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TAXONOMIC STUDIES IN MAGONIA ST. HIL. (SAPINDACEAE)

C. A. JOLY, G. M. FELIPPE AND T. S. MELHEM

Joly, C. A., G. M. Felippe (Instituto de Biologia, Universidade Estadual de Campinas, Cidade Universitária, Barão Geraldo, 13100, Campinas, Brasil) and T. S. Melhem (Instituto de Botânica de São Paulo, Brasil). Taxonomic studies in *Magonia* St. Hil. (Sapindaceae). Brittonia 32: 380–386. 1980.—A study analysing the pubescence pattern of leaflets, branchlets and bracts, leaflet size and shape, leaflet apex shape, number of leaflets per leaf, leaflet phyllotaxy, flower size, fruit size and shape, pollinic tetrad size, and exine sculpture pattern of the genus *Magonia* St. Hil. proved that distinction between the two species *M. glabrata* St. Hil. and *M. pubescens* St. Hil. is not possible because of the continuous gradient of these characteristics. The results led to the conclusion that the genus *Magonia* is monospecific, and it was decided that the valid name should be *Magonia pubescens* St. Hil., of which the name *Magonia glabrata* St. Hil. is now a synonym.

Magonia is a typical "cerrado" genus occuring in Paraguay and in the following Brazilian States: Maranhão, Piauí, Ceará, Bahia, Minas Gerais, Goiás, Mato Grosso, Mato Grosso do Sul and São Paulo (Joly & Felippe, 1980).

Magonia was described by St. Hilaire (1824) and was based upon material collected by him between 1816 and 1821 in Minas Gerais. He presented a diagnosis of the genus and described two species, *M. pubescens* and *M. glabrata,* and in 1825 published a more detailed description.

Martius described the same genus under the name *Phaeocarpus,* a name which is invalid because it lacks a complete diagnosis (Radlkofer, 1896). Thus the generic name *Magonia* St. Hil. has been adopted since Radlkofer's revisions of the Sapindaceae (1892–1900, 1965).

The pubescence of the leaflets, branchlets and bracts was used by St. Hilaire (1824) and the shape and size of the fruits by Radlkofer (1892–1900) to distinguish *M. glabrata* from *M. pubescens*. Melhem & Campos (1969) showed that *M. glabrata* had small pollinic tetrads with thick striae and *M. pubescens* larger tetrads with delicate striae.

The present study was conducted to find out if these characteristics or others can be used to separate *M. glabrata* from *M. pubescens*.

Materials and Methods

Collections of *Magonia* from the following herbaria were examined: Museu Nacional (R) and Jardim Botânico (RB) do Rio de Janeiro; Instituto de Botânica de São Paulo (SP); Universidade de Brasilia (UB); Universidade Estadual de Campinas (UEC); Museé National d'Histoire Naturelle de Paris (P), where the type material of the two species of St. Hilaire are deposited. A detailed list of the material examined is given below:

Alvaro Silveira (R 102226)
A. Macedo 427 (SP)
A. Macedo 2572 (SP)
A. P. Duarte 1253 (RB)
Carlos A. Joly 1 (UEC)
Carlos A. Joly 2 (UEC)
Carlos A. Joly 3 (UEC)
Carlos A. Joly 4 (UEC)
Carlos A. Joly 5 (UEC)
Carlos A. Joly 6 (UEC)
Carlos A. Joly 7 (UEC)
Carlos A. Joly 8 (UEC)
Carlos A. Joly 9 (UEC)
Carlos A. Joly 10 (UEC)
Carlos A. Joly 11 (UEC)
Carlos A. Joly 12 (UEC)
Carlos A. Joly 13 (UEC)
Carlos A. Joly 14 (UEC)
Carlos A. Joly 15 (UEC)
Carlos A. Joly 16 (UEC)
Carlos A. Joly 17 (UEC)
Carlos A. Joly 18 (UEC)

Carlos A. Joly 19 (UEC)
Carlos A. Joly 20 (UEC)
Carlos A. Joly 21 (UEC)
Carlos A. Joly 22 (UEC)
Carlos A. Joly 23 (UEC)
Carlos A. Joly 24 (UEC)
Carlos A. Joly 25 (UEC)
Carlos A. Joly 26 (UEC)
Carlos A. Joly 27 (UEC)
Carlos A. Joly 28 (UEC)
Comissão Rondon 542 (R)
Comissão Rondon 544 (R)
Comissão Rondon 4648 (SP)
David R. Hunt et J. F. Ramos 5823 (SP)
D. Sucre et J. F. da Silva 9338 (RB)
E. P. Heringer 12185 (UB)
E. Hassler 10614b (RB)
Fr. Allemão et M. de Cysneiros 249 (R)
Glaziou 9714 (R)
Glaziou 12500 (R)
Glaziou 20864 (R)
G. Felippe et al. (UEC 7352)
G. Hatschbach 24600 (UEC)
G. Nunes 76 (RB)
Goro Hashimoto 669 (SP)
G. O. Malme 1923 (R)
H. J. Irwin et T. R. Soderstrom 5492 (RB)
J. A. Ratter 107 (UB)
J. A. Ratter 267 (UB)
J. A. Ratter et J. Ramos 381 (UB)
J. A. Ratter 1908 (UB)
J. E. de Oliveira (R 66249)
J. G. Kuhlmann 89 (RB)
J. G. Kuhlmann (RB 148762)
J. Mattos (SP 131304)
Labouriau et Válio 1223 (SP)
L. Labouriau et Válio 1237 (SP)
L. H. Correa de Sá (RB 77984)
Markgraf, Mello Barreto et Brade 3183 (RB)
Mello Barreto 6086 (R)
Miranda Bastos 48 (RB)
P. Campos Porto 2559 (RB)
P. Gibbs et al. (UEC 2001)
P. Gibbs et al. (UEC 8424)
Saint Hilaire B[1] 1745 (P)
Saint Hilaire B[1] 1886 (P)
Schwake 1236 (R)
Tecla Hartmann 85 (SP)
Ynes Mexia 5618 (R)
Zehntner 338 (R)
Zehntner 405 (RB)

Fresh material, collected in the "cerrado" of Campininha, Moji Guaçu, São Paulo State (22°15′S and 47°09′W) and deposited in the herbaria of the Universidade Estadual de Campinas (UEC), Brazil, was also studied. This material will be referred to as Campininha material.

The pubescence of leaflets was examined (under a Zeiss stereomicroscope) and classified according to the following patterns:

pattern I—adaxial surface with hairs only on the midrib and abaxial surface hairless;

pattern II—adaxial surface with hairs on the midrib and secondary veins and abaxial surface hairless or with hairs on the midrib and/or secondary veins; and

pattern III—adaxial and abaxial surfaces with hairs on the midrib and secondary and tertiary veins.

Patterns I and III were used to distinguish *M. glabrata* and *M. pubescens,* respectively, by St. Hilaire (1824, 1825).

Seeds from various fruits were germinated in Petri dishes. The seedlings were transferred to pots, and after two months the pubescence of all leaflets was examined.

The shape and size of the fruit, described by Radlkofer (1892–1900) as trigonous and small (8.5–9.0 cm wide) in *M. pubescens* and subhexagonal and larger (9.5–10.0 cm wide) in *M. glabrata,* were studied.

Size was measured with a sliding caliper and the fruits were assigned to class intervals of 0.9 cm and plotted on a graph. An attempt was made to correlate shape and size of fruits with the pubescence pattern of leaflets, as proposed by Radlkofer (1892–1900, 1965).

The length and the width (at the middle) of the leaflets were measured, the presence of a mucro and the shape of the leaflet apex were observed and the phyllotaxy and number of leaflets per leaf were determined. At least 10 leaflets per plant were examined.

Length and width of petals and sepals were measured. The larger axis of the petal was considered as the length, and the width was always measured at the

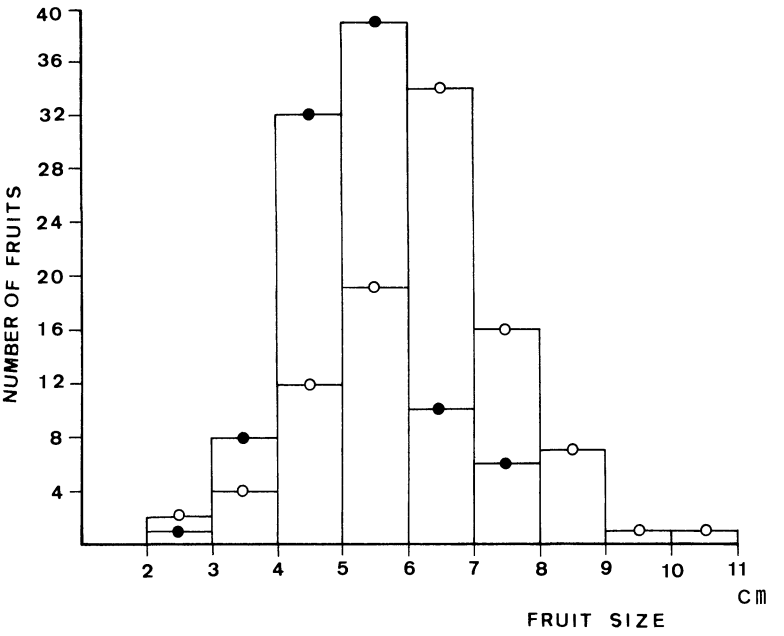

FIG. 1. Distribution of width (open circles) and height (closed circles) of *Magonia* fruits.

most expanded apical region. Sepal width was measured at the base. *Magonia* has a zygomorphic calyx, with two types of sepals: type *a* with the length twice the width and type *b* with the length 1.5 times the width.

For palynological study, material was obtained from at least two flowers from each specimen. Several specimens were studied, but the statistical analysis was done using the following materials:

Carlos A. Joly 12 (UEC)
Carlos A. Joly 14 (UEC)
G. M. Nunes 76 (RB)
J. G. Kuhlmann (RB 148762)
M. A. Lisboa 2336 (RB)
P. Gibbs et al. (UEC 8424)
St. Hilaire B[1] 1745 (P)
St. Hilaire B[1] 1886 (P)

Because preliminary studies had shown that no differences could be seen between the pollen grains of male and of hermaphrodite flowers, only male flowers were used. The tetrads were prepared by acetolysis (Erdtman, 1960), and the pollen tetrads were observed in permanent glycerin jelly with cover slip and paraffin sealing (Melhem & Mattos, 1972).

Measurements were taken from 25 tetrads from at least two flowers of each plant. The tetrads were measured in the position proposed by Melhem & Campos (1969). The measurements were made with a binocular Zeiss microscope with a ×12.5 eye piece and an ocular of ×40. Significant differences between tetrads were tested by the use of 95% confidence limits.

The sculpture of the exine was analysed with ×625 and ×1562.5 enlargement and from photographs taken with a Zeiss photomicroscope with an enlargement of ×160 or ×400.

Results

Analysis of the pubescence patterns of herbarium specimens showed that 26 percent of them did not fit either as pattern III (*M. pubescens*) or pattern I (*M.*

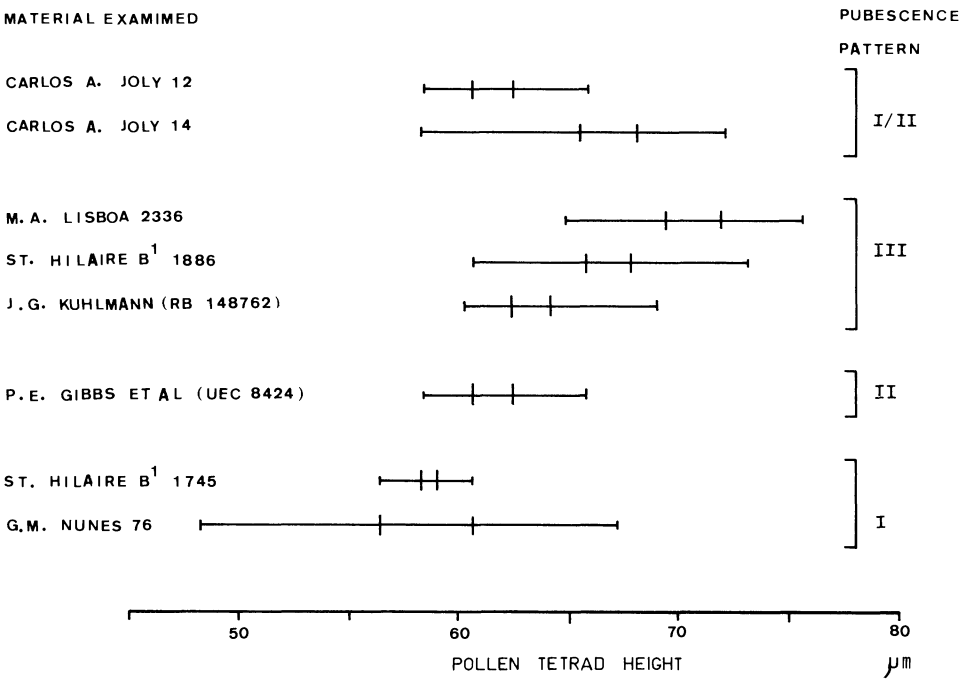

FIG. 2. Relationship between pollen tetrad height and leaflet pubescence patterns. The range of measurements and the 95% confidence limits are shown.

glabrata) but matched pattern II. Individual leaflets could be classified by these three patterns, but leaflets of different patterns were found within the same leaf. Of leaf specimens from Campininha, 12 percent could be classified as pattern I, 12 percent as pattern II, 40 percent as pattern III and 36 percent as a mixture of patterns I and II (I/II). These results show that there is a gradient in leaflet pubescence patterns. This gradient of leaflet pubescence was accompanied by a gradient of pubescence of the branchlets and bracts. This latter gradient was not very evident on herbarium material (due to hairs being lost) but was easily recognized in fresh material. In Campininha, leaflet pubescence was observed on various trees in the *Magonia* population. On a single tree it was possible to recognize leaves of which all the leaflets belonged to pattern I or pattern II as well as leaves of which some leaflets belonged to pattern I and some to pattern II.

Analysis of the seedlings grown from fruits collected in Campininha from trees with leaflets with pubescence pattern II (4 fruits) showed wide variation in pubescence: 45 percent of the seedlings had leaves with all leaflets of pubescence pattern I, 17.5 percent had leaves with all leaflets of pattern II and 37.5 percent had leaves with leaflets of both patterns I and II. Seedlings grown from fruits collected from trees with leaflets with pubescence pattern III (2 fruits) produced leaves of which all leaflets were of pattern III. Seedlings from fruits from trees in which the pubescence pattern was not known were also examined. Fruit 1 produced seedlings of which 22.2 percent had leaves with leaflets of pubescence pattern I, 55.5 percent had leaves with leaflets of pubescence pattern II and 22.2 percent produced leaves with leaflets of patterns I and II. Of the seedlings from fruit 2, 50 percent had leaves with all leaflets of pattern I, 10 percent with all

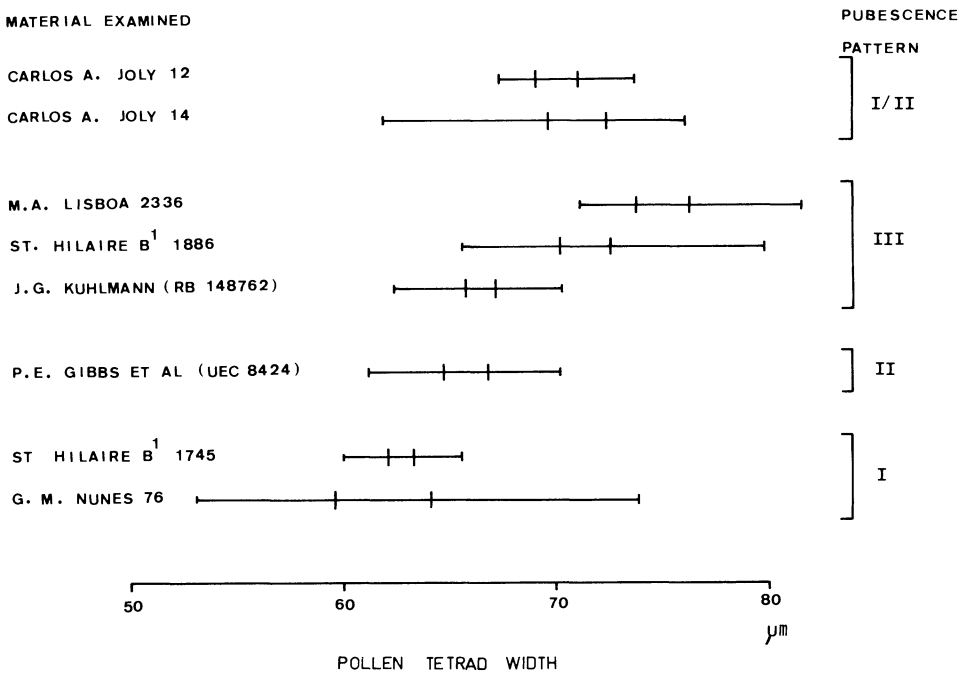

FIG. 3. Relationship between pollen tetrad width and leaflet pubescence patterns. The range of measurements and the 95% confidence limits are shown.

leaflets of pattern II and 40 percent leaves with leaflets of patterns I and II. In conclusion pubescence patterns of leaflets cannot be used to define species of *Magonia*.

The study of the size and shape of fruits was based on the Campininha material because herbarium material, for the most part had none. The distribution of the fruit size data, when divided into classes, proved to be normal (Fig. 1). The measurements of fruit size showed a gradient in the population, and there is no relationship between size of the fruits and the pubescence pattern of the tree. There is a gradient in fruit shape from trigonous to almost spherical, and fruits of various shapes were collected from the same tree. It was not possible to find any correlation of fruit shape and size with leaflet pubescence. Thus, size and shape of fruits cannot be used to separate *M. pubescens* from *M. glabrata*.

A gradient of size occurs in height and width of pollen tetrads. It was not possible to find a correlation between the pubescence pattern of the leaflets of the studied material and tetrad size (Figs. 2 & 3).

Analysis of the exine pattern of pollen grains showed two distinct patterns. Figure 4 shows the rugulate exine pattern found only in specimens with leaflet pubescence pattern I. Figure 5 shows the striate type found in specimens with pubescence patterns I/II, II and III. However, the type material of *Magonia glabrata* exhibited pubescence pattern I and tetrad size typical of material with pubescence pattern I but exhibited striate exine sculpture. Thus, the pollen is another character that cannot be used to separate *M. pubescens* from *M. glabrata*.

Several other characteristics were studied to see if any of these could be used to separate species.

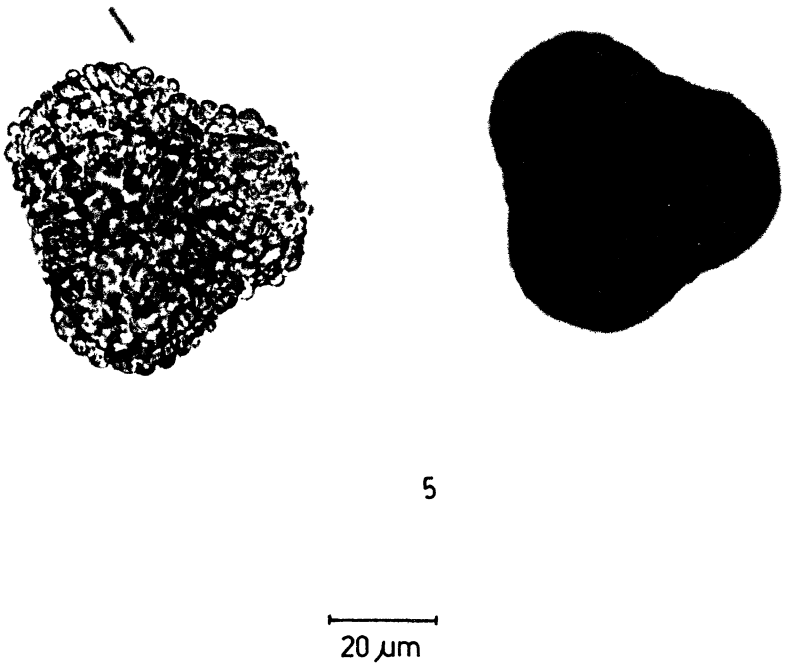

FIG. 4. Tetrad of *Magonia* with rugulate exine sculpture.
FIG. 5. Tetrad of *Magonia* with striate exine sculpture.

The length of the leaflets varied from 1.2 to 12.1 cm, their width from 1.0 to 5.6 cm and the mean number of leaflets per leaf varied from 5 to 12. In all cases there was a gradual variation from the smaller to the higher number. The shape of the leaflet apex varied from obtuse to emarginate and the phyllotaxy of the leaflets from subopposite to alternate. All leaflets examined possessed a definite mucro. The petal length varied from 4.5 to 17.0 mm and the width from 1.0 to 4.0 mm. The length of type *a* sepals varied from 2.8 to 3.7 mm and the width from 1.3 to 1.7 mm. The length of type *b* sepals varied from 2.4 to 3.2 mm and the width from 1.6 to 1.9 mm. The size of the flowers varied within the same tree. In some specimens both hermaphrodite and male flowers were measured, and the hermaphrodite flowers were found to be larger (petals = 13.24 mm ± 0.79) than the male flowers (petals = 10.97 mm ± 1.41). Again there were gradients in all these characteristics, and thus none is useful in species separation.

Discussion

The analysis of the results showed that the pubescence characters used by St. Hilaire (1824, 1825) and Radlkofer (1892–1900, 1965) to separate these two species are invalid and cannot be used to separate the two species.

The normal distribution of fruit sizes and the variation of fruit shape within a tree prove that the second character used by Radlkofer (1892–1900, 1965) cannot

be used to separate *M. pubescens* from *M. glabrata*. The fruit size data obtained here also showed that the dimensions given by Radlkofer (7.0 cm high and 8.5–9.0 cm wide for *M. pubescens* and 7.0 cm high and 9.5–10.0 cm wide for *M. glabrata*) represent the extremes in size.

All other characters studied also showed continuous gradients and none of these adequately distinguishes the two species.

It was impossible to correlate pollen exine sculpture patterns with the other characteristics considered. Striate patterns were found in specimens with pubescence patterns I, II, III and I/II. This shows that the use of exine sculpture to distinguish these two species is not possible.

Analysis of the results presented here shows that it is impossible to separate *M. glabrata* from *M. pubescens,* hence the genus *Magonia* St. Hil. is monospecific. As the leaflets always have hairs, at least on the adaxial surface of the midrib and as neither name has priority, we decided to maintain *Magonia pubescens* St. Hil. as the valid name, and to place *Magonia glabrata* St. Hil. as a synonym. The diagnosis of the genus *Magonia* St. Hil. now becomes the diagnosis of the single species, *Magonia pubescens.*

Acknowledgments

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