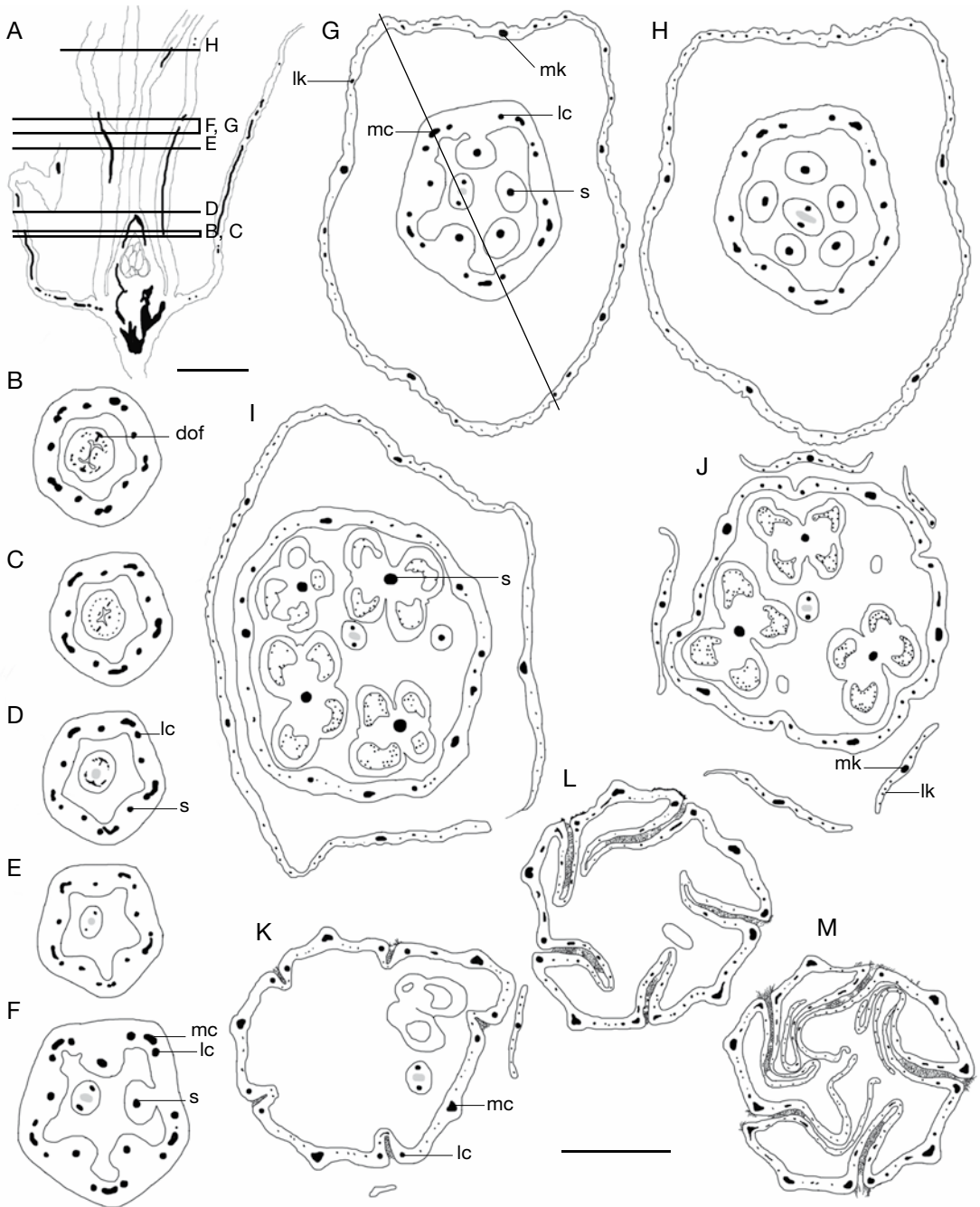


FIG. 4. — *Metternichia principis* J.G.Mikan, *Carvalho s/n*, flower vascularisation: **A**, longitudinal section in immature bud, along plane indicated in G; **B-L**, cross section from ovarian apex to flower apex, as indicated in A (B-F are drawn without sepals). Symbols: blackened areas: vascular tissue; gray areas: transmitting tissue. Abbreviations: **dof**, fusion of dorsal and lateral bundles in the dorsal zone; **lc**, lateral petal bundle; **lk**, lateral sepal bundle; **mc**, median petal bundle; **mk**, median sepal bundle; **s**, staminal bundle.

pattern described for other members of the family. *Metternichia* exhibits a continuous vascular cylinder in the pedicel of the flower. Armstrong (1986) believed that this character was representative of the traditional Cestroideae subfamily. This fact has not been completely supported by Lycieae-Solanoideae (Armstrong 1986; Bernardello 1987), where the vascular cylinder is continuous also in the pedicel.

In the calyx, the main sepal bundle diverges from the siphonostele, while the lateral sepal bundles come from the median sepal bundles and from the distal portion of the median petal trace, this pattern has already been described in other members of Cestroideae (Armstrong 1986). According to Hamed & Mourad (2004), who analysed the calyx vascularisation in the family, the vascular tissue in this whorl verticil shows four possible patterns; the model displayed for *M. principis* corresponds to the fourth pattern described by the authors. Unlike *Metternichia*, in three species of *Cestrum* the first pattern is present, where the lateral bundles only arise from the sepal median. According to the observations from these authors and to the evidence here presented, there is no apparent connection between the calyx vascularisation and the taxonomic rank.

The corolla does not show any particularity, alternating the five main petal bundles with the median sepal bundles and producing two smaller lateral bundles, as it is usual in the family (Armstrong 1986). A similar situation occurs with the nectary which is not supplied by a special vascular tissue, as has been reported for other Solanaceae species (Armstrong 1986; Bernardello 1986; Hunziker 2001), but information about this is lacking for the most related genera of *Metternichia*.

In Solanaceae, the vascular tissue in the base of the ovary can show two patterns, in a circle as occurs in Cestreae (Liscovsky 2007) and other members of the family (Murray 1945; Armstrong 1986; Bernardello 1987; Rodriguez 2000a, b), or in a divided stele (Rodriguez 2000a). Nevertheless, in *Metternichia* the bundles that will finally irrigate the ovary, are fused into two very remarkable arcs, as we explained above; it would be very useful to know if the same situation occurs in other allied genera of

*Metternichia*. In *Humbertia madagascariensis* Lam. (Convolvulaceae) two arcs are present too, but do not result from a fusion of bundles, they seem to result from a rearrangement of the central stele (Deroin 1992). In both species the vasculatures of the gynoecium appear to have kept very primitive features for the family. On the other hand the floral vascularisation in Erycibaeae (Convolvulaceae) presents evident similarities with those basal Solanaceae in particular with Cestreae (Deroin 2002). Whereas the gynoecium of *Cardiochlamys* appears however highly derived by showing a gynophor, and lacking any ovarian septum (Deroin 2004).

Regarding the ventral bundles number of the ovary in Solanaceae, in general there are 1, 2 or 4 (Murray 1945), although in *Nicandra physalodes* (L.) Gaertn. (Nicandreae-Solanoideae) there are 10 bundles (Rodriguez 2000b). In some cases, the number of ventral bundles has been useful to find differences between species of Solanaceae (Moscone 1986; Bernardello 1987; Rodriguez 2000b). *Metternichia* has two pairs of ventral bundles in the base of the ovary (two bundles to each carpel), one pair in the septum from its base to the third upper zone (two heterocarpelate bundles), and four bundles in the superior zone of the septum. The different patterns based on the number of ventral bundles (Armstrong 1986) do not show a taxonomic tendency; however, the reduction of them (from 4 to 1) is considered a derivative character (Murray 1945); according to this proposal, *Metternichia* has a primitive pattern, which is in coincidence with the ancestral lineage attributed by Fay *et al.* (1998) and Santiago-Valentin & Olmstead (2003). On the contrary, members of Cestreae possess two ventral bundles in the base of the septum which join in a single one at half its length (Liscovsky 2007). This condition is a derivative pattern in the family (Murray 1945), and again is coincident with phylogenetic analyses based on molecular data (Santiago-Valentin & Olmstead 2003), where Cestreae is not in a basal placement into Solanaceae.

Finally, the style is commonly supplied by dorsal bundles (Murray 1945; Bhatnagar & Uma 1969; Bernardello 1987; Rodriguez 1998, 2000a, b; D'Arcy *et al.* 2001). In general there are two remarkable dorsal bundles, except in *Nicandra physalodes* where

five dorsal ones were observed (Rodríguez 2000b). In contrast to Cestreae, with the common pattern of the family (Liscovsky 2007), in *Metternichia*, the dorsal bundles are not well differentiated, though in the apex of the dorsal carpellary zone, the dorsal bundles and several lateral bundles fuse resulting in two greater bundles which supply the style all along (Liscovsky 2007).

In conclusion, the vascular characters of *Metternichia* would add evidences in relationship with its position in the family. Vascular analyses of the flower of Goetzeaceae and Duckeodendraceae are necessary for comparative studies.

New evidences support the position of *Metternichia* separated from the Cestreae, as it is currently accepted by morphological (Hunziker 2001) and molecular data (Santiago-Valentin & Olmstead 2003), and its inclusion into the tribe Metternichieae. Additional and varied information is upholding this suggestion: the chromosome number ( $x = 13$ ), the presence of large and echinate pollen grains, the morphology of the seed (javelin-shaped, triquetrous, hilum near the base), and the scanty endosperm (Hunziker 2001). The novel anatomical evidence is: the vascularisation of the flower (at the level of corolla, androecium and in the base of the ovary), and the position of the placenta in the base of septum. We can add other anatomical differences found in relation to Cestreae tribe (Liscovsky 2007) in leaf (the outline of epidermal cells, the kind of trichomes, the presence of druses), stem (the presence of druses and fibres in relation to the internal phloem), gynoeceum (kind of ovules and position of the stigma), androecium (filament insertion, development of stomium, presence of crystals, features of anther wall), fruit (distribution and size of sclerenchymatous cells) and seed (pattern of thickness of epidermal cells).

Finally, through this study some aspects of floral anatomy, especially its vascularisation, put in evidence the necessity to emphasise the careful observation of some characters in comparative studies, such as the origin of the style (terminal or subterminal or nearly so), the shape and position of the stigma, the position of the placenta in relation to the septum, the number of ventral bundles in the ovary, the process to form sepal, petal, androecium and

ovary bundles, the insertion of the filament and the presence of placentoid and crystals in the anther. Those characteristics are factors of variability and potentially with taxonomic value in the family.

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