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Chromosome variation in *Araceae*: I

POTHOEAE TO STYLOCHITONEAE

C. J. MARCHANT

INTRODUCTION

The widespread and very natural family *Araceae* poses something of a taxonomic dilemma. Treatments of its member genera vary widely and the two major classifications, those of Engler (1920) and Hutchinson (1959), bear little resemblance to each other in their subdivision. Even opinions on phenotypic primitiveness and evolutionary progression are at variance where the treatments of Hutchinson (1959: 629–635) and Engler (1920: 63–66) are compared. For instance *Pothos* L., placed well up the scale of advancement by Hutchinson, is one of the most primitive genera according to Engler.

Published accounts of chromosome studies in the family are fairly numerous but for the most part they are scattered species-counts amongst general lists and very often the karyotypes are neither adequately described nor well-illustrated.

Amongst the larger papers on the cytotaxonomy of *Araceae* are those of Sharma & Das (1954), Mookerjea (1955), Pfitzer (1957) and Sharma & Bhattacharya (1966). Despite the wide range of species described in these papers there are many genera, and indeed sections of the family, which are not known cytologically. That there is a wide range of cytological diversification within the family is evidenced by the published information and there is clearly a striking lack of correlation of the karyotype patterns and basic numbers with either of the major taxonomic treatments. It is these considerations, and the availability of a considerable representation of Aroid genera in the living collections at Kew, which have prompted the present investigation.

The current series of papers, of which this is the first, is an attempt to extend chromosome information to every genus of *Araceae* and to use this information as far as possible to elucidate evolutionary trends and to determine whether chromosome information can assist taxonomic treatment of this complex assemblage of genera.

When sufficient background information on karyotypes has been built up it is hoped it will enable a useful study to be made of quantitative nuclear DNA measurements throughout the family, and will provide a basis for possible future changes in taxonomic classification.

MATERIALS AND METHODS

Chromosome preparations were made from root-tips, either subterranean or, where young and active, aerial. Depending on their size, tips were sometimes slit longitudinally before placing in pretreatment fluid to assist penetration. After a pretreatment in saturated alphabromonaphthalene for 3 hours (or overnight in cases of small chromosomes) roots were fixed in 3:1 acetic:alcohol and stained in basic fuchsin before squashing.

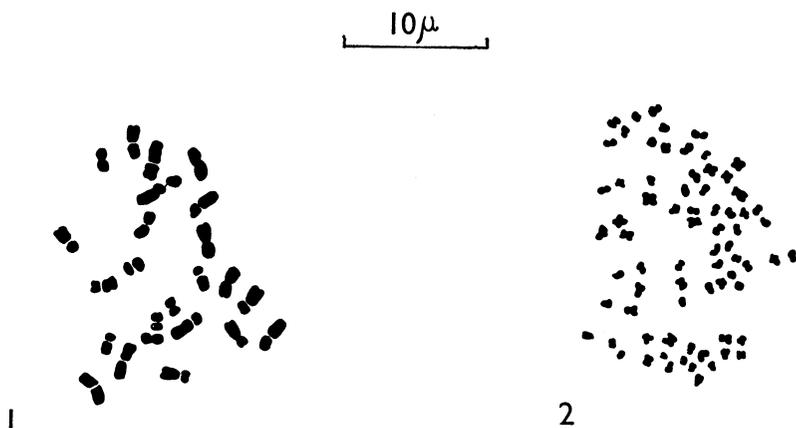


FIG. 1. Drawings of somatic chromosome complements. 1, *Pothos* aff. *scandenti*, $2n = 24$. 2, *Calla palustris*, $2n = 72$.

Photographs were taken with a Zeiss Photomicroscope and drawings made on a Zeiss Drawing Apparatus at the magnification indicated.

All plant material is from live specimens in the Kew collection. Voucher specimens are filed in the Kew Herbarium.

RESULTS

Chromosome karyotypes of this family are very varied in both chromosome size, pattern and basic number. Karyotypes representing 44 genera (about 35 per cent. of the total family) have been examined at the time of this publication. Since so many genera are being studied it is necessary to publish the results in manageable proportions in a series of papers of which this forms the first instalment. For convenience the generic groupings are based on the tribal classification of Hutchinson (1959) so as to provide some sort of understandable order but it should be understood that the employment of such grouping does not by any means indicate my own agreement with it.

For direct comparison all karyotypes in this and ensuing papers are drawn and printed at the same magnification.

A full appraisal of the overall cytology of the family will be deferred until the final paper of the series.

Pothoeae

Of the two genera in this tribe only one, *Pothos* L. (as *P.* aff. *scandenti* L.), has been available for study. The plant has a $2n$ number of 24 small chromosomes (Fig. 1/1, above) based on $x = 6$ or 12. In one metacentric pair there is apparently a secondary constriction in the middle of one arm. *Pothos scandens* has previously been counted as $2n = 24$ by Snoad (1952).

Calleae

Calla palustris L. (Fig. 1/2, above) had a $2n$ chromosome number of 72 small chromosomes. Previous counts are similarly based on $x = 6$ or 9

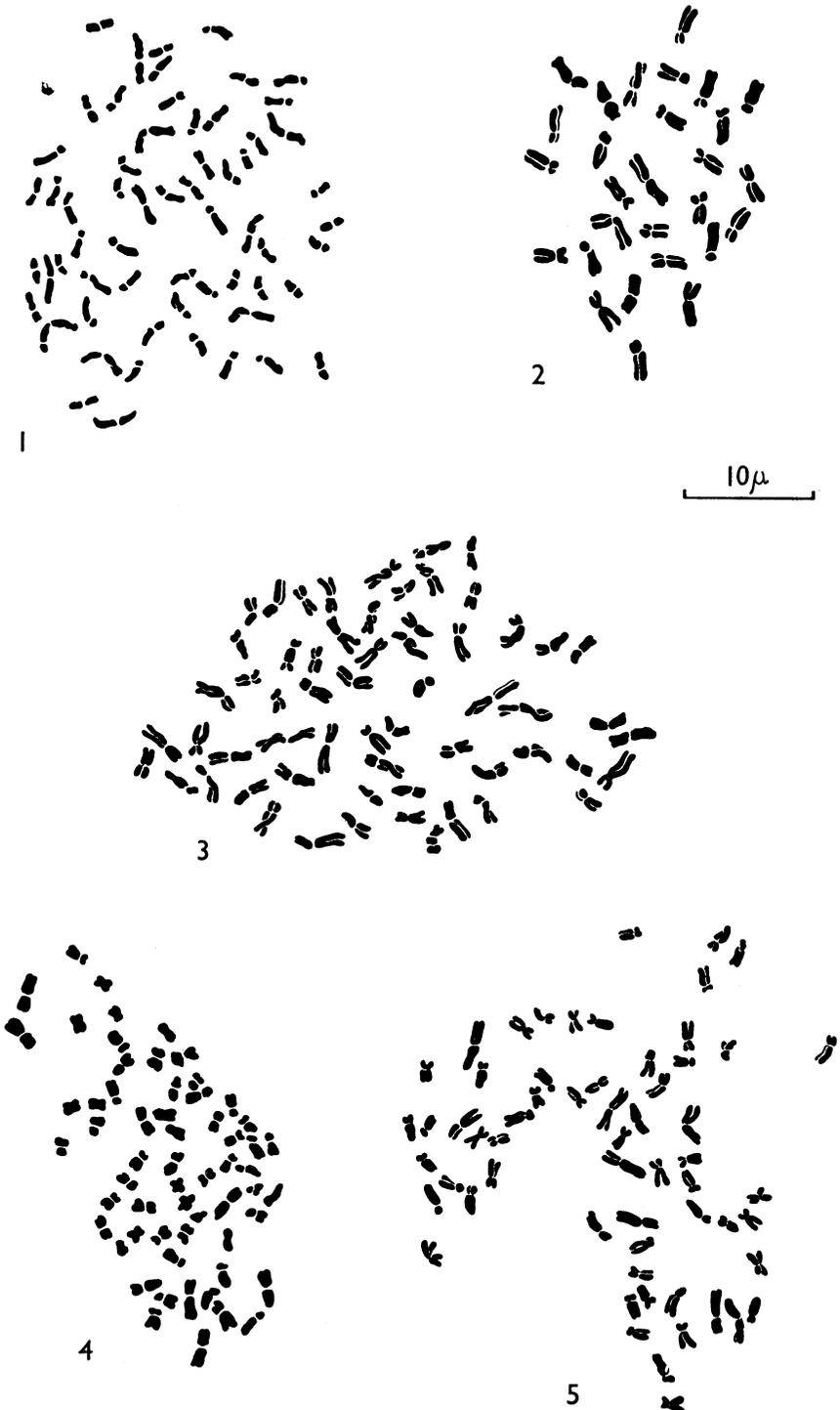


FIG. 2. Drawings of somatic chromosome complements in the tribe *Monstereae*. 1, *Epipremnum pinnatum*, $2n = 60$. 2, *Stenospermation popayense*, $2n = 28$. 3, *Monstera friedrichsthalii*, $2n = 60$. 4, *Rhaphidophora celatocaulis*, $2n = 60$. 5, *Scindapsus pictus*, $2n = 60$.

(Hagerup, 1941; Löve & Löve, 1965; Löve & Ritchie, 1966) except for an aneuploid series ($2n = 63, 69, 70$) reported by Ehrenberg (1945). The other genus in this tribe (*Pycnospatha* Gagnep.) is not in cultivation at Kew.

Monstereae

Counts of $2n = 28$ ($x = 7$) and $2n = 60$ ($x = 10$) were obtained for *Stenospermation popayense* Schott (Plate 3/3, p. 322 & Fig. 2/2, p. 317) and *Epipremnum pinnatum* (L.) Engl. (Fig. 2/1) respectively, both with medium-sized chromosomes. A previous count of $2n = 56$ for *E. pinnatum* (as *Pothos decursivus* Wall.) has been reported by Mookerjea (1955), but Ito (1942) reports $2n = 60$ for *E. mirabile*.

The counts of $2n = 60$ and $2n = c.110$ for *Scindapsus pictus* Hassk. (Plate 3/4 & Fig. 2/5) and *S. pictus* Hassk. var. *argyraeus* Hort. ex Engl. suggest a base number of $x = 10$ and are at variance with the $2n = 112$ for *Scindapsus pictus* reported by Delay (1950) and the $2n = 56$ ($x = 7$) reported by Bhattacharya (1957) for *S. officinalis* (Roxb.) Schott. The aneusomaty reported in this latter species by Bhattacharya (*l.c.*) was not observed in Kew material.

Two species of *Rhaphidophora* Hassk. were counted, both with small chromosomes and based on $x = 10$ (or 15); *R. celatocaulis* Alderwer. with $2n = 60$ (Fig. 2/4) and *R. peepla* (Roxb.) Schott with $2n = c.120$. Mookerjea's (1955) count of $2n = 54$ ($x = 9$) for *Rhaphidophora decursiva* (Roxb.) Schott does not correspond, nor does $2n = 56$ reported by Delay (1950) for *R. celatocaulis* (as *Monstera latevaginata*).

Monstera friedrichsthalii Schott has $2n = 60$ ($x = 10$) medium-sized chromosomes (Plate 3/1, p. 322 & Fig. 2/3, p. 317) agreeing with the count of Pfitzer (1957) for *M. deliciosa* Liebm. but not with earlier counts of $2n = 24$ (Darlington & Janaki Ammal, 1945) and $2n = 56$ (Malvesin-Fabre, 1945).

According to my counts this tribe would seem to have considerable cytological uniformity with $x = 10$ for all except *Stenospermation* Schott but there are still six more genera to be studied.

Stylochitoneae

One accession of *Zamioculcas* Schott (identified as *Z. zamiifolia* (Lodd.) Engl.) has $2n$ counts of 34 (Plate 3/2, p. 322 & Fig. 3/1, p. 319). Previous counts for the same species are $2n = 34$ (Pfitzer, 1957) and $2n = 32$ (Malvesin-Fabre, 1945). A base of $x = 17$ is thus indicated in this large-chromosome genus.

For two species of *Stylochiton* Lepr., one *S. puberulus* N.E.Br., and one unnamed, counts of $2n = 28$ ($x = 7$) medium chromosomes (Fig. 3/2) were made. No previous counts are available for comparison.

Carlephyton madagascariense Jumelle has $2n = 108$ small chromosomes (Fig. 3/4) and a base of $x = 6$ or 9. No previous counts have been published.

Arophyton tripartitum Jumelle with $2n = c.76$ and small chromosomes needs further study to obtain a precise count and to compare with *A. buchettii* Bogner with $2n = 40$ medium-sized chromosomes (Fig. 3/3). Possibly the basic number will prove to be $x = 10$.

There is apparently little relationship in basic chromosome number



FIG. 3. Drawings of somatic chromosome complements in the tribe *Stylochitoneae*. 1, *Zamioculcas zamiifolia*, $2n = 24$. 2, *Stylochiton* sp., $2n = 28$. 3, *Arophyton buchettii*, $2n = 40$. 4, *Carlephyton madagascariense*, $2n = 108$.

between genera of this tribe, despite their comparatively compact distribution in East Africa and Madagascar.

DISCUSSION

It is not intended at this juncture to discuss in detail the chromosome counts listed but it is hoped that their publication at this stage may be of value to the taxonomist. When an overall survey of the family has been completed it will be possible to review the results, to relate characters to such matters as geographic distribution and reproductive systems, and to comment on the usefulness or otherwise of chromosome information in helping to determine evolutionary trends and taxonomic relationships within the family.

Even with the few genera listed here, the diversity of chromosome size and base number is already evident but the tribe *Monstereae* does show cohesion between its component genera with the base of $x = 10$. However, so far as can be seen at present there is an absence of any major deviations or extremes of karyotype pattern (*e.g.* acro- or telocentrics or bimodal complements) between the genera examined to date.

Disagreements with some previous chromosome counts are not easily explained. To testify to the accuracy of the present counts I can only refer to the text figures and plate as visual evidence and point out that most of the plants in Table 1 (p. 321) have been taxonomically determined at Kew.

ACKNOWLEDGEMENTS

I am grateful for the encouragement of Dr. Keith Jones and Mr. E. Milne-Redhead during preparation of this paper and for the technical assistance of Miss C. Brighton.

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TABLE 1. List of chromosome counts in the Araceae

Name	Kew Entry No.	Cytology Accession No.	Origin	Chromosome No. (2n)	Basic No. (x)	Size, S.M. or L. (small, medium or large)	PREVIOUS COUNTS			
							Name	Chromosome No. (2n)	Author	Date
Tribe Pothoaceae <i>Pothos</i> aff. <i>scandens</i>	426-63	68.1606	North Borneo, <i>Giles & Wootlams</i> P.B.72	24	6,12	S	<i>P. scandens</i>	24	Snoad	1952
Tribe Callitaeae <i>Callia palustris</i>		65-544	Northern Europe	72	6,12	S	<i>C. palustris</i>	36,72 63,69,70 36 36	Hagerup Ehrenberg Löve & Löve Löve & Ritchie	1941 1945 1965 1966
Tribe Monstereae <i>Stenospermatum popayense</i> <i>Epipremnum pinnatum</i> <i>Scindopus pictus</i> <i>S. pictus</i> var. <i>argyreaus</i> <i>Rhaphidophora celatocalis</i> <i>R. pepla</i> <i>Monstera friedrichshaltii</i>	169-42 263-58 434-63 664-61 468-63 671-62	65.1360 65.472 68.1502 65.613 68.1604 64.465 65.164	Oxford Bot. Gard. (Columbia) Glasnevin Bot. Gard. North Borneo, Melalap Hill, <i>Giles & Wootlams</i> P.B.110 Java & Borneo Indo-Malaysia, <i>McSwiney</i> North Borneo, near Tesom, <i>Giles & Wootlams</i> P.B.322 Guatemala, <i>Stedal</i>	28 60 60 c.110 60 c.120 60	7 10 10 10 10 10 10	M M M M M M M	<i>E. pinnatum</i> (as <i>Pothos decursivus</i> Wall.) <i>E. mirabile</i> <i>S. officinalis</i> <i>S. pictus</i> <i>R. celatocalis</i> (as <i>Monstera latevagnata</i>) <i>R. decursiva</i> <i>M. deliciosa</i> " " "	56 60 56 112 56 54 24 56 60	Mookerjia Ito Bhattacharya Delay Delay Mookerjia Darlington & Janaki Ammal Malvesin-Fabre Pfitzer	1955 1942 1957 1950 1950 1955 1945 1945 1957
Tribe Stylochitonaceae <i>Zamioculcas zamifolia</i> <i>Stylochiton puberulus</i> <i>Stylochiton</i> sp. <i>Carephyton madagascariense</i> <i>Arophyton tripartitum</i> <i>A. buchettii</i>	349-63 231-56 593-67 719-67 190-68 190-68	64.1606 64.1761 68.1617 68.1650 68.1652 68.1651	Kenya, Taita Distr., <i>Bally</i> 12731 Tanzania, Segera Hill, Karogwe road, <i>Greenway</i> Tanzania, <i>Bogner</i> 124 Madagascar, <i>Bogner</i> 169 Madagascar, <i>Bogner</i> 205 Madagascar, Anono Kambo, W. of Ranomantny, Zahamena, <i>Bogner</i> 207	34 28 28 108 c.76	17 7 7 6,9 ?	L M M S S	<i>Z. zamifolia</i> " " " " "	34 32	Pfitzer Malvesin-Fabre	1957 1945

- Malvesin-Fabre, G. (1945). Contribution à la caryologie des Aracées. Thèse, Sciences, Univ. Bordeaux 1945: 1-275.
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A new genus of Leguminosae-Phaseoleae.—A second attempt to preserve the name *Dolichos* L. in a way to ensure the minimum of nomenclatural changes has failed, but yet another attempt will be made since the voting by the Spermatophyta Committee was exceedingly close and not entirely satisfactory. The facts of the case are given in two notes (*Regn. Veg.* 40: 26-7 (1965) and *Taxon* 17: 170-3 (1968)). A detailed paper on the subdivision of *Dolichos* has been held up in the press but one genus needs provisional validation to enable other workers to refer to it. Whatever way the nomenclatural problem is finally solved the name of the genus described below will not be affected.

Macrotyloma (*Wight & Arn.*) *Verdc.*, gen. et. stat. nov. a *Dolicho* L. congeneribusque appendiculis vexilli elongatis, stylo tenui haud incrassato, granulis pollinis spinulosis valde differt.

Dolichos L. unspecified infrageneric grouping *Macrotyloma* Wight & Arn., *Prodr. Fl. Pen. Ind. Or.*: 248 (1834).

Dolichos L. subgen. *Macrotyloma* (Wight & Arn.) Bak. in *Fl. Brit. India* 2: 210 (1876).

Dolichos L. group II of Wilczek in *Fl. Congo Belge* 6: 291 (1954).

Herbae annuae vel perennes, scandentes, prostratae vel erectae. *Folia* pinnatim trifoliolata. *Corolla* glabra, flava, albidi- vel viridi-flava, raro rubescens. *Alae* angustae; carina haud torta. *Stamina* diadelfia; antherae uniformes. *Ovarium* lineari-oblongum vel lineare, 3-13-ovulatum. *Stylus* ± filiformis, tenuis, glaber vel breviter pubescens, haud barbatus; stigma terminale, subcapitatum, saepe penicillatum.

Lectotypus generis **Macrotyloma uniflorum** (*Lam.*) *Verdc.*, comb. nov. (*Dolichos uniflorus* Lam., *Encycl. Meth.* 2: 299 (1786)).

Species circa 25, Africae et Asiae incolae.

PLATE 3

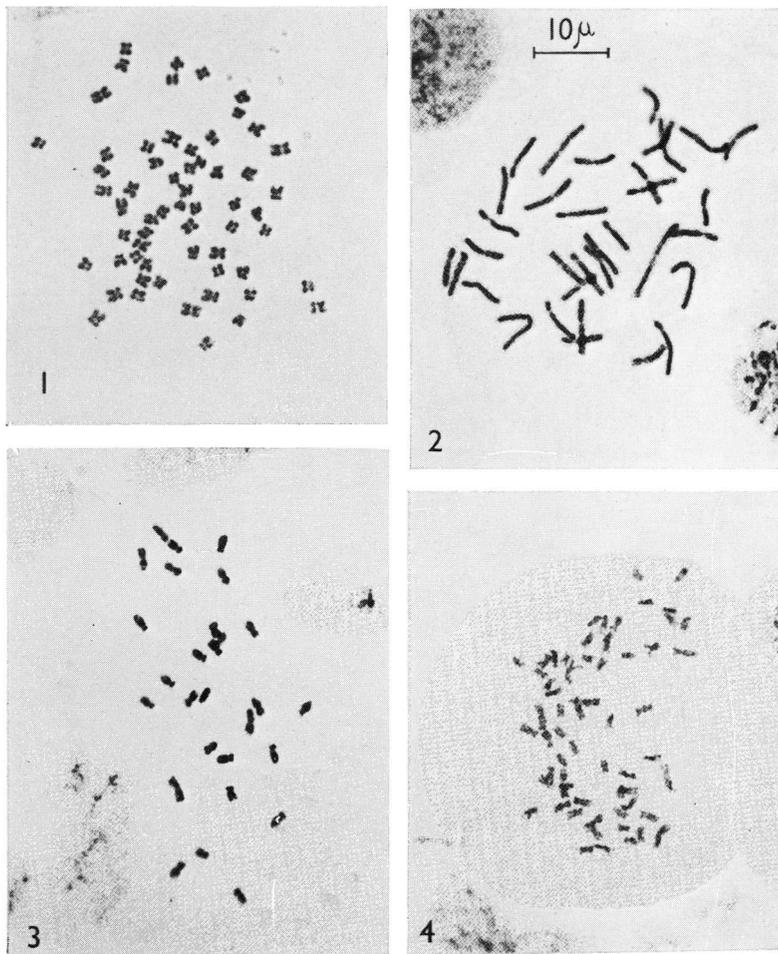


PLATE 3. Pretreated mitotic chromosomes from root tips. **1**, *Monstera friedrichsthalii*, $2n = 60$. **2**, *Zamioculcas zamiifolia*, $2n = 34$. **3**, *Stenospermation popayense*, $2n = 28$. **4**, *Scindapsus pictus*, $2n = 60$.