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CHROMOSOME NUMBERS FOR *Anthurium* AND *Philodendron* spp. (ARACEAE) OCCURRING IN BAHIA, BRAZIL

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Abstract

Chromosome numbers for four species of *Anthurium* and four species of *Philodendron* from Bahia, Brazil, were determined. New counts 2n = 30 for *A. longipes* and *A. affine*, 2n = 32 for *P. pedatum* and 2n = 34 *P. blanchetianum* and *P. pachyphyllum* represent the first reports for these species. The 2n = 32 found for *P. imbe* and 2n = 90 for *A. bellum* differ from earlier reports, whereas 2n = 30 and 60 for *A. pentaphyllum* var. *pentaphyllum* confirms previous counts. *A. affine* had one to four B-chromosomes. We suggest secondary base numbers x = 15 for *Anthurium* and x = 16, 17 and 18 for *Philodendron*, produced by hybridizations and duplications involving the primary base numbers x = 7, 8 and 9.

INTRODUCTION

Araceae comprises about 105 genera and more than 3,300 species, predominantly distributed in the tropical areas of Asia and South America. *Anthurium* and *Philodendron* are exclusively Neotropical, with about 800 and 350-400 species known, respectively, together accounting for almost half of the species in this family. *Anthurium* is also the most complex genus, from a taxonomic viewpoint, due to its large morphological diversity and great phenotypic plasticity. It is adapted to a number of different tropical wet forest environments, as well as caatinga, cerrado, and restingas (coastal forest with sandy soil).

There is a need to generate cytological and morphological information useful for examining relationships within and between sections in these large genera (Croat and Sheffer, 1983). The majority of *Anthurium* species have 2n = 30 chromosomes. Some are polyploid with 2n = 60, while a few species have 2n = 20 to 124 chromosomes (Petersen, 1989). Chromosome analyses are available for only ~20% of the species in this genus.

Inflorescence, floral morphology and anatomy are sufficiently variable in *Philodendron*, especially subgenus *Philodendron*, to furnish a useful basis for extending and improving the infrageneric classification. However, Mayo (1990) also indicates that the study of other characters is highly desirable. Chromosome counts in the genus are available for only 10% of the species, with a predominance of 2n = 32, 34 and 36, and isolated counts of 2n = 30 and 33. A check-list of species from the State of Bahia, includes 29 *Anthurium* species and 27 *Philodendron* species (Mayo, S.J., unpublished results). In this report, we assess the chromosome numbers of four *Anthurium* species and four *Philodendron* species, among those listed by Mayo.

MATERIAL AND METHODS

Samples were collected from natural habitats, except *P. pedatum* which was cultivated as an ornamental. Voucher specimens were prepared and deposited in the herbarium ALCB of the Instituto de Biologia, Universidade Federal da Bahia, Salvador, Brazil (Table I).

Root-tips for cytological preparations were collected from potted plants and pretreated in an aqueous solution of 8-hydroxyquinoline for 4 h at 18ºC and fixed in 1:3 acetic alcohol for 18-24 h. Root-tips were transferred to 70% alcohol and stored at 4ºC. They were then hydrolyzed in 1 N HCl for 8 min at 60ºC and stained following the Feulgen method (Sharma and Sharma, 1980). Squashes were made in a 1% aceto-carmine solution. Coverslips were removed in 45% acetic acid and the slides and the coverslips mounted in Canada balsam. At least 10 metaphases of each species were examined for chromosome counts.

RESULTS AND DISCUSSION

The *Anthurium* species had somatic chromosome numbers of 2n = 30, 60 and 90, whereas the *Philodendron* species had 2n = 32 and 34 (Table I, Figures 1-3). The *A. affine* karyotype consists of eight pairs with a centromere in a median position, and seven in the submedian position, one pair of which has satellites on the distal short arm. The number of B-chromosomes in the karyotypes derived from cells of the same and different plants varied from one to four (Figure 1). The B-chromosomes of this species are large and can be distinguished from satellites. The latter are easily lost in the squash. This is a typical member of section *Pachyneurium*. A majority of such species are 2n = 30, with some 2n = 60, and an isolated count

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Table I - Voucher number, origin and chromosome number of *Anthurium* and *Philodendron* species.

Species	Voucher number	Plants analyzed	Collection locality	Present count 2n	Previous count		
					n	2n	Authors
A. affine Schott	ALCB-026689	>10	Salvador	30 + 1-4B	-	-	-
A. longipes N.E. Brown	ALCB-027780	>10	Salvador	30	-	-	-
A. bellum Schott	ALCB-027779	>10	Cachoeira	90	-	30	Sheffer and Croat, 1983
						56	Mookerjea, 1955
					28		Bhattacharya, 1976 (*apud* Petersen, 1989)
A. pentaphyllum(Aubl.) G. Don *var. pentaphyllum*	ALCB-027978	3	Cachoeira	30	-	30	Pfitzer, 1957
	ALCB-027473	1	Simões Filho	60	-	60	Sheffer and Croat, 1983
							Sheffer and Kamemoto, 1976
P. blanchetianum Schott	ALCB-026037	>10	Cachoeira	34	-	-	-
P. pachyphyllum Krause	ALCB-031768	3	Palmeiras	34	-	-	-
P. imbe Schott	ALCB-029632	>10	Salvador	32	17	-	Pfitzer, 1957
						34	Tsuchiya and Takada, 1962
P. pedatum (Hook.) Kunth	ALCB-029634	1	Salvador	32	-	-	-

of 2n = 48 in *A. jenmanii* (Sheffer and Kamemoto, 1976; Sheffer and Croat, 1983).

The number of somatic chromosomes in *A. longipes* is 2n = 30. Chromosomes with the centromere in the submedian position predominated. *A. bellum* and *A. longipes* belong to section *Urospadix*, which is apparently based on 2n = 30 (Croat and Sheffer, 1983). Thus, *A. bellum*, 2n = 90, may represent a hexaploid. This count disagrees with previous determinations of 2n = 56 (Mookerjea, 1955) and n = 28 (Bhattacharya, 1976 *apud* Petersen, 1989). Chromosomes of *A. bellum* were apparently smaller compared to the rest of the species analyzed. This decrease in chromosome size may be related to a high ploidy level, which has also been observed in other genera such as *Allium, Piper and Ranunculus* (Brat, 1965; Samuel *et al.*, 1986; D'Ovidio and Marchi, 1990). At least two chromosome pairs with satellites were observed. The karyotype analyzed by Mookerjea (1955) had 10 pairs with a secondary constriction, one of which had a large satellite.

The counts 2n = 30 and 2n = 60 for *A. pentaphyllum* var. *pentaphyllum* confirm earlier counts for this species (Gaiser, 1927 *apud* Petersen 1989; Sheffer and Kamemoto, 1976; Sheffer and Croat, 1983). The diploid form had one chromosome pair with satellites, while the tetraploid had two pairs of chromosomes with satellites (Figures 1, 2). Analyses made by Sharma and Bhattacharya (1966) in *A. pentaphyllum* var. *pentaphyllum* (given as *A. variable*) with 2n = 60 showed two chromosome pairs with satellites, with four fragments, while Marchant (1973) registered 2n = 60 and one B chromosome. The latter was not observed in the present study. Similarly, Sheffer and Kamemoto (1976) determined 2n = 30 and 60 in *A. pentaphyllum* var. *bombacifolium* (given as *A. aemulum*) and *A. pentaphyllum* var. *digitatum* (given as *A. digitatum*). *A. pentaphyllum* is a very polymorphic species belonging to the section *Dactylophyllium*.

Chromosome numbers for *P. blanchetianum* and *P. pachyphyllum*, both 2n = 34, and *P. pedatum*, 2n = 32, were determined for the first time in this work (Figure 3). The count for *P. imbe*, 2n = 32, disagrees with previous determinations of 2n = 34 (Tsuchiya and Takada, 1962) and n = 17 (Pfitzer, 1957). One chromosome pair with satellites was observed in both *P. imbe* and *P. pachyphyllum*.

The majority of *Philodendron* species that have been studied have 2n = 34 chromosomes; few are 2n = 32, and an even smaller number concentrated in the subgenus *Meconostigma* are 2n = 36. We found no relationship between the chromosome number of a species and the subgenus or section to which it belonged. All species examined here belong to subgenus *Philodendron*, but *P. blanchetianum* (2n = 34) belongs to section *Philodendron*, *P. pedatum* (2n = 32) to section *Schizophyllum*, while *P. imbe* (2n = 32) and *P. pachyphyllum* (2n = 34) belong to section *Calostigma*. Still, the most divergent number in the genus *Philodendron* is the count 2n = 54 for *P. wendlandii*, reported by Subramunian and Munian (1988). On the other hand, there are different counts for the same species, such as *P. selloum*, 2n = 32, 34, 36, 48, *P. gloriosum*, 2n = 34, 33, 32, 30, *P. cuspidatum*, 2n = 36, 30, and *P. scandens*, 2n = 32 and 30 (cf. Petersen 1989). A similar variation was observed in *P. imbe*, 2n = 32, in the present work, and 2n = 34 (Pfitzer, 1957; Tsuchiya and Takada, 1962). If these disagreements are not due to erroneous species identifications, it can be concluded that aneuploidy plays a role in intraspecific variation. The basic number for this genus has not yet been established. Grayum (1990) suggests an ascendent and descendent aneuploid series, starting from a basic number x = 7 in the evolution of Araceae, which gives rise to primary basic numbers, such as x = 6, 8, 9 and perhaps 5, 10 and 11. Subsequent chromosome duplications may have resulted in paleodiploids, based

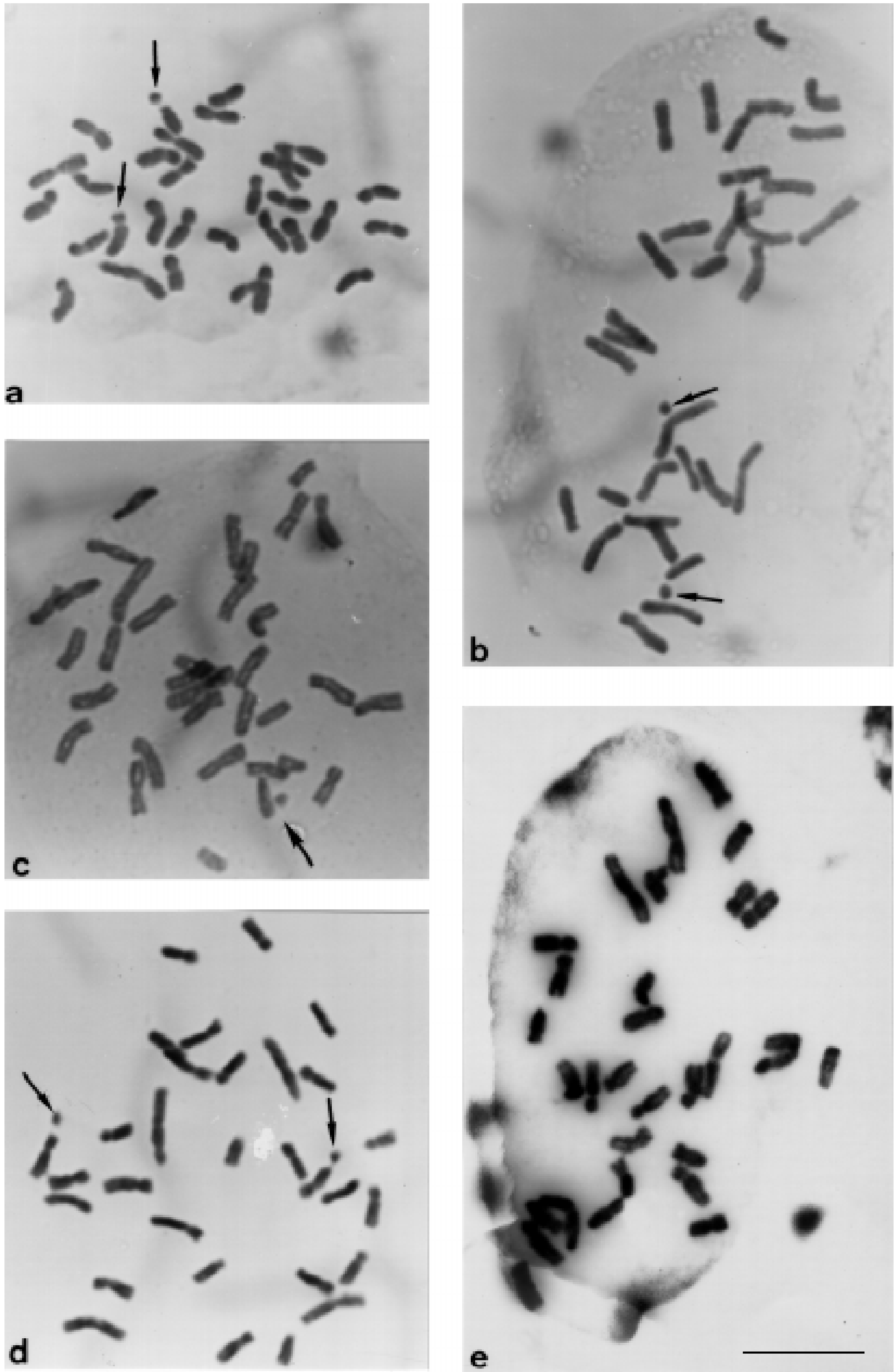

Figure 1 - Mitotic metaphases in *Anthurium* species. (a) *A. affine*, 2n = 30 + 1B. (b) *A. affine*, 2n= 30 + 2B. (c) *A. affine*, 2n = 30 + 4B. (d) *A. pentaphyllum* var. *pentaphyllum* 2n = 30. (e) *A. longipes*, 2n = 30. Satellites are indicated by arrows. The bar represents 10 µm.

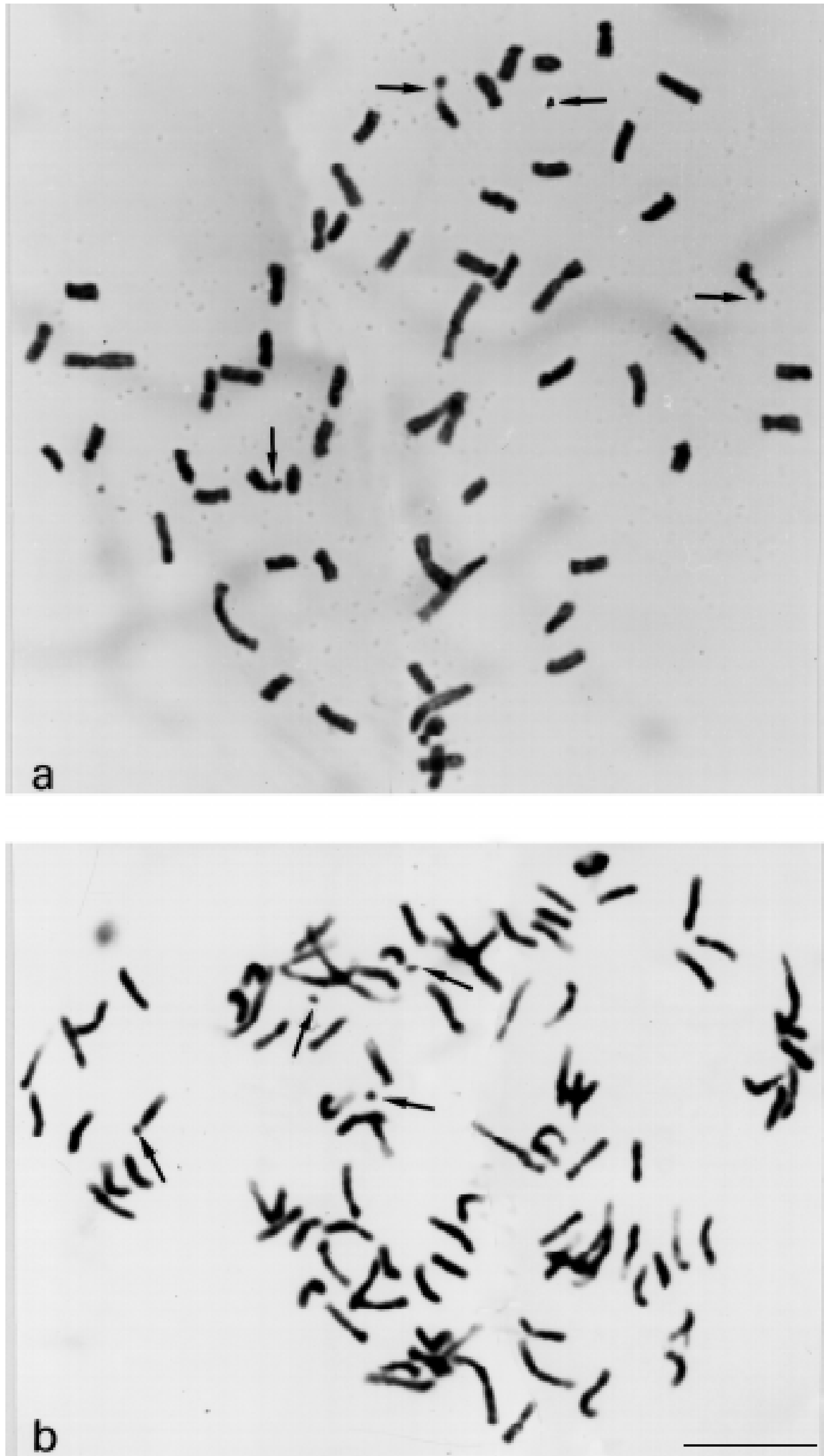

Figure 2 - Mitotic metaphases in polyploid *Anthurium* species. (a) *A. pentaphyllum* var. *pentaphyllum,* 2n = 60. (b) *A. bellum,* 2n = 90. Satellites are indicated by arrows. The bar represents 10 μm.

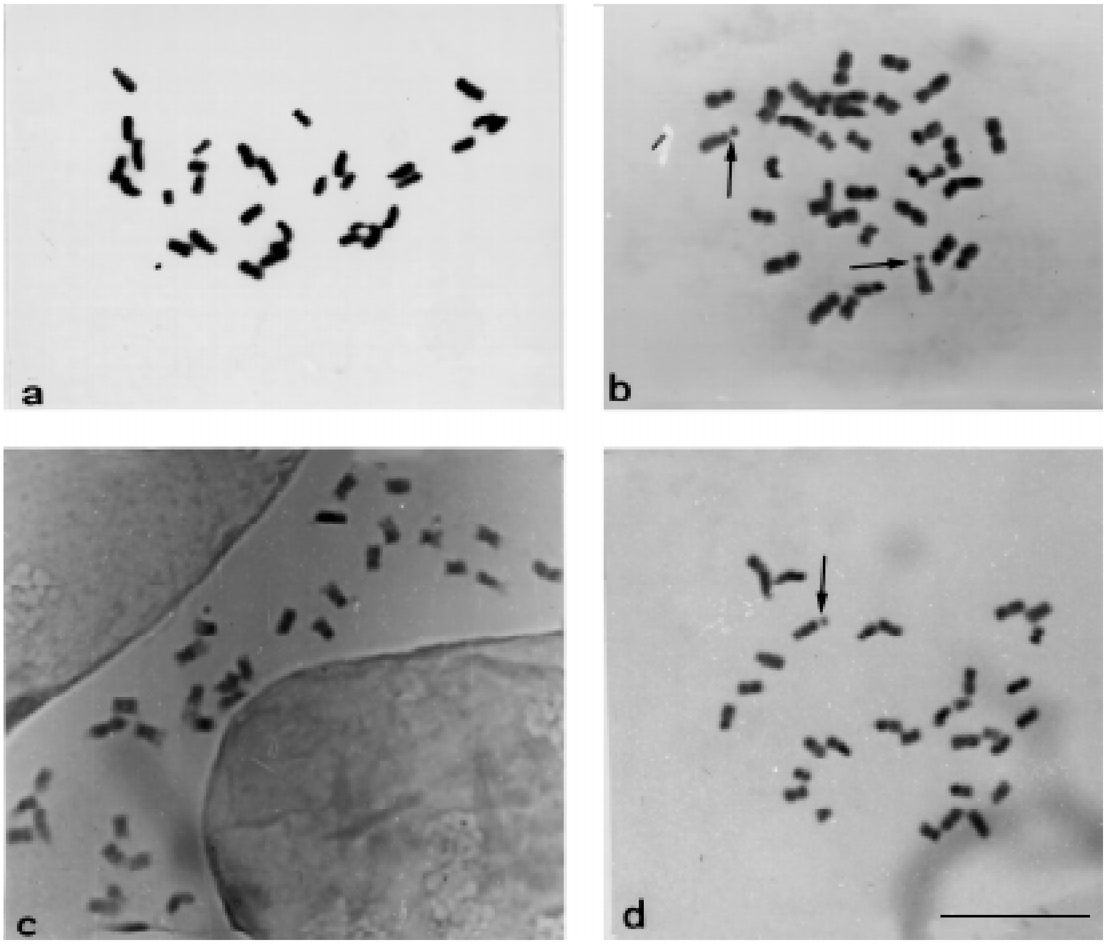

Figure 3 - Mitotic metaphases in *Philodendron* species. (a) *P. pedatum,* 2n = 32. (b) *P. pachyphyllum* 2n = 34. (c) *P. blanchetianum* 2n = 34. (d) *P. imbe* 2n = 32. Satellites are indicated by arrows. The bar represents 10 μm.

on these numbers. Afterwards, autopolyploidy and amphiploidy must have played an important role in the evolution of the genera. The diploid number 2n = 32 in *P. imbe* and *P. pedatum* must be based on the primary basic number x = 8, while the diploid number 2n = 34, observed in *P. blanchetianum* and *P. pachyphyllum,* may have an amphidiploid origin, involving species with x = 8 and x = 9, and subsequent chromosome duplication. In a similar way, in *Anthurium* it is possible that amphiploidy, involving primary basic numbers x = 7 and x = 8, gave rise to the basic secondary number x = 15, present in most previous counts. The counts 2n = 60 and 2n = 90, in the present work, and 2n = 124 (120 + 4 B-chromosomes) in *A. lucidum* and *Anthurium* sp. (Marchant, 1973) are multiples of this basic number. The count variations 2n = 31, 32, 34, 35 and 63 (cf. Petersen, 1989) can be explained by additional counts of B-chromosomes. Nevertheless, the 2n = 56 counts in *A. bellum,* not confirmed in the present work, 2n = 28 in *A. patulum* (Sharma and Bhattacharya, 1966), 2n = 48 in *A. jenmanii* (Sheffer and Croat, 1983), 2n = 20, 40, 60 in *A. gracile* (Sheffer and Croat, 1983; Sheffer and Kamemoto, 1976, as *A. scolopendrinum*) and 2n = 44 in *A. scherzerianum* (Subramunian and Munian, 1988) suggest the existence of other evolutionary lines in *Anthurium*. Additional cytological analysis in a larger number of species is important for establishing the basic number, as well as understanding trends in chromosome evolution within the genus. In the State of Bahia, almost all *Philodendron* and *Anthurium* species are endemic and belong to complexes whose developmental center lies in the Atlantic forest region. Distinct speciation patterns are found within eastern Brazil, though an affinity with several species from other regions in South America is also apparent (Mayo, 1984). For this reason, South American species represent an important study source, both for their evolutionary history and present diversity, and because there is no chromosome data for a large number of species.

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RESUMO

O número de cromossomos de quatro espécies de *Anthurium* e quatro espécies de *Philodendron* coletadas no Estado da Bahia, Brasil, foi determinado. As contagens 2n = 30 para *A. longipes* e *A. affine*, 2n = 32 para *P. pedatum* e 2n = 34 para *P. blanchetianum e P. pachyphyllum* representam o primeiro registro para estas espécies. Os números diplóides 2n = 32 encontrado para *P. imbe* e 2n = 90 para *A. bellum* diferem de registros anteriores, enquanto 2n = 30 e 60 para *A. pentaphyllum* var. *pentaphyllum* confirmam determinações anteriores. *A. affine* tem um a quatro cromossomos B. Nós sugerimos o número básico secundário x = 15 para *Anthurium* e x = 16, 17 e 18 para *Philodendron*, produzidos por hibridações e duplicações envolvendo os números básicos primários x = 7, 8 e 9.

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