



New species of *Amorphophallus* (Araceae) in the Philippines and an updated key

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Key words

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Abstract The number of named Philippine species of the genus *Amorphophallus* (Araceae-Thomsonieae) amounts to 13 today. Three existing species names (not included in this count) cannot be attributed to presently recognized species for lack of their holotypes, which were all destroyed in WWII. Five new species are described here and an identification key to all species recognized from the Philippines is presented.

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INTRODUCTION

The first endemic Philippine *Amorphophallus* species was described by Engler & Gehrmann (in Engler 1911): *A. longispathaceus* from 'Todaya, Mt Apo, Southeast Mindanao'. The holotype was destroyed in WWII and only one isotype exists (K) but is a leaf fragment which does not allow proper linking to known plants today. The same holds for the next two species described, *A. merrillii* K.Krause (1912 'Cavilli Island') and *A. luzoniensis* Merr. (1915 'Luzon, Cagayan'), of which no authentic material remains. The protologues of all three species lack enough detail to link them to presently recognized species. They are therefore excluded from the identification key.

In 1992 Bogner & Hetterscheid published the first new species (*A. palawanensis* Bogner & Hett.) after Merrill (1915). A group of four new species (*A. dactylifer* Hett., *A. declinatus* Hett., *A. rostratus* Hett. and *A. salmoneus* Hett.) was subsequently described by Hetterscheid (1994). *Amorphophallus natolii* Hett. et al. was published in 2012 and the next and most recent new species was *A. adamsensis* Magtoto et al. (2013). Here we describe five new species, which, including the widespread *A. paeoniifolius* (Dennst.) Nicolson, brings the total number of Philippine species to 13 (not including the three incompletely known ones).

All but one species (*A. paeoniifolius*) known from the Philippines are endemic. *Amorphophallus paeoniifolius* occurs in all tropical parts from India eastwards into Polynesia and southwards to northern Australia. Its long agricultural history accounts for its unusually wide geographical range, which undoubtedly is largely due to populations escaped from cultivation. This is suggested also to be the case for the Philippine occurrences of it.

In the online Co's Digital Flora of the Philippines (Pelser et al. 2011 onwards) two additional species are mentioned, *A. variabilis* Blume and *A. plicatus* Bok & H.J.Lam. The photograph of

the plant identified as the Javan species *A. variabilis* (from Palawan), in fact shows *A. declinatus* Hett. and the plant identified as the Sulawesi species *A. plicatus* (Iloilo, no picture), is probably *A. yaoi* (sp. nov., presented below).

KEY TO THE PHILIPPINE SPECIES OF AMORPHOPHALLUS (EXCL. A. LONGISPATHEUS, A. LUZONIENSIS AND A. MERRILLII, SEE ABOVE)

1. Inflorescence short pedunculate, spathe sessile on the soil or almost so 2
1. Inflorescence long pedunculate; peduncle longer than spathe 5
2. Spathe hooded (fornicate), hiding the spadix 1. *A. fornicatus*
2. Spathe campanulate, opening widely exposing the spadix 3
3. Spadix far exceeding the spathe, appendix narrowly elongate, smooth, style slender, stigma entire 5. *A. yaoi*
3. Spadix as long as or at most 10 cm longer than spathe, appendix (broadly) conical or fusiform-conical, smooth or irregularly wrinkled/folded, style sturdy or slender, stigma shallowly or strongly lobed 4
4. Spadix shorter than or slightly longer than spathe, appendix broadly conical-triangular, base cuneate or overarching, surface usually wrinkled/folded, spathe margin not rolled inwards, style slender, at least twice as long as ovary *A. paeoniifolius*
4. Spadix as long as or at most 10 cm longer than spathe, more or less distinctly appendix fusiform-conical, base more or less constricted, surface inside smooth or very shallowly rugulose, spathe margin narrowly rolled inwards, style sturdy, almost as long as ovary or slightly longer 4. *A. urceolatus*
5. Spathe small, not longer than 10 cm, purple on both sides *A. palawanensis*
5. Spathe considerably longer than 10 cm, purple, white, green or multi-coloured 6
6. Appendix densely set with long, thin hairs; spathe limb near uniformly white with or without a pink-purplish hue *A. natolii*

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Plate 1 *Amorphophallus fornicatus* Hett., J.R.C.Callado & Wistuba (plant cultivated in Hamburg Botanical Garden). a. Leaf; b. inflorescence; c. inflorescence cut open exposing the entire spadix; d. lower part of spadix. — Photos by: a–b. C. Claudel; c–d. W. Hetterscheid.

6. Appendix smooth or verrucose, spathe limb mostly partly white but more usually purple, never pink 7
7. Sterile zone between female and male zone present, covered with broadly flattened, shield-like staminodes 8
- 7 Sterile zone between female and male zones absent 9
8. Spadix shorter or only slightly longer than spathe; appendix surface heavily verrucose *A. salmoneus*
8. Spadix far outreaching the spathe; appendix smooth or shallowly rugulose 3. *A. rayongii*
9. Spadix shorter than spathe; appendix fusiform; stigmas with 4–5 prominent, rod-like extensions 2. *A. cidarioides*
9. Spadix distinctly longer than spathe; appendix narrowly elongate conical, stigmas without extensions 10
10. Style 1 mm or shorter 11
10. Style 2 mm or longer 12
11. Stigma trilobed, lobes equal, tuber developing numerous small globose offsets each year, leaf blade without intercalary bulbils; spathe base inside heavily verrucate, sometimes slightly confluent forming shallow ridges *A. declinatus*
11. Stigma one- or trilobed and then one lobe much larger than the other two; tuber not developing offsets; mature leaf blade with a central half-intercalary bulbil at the junction of the petiole and the lamina and sometimes at the first major branching points of the main segments; spathe base inside heavily verrucate, verrucae often confluent forming very prominent ridges *A. rostratus*
12. Spathe broadly triangular, almost as broad as long; spadix at most twice as long as the spathe; leaflets more or less gradually narrowing to a short, acuminate tip *A. dactylifer*
12. Spathe elongate triangular, twice longer than broad; spadix at least 2.5 times longer than spathe; leaflets abruptly narrowed into a long, narrow acuminate tip *A. adamsensis*

DESCRIPTIONS OF NEW SPECIES

Herbarium acronyms follow Thiers (continuously updated), except DLSU-DH (De La Salle University-Dasmariñas).

1. *Amorphophallus fornicatus* Hett., J.R.C.Callado & Wis-tuba, *sp. nov.* — Plate 1

Etymology. The species epithet refers to the shape of the spathe limb.

Type. J.R.C. Callado JRCC 982 (holo PNH 256728), Philippines, Luzon, Quezon National Park, Atimonan, 26 July 2013.

Tuber globose, 4–5 by 4–5 cm, white, with one (or more?), globose offset, the latter c. 1 cm diam. *Leaf* solitary; petiole 43–55 by 1–1.5 cm, smooth, uniformly pale green or rarely with very few whitish spots near the base; lamina 45–65 cm across, moderately dissected, an epiphyllar bulbil developing in the centre, this depressed globose, verrucate, c. 1 cm diam, rachises not winged; leaflets elliptic to elongate elliptic, 3–19 cm long, 1–7 cm across, acuminate, slightly leathery, upper surface glossy mid green, lower surface dull pale green. *Inflorescence* short pedunculate; peduncle 1–2 cm long, entirely hidden in the soil, stretching to twice its length during fruiting. *Spathe* ovate when spread out, 19–20 cm long, 10–11 cm diam at the base of the limb, erect, basal part strongly convolute, tubular, limb fornicate, overtopping the spadix, acute, opening wider at male anthesis with margins reflexing, base outside off-white or pale green with whitish orbicular spots, with or without a purplish, white-maculated margin, inside basal part pale purplish, with a few larger verrucae or slightly grooved, upper part off-white. *Limb* outside whitish green or with a pale purplish background but largely hidden by large, strongly confluent whitish spots,

inside deep purplish with numerous, small whitish spots, less numerous towards the margin. *Spadix* sessile, shorter than spathe, 12–13.5 cm long; female zone cylindric, 1.5–1.7 cm long, 1.6 cm diam, pistils congested; male zone obconic, 4.5–5 cm long, 1.6–1.8 cm diam at the base, 2.2–2.3 cm diam at the top, base and top truncated; appendix stipitate (stipe 0.3–0.5 cm long, grooved or with very flattened, elliptical staminodes), narrowly to broadly elongate conical, 7.5 cm long, 4 cm diam, obtuse, dark purple, surface strongly echinate-papillate, echinae (staminodes) fleshy, narrowly conical, c. 1 mm long, shorter near the top, acute or obtuse. *Ovary* depressed, 1 mm long, 2 mm diam, unilocular, blackish purple; style curved upwards, 1–1.5 mm long, 0.8 mm diam, ridged, blackish purple; stigma thin, whitish, transversely bilabiate to irregularly stellate, 2-, 3- or multilobed, to 1.3 mm diam, lobes conical. *Male flowers* consisting of 3 stamens; stamens 2 mm long; filaments almost free to the base 1 mm long, 0.7 mm diam, anthers halter-shaped in cross-section, 1 mm long, c. 1 mm diam, pale pinkish; thecae subglobose, top subtruncate to obtuse, separated by a deep, groove-like connective, pores apical, elliptic. *Infructescence* cylindric; berries ovate, c. 9 mm long, c. 8 mm diam, smooth, orange; seeds c. 7 mm long, c. 4 mm diam.

Distribution — Philippines, Luzon, Quezon National Park, Atimonan.

Note — The shape of the spathe of *A. fornicatus* and the echinate appendix are unique compared to all species of the genus in Asia. In both characters it shows a remarkable similarity to the West African *A. dracontoides* (Engl.) N.E.Br. The narrow spathe base and several characters of the female and male zone, and the pistils and anthers are reminiscent of *A. hottae* Bogner & Hett. from Sabah (eastern Malaysia). The leaf is also similar to that of the latter species, up to the formation of epiphyllar bulbils.

2. *Amorphophallus cidarioides* J.R.C.Callado, Medecilo & Hett., *sp. nov.* — Plate 2

Etymology. The species epithet is based on the resemblance of the stigma with its extensions to species of the sea urchin genus *Cidaris* Leske.

Type. J.R.C. Callado JRCC 2516 (holo PNH 256729), Philippines, Panay Island, Luho, Brgy. Caratagan, Calinog, Iloilo, 22 Feb. 2017.

Tuber depressed globose, 5–9 cm diam, 3.5–5.5 cm high. *Petiole* 88–132 cm long, 1.3–4 cm diam at the base, 0.9–2 cm at the top, surface smooth, whitish to very pale green with numerous, densely set, often confluent, narrowly elliptical dark brown spots and dots. *Lamina* 128–185 cm diam, rachises unwinged but for the most distal parts, developing swellings at the branching point, these verrucose and possibly forming new plants after leaf senescence; leaflets ovate to elongate elliptical, 17–32 cm long, 5.5–9 cm wide, long acuminate, upper surface dull dark green, collective vein rather distant from the margin, conspicuous. *Inflorescence* solitary; peduncle c. 70 cm long, 1.8 cm diam at the base, smooth, dirty pale brownish whitish with numerous narrowly elliptical, dark brown spots. *Spathe* triangular-ovate, 23 cm long, 10 cm wide, erect, base and limb not strongly separated, top involute and spiralling over a short distance, apex broadly acute, base inside verrucose, white, outside pale purplish with scattered, small, blackish green spots, limb inside maroon, outside purplish with numerous, scattered, small blackish green spots. *Spadix* sessile, shorter than spathe, 15.5 cm long; female zone cylindric, 3.5 cm long, 2.4 cm diam, pistils crowded; male zone cylindric, 4 cm long, 3.4 cm diam, stamens crowded; appendix fusiform-conical, 8 cm long, 3.5 cm diam above the base, base constricted forming a very short, stipe-like part of 2.4 cm diam, surface smooth, dark maroon, top obtuse. *Ovaries* depressed-globose, 2.5–3



Plate 2 *Amorphophallus cidarioides* J.R.C.Callado, Medecilo & Hett. (type plant before conservation). a. Leaf lamina; b. inflorescence; c. lower part of spadix with female and male zone; d. detail of the female zone showing stigmas with rod-shaped extensions. — Photos by: M.P. Medecilo.

mm diam, 2 mm long, angulate, off-white, unilocular; stigma sessile, depressed, triangular, 1–1.2 mm diam, 0.5 mm high, with three rod-like extensions, almost perpendicular to the stigma surface or more horizontally radiating from the centre; extensions cylindric, fleshy, 1.5 mm long, 0.2 mm diam, obtuse, base sometimes slightly thickened, surface rugulose, off-white. Number of stamens per male flower not determinable; stamens 3–3.5 mm long, narrowly cylindric, white; filaments free, 2 mm long, 0.5 mm diam; anthers 1–1.5 mm long, 0.8 mm diam; connective dome-shaped; pores subapical, slit-like.

Distribution — Only known from the type locality.

Note — A species unique in the entire genus because of the rod-like extensions on the stigmas. The thin, elongate stamens are also rare in the genus.

3. *Amorphophallus rayongii* Hett. & Medecilo, *sp. nov.* — Plate 3

Etymology. The species is named after Ray Ong, who discovered it on Boracay island.

Type. G. Yao s.n. (holo PNH 256730), Philippines, Boracay Island, Malay, Aklan, along vacant lots near the resort shoreline, 20 May 2012.



Plate 3 *Amorphophallus rayongii* Hett. & Medecilo (plant cultivated in the Philippines). a. Inflorescence; b. leaf; c. spathe cut open exposing larger part of the spadix; d. lower part of the spadix showing basal female zone and part of the male zone with in between the staminodial zone. — Photos by: R. Ong.



Plate 4 *Amorphophallus urceolatus* Hett., A.Galloway & Medecilo (plant cultivated in the Philippines). a. Part of the leaf lamina; b. inflorescence; c. spathe cut open exposing female and male zone; d. female zone. — Photos by: a, d. A. Galloway; b–c. M.P. Medecilo).

Tuber irregularly globose, to at least 8 cm diam, producing few offsets, released in next growing season after initiation. *Petiole* 35 by 0.8 cm, smooth, pale green, upper part with scattered, whitish spots, lower part with indistinct olive green spots. *Lamina* 70 cm diam, rachises very narrowly winged throughout; leaflets elongate elliptic, 4–19 cm long, 1.5–5 cm wide, acuminate. *Peduncle* c. 100 cm long, c. 2.5 cm diam, smooth, pale green. *Spathe* elongate triangular, 23.5 cm long, 12 cm wide

(base), base and limb separated by a constriction, base outside green, inside upper part green, lower part maroon, limb erect, outside pale brown, inside dark brown, base inside densely verrucate. *Spadix* longer than spathe, 52.5 cm long; female zone cylindric, 2 cm long, 1.7 cm diam, flowers congested; male zone 10.5 cm long, 1.8 cm diam, flowers congested; sterile zone between female and male zone 1 cm long, 1 cm diam, with slightly separated synandrodies; appendix narrowly elongate conical,

39 cm long, 2 cm diam at the base, gradually tapering to the subacute top, surface rugulose, pale green or off-white. *Ovaries* depressed, 4 mm diam, 2 mm high, pale green, unilocular; style 1–2 mm long, 1 mm diam, curved upwards, pale green; stigma depressed or transversely bilabiate, 3 by 1.5 mm diam, 0.8 mm high, more or less strongly 2–3-lobed, surface verrucate, pale brown. *Male flowers* consisting of 4–5 stamens; stamens 2 mm long; filaments very short, free, c. 0.2 mm long; anthers off-white, subtruncate, 1.8 mm long, 2 mm diam, connective slightly sunken, pores apical, slit-like. *Synandrades* elliptical, 4–7 mm long, 3–4 mm diam, 2 mm high, flattened, surface densely verrucate or irregular.

Distribution — Known only from the type locality.

Notes — *Amorphophallus rayongii* is morphologically very close to *A. salmoneus*, with which it shares the flattened, verrucate synandrades between the male and female zone. No other species on the Philippines show this character. It is not a unique character in the genus and is found in quite a number of species from SE Asia, although the verrucate surface of the Philippine species is unique.

Amorphophallus salmoneus has been placed in subg. *Amorphophallus* (Claudel et al. 2017) close to *A. dactylifer* and *A. declinatus* both Philippine species. This subclade is part of a larger clade with exclusively insular SE Asian species from Indonesia and East Malaysia. However, all other species with synandrades similar to those of *A. salmoneus* and *A. rayongii* are part of subg. *Scutandrium* Hett. & Claudel, dominated by mainland SE Asian species. The synandrades therefore are clearly a parallel expression developed from fertile male flowers in different clades.

4. *Amorphophallus urceolatus* Hett., A. Galloway & Medecilo, sp. nov. — Plate 4

Etymology. The specific epithet refers to the urn-shape of the spathe.

Type. M.P. Medecilo 623 (holo PNH 256731; iso DLSU-DH), Philippines, Luzon (Mt Palpag, Maragondon, Cavite), 13 June 2015.

Tuber depressed globose, somewhat irregular with raised areas, no offset development, 6–12 cm diam, 4–8 cm high. *Petiole* 45–120 cm long, 3–9 cm diam, largely smooth, near the base slightly or strongly verrucate, blackish grey with smaller and larger, elongate elliptical whitish spots; lamina 60–120 cm diam, rachises winged above the basal branches; leaflets elongate elliptical, 1.5–15 cm long, 2.5–6 cm diam, upper side glossy green, lower surface glossy pale green, margin undulate, top long acuminate. *Inflorescence* solitary, short pedunculate, held at ground level. *Spathe* broadly oval, campanulate, 20 cm long, 25 cm diam, base convolute, separated from the limb by a shallow constriction, inside purple, verrucate with warts slightly separated, sometimes with a few short grooves, outside pale green with scattered whitish rounded spots; limb oblique to almost horizontal, inside basal part pale to mid green, margin or almost entire surface pale to dark purple, margin partly rolled inwards, more or less undulating, outside pale green with faint purplish hue to purplish with greenish vertical bands, entire surface with scattered, whitish, rounded spots and less numerous, small punctiform blackish green dots. *Spadix* shortly stipitate, 22.2 cm long, slightly shorter to slightly longer than the spathe; female zone cylindric, 2.8 cm long, 2 cm diam, flowers slightly distant, sometimes missing from the upper 0.5 cm; male zone subcylindric, with the base constricted, 3.5 cm long, 1.7 (base)–2.5 (top) cm diam, flowers congested; appendix narrowly to broadly fusiform-conical, 16 cm long, 3.5 cm diam just above the base, smooth, dark purple, gradually or more abruptly tapering to the top. *Ovary* depressed, 4 mm diam, 3 mm high, 2–3-locular, pale or dark purple with a whitish base; style 5 mm

long, 1 mm diam, dark purple; stigma strongly or shallowly bilobed, 1.5 mm high, 3 mm diam (long axis), surface rugulose, yellow to dirty greyish brown. *Male flowers* with 3–5 stamens in lower part but indeterminable in the remaining part; stamen 2 mm long, 1.2 mm diam, off-white; filament free, 0.3 mm long, 1.2 mm diam; theca truncate, 1.7 mm long, 1.2 mm diam (long axis), pores slit-like, apical.

Distribution — This species can also be found in other parts of the Philippines. The following locations have all been mentioned to the authors by third parties and no collections have been made. The observations have been verified by the authors. Luzon Island (Rizal: Barras, Laguna: Mt Makiling, Cavite: Mt Palpag), Mindanao (General Santos City: K'laja karst).

Note — Of the four, short pedunculate species in the Philippines, *A. urceolatus* clearly resembles *A. yaoi*. It differs from the latter by the spadix being approximately as long as the spathe, by the much shorter and broader appendix and the stigma being shallowly or strongly bilobed.

5. *Amorphophallus yaoi* A. Galloway, Hett. & Medecilo, sp. nov. — Plate 5

Etymology. The species is named after George Yao, a superb plantsman, for his many contributions to botany specifically aroids, horticulture and conservation of the flora of the Philippines.

Type. J.R. Callado JRCC1475 (holo PNH 256732; iso DLSU-DH), Philippines, Panay Island, Dingle, Iloilo (Bulabog Putian National Park), in shaded areas and hilly forest, 27 May 2014.

Tuber globose, somewhat irregular with raised areas, no offset development, 6–7 cm diam, 6–7 cm high. *Petiole* 80–100 cm long, 2–3 cm diam, largely smooth, near the base slightly or strongly verrucate, generally grey with a mix of either pale black or pale brown, or pale green with smaller and larger, elongate elliptical dull whitish spots. *Lamina* 70–80 cm diam, rachises winged above the basal branches; leaflets elongate elliptical, 1.5–15 cm long, 2.5–8 cm diam, upper side glossy green, lower surface glossy pale green, margin even, smooth, top long acuminate. *Inflorescence* solitary, short pedunculate, held at ground level or 2–6 cm above ground level. *Spathe* broadly oval, campanulate, 25–30 cm long, 22–28 cm diam, base convolute, separated from the limb by a shallow constriction, inside purple to dull maroon, verrucate with warts slightly separated, outside pale green with scattered whitish rounded spots and black dots; limb oblique, inside basal part pale green, margin or almost entire surface pale to dark purple to dull greenish beige, margin partly rolled inwards, more or less undulating, outside pale green with faint purplish hue to purplish with greenish vertical bands, entire surface with scattered, whitish, rounded spots and less numerous, small punctiform purplish dots. *Spadix* sessile, 40 cm long, longer than the spathe; female zone cylindric, 4.5 cm long, 3 cm diam, flowers slightly distant; male zone cylindric to subcylindric, with the base constricted, 5.5 cm long, 2 (base)–3 (top) cm diam, flowers congested; appendix narrowly conical to slightly fusiform-conical, 30 cm long, 1.5–3 cm diam just above the base, smooth, sometimes lower 1 cm having thornlike projections 3 mm long, dark purple to dull maroon, gradually tapering to the top. *Ovary* 4.5 mm diam, 2.5 mm high, 1–3-locular, dark purple; style 5.5 mm long, 1 mm diam, dark purple; stigma shallowly bilobed, 1.25 mm high, 1.5 mm diam (long axis), minutely verrucate, creamy white to bright yellow. *Male flowers* with 3–5 stamens; stamen 3 mm long, 2.5 mm diam, off-white; filament free; theca truncate, pores slit-like, apical. *Pollen* creamy white to bright yellow. *Infructescence* cylindric; berries 1–3-seeded, generally ovate, c. 1.5 cm long, c. 1 cm diam, smooth, dull reddish orange, stigmas persistent; seeds c. 8 mm long, c. 2–3 mm diam.



Plate 5 *Amorphophallus yaoii* A.Galloway, Hett. & Medecilo (a–b plant in habitat; c–d plant cultivated in the USA). a. Leaf; b. inflorescence; c. detail of the female zone; d. spathe cut open exposing larger part of the spadix. — Photos by: a, c–d. A. Galloway; b. R. Perez.

Distribution — Capiz province, Panay Island; Romblon Island: Odiongan. These occurrences have been verified by the authors, based on photographs of third parties.

Additional material. *A. Galloway* AGA-1550-01 (PNH), from a plant cultivated by A. Galloway (orig. coll. A. Galloway, Philippines, Panay Island, Aug. 2003); *A. Galloway* AGA-2168-01 (PNH), from a plant cultivated by A. Galloway (orig. coll.: A. Galloway, Philippines, Panay Island, Dumalag, Capiz province, in hilly, shaded areas, 26 Mar. 2011); *A. Galloway* AGA-2176-01 (PNH), from a plant cultivated by A. Galloway (orig. coll. Kurt Tan, Philippines, Tablas Island, Romblon, 2010).

Note — Of the four, short pedunculate species in the Philippines, *A. yaoii* clearly resembles *A. urceolatus* sp. nov. (see above). It differs from the latter by the spadix being much longer than the spathe, and by the much longer and more slender appendix. The campanulate spathe separates it from *A. fornicatus* sp. nov. and the elongate, unfolded appendix from *A. paeoniifolius*.

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