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Cytogenetics of twelve species of Malpighiaceae A. Juss. from Southeastern Brazil

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Abstract - The family Malpighiaceae shows a great chromosomal number diversity, with polyploidy and disploidy between and within species. Cytological studies have played an important role in the taxonomy of Malpighiaceae. In the present work we studied twelve species and present the chromosome numbers and for seven of them karyomorphological characters and chromosomal ideograms. The chromosomes are predominantly small and metacentric. No meiotic abnormalities were found, and they presented a high viable pollen index. We analyzed the relationship between the taxonomic distribution of taxa and the distribution of chromosomal numbers in Malpighiaceae species. The sub-family Malpighioideae presents chromosome numbers based on x=5 and the sub-family Byrsonimoideae presents numbers based on x=6. The basic number x=5 for Malpighiaceae is a new proposal, supported by some counts for the genera *Banisteriopsis*, *Heteropterys*, *Peixotoa* and *Tetrapterys*.

Key words: basic number, Byrsonimoideae, cytotaxonomy, karyomorphology, Malpighioideae.

INTRODUCTION

The Malpighiaceae family comprises about 71 genera and 1250 species, well distributed in the New World, with 950 species of 41 genera (MAKINO-WATANABE 1988). Although Malpighiaceae usually present climbing habit, shrubs and threes can be observed (ROBERTSON 1972). The family is taxonomically divided in two subfamilies: Malpighioideae and Byrsonimoideae. Malpighioideae usually present climbers with winged fruits, while Byrsonimoideae show shrub-trees species with non-winged fruits, most of which are drupes.

Because of its ecological and geographic amplitude, the family Malpighiaceae presents a great diversity of habits, fruit types and pollen grains (MAKINO-WATANABE 1988). Besides its morphological diversity, this family shows a remarkable variety of chromosomal number reports. With regard to Malpighiaceae, the literature cites n= 6, 9, 10, 11, 12, 17, 19, 20, 21, 26, 27, 28, 29 and 42. SINGHAL *et al.* (1985) mention a great chromosome diversity for the family, that involves inter and intra-specific polyploidy and disploidy. There are reports of intra-generic and even intra-specific chromosomal number variations. In addition to numeric variation, a few papers bring karyomorphological data showing considerable chromosomal length variety. The most common chromosome shape is small and metacentric (RILEY and HOFF 1961; DIFULVIO 1979; DEVAR and BORAIAH 1981; LOMBELLO and FORNI-MARTINS 1998).

Cytogenetic works were important in taxonomic position of species into the family Malpighiaceae. ANDERSON (1993) situates the genera *Bunchosia*, *Dicella* and *Thryallis* in the sub-family Malpighioideae, based on their chromosomal numbers. Rather than contributing to the cytogenetic knowledge of the family

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Table 1 – Studied species with their chromosome numbers (*n* and 2*n*), vouchers (L-Lombello and FM-Forni-Martins) and locality of collect in Brazil.

Species	*n*	2*n*	Voucher	Locality
Bunchosia armeniaca (Cav.) Rich.*	-	60	L.49	Campinas-SP**
Byrsonima intermedia A. Juss.	12	-	FM	Itirapina-SP
Camarea ericoides St. Hill.	17	-	L.36	Carrancas-MG
Dicella bracteosa (A. Juss.) Griseb.	10	20	L.10	Campinas-SP
Galphimia brasiliensis (L.) A. Juss.*	-	24	L.50	Campinas-SP**
Janusia guaranítica (St. Hill.) A. Juss.	-	40	L.58	Americana-SP
Mascagnia anisopetala (A. Juss.) Griseb.	30	60	L.17	Campinas-SP
Mascagnia cordifolia (A. Juss.) Griseb.	-	40	L.26	Campinas-SP
Mascagnia sepium (A. Juss.) Griseb.*	10	-	L.21	Campinas-SP
Peixotoa tomentosa A. Juss.*	10	20	L.39	Carrancas-MG
Tetrapterys phlomoides (Sprengel) Niedenzu*	-	50	L.29	Mogi-Mirim-SP
Tetrapterys sp.*	10	-	L.15	Mogi-Mirim-SP

* Unpublished count, **cultivate species

Malpighiaceae, this paper is intended to analyze the relationship between cytogenetic data and the taxonomy organization based on morphological and geographical aspects.

MATERIALS AND METHODS

Seeds and floral buds of Malpighiaceae species collected from areas of cerrado (Mogi-Mirim-SP, Itirapina-SP, Carrancas-MG) and forest (Santa Genebra Forest Reserve, Campinas-SP). Some cultivated species were also studied. They were collected in the district of Barão Geraldo, Campinas-SP and in the municipality of Americana-SP. Vouchers of all studied species are deposited at the UEC herbarium (Table 1). Seeds were germinated in Petri dishes. Root tips were pre-treated with PDB in saturated solution for 3 to 5 hours, at 16-18°C. This material was fixed with Carnoy's solution (alcohol 3:1 acetic acid, v/v).

The root tips were hydrolyzed with HCl 5N and stained with Giemsa (GUERRA 1983). The anthers of floral buds were squashed with acetic carmine. The chromosome ideograms were based on 10 cells for each species. The nomenclature rule used for chromosome classification is that proposed by LEVAN *et al.* (1964) modified by GUERRA (1986).

RESULTS

Twelve chromosomal numbers were obtained. As for *Byrsonima intermedia, Camarea ericoides, Mascagnia sepium* and *Tetrapterys* sp. only haploid numbers were obtained. As for *Bunchosia armeniaca, Galphimia brasiliensis, Janusia guaranitica, Mascagnia cordifolia* and *Tetrapterys phlomoides* only diploid numbers were observed. *Dicella bracteosa, Mascagnia anisopetala* and *Peixotoa tomentosa* showed both haploid and diploid numbers (Table 1, Fig. 1).

All the studied species showed relative small chromosomes except *Galphimia brasiliensis* and *Bunchosia armeniaca* (Figs. 1 and 2), which longest chromosomes are 8.4 µm and 5.1 µm long, respectively (Table 2). With regard to the other 10 studied species, *Dicella bracteosa* showed the longest chromosomes, 3.7 µm (Table 2). As a pattern, we noticed small and metacentric chromosomes were predominant (Table 2, Fig. 2). For seven species we presented the total chromatin length (TCL) and the TF% index (HUZIWARA 1962) (Table 2).

No abnormality was observed in the meiotic process (Fig. 1). The indexes of viable pollens were high: *Byrsonima intermedia* (96.53%),

Table 2 – Chromosome lengths, total chromatin length (TCL), TF% index (HUZIWARA 1962) and karyotype formula (K.F.).

Species	Lengths	TCL	TF%	K.F.
Bunchosia armeniaca (Cav.) Rich.	2.2 ± 0.31 – 5.1 ± 0.84	202.2 ± 27.2	45.10	26m+4sm
Dicella bracteosa (A. Juss.) Griseb.	2.0 ± 0.22 – 3.7 ± 0.57	56.4 ± 7.84	43.97	8m+2sm
Galphimia brasiliensis (L.) A. Juss.	3.8 ± 0.42 – 8.4 ± 0.83	143.8 ± 9.22	44.08	11m+1sm
Janusia guaranítica (St. Hill.) A. Juss.	1.1 ± 0.14 – 2.6 ± 0.41	74.0 ± 8.64	41.08	14m+6sm
Mascagnia anisopetala (A. Juss.) Griseb.	1.1 ± 0.08 – 2.1 ± 0.10	94.0 ± 4.01	45.95	28m+2sm
Mascagnia cordifolia (A. Juss.) Griseb.	1.4 ± 0.15 – 3.2 ± 0.67	80.4 ± 8.14	42.78	17m+3sm
Tetrapterys phlomoides (Sprengel) Niedenzu	1.5 ± 0.05 – 3.2 ± 0.48	105.4 ± 11.8	44.20	22m+3sm

Carnarea ericoides (94.4%), *Dicella bracteosa* (95.54%), *Mascagnia sepium* (88.86%) and *Peixotoa tomentosa* (92.62%).

DISCUSSION

Six of the chromosomal numbers now reported have never been presented before (Table 1). The populations studied have never been cytogenetically investigated, except for *Mascagnia anisopetala*, studied by LOMBELLO and FORNI-MARTINS (1998). Besides the haploid number now presented for *Mascagnia anisopetala*, karyological data of this species were observed for the first time (Table 3). It made it possible to construct their ideograms (Fig. 2).

The inter- and intraspecific chromosomal number variation will be discussed within the respective sub-tribes, tribes and sub-families, following the family structure proposed by NIEDENZU (1928), modified by MORTON (1968), ANDERSON (1977, 1993) and VOGEL (1990) where two sub-families are considered: Malpighioideae and Byrsonimoideae.

Chromosomal Numbers of Malpighioideae

This sub-family is divided into 5 tribes, with chromosomal number reports for 4 tribes: Banisterieae, Hiptageae, Gaudichaudieae and Tricomaricae (Table 3). Among the genera with the highest number of studied species, only *Camarea* did not present a chromosomal number that is a multiple of 10 (Table 3).

Only one chromosomal number differed from those here reported: $2n$=40 for *Janusia guaranitica*, in contrast with n=19 reported by ANDERSON (1993) (Table 3). All the reported

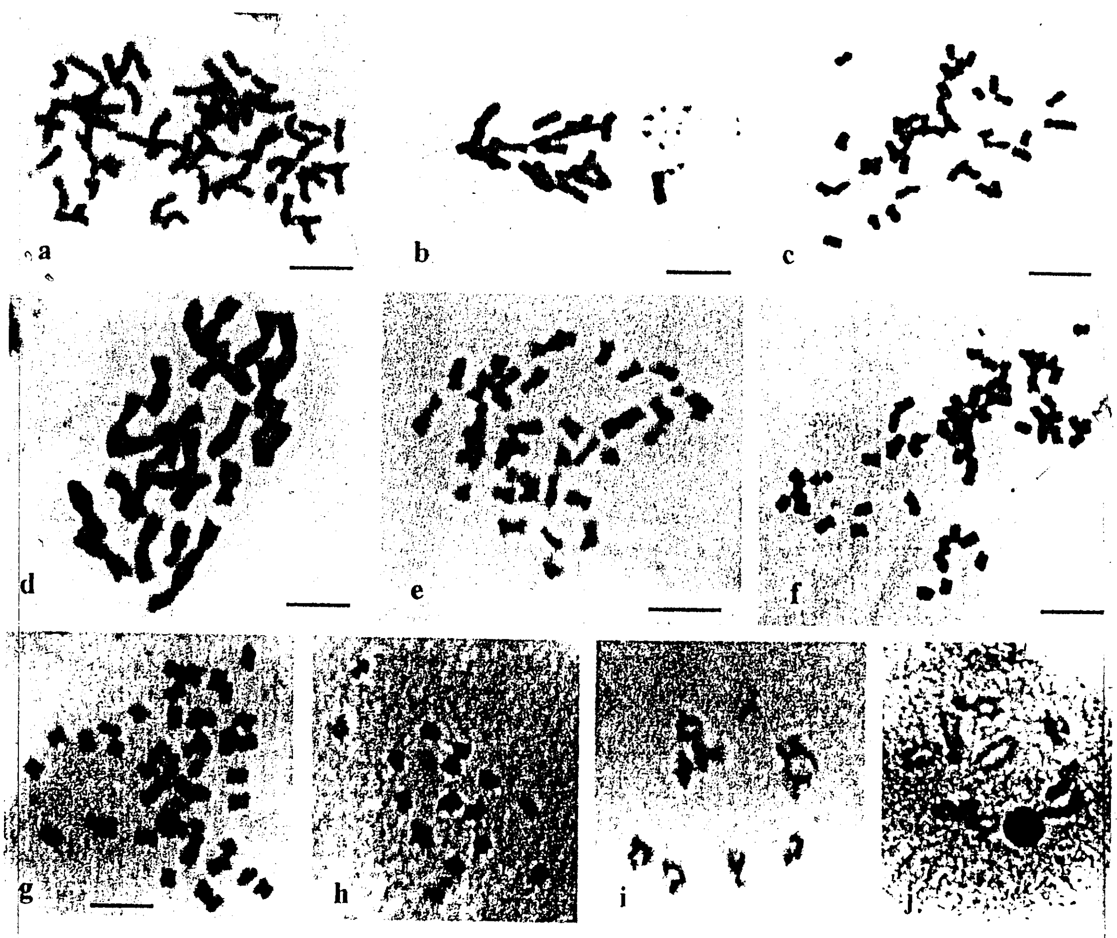

Fig.1 – Mitotic metaphases of A: *Bunichosia armeniaca* ($2n$=60), B: *Dicella bracteosa* ($2n$=20), C: *Mascagnia cordifolia* ($2n$=40) D: *Galphimia brasiliensis* ($2n$=24), E: *Janusia guaranitica* ($2n$=40), F: *Mascagnia anisopetala* ($2n$=60), G: *Tetrapterys phlomoides* ($2n$=50), H: *Camarea ericoides* (n=17), I: *Mascagnia sepium* (n=10), J: *Peixotoa tomentosa* (n=10). Bar 5μm.

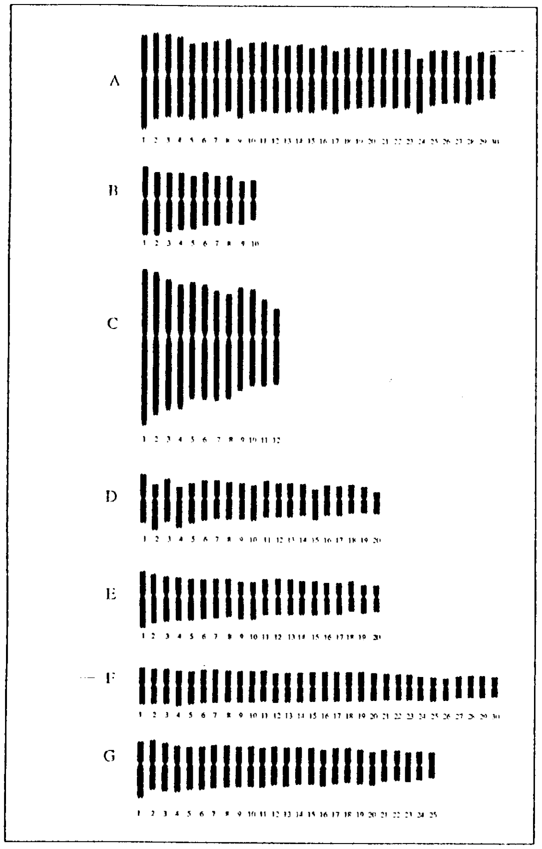

Fig. 2 – Ideograms of A: *Bunchosia armeniaca* ($2n$=60), B: *Dicella bracteosa* ($2n$=20), C: *Galphimia brasiliensis* ($2n$=24), D: *Janusia guaranítica* (2n=40), E: *Mascagnia cordifolia* ($2n$=40), F: *Mascagnia anisopetala* ($2n$=60), G: *Tetrapterys phlomoides* ($2n$=50). Bar 5μm.

counts on the genera indicate a polyploid series based on x=10.

Bunchosia armeniaca presented $2n$=60, and is one of the several cases of polyploidy in the family (Table 3). There is only one report for *Bunchosia* in the literature: *Bunchosia montana* A. Juss. with n=20 (ANDERSON 1993), also polyploid, which ANDERSON (1993) includes into the subfamily Malpighioideae. The chromosomal number based on x=10 seems to confirm this position, although its relatively big chromosomes (Table 2) differ from those presented by the species of this group. *Bunchosia* belongs to a still indeterminate tribe (Table 3).

Carnarea ericoides, n=17, seems to originate from an n=20 ancestral aneuploidy, as ANDERSON (1993) pointed out in his comparative study of *Carnarea* and *Aspicarpa* (n=20 or 40). Our results agree with that presented by ANDERSON (1993) for those species. The other three species studied by this author showed the same chromosomal numbers (Table 3). MAMEDE (1990) includes *Camarea* in the sub-family Malpighioideae, tribe Gaudichaudieae. ANDERSON (1993) agrees with this arrangement, although he considers that its chromosomal number is more related to those presented by the species of the Byrsonimoideae sub-family.

Dicella bracteosa, with n=10 and $2n$=20, showed the same count presented by ANDERSON (1993) for this species (Table 3). This count is also coherent with those presented in the literature for the sub-family Malpighioideae. ANDERSON (1993) used the basic number x=10 presented by the genus to include this genus into Malpighioideae, in spite of its non-winged fruits. Most Malpighioideae genera, like *Banisteriopsis* and *Heteropterys*, present winged fruits. As *Bunchosia*, *Dicella* belongs to an indeterminate tribe.

In the genus *Mascagnia* we observed a polyploid series based on x=10 in the three studied species. The diploid number $2n$=40 presented for *Mascagnia cordifolia* agrees with the haploid number n=20 presented by ANDERSON (1993) for this species (Table 3).

Peixotoa tomentosa, with n=10 and $2n$=20 (Table 1), presented count coherent with those found by ORMOND *et al.* (1981), FORNI-MARTINS *et al.* (1989) and ANDERSON (1993) for some species of *Peixotoa*. ANDERSON (1993) presented n=15 for *Peixotoa reticulata* Griseb. FORNI-MARTINS *et al.* (1995) showed the same count for an indeterminate *Peixotoa*. It would be very interesting to investigate the similarity between the two species studied in these works. For the indeterminate *Peixotoa* FORNI-MATINS *et al.* (1995) observed trivalents in diakinesis, with some irregularities in the anaphase I chromosome disjunction. This species shows a high index of unviable pollen. ANDERSON (1993) did not observe abnormalities in the meiotic process. As for *Peixotoa*, the possible basic number x=5 may be considered. This hypothesis could explain the occurrence of haploid numbers n=15.

The diploid number $2n$=50 of *Tetrapterys phlomoides* represents the first count for the genus. As observed for *Peixotoa*, the diploid number $2n$=50 represents a possible polyploid number based on x=5.

The chromosomal numbers here obtained seem to rectify ANDERSON's (1977) hypothesis that x=10 is the most representative basic number

Table 3 – Malpighiaceae species with chromosome number reports, located into their tribes and sub-tribes, based on systematic of NIEDENZU (1928), MORTON (1968), ANDERSON (1977, 1993) and VOGEL (1990).

Sub-family	Tribe	Sub-tribe	Species	n	2n	Authors
Malpighioideae	Banisterieae	Banisteriinae	*Banisteriopsis acapulcensis*	10	-	GATES 1982
			B. acerosa	10	-	GATES 1982
			B. andersonii	10	-	ANDERSON 1993
			B. angustifolia	10	-	ANDERSON 1993
			B. argyrophylla	10	-	GATES 1982
			B. caapi	-	20	BALDWIN 1946
			B. campestris	10	-	LOMBELLO 2000
			B. cipoensis	10	-	ANDERSON 1993
			B. hypercifolia	10	-	GATES 1982
			B. laevifolia	10	-	GATES 1982
			B. muricata	20	-	GATES 1982
			B. oxyclada	10	-	GATES 1982
			B. pubipetala	-	20	LOMBELLO 2000
			B. pulchra	10	-	GATES 1982
			B. stellaris	-	80	LOMBELLO 2000
			B. valvata	10	-	ANDERSON 1993
			B. vernoniifolia	10	-	GATES 1982
			Cordobia argentea	9	-	ANDERSON 1993
			Heteropterys angustifolia	-	34	SEMPLE 1970
			H. anoptera	-	20	LOMBELLO 2000
			H. byrsonimifolia	10	-	ANDERSON 1993
			H. campestris	10	-	ANDERSON 1993
			H. chrysophylla	10	20	LOMBELLO 2000
			H. coleoptera	10	-	ORMOND *et al.* 1981
			H. escallonifolia	10	-	ANDERSON 1993
			H. hypercifolia	10	-	DIFULVIO 1979
				-	20	MANGENOT and MANGENOT 1962
			H. leona	-	42, 56	ROY and MISHRA 1962
				-	58	PAL 1964
			H. lundeniana	-	30	NAZEER and MADUSOODANAN 1981
			H. pteropetala	-	20	LOMBELLO 2000
			H. salicifolia	-	30	CHEN AND HUANG 1989
			H. sericea	10	-	ANDERSON 1993
			Jubelina magnifica	10	-	ANDERSON 1993
			Peixotoa glabra	10	-	ANDERSON 1993
			P. hispidula	10	-	ORMOND *et al.* 1981
			P. reticulata	15	-	ANDERSON 1993
			P. tomentosa	10	20	PRESENT WORK
			Peixotoa sp	-	30	FORNI-MARTINS *et al.* 1989
			Stigmaphyllon ciliatum	-	18	SNOAD 1955
				-	20	PAL 1964
			S. jatrophifolium	10	-	ANDERSON 1993
			S. lacunosum	-	20	PAL 1964
			S. lalandianum	10	-	LOMBELLO and FORNI-MARTINS 1998
			S. littorales	-	22	ROY and MISHRA 1962
			S. paralias	10	-	ORMOND *et al.* 1981
			S. periplocaefolium	-	20	PAL 1964
				10	-	SINGHAL *et al.* 1985
			S. retusum	10	-	ANDERSON 1993
		Sphedamno-carpinae	*Acridocarpus longiflolius*	-	18	MANGENOT and MANGENOT 1958
			A. smeathmannii	-	18	MANGENOT and MANGENOT 1958
			A. austrocaledonicus	9	-	CAN and MCPHERSON 1986
			Sphedamnocarpus pruriensis	-	20	PAIVA and LEITÃO 1987
	Hiptageae	Aspidopteri-diinae	*Hiptage benghalensis*	-	42, 56	ROY and MISHRA 1962
				-	58	PAL 1964
				-	56+0-1b	BIR *et al.* 1980
				30	-	GILL *et al.* 1990
				28	-	SANDHU and MAN 1988
			Triaspis nelsonii	-	20	RILEY and HOFF 1961
			T. odorata	-	20	MANGENOT and MANGENOT 1958
			Tristellateia australis	-	18	RAMAN and KESAVAN 1963
			Barnebya harleyi	29(30)	-	ANDERSON 1993

Sub-family	Tribe	Sub-tribe	Species	n	2n	Authors
Malpighioideae	Hiptageae	Mascagniinae	*Callaeum macropterum*	10	-	BAKER and PARFITT 1986
			C. septentrionale	10	-	ANDERSON 1993
			Diacidia rufa	23(24)	-	ANDERSON 1993
			Ectopopterys soejartoi	8	-	ANDERSON 1993
			Jubelina magnifica	10	-	ANDERSON 1990
			Mascagnia anisopetala	30	-	PRESENT WORK
				-	60	LOMBELLO and FORNI-MARTINS 1998
			M. cordifolia	20	-	ANDERSON 1993
				-	40	PRESENT WORK
			M. polybotrya	10	-	ANDERSON 1993
			M. sepium	10	-	PRESENT WORK
			Malpighia coccigera	10	-	SARKAR *et al.* 1973
				-	20	GAJAPATHY 1962
			M. glabra	10	-	BAWA 1973
				20	-	SARKAR *et al.* 1980
				-	20	PANDEY and PAL 1980
				-	40	PAL 1964
			M. punicifolia	-	20	SARKAR *et al.* 1982
			Mionandra camareoides	10	-	BERNARDELLO *et al.* 1990
			Tetrapterys phlomoides	-	50	PRESENT WORK
			Tetrapterys sp.	10	-	PRESENT WORK
	Tricomarieae		*Echinopterys eglandulosa*	10,20	-	ANDERSON 1993
	Gaudichaudieae		*Aspicarpa brevipes*	40	-	ANDERSON 1993
			A. harleyi	40	-	ANDERSON 1993
			A. humilis	40	-	ANDERSON 1993
			A. hyssopifolia	40	-	ANDERSON 1993
			A. pulchella	40	-	ANDERSON 1993
			A. schininii	20	-	ANDERSON 1993
			Camarea affinis	17	-	ANDERSON 1993
			C. axillaris	17	-	ANDERSON 1993
			C. ericoides	17	-	ANDERSON 1993
			C. hirsuta	17	-	ANDERSON 1993
			Gaudichaudia albida	40	-	ANDERSON 1993
			G. chasei	40	-	ANDERSON 1993
			G. cycloptera	40	-	ANDERSON 1993
			G. sp. aff. *cycloptera*	80	-	ANDERSON 1993
			G. diandra	40	-	ANDERSON 1993
			G. galeottiana	40	-	ANDERSON 1993
			G. krusei	40	-	ANDERSON 1993
			G. mcvaughii	40	-	ANDERSON 1993
			Gaudichaudia sp.	80	-	ANDERSON 1993
			Gaudichaudia sp.	80,120	-	ANDERSON 1993
			G. subverticulata	40	-	ANDERSON 1993
			Janusia anisandra	40	-	ANDERSON 1993
			J. californica	10	-	ANDERSON 1993
			J. gracilia	20	-	ANDERSON 1993
			J. guaranitica	19	-	ANDERSON 1993
				-	40	PRESENT WORK
			J. janusoides	20	-	ANDERSON 1993
			J. lindmanii	20	-	ANDERSON 1993
			J. linearis	10	-	ANDERSON 1993
			J. mediterranea	20	-	ANDERSON 1993
			J. occhionii	20	-	ANDERSON 1993
			J. prancei	20	-	ANDERSON 1993
			J. shwannioides	20	-	ANDERSON 1993
			Peregrina linearifolia	19	-	ANDERSON 1985
	Indeterminate		*Bunchosia montana*	20	-	ANDERSON 1993
			B. armeniaca	30	60	PRESENT WORK
			Dicella bracteosa	10	-	ANDERSON 1993
				-	20	PRESENT WORK
			Thryallis longifolia	(29)30	-	ANDERSON 1993

Sub-family	Tribe	Sub-tribe	Species	n	2n	Authors
Byrsonimoideae	Galphimieae		*Blepharandra hypoleuca*	12	-	ANDERSON 1993
			Galphimia angustifolia	12	-	ANDERSON 1993
			G. brasiliensis	-	24	PRESENT WORK
			G. glauca	6	-	SEAVEY 1975
				-	20	TAKAGI 1938
				-	24	NANDA 1962
				-	12	KYHOS 1966
			G. gracilis	-	24	ROY and MISHRA 1962
				12	-	LEWIS and OLIVER 1970
			G. nitida	-	24	RAMAN and KESAVAN 1963
			G. angustifolia	12	-	LEWIS and OLIVER 1970
			Lophanthera lactescens	6	-	ANDERSON 1983
				-	12	LEWIS and OLIVER 1970
			L. hammelii	6	-	ANDERSON 1993
			Pterandra egleri	12	-	ANDERSON 1993
			Verrucularia glaucophylla	6	-	ANDERSON 1993
	Byrsoniminae		*Byrsonima basiloba*	12	-	ANDERSON 1993
			B. crassifolia	-	20	NANDA 1962
				12	-	BAWA 1973
			B. coccolobifolia	12	-	FORNI-MARTINS *et al.* 1992
				-	24	FORNI-MARTINS *et al.* 1995
			B. intermedia	12	-	FORNI-MARTINS *et al.* 1992
				-	24	FORNI-MARTINS *et al.* 1995
			B. macrophylla	12	-	ANDERSON 1993
			B. oblongifolia	12	-	ANDERSON 1993
			B. rigida	12	-	ANDERSON 1993
			B. sericea	12	-	ANDERSON 1993
			B. verbascifolia	12	-	FORNI-MARTINS *et al.* 1992
				-	24	FORNI-MARTINS *et al.* 1995
			Mcvaughia bahiana	10	-	ANDERSON 1979

for Malpighiaceae. Actually x=10 based numbers are the most frequent in sub-family Malpighioideae (Table 3). Numbers x=10 derivate occur in almost all the studied genera. Although we could not find any $2n=10$ for Malpighiaceae species in the literature, some are exclusive multiple of five haploid numbers. Thus, we may consider that x=10 is an x=5 derived basic number.

Heteropterys, *Stigmaphyllon*, *Hiptage* and *Peregrina* are genera that present inter- and intraspecific divergent reports. These chromosomal number variations are probably due to diploidy of count based on x=5. In sub-tribe Sphedamnocarpinae, tribe Banisterieae, only *Sphedamnocarpus pruriensis* presents a chromosomal number based on x=10 ($2n=20$). However, three *Acridocarpus* species present numbers based on x=9 ($n=9$ and $2n=18$). This basic number is probably a derivation through reductional disploidy of an ancestral with $n=10$.

Chromosomal Numbers of Byrsonimoideae

This sub-family is divided into 3 tribes: Acmanthereae, Byrsonimeae and Galphimieae. A sequence based on x=6 is strongly indicated by the chromosomal numbers count made so far (Table 3). Their chromosomes are relatively big, like those of *Lophanthera lactescens* Ducke (LOMBELLO 2000). ANDERSON (1977, 1983) considers Byrsonimoideae the most primitive group of Malpighiaceae.

The haploid number $n=12$ presented for *Byrsonima intermedia*, which belongs to the tribe Galphimieae, agrees with all the chromosomal number reports for the genus (Table 3). Only *Byrsonima crassifolia* (L.) HBK with $2n=20$ differs from this account (NANDA 1962).

For *Galphimia brasiliensis* we observed a diploid number ($2n=24$, Table 1) coherent with the reports for the genus *Galphimia*, as well as for Byrsonimoideae. This sub-family presents almost all chromosomal numbers based on x=6 (Table 3). Its chromosomes are longer than those observed in the other studied species (Table 2).

For the sub-family Byrsonimoideae we can indicate the basic number x=6, as proposed BAWA (1973), based on *Lophanthera lactescens* counts, beyond other chromosomal numbers of Byrsonimoideae species. Exceptions are the *Byrsonima* species above cited and *Macvaughia bahiana* W.

R. Anderson (n=10) presented by ANDERSON (1979). Although FORNI-MARTINS *et al.* (1995) consider x=12 the basic number for *Byrsonirna*, it is probably derived from x=6.

Even considering x=10 the most representative basic number, it is probably derived from x=5, that is probably derived through reductional diploidy or aneuploidy of x=6. This basic number x=5 also occurs in some related families of the Malpighiales order, such as Passifloraceae, Turneraceae and Violaceae (RAVEN 1975; WATSON and DALWITZ 1992). As pointed by ANDERSON (1983), x=6 is probably Malpighiaceae most primitive basic number.

Karyomorphology of Malpighiaceae

Among the few karyomorphological data for Malpighiaceae species presented in the literature, we must highlight the work of DEVAR and BORAIAH (1981), that brought detailed chromosome lengths and morphology of *Hiptage benghalensis* (L) Kurz (2n=58). Its chromosome length varies from 1.62 to 3.25 µm, and its chromosomes were predominantly metacentric. RILEY and HOFF (1961) mentioned small chromosome for *Triaspis nelsonii* Oliver, although no measures or centromeric positions were presented. There are no karyomōrphological data for the species studied in this work.

The studied species chromosomes are, for the most, relatively short, like those of *Mascagnia anisopetala*, which vary from 1.1 to 2.0 µm (Table 2). Only for *Galphimia brasiliensis* did we observe longest chromosomes, which vary from 3.8 to 8. µm. This seems to be a character of the Byrsonimoideae, as observed by LOMBELLO (2000) for *Lophanthera lactescens*, with chromosomes that range around 11.0 µm. The lengths observed for *Bunchosia armeniaca* (2.2-5.1 µm) are also longer than for other Malpighioideae species. This data may lead to a relocation of *Bunchosia*, which is included into Malpighioideae, based on its basic number x=10, although it possesses morphological characters more related to Byrsonimoideae.

The total chromatin length (TCL) varies almost 300% between some species, as *Janusia guaranitica* and *Bunchosia armeniaca* (Table 2). This is more related to chromosome length variation than to chromosomal number variation between the studied species.

According to STEBBINS (1971), the predominance of metacentric chromosomes in the ideograms, together with the symmetrical karyotype pointed by TF% index (Table 2, Fig. 2) indicate a primitive character for all the studied species. Even for *Hiptage benghalensis*, where sub-metacentric chromosomes predominate, DEVAR and BORAIAH (1981) observed a strong karyotype symmetry. There is no significant variation between the TF% indexes of the studied Malpighioideae and *Galphimia brasiliensis* or *Lophanthera lactescens*, the Byrsonimoideae species for which we have karyomorphological data.

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