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Source: Willdenowia, 35(2) : 333-344

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.35.35216

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JOSEF BOGNER & EDUARDO G. GONÇALVES

Two new species of *Xanthosoma (Araceae)* from South America and notes on the tribe *Caladieae*

Abstract

Bogner, J. & Gonçalves, E. G.: Two new species of *Xanthosoma (Araceae)* from South America and notes on the tribe *Caladieae.* – Willdenowia 35: 333-344. – ISSN 0511-9618; © 2005 BGBM Berlin-Dahlem.
doi:10.3372/wi.35.35216 (available via http://dx.doi.org/)

Two new species of *Xanthosoma* sect. *Acontias, X. mariae* and *X. latestigmatum,* are described and illustrated. They have pilose, pedate leaf blades as have in *Xanthosoma* only *X. plowmanii* and *X. pottii,* and their pollen grains are released as monads, unlike in all other *Xanthosoma* species, which, as far as studied, release the pollen in tetrads. *X. mariae* is an evergreen plant mainly distinguished by its dark green velvety lustrous leaf blades with numerous leaflets and tuber-like swellings at the junction of petiole and blade; the gynoecium is of the *Acontias* type and the ovary is pilose in the lower part. *X. latestigmatum* is seasonally dormant and has medium green leaf blades with numerous leaflets and no tuber-like swellings; the gynoecium is of the *Caladium* type (with a very broad stigma) and completely glabrous. The relationship of the genera *Caladium* and *Xanthosoma* is discussed, *C. paradoxum* is transferred to *Xanthosoma* and the new combination *X. paradoxum* validated, and a key to the genera of the tribe *Caladieae* given.

Introduction

Two new species of *Xanthosoma* Schott cultivated in recent years in the Botanischer Garten München are described here. *X. mariae* has been collected only once in Peru by Mary Sizemore. *X. latestigmatum* was at first thought to have been collected only once in Venezuela by Manfred Speckmaier; we then recognized it among other collections from Venezuela and Colombia, the earliest having been made by H. F. A. von Eggers in 1891. *X. mariae* is a very handsome species of horticultural value and has already been used in breeding by John Banta (Alva, Florida). However, it is somewhat sensitive in cultivation and has to be grown in Europe in deep shade with high temperature and humidity. We were very surprised to find that the pollen grains of both species are released as monads and not in tetrads as expected (see discussion in Mayo & Bogner 1988). SEM studies of more material confirmed this finding. When Mike Madison (1981) studied the *Caladieae,* he concluded that pollen grains are released as monads in *Cala-*

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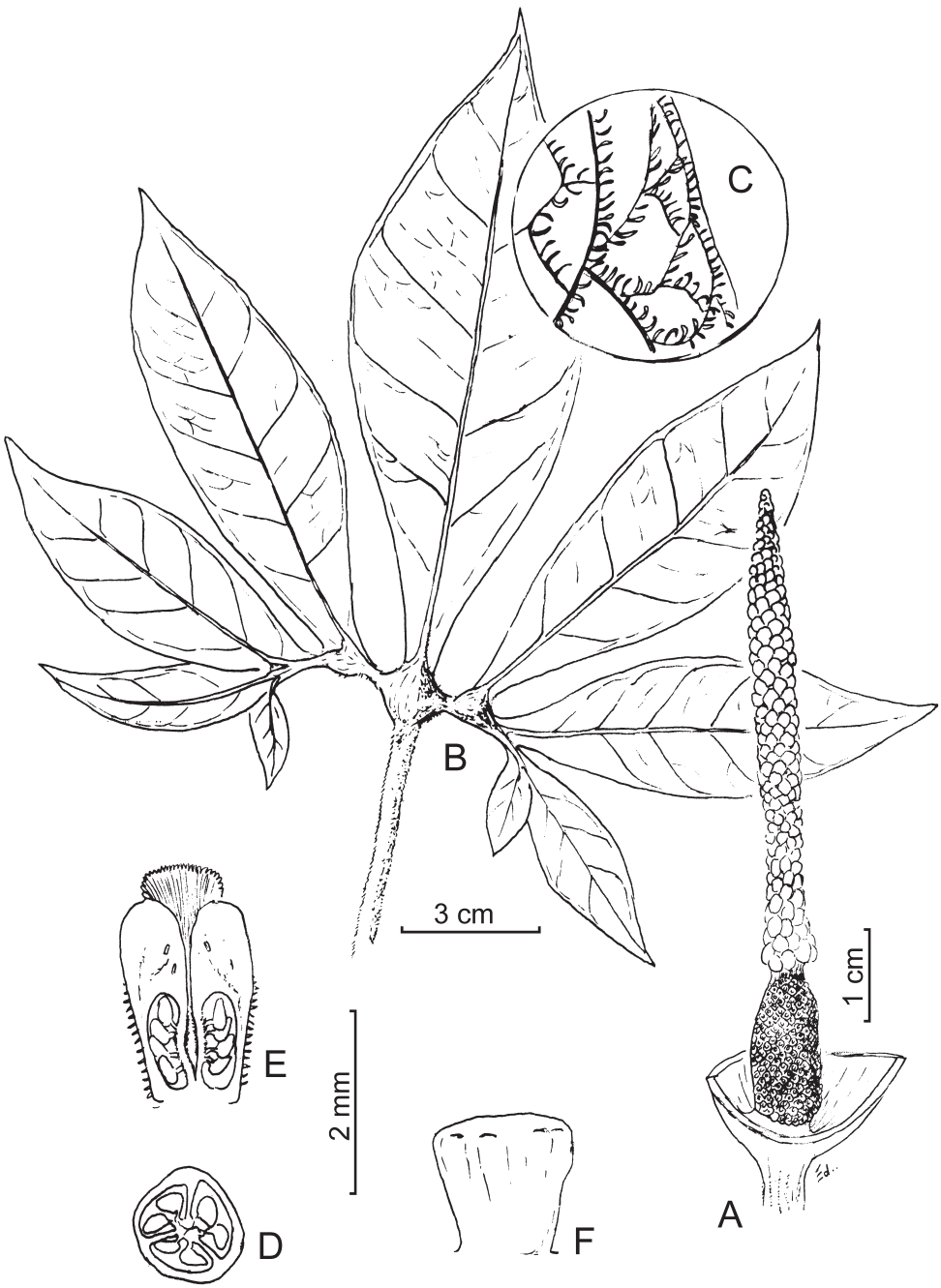


Fig. 1. *Xanthosoma mariae* – A: spadix, most of spathe removed; B: leaf, note the tuber-like swellings at junction of petiole and blade; C: close up of lower surface of a leaflet with hairs on the veins; D: cross section of ovary; E: longitudinal section of gynoecium; F: synandrium, side view. – Drawn by E. G. Gonçalves from the type collection.

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dium and as tetrads in *Xanthosoma*. Our findings show that this does not hold true. Both new species clearly belong to *X.* sect. *Acontias* due to their possession of a tuber and pedate leaves, a combination of characters not found in *Caladium.* Moreover, our two new species are apparently closely related to the Brazilian species *X. plowmanii* Bogner (1986) and *X. pottii* E. G. Gonç. (Gonçalves 1999), with which they also share the remarkable character of pilose leaves.

Xanthosoma (sect. *Acontias* (Schott) Engl.) ***mariae*** Bogner & E. G. Gonç., **sp. nov.**
Holotypus: Specimen preserved in July 2004 by J. Bogner from a plant cultivated in the Botanical Garden Munich of the wild source "Peru, Prov. San Martin, between Tarapoto and Yurimaguas, near San Antonio, 6°22'21"S, 76°17'25"W, 700-800 m, growing in deep shade in organic detritus on the forest floor in scattered colonies, 6.1.1996, leg. Mary Sizemore"(M; isotypus: UB) – Fig. 1-3, 4a.

Herba tuberosa, sempervirens. *Folia* rosulata; petiolus 30-45 cm longus, pilosus, intense viridis; lamina pedatisecta, 5-7 foliolis; foliola elliptica supra atroviridia velutina glabra, subtus pallidiora, mediocriter virida pilis minutis albis obtecta; folia adulta incrassationes tuberiformes in junctura inter petiolum et laminam formantia propagatione vegetativa. *Spatha* 8-10 cm longa, extus pilosa intus glabra. *Spadix* 7-8 cm longus, parte femina c. 1.7 cm longa, parte sterili synandrodiis c. 1.5 cm longis obsita, parte mascula c. 4.5 cm longa. *Ovarium* in parte inferiore pilosum; stylus latus cohaerens. *Pollen* in monadis. Numerus chromosomatum $2n = 26$.

Evergreen herb with tuber 1-1.5 cm in diameter. *Leave*s several, basal, tufted; adult leaves with somewhat flat, brown and somewhat irregular, tuber-like swelling up to 1 cm in diameter at the junction of petiole and leaf blade, capable of vegetation propagation; juvenile leaves lacking tuber-like swellings, very young leaves usually maculate along the midrib. *Petiole* 30-45 cm long and 0.3-0.6 cm in diameter, terete, dark green, covered with minute white hairs; sheath 7-14 cm long; *leaf blade* pedatisect, with 5-7 leaflets; middle leaflet inserted ± opposite petiole, other leaflets borne on a short rachis 1-1.5 cm long; *leaflets* elliptic, base cuneate and apex cuspidate, on upper face dark green and velvety, on lower face lustrous, medium green, mid vein densely covered with minute white hairs (like the petiole), lateral veins and those of lower order less densely so, otherwise lower face glabrous; the middle leaflet being the largest, up to 17 cm long and 6.5 cm wide, the lateral smaller, up to 14 cm long and 5 cm wide, the outermost leaflets smallest, up 5-8 cm long and 1.5-3 cm wide, the two outermost ones somewhat asymmetric; *venation* reticulate, veins more prominent on lower face, on upper face slightly lighter coloured; middle vein quite strong, 7-11 primary lateral veins on each side, with interprimary veins (of second order and these thicker than those of third order), forming a typical colocasioid pattern, inframarginal collective veins present, inner collective vein 1.5-2 mm from the margin and the outer collective vein very fine, running closer to the margin. *Cataphylls* 4.5-8 cm long. *Peduncle* 10-13 cm long and c. 0.4 cm in diameter, medium green and, like the petiole, covered with minute white hairs. *Spathe* 8-10 cm long, outside minutely hairy, inside glabrous, constricted at the middle; *tube* convolute, outside and inside green, limb of spathe whitish to greenish, white on both sides or especially inside ± cream coloured. *Spadix* shorter than spathe, 7-8 cm long, ± sessile; *female zone* c. 1.7 cm long and 0.8-0.9 cm in diameter, yellowish; *sterile zone* with synandrodes, c. 1.5 cm long and becoming narrower towards the male zone, basally 0.8-0.9 cm and apically 0.4-0.5 cm in diameter, whitish; *male zone* c. 4.5 cm long and 0.4-0.5 cm in diameter, acute, fertile to apex, whitish to cream coloured. *Flowers* unisexual, naked. *Female flowers* (gynoecia) subcylindric, c. 2.5 mm long and 1.1 mm in diameter; ovary minutely hairy in lower half, whitish, with usually 3 deeply intrusive parietal placentae, ovules many, hemianatropous; style broad, coherent, whitish to yellowish; stigma disk-like, c. 0.7 mm in diameter, yellow and slightly papillose. *Synandrodes* 3-5 mm long and 2-3 mm wide (viewed from above). *Male flowers* (synandria) c. 2 mm long and wide, thecae lateral, well pronounced, each theca long and thin, opening by an apical pore. *Pollen* in monads, grains globular, inaperturate, 33-36 µm in diameter, exine psilate. Chromosomes: $2n = 26$.

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Fig. 2. *Xanthosoma mariae* – A: leaves, note the velvety lustrous surface; B: flowering plant, habit; C: tuber-like swellings (arrows) at the junction of petiole and blade. – Photographs by J. Bogner from plants cultivated in the Botanical Garden Munich.

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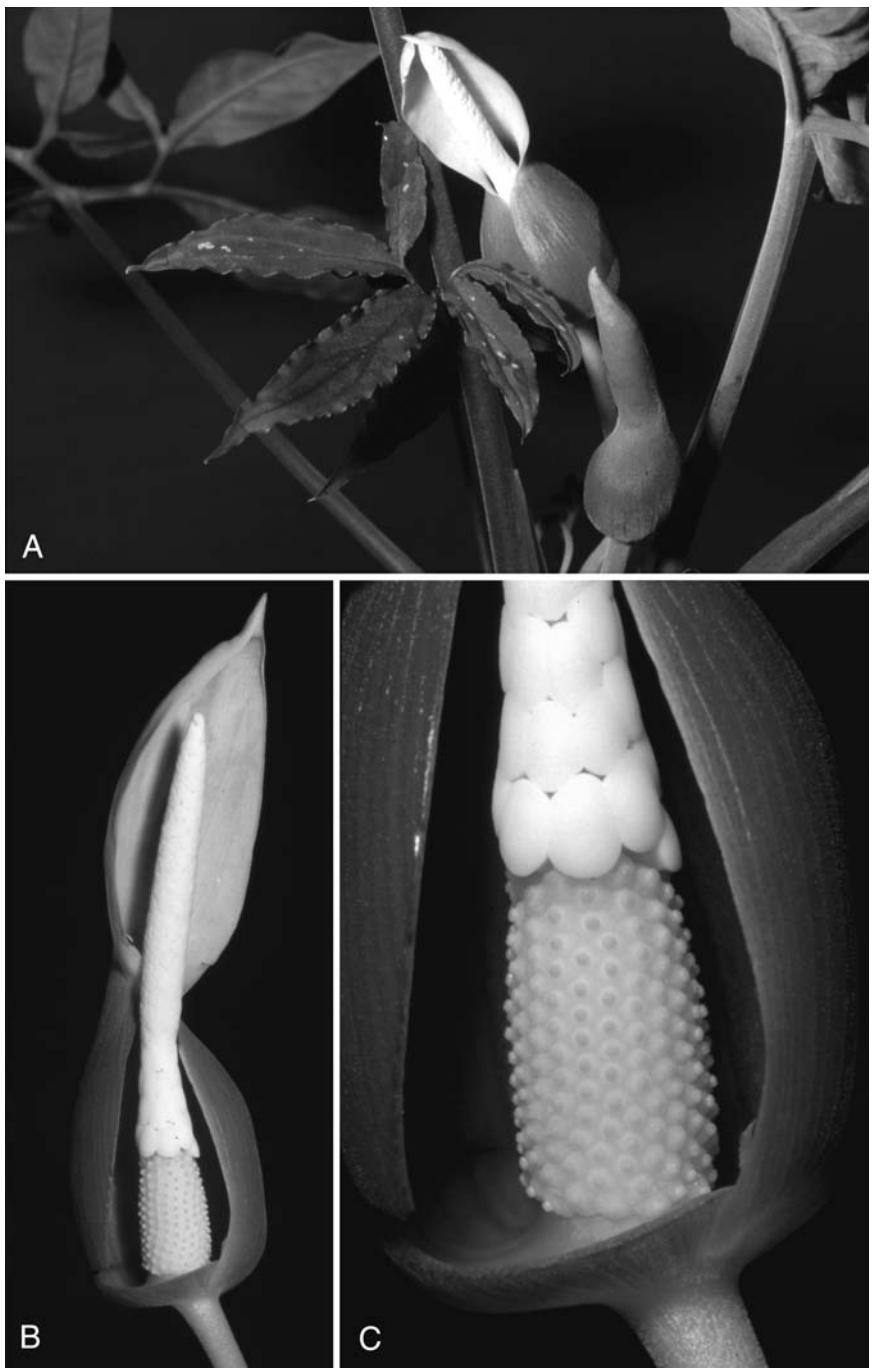


Fig. 3. *Xanthosoma mariae* – A: inflorescences and leaves; B: inflorescence, spathe partly removed; C: lower part of spadix with the female zone and above the sterile zone with synandrodes. – Photographs by G. Gerlach from plants cultivated in the Botanical Garden Munich.

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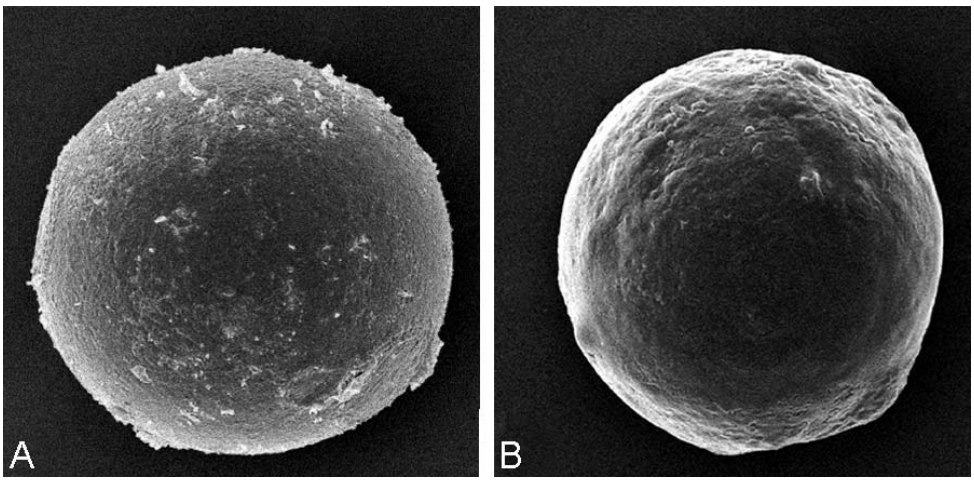


Fig. 4. Pollen grains always released in monads – A: *Xanthosoma mariae;* B: *X. latestigmatum.* – SEM photographs by M. Hesse from the type collections.

Distribution. – The species is only known from the type collection.

Eponymy. – *Xanthosoma mariae* is named for Mary Sizemore, who discovered this new species in the rainforest of Peru, in recognition of her excellence as a plant collector and horticulturist.

Notes. – A juvenile plant of *Xanthosoma mariae* was illustrated by John Banta under the name *X. plowmanii* in Aroideana 26: 54, fig. 1. 2003; it shows the maculation along the midrib typical of juvenile leaves.

Distinction. – *Xanthosoma mariae* is mainly distinguished by dark green, velvety lustrous, pilose and pedate leaf blades with tuber-like swellings at the junction of petiole and leaflets, by the ovaries that are pilose in the lower part and by pollen released in monads. The type of tuber-like swellings is unique in the tribe *Caladieae* and has only been observed otherwise in the *Araceae* in *Amorphophallus* Decne., e.g. in *A. symonianus* Hetterscheid & M. Sizemore (Hetterscheid & Ham 2001). Different in shape, small, globose tubercles at the leaf blades are known in a few cases in the genera *Amorphophallus* (e.g. *A. bulbifer* Blume), *Pinellia* Ten. (e.g. *P. cordata* N. E. Br.) and *Typhonium* Schott (e.g. *T. violifolium* Gagnep.). These swellings are an interesting adaptation for vegetative reproduction because each fallen leaf may develop one to three potential new plants.

Xanthosoma (sect. *Acontias* (Schott) Engl.) ***latestigmatum*** Bogner & E. G. Gonç., **sp. nov.**
Holotypus: Specimen preserved in September 2002 by J. Bogner from a plant cultivated in the Botanical Garden Munich of the wild source "Venezuela, Estado Miranda, near San Francisco de Macaira, Hacienda La Elvira, 500-700 m, leg. M. Speckmaier" (M; isotypus: UB) – Fig. 4b, 5-6.

Herba temporaliter dormiens, tuberosus. *Tuber* (2-)3-4 cm in diameter. *Folia* rosulata, in toto pilosa; petiolus 25-32 cm longus, maculatus; lamina pedatisecta 11-13 foliolis; foliola oblanceolata vel elliptica vel interdum elliptico-oblonga, viridia. *Spatha* 10-16 cm longa, extus pilosa, intus glabra. *Spadix* 9-12 cm longa, parte femina 1.5-2 cm longa, parte sterili synandrodiis 1.5-2.5 cm longis obsita, parte mascula 5-8 cm longa. *Stylus* et stigma latum, cohaerens. *Pollen* in monadis.

Herb with a dormant stage, with a tuber (2-)3-4 cm in diameter. *Leaves several,* basal, tufted, pilose in all parts; *petiole* 25-32 cm long and 0.2-0.4 cm in diameter, maculate, pilose (rough with

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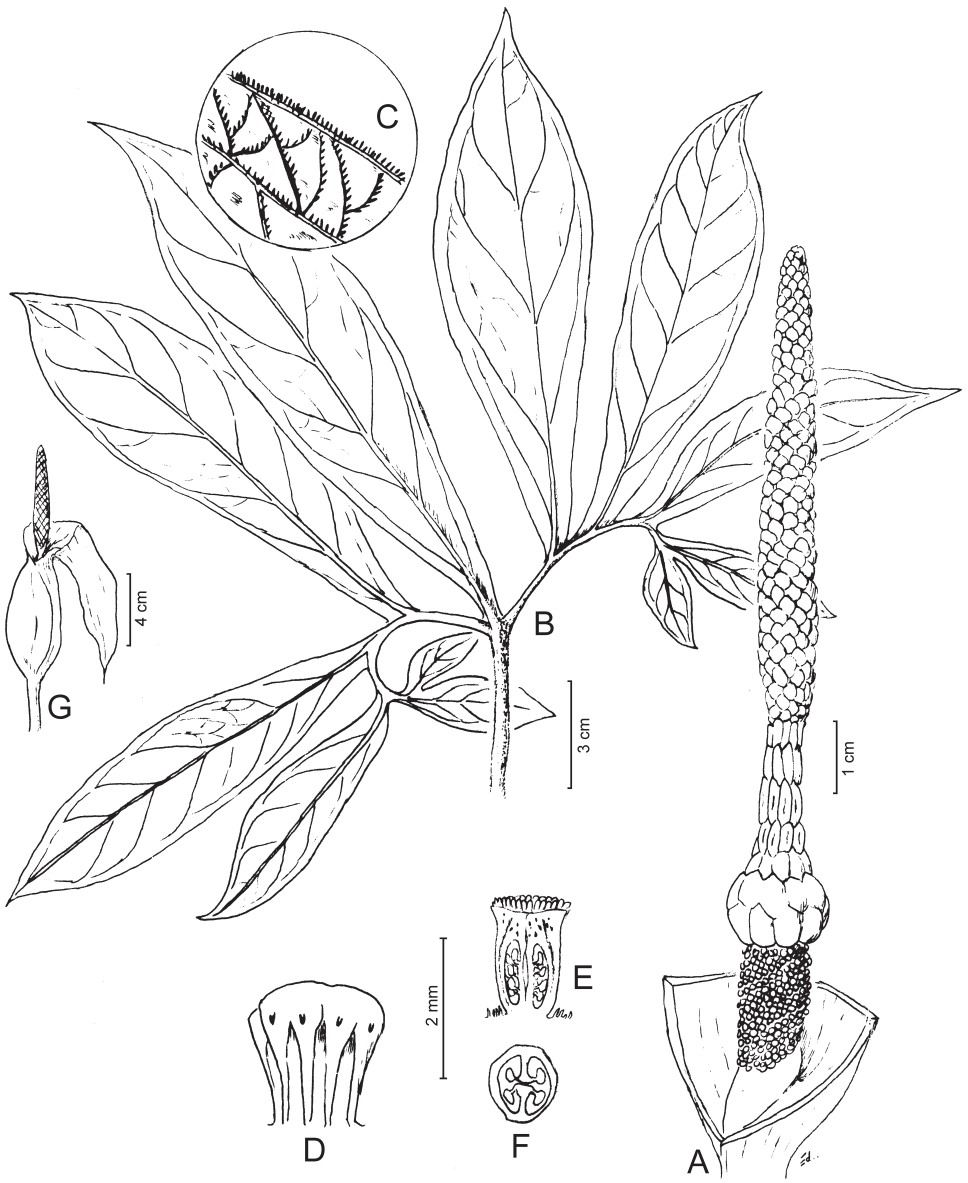


Fig. 5. *Xanthosoma latestigmatum* – A: spadix, most of the spathe removed; B: leaf; C: close up of the lower leaf face with hairs on the veins and margin; D: synandrium, side view; E: longitudinal section of gynoecium; F: cross section of ovary; G: inflorescence. – Drawn by E. G. Gonçalves from the type collection.

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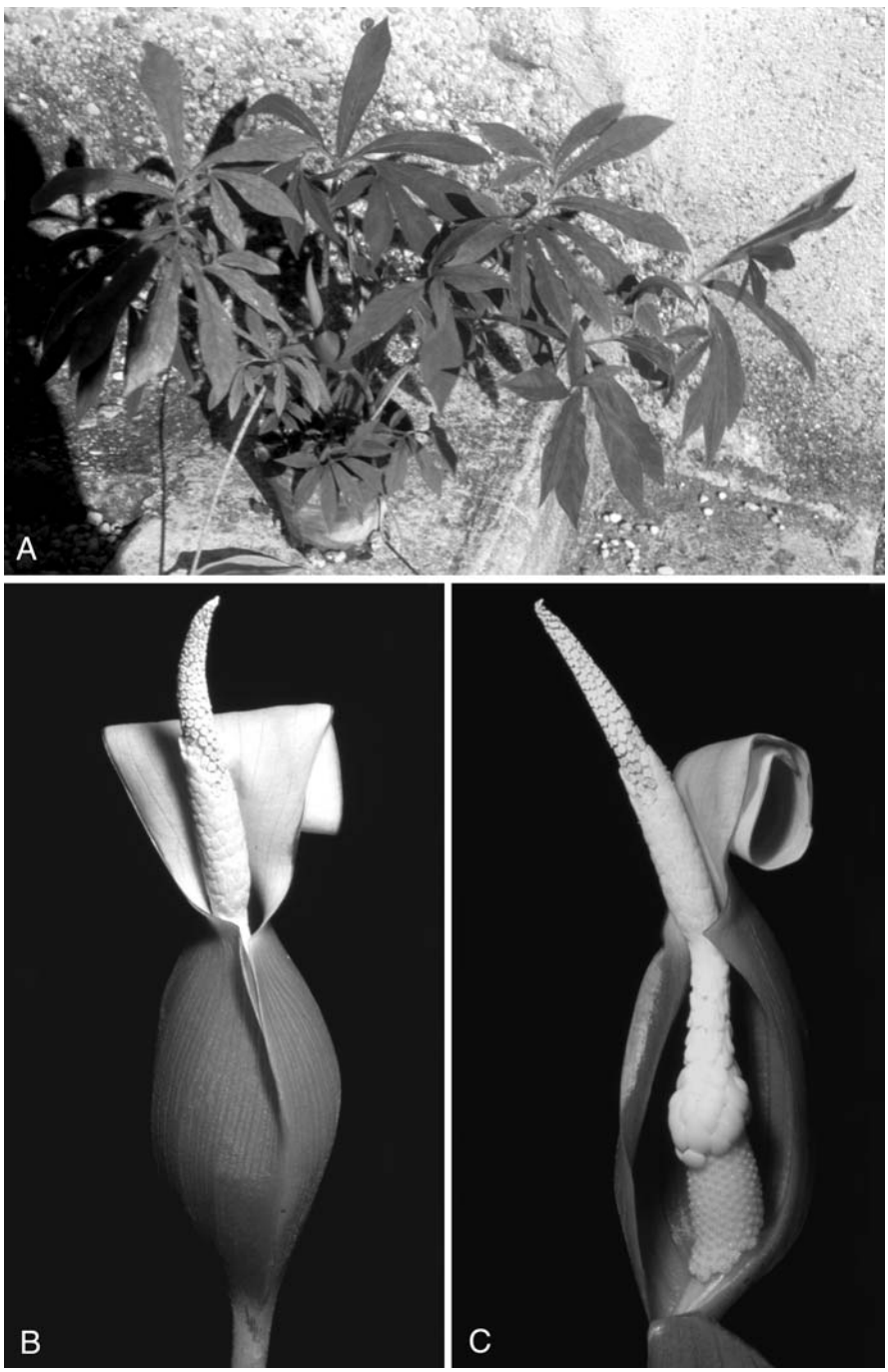


Fig. 6. *Xanthosoma latestigmatum* – A: flowering plant, habit; B: inflorescence in front view; C: inflorescence, spathe partly removed, showing female zone, sterile zone with synandrodes and male zone. – Photographs by J. Bogner (A) and G. Gerlach (B-C) from plants cultivated in the Botanical Garden Munich.

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very short stiff hairs); sheath 6-8 cm long; *leaf blade* pedatisect, leaflets (in adult stage) (7-)11-13, mid to light green (not shiny), lower face covered with very short whitish hairs, densely so on the veins, upper face also with very short whitish hairs and slightly rough-textured; rachis 7-10 cm long and 0.1-0.3 cm in diameter, distance between leaflets 0.5-2 cm, becoming shorter towards outermost leaflets; *leaflets* oblanceolate to elliptic or sometimes elliptic-oblong, the central one the largest, 5-10(-12) cm long and (1.5-)2-4 cm wide, the lateral smaller up to 5-10(-12) cm long and 0.5-1.5 cm wide, the outermost often only 1-2 cm long; apex cuspidate, base cuneate, sessile (on rachis), in the lateral leaflets decurrent on one side onto the rachis; *venation* reticulate; midrib well differentiated, primary lateral veins 6-10 on each side, interprimary veins present between them, third order veins much more slender; inner collective vein 1-2 mm distant from margin, outer collective vein ± 0.5 mm distant from margin. *Cataphylls* 8-9 cm long, membranaceous. *Peduncle* 10-15 cm long and 0.4-0.5(-0.8) cm in diameter, finely maculate, pilose (covered with very short dense hairs). *Spathe* 10-16 cm long, constricted at the middle, outside pilose, inside glabrous; tube somewhat inflated, convolute, 5-6 cm long and 2-2.5 cm in diameter, light green; *limb* ovate-oblong, 5-9 cm long, white to greenish white with red margin, apex cuspidate. *Spadix* shorter than spathe, 9-12 cm long, shortly stipitate; *female zone* ± cylindric to obconic, 1.5-2 cm long and 0.7-1.2 cm in diameter; *sterile zone* (between female and male zone) 1.5-2.5 cm long, basally much thicker and 1.2-1.5 cm in diameter with large synandrodes, apically 0.5-0.8 cm in diameter, white, synandrodes elliptic to oblong when viewed from above, the flattened surface with somewhat sunken centre, 6-7 mm long and 3-4 mm wide, c. 2 mm deep, the lowermost thickly swollen and c. 4 mm deep; *male zone* fertile to apex, whitish to cream-coloured, 5-8 cm long, basally c. 8 mm in diameter and narrowing towards acute apex. *Flowers* unisexual, naked. *Female flowers* (gynoecia), densely arranged c. 3 mm long and 1.2-1.3 mm in diameter, ovary somewhat ovoid, c. 2 mm long and 1-1.2 mm in diameter, white, with 2-3(-4) deeply intrusive placentae, ovules many, hemianatropous, c. 0.2 mm long; style broad, 0.8 mm thick and approximately as broad as the ovary, coherent, whitish to pale yellow, stigma disc-like, somewhat sunken centrally, yellow, 0.8-1 mm in diameter, papillose. *Male flowers* (synandria) connate of 5-6 anthers (10-12 thecae), whitish to cream coloured, flat-topped, sometimes somewhat irregular, well incised by the anthers (viewed from above), c. 2 mm deep, the lower ones elliptic when viewed from above, 2-3.5 mm long and 1.8-2.2 mm wide, then becoming broader and ± roundish towards middle of the male zone, 2-3 mm in diameter, the uppermost smaller, 1.8-2 mm in diameter with c. 4 anthers (= 8 thecae), thecae situated laterally and long-cylindric, c. 1.8 mm long, slender, c. 0.25 mm in diameter, opening by an apical pore. *Pollen* released in monads, grains globular, inaperturate, c. 30 µm in diameter, exine psilate.

Etymology. – *Xanthosoma latestigmatum* is named for its very broad stigma, which is, unusual for *Xanthosoma,* of ± the same diameter as the ovary.

Distribution. – Venezuela and Colombia.

Other specimens seen. – VENEZUELA: Hecrisde El Paraiso, 6.6.1891, *Eggers 13008* (L). — COLOMBIA: Hacienda El Carmen, highway La Uribe to Sevilla, 7 km east of La Uribe, 4°15'N, 76°02'W, 9.7.1994, *Silverstone-Sopkin & Paz 6890* (MO); Cundimarca, San Francisco, Vereda Torriba a lo largo del Rio San Miguel, 1500-1600 m, 30.8.1943, *Garcia-Barriga & al. 10930* (COL).

Notes. – *Xanthosoma latestigmatum* is mainly distinguished by its mid to light green, matte, pedate leaf blades with 11-13 leaflets lacking tuber-like swellings, glabrous ovaries, broad stigmas of the *Caladium* type and pollen released in monads.

Xanthosoma (sect. *Xanthosoma*) ***paradoxum*** (Bogner & Mayo) Bogner, **comb. nov.**
≡ *Caladium paradoxum* Bogner & Mayo in Willdenowia 18: 240. 1988.

Xanthosoma paradoxum is characterized by disc-like, coherent styles but with stigmas as broad as the ovary (gynoecium of the *Xanthosoma* type), pollen in monads and entire leaf blades. In spite of its strong affinity with *Xanthosoma* species we originally placed the species in *Caladium*

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for its pollen released as monads. In the light of our new findings, we transfer the species here to *Xanthosoma.* Most *Xanthosoma* species flower contemporaneously with the leaves, but *X. paradoxum* flowers before the leaves appear as is rather usual in *Caladium*.

Discussion

Our two new species of *Xanthosoma* are most notable for their pollen released in monads. According to Madinson (1981) *Caladium* species release the pollen in monads and *Xanthosoma* in tetrads. *X. mariae* and *X. latestigmatum,* however, clearly belong to *Xanthosoma* sect. *Acontias,* which is characterized by pedatisect leaves and tuberous, non-aerial stems. In *Caladium,* as in *Xanthosoma* sect. *Xanthosoma,* all species have entire leaf blades, only one species, *C. ternatum* Madison, has ternate leaf blades. Within *X.* sect. *Acontias* our new species are, moreover, closely related to the Brazilian species *X. plowmanii* and *X. pottii,* as is, in spite of the latter species releasing their pollen in tetrads, quite apparent by the rare and therefore significant pilosity of the leaves, which all four species have in common. The presence of both monads and tetrads in the same genus is very rare but not unique in the plant kingdom. For instance, in the monocots *Typha minima* Funck ex Hoppe *(Typhaceae)* has the pollen in monads while all other species have it in tetrads, in the dicots *Epilobium* L. *(Onagraceae)* has both types, and also *Podophyllum* species such as *P. hexandrum* Royle (syn. *P. emodi* Hook. f. & Thompson) release the pollen in tetrads, whereas *P. peltatum* L. and *P. pleianthum* Hance have their pollen in monads (Erdtman 1945).

Another character stressed to distinguish the genera *Caladium* and *Xanthosoma* is the structure of the female flowers. Nonetheless, there is much more variation than previously thought, since a lot of material has been collected since Engler's revision (Engler 1920). In particular studies by Gonçalves (2004) have shown a wide range of style and stigma shapes. Previously *Caladium* has been mainly distinguished by a stigma as broad as the ovary, often said to be sessile (but there is also a broad, not modified style or stylar region) from *Xanthosoma,* which has been characterized by disk-like, broadened and coherent styles with a centrally smaller stigma, at least narrower in diameter than the ovary. Now we known at least six different types of styles in *Xanthosoma: Xanthosoma* type, *Acontias* type, *Cyrtospadix* type, *Chlorospatha* type (Gonçalves 2004), *Caladium* type (in *X. latestigmatum*) and a ± sessile stigma in *X. feuersteiniae* Croat & Bogner (Croat & Bogner 2005). Further studies of the female flower morphology, which is often difficult to identify in old, badly preserved herbarium material, are ongoing, using fresh or pickled material.

Engler (1920), Madison (1981) and Grayum (1984) maintained the genus *Aphyllarum* S. Moore, but Bogner & Mayo (in Bogner & Nicolson 1991) considered the single species, *A. tuberosum* S. Moore, as a true *Caladium,* because the pollen is shed in monads and the styles are not coherent, and transferred it to that genus. Also in the light of our new results we still think that the alternative placement of *C. tuberosum* together with *C. paradoxum (X. paradoxum)* in an expanded genus *Aphyllarum* would be artificial, as is only supported by pollen released in monads.

Considering the pollen and gynoecium characters, it is apparent from the comments above that delimitations between *Xanthosoma* and *Caladium* has become blurred, thus raising the question whether their separation is still justified. Preliminary DNA analysis (partly unpublished) revealed two separate clades for *Caladium* and *Xanthosoma,* but are based only on few species. Further molecular studies are in progress. Unfortunately no material is so far available for some critical species, e.g., *Xanthosoma paradoxum, Caladium tuberosum, Caladium ternatum* Madison, *Caladium andreanum* Bogner and others. Until more molecular data and complete revisions are available, we should maintain the traditional delimitation of these genera.

In order to distinguish the genera of the *Caladieae* we provide a revised key.

Key to the genera of *Caladieae*

1. Plants terrestrial or geophytic, climbers or hemiepiphytes 2
– Plants aquatic, completely submerged (only the inflorescence appears over the water surface); leaf blades linear, bullate; N South America (Guianas) . . . . . *Jasarum*

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2. Plants climbers or hemiepiphytes, sometimes creeping on ground; internodes long; berries connate into a syncarp; neotropics . . . . . *Syngonium*
– Plants terrestrial or geophytic, few helophytes, never climbing; internodes very short (leaves often in a rosette); berries free from each other 3
3. Paleotropic plants; spathe not distinctly constricted; synandria peltate; gynoecia laxely arranged . . . . . *Hapaline*
– Neotropic plants; spathe well constricted (except *Xanthosoma feuersteiniae*); synandria also truncate but not peltate; gynoecia densely arranged 4
4. Pollen shed in tetrads (except *Xanthosoma paradoxum, X. mariae, X. latestigmatum*); leaf blades entire, trifid or trisect to pedatifid or pedatisect 5
– Pollen shed in monads; leaf blades always entire, often peltate, cordate to sagittate or hastate, rarely trilobed *(Caladium ternatum)* 6
5. Spathe tube usually subglobose, inflated (except *Xanthosoma feuersteiniae)*; female zone of spadix free; styles mostly discoid and laterally swollen or thickened and coherent or not; synandrodes between female and male flowers ± prismatic . . . . . *Xanthosoma*
– Spathe tube narrow and elongate; female zone of spadix mostly adnate to spathe; styles or stylar region thin, spreading, spongious, diaphanous, mantle-like or rarely inconspicuous or ± absent *(Chlorospatha longipoda);* synandrodes between female and male flowers usually irregular or fungiform, never prismatic . . . . . *Chlorospatha*
6. Spathe tube always convolute; stylar region as broad as ovary and not specially modified; synandrodes between female and male flowers well developed and prismatic; placentas parietal; seeds several, rarely 1 to 2; whole neotropics . . . . . *Caladium*
– Spathe tube gaping widely at anthesis; style much narrower than ovary; synandrodes absent (female and male flowers contiguous); placenta basal; seed solitary; Bolivia, central and E Brazil . . . . . *Scaphispatha*

Acknowledgements

We are very grateful to Mrs Mary Sizemore (De Land, Florida) and Mr Manfred Speckmaier (Freising, Bavaria) for putting living plants of the new species at our disposal, Dr Helmut Roessler (München) for the translation of the diagnosis into Latin, Dr Günter Gerlach (München) for photographs, Prof. Dr Michael Hesse (Wien) and Prof. Dr Christopher Cook (Zürich) for information on the presents of tetrads and monads in the same genus, and Dr Simon Mayo (Kew) and Mr Peter Boyce (Kuching) for linguistic advice and valuable comments on the text. SEM photographs were produced by Prof. Dr Michael Hesse in the Palynological Laboratory of the Botanical Institute of the University of Vienna. The work of the second author was funded by CNPq (Auxílio Pesquisa) and SIGEP-UCB.

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