

**REVISION OF AMORPHOPHALLUS BLUME EX DECNE. SECT.
AMORPHOPHALLUS (ARACEAE) IN INDIA**

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Abstract

Amorphophallus Blume ex Decne. sect. *Amorphophallus* in India is revised. It is the smallest of the three sections in India with five species, viz. *A. hirsutus* Teysm. & Binn., *A. kachinensis* Engl. & Gehrm., *A. longistylus* Kurz, *A. napalensis* (Wall.) Bogner & Mayo and *A. paeoniifolius* (Dennst.) Nicolson. *Amorphophallus paeoniifolius* is the widely distributed species in India with two varieties, viz. *A. paeoniifolius* var. *paeoniifolius*, and var. *campanulatus* (Decne.) Sivad. *Amorphophallus longistylus* is the only species of the section endemic to India.

Introduction

Amorphophallus Blume ex Decne. sect. *Amorphophallus* (Araceae) is the smallest of the three sections represented in India. Revisions of the other two sections, viz. *Rhaphiophallus* and *Conophallus* have been carried out recently by Jaleel *et al.* (2011, 2012).

Engler (1911) in his revision of the genus treated *Amorphophallus campanulatus* Decne. [= *A. paeoniifolius* (Dennst.) Nicolson] under the section *Cundarum* Engl. which is a renaming of *Candarum* Rchb. ex Schott. According to Engler (1911), composition of the name '*Candarum*' was improper and he renamed it as '*Cundarum*' stating that the name is derived from the Indian name '*Kunda*' (= *Amorphophallus campanulatus*) to which the suffix '*arum*' was added resulting in '*Kundarum*' and written as '*Cundarum*'. He considered it as a new name with his authorship. But as per Art. 60.1 of ICN (McNeill *et al.*, 2012) the original spelling of a name or epithet is to be retained, and hence the name *Cundarum* Engl. is treated as illegitimate. Engler (1911) included *Amorphophallus campanulatus*, the type of the genus *Amorphophallus* under the section *Cundarum* Engl. As per Art. 22.1. of ICN, the name of any subdivision of a genus that includes the type of an adopted, legitimate name of the genus to which it is assigned is to repeat that generic name unaltered as its epithet, and accordingly the correct name of the section of *Amorphophallus* that includes *Amorphophallus campanulatus* [= *A. paeoniifolius*] should have been *Amorphophallus* sect. *Amorphophallus*, and it is used in the present study.

Out of the seventeen species of *Amorphophallus* included in *Flora of British India* by Hooker (1894), only eight were reported to be occurring in India and *Amorphophallus longistylus* Kurz ex Hook. f., *A. campanulatus* (= *A. paeoniifolius*) and *A. dubius* Blume (= *A. paeoniifolius*) are among those belonging to the section *Amorphophallus* as per the present standards adopted for species delimitation. Engler (1911) in his monographic work included *A. longistylus* under the section *Conophallus*, and *A. napalensis* was treated under the genus *Thomsonia* which was later transferred to *Amorphophallus* by Bogner *et al.* (1985). Since Engler's work, several new species have been discovered from various parts of India. Brief accounts on earlier taxonomic work on Indian *Amorphophallus* have been provided by Jaleel *et al.* (2011, 2012). The present article is the third and final part of revision of the genus *Amorphophallus* in India.

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The methodology adopted in earlier works (Jaleel *et al.*, 2011, 2012) have been followed in the present work. Extensive and exhaustive field explorations covering all seasons were made all over India for collection and recording relevant data of the specimens.

Indian specimens available at various major herbaria such as ASSAM, BM, BSA, BSD, BSHL, BSI, CAL, CALI, DD, GH, JCB, K, KFRI, L, M, MH, PBL, TBGT and US were consulted, and representative specimens were cited.

Taxonomic treatment

Amorphophallus Blume *ex* Decne., *Nouv. Ann. Mus. Hist. Nat.* 3: 366 (1834), *nom. cons.* [Taxon 31: 310 (1982)].

Type: Amorphophallus campanulatus Decne. [= *A. paeoniifolius* (Dennst.) Nicolson].

Amorphophallus Blume *ex* Decne. sect. **Amorphophallus**, *emend.* Sivad. *mut. char.* [*Amorphophallus* sect. *Candarum* Blume, *Rumphia* 1:139 (1835). *Amorphophallus* sect. *Cundarum* Engl., *Pflanzenr.* IV. 23C (48): 74 (1911), *nom. illegit.*].

Spathe usually campanulate with a basal convolute tube and an upper horizontally spreading limb or with basal convolute tube and erect, oblong or oblong-ovate or ovate limb; appendix usually conoid, hemispheric or cylindrical; style always long, equal to or 2-4 times the height of ovary; stigma lobed.

Key to the Indian species of *Amorphophallus* sect. *Amorphophallus*

1. Peduncle 3-8 cm long; spathe broadly campanulate with basal convolute tube and horizontally spreading limb; spadix-appendix sub-globose or conoid. 2
- Peduncle more than 20 cm long; spathe ovate with basal convolute tube and upper erect open limb; spadix-appendix elongate-ovoid or cylindrical. 3
2. Spadix-appendix with subglobose base and apical short cylindrical truncate column bearing short stiff hairs. *A. hirsutus*
- Spadix-appendix subglobose or conoid, glabrous. *A. paeoniifolius*
3. Petiole and peduncle smooth with even surface; spadix shorter than spathe; appendix elongate-ovoid with irregular longitudinal grooves or fissures, or cylindrical with warts; style length more or less equal to the height of ovary. 4
- Petiole and peduncle smooth with uneven surface having small bumps; spadix longer than spathe; appendix elongate, cylindrical with tapered tip, smooth; style 2-3 times the height of ovary. *A. longistylus*
4. Spadix stipitate; appendix elongate-ovoid, surface with irregular longitudinal grooves or fissures; style straight; stigma inconspicuously 3-lobed. *A. kachinensis*
- Spadix sessile; appendix cylindrical, surface rough with short prominent protuberances; style bent towards spadix-axis; stigma 4-lobed. *A. napalensis*

Amorphophallus hirsutus Teysm. & Binn., *Naturk. Tijdschr. Nederl. Ind.* XXIV: 332 (1862); Engl., *Pflanzenr.* IV. 23C (48): 106 (1911); Sivad. & Jaleel, *Rheedea* 10(2): 143 (2000) (**Fig. 1**).

Type: West Sumatra, Soeka Menanti, Ophir, (no date), *Buennemeijer* 1019 (*Neotype:* BO).

Tubers depressed-globose, 4.5-8.5 cm diam. and 2.5-5.0 cm thick in vegetative phase; c. 11 cm diam. and 7 cm thick in reproductive phase; root scars thickened, annulate. Petiole 73-82 cm

long, pale green with small blackish green irregular specks and mottles with minute dark green spots in between, paler towards the tip, extreme base with purplish blue hue; some petioles with pale green background having large irregular blackish green patches with light greyish margin, and minute greenish spots in between, and paler towards the tip. Leaflets sessile, elliptic-lanceolate, large leaflets 11-17 × 3-5 cm, small 6.2-10.5 × 1.8-4.0 cm, acuminate at apex, base unequal, decurrent on rachis, greenish above and pale below. Peduncle short, 3.0-5.5 cm long, greenish in colour. Spathe campanulate, broadly triangular-ovate, c. 17.5 × 26.0 cm, basal tube separated from limb by a constriction, tip acute, margin undulate; tube c. 7.5 cm diam. and 5.5 cm

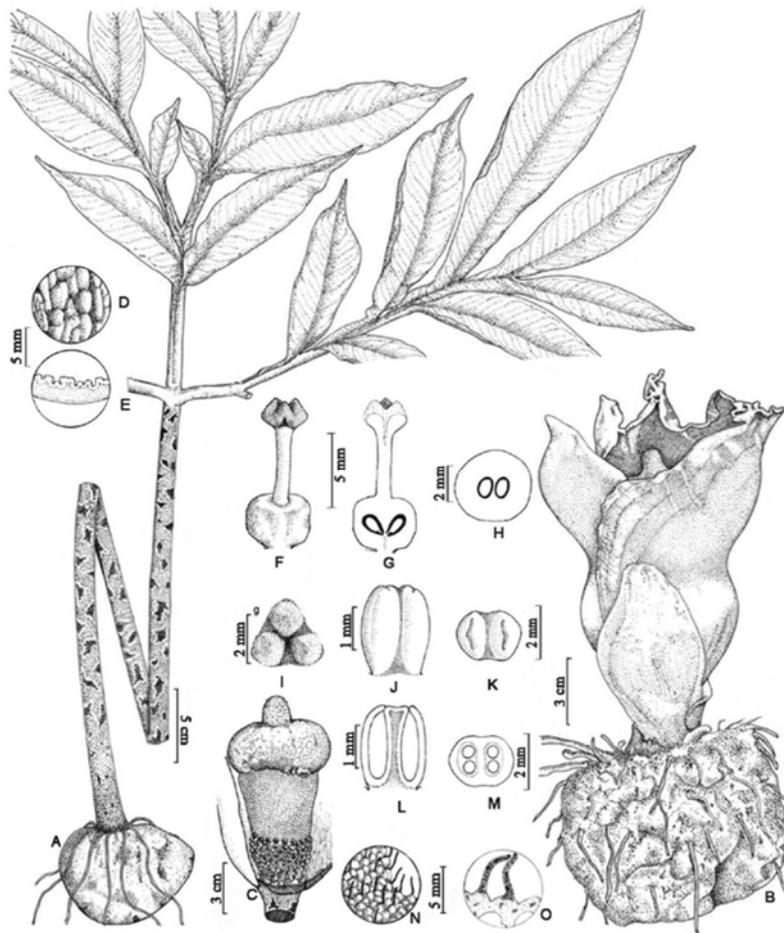


Fig. 1. *Amorphophallus hirsutus* Teysm. & Binn. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed showing spadix; D. Small basal inside portion of spathe; E. A small basal portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Male flower - view from broad side; K. Male flower - view from top; L. Male flower - l.s.; M. Male flower - c.s.; N. A small portion of apical portion of spadix-appendix showing papillae; O. Appendix papillae - enlarged.

high, greenish outside with few small white mottling, smooth, pale greenish inside, purplish-orange or maroon at extreme base, rough, irregularly and longitudinally rugose and verrucate; limb c. 9.5 cm long spreading, up to c. 12 cm diam., purplish outside and inside. Spadix shorter than spathe, c. 12.5 cm long; sessile, female zone c. 3.3 cm long; male zone c. 3.8 cm long; appendix c. 3 cm high and c. 5.5 cm diam. Female flowers dense, each flower c. 10 mm high; ovary subglobose, pale greenish, c. 4 mm diam. and 3 mm high, 2-3-locular, each locule with a single basal anatropous ovule; style c. 5 mm long, purplish; stigma 2-3-lobed, c. 2.5 mm diam., pale yellowish. Male flowers dense, pale yellowish with purplish tinge at top of connectives; each c. 2 mm high, sessile, inconspicuously 2-lobed. Spadix-appendix subglobose, light purplish yellow, rough, abruptly narrowed to a cylindrical truncate column of c. 1.8 cm high and 0.9 cm diam., light purplish yellow, rough; cylindrical column and its basal surrounding portion covered with stiff slender bulbous-based papillae; papillae on cylindrical column smaller compared to that of basal neighbouring portion; appendix becomes unevenly bullate after anthesis.

Phenology: Flowering: May; fruiting: Fruiting specimens could not be collected.

Representative specimens examined: **Andaman and Nicobar Islands:** Great Nicobar Island, On the way to East-West Road, 17.5.1999, *Abdul Jaleel* RIA 350 (Infl.) (CALI); *Ibid.*, 17.5.1999, *Abdul Jaleel* RIA 351 (tuber and leaf) (CALI); *Ibid.*, 20.5.1999, *Abdul Jaleel* RIA 355 (tuber and leaf) (CALI). **Kerala:** Calicut University Botanical Garden, 17.4.2000, *Abdul Jaleel* RIA 382 (Infl.) (CALI) (originally collected from East West Road, Great Nicobar Island, and introduced and flowered in the Calicut University Botanical Garden).

Notes: *Amorphophallus hirsutus* resembles *A. paeoniifolius* and *A. prainii* in general vegetative morphology and inflorescence, especially during the early stages. It differs from the latter two by having a subglobose appendix with a cylindrical apical column covered with short stiff papillae. There is no other Indian species with hairs on the spadix-appendix.

Distribution: Originally collected from Java and Hetterscheid and Ittenbach (1996) reported its occurrence in Western Sumatra. Sivadasan and Jaleel (2000) first reported it from Great Nicobar islands of India where it is rare.

Amorphophallus kachinensis Engl. & Gehrm. in Engler, Pflanzenr. IV. 23C (48): 91 (1911); Hett. & Itten., Aroideana 19: 87 (1996). (Fig. 2).

Type: Upper Burma, Kachin Hills, 20.5.1898, *Shaik Mokim*, s.n. (*Holotype:* CAL).

Tubers depressed-globose, 5-30 cm diam. and 3-5 cm thick, skin brownish; produce offsets. Petiole c. 20 cm long, smooth, dirty white background with green to reddish brown spots. Leaflets elliptic, 6-9 × 2-3 cm, tip acute-acuminate. Peduncle 24-80 cm long. Spathe more or less boat-shaped, slightly convolute at base, 8-29 × 7-14 cm, tip rounded or truncate, green or greenish brown outside with green spots or purplish stripes and spots; light purplish within, with scattered, shallow, punctiform warts at base. Spadix much shorter than spathe, 6.5-18.0 cm long, stipitate, stipe 0.2-1.0 cm long; female zone c. 5 cm long; male zone c. 7.5 cm long; spadix-appendix c. 15 cm high. Female flowers dense, each c. 2.5 mm high; ovary sub-globose, c. 1.5 mm high, unilocular with basal anatropous ovule; style c. 0.7 mm long; stigma inconspicuously 3-lobed. Male flowers dense, each c. 2 mm broad, sessile, inconspicuously 2-lobed. Spadix-appendix ellipsoid or ovoid with several irregular longitudinal grooves or fissures.

Phenology: Flowering: April - May.

Representative specimens examined: **Arunachal Pradesh:** Ziro, 10.4.2006, *Abdul Jaleel* RIA 424 (infl.) (CALI); *Ibid.*, 7.8.2006, *Abdul Jaleel* RIA 430 (leaf) (CALI).

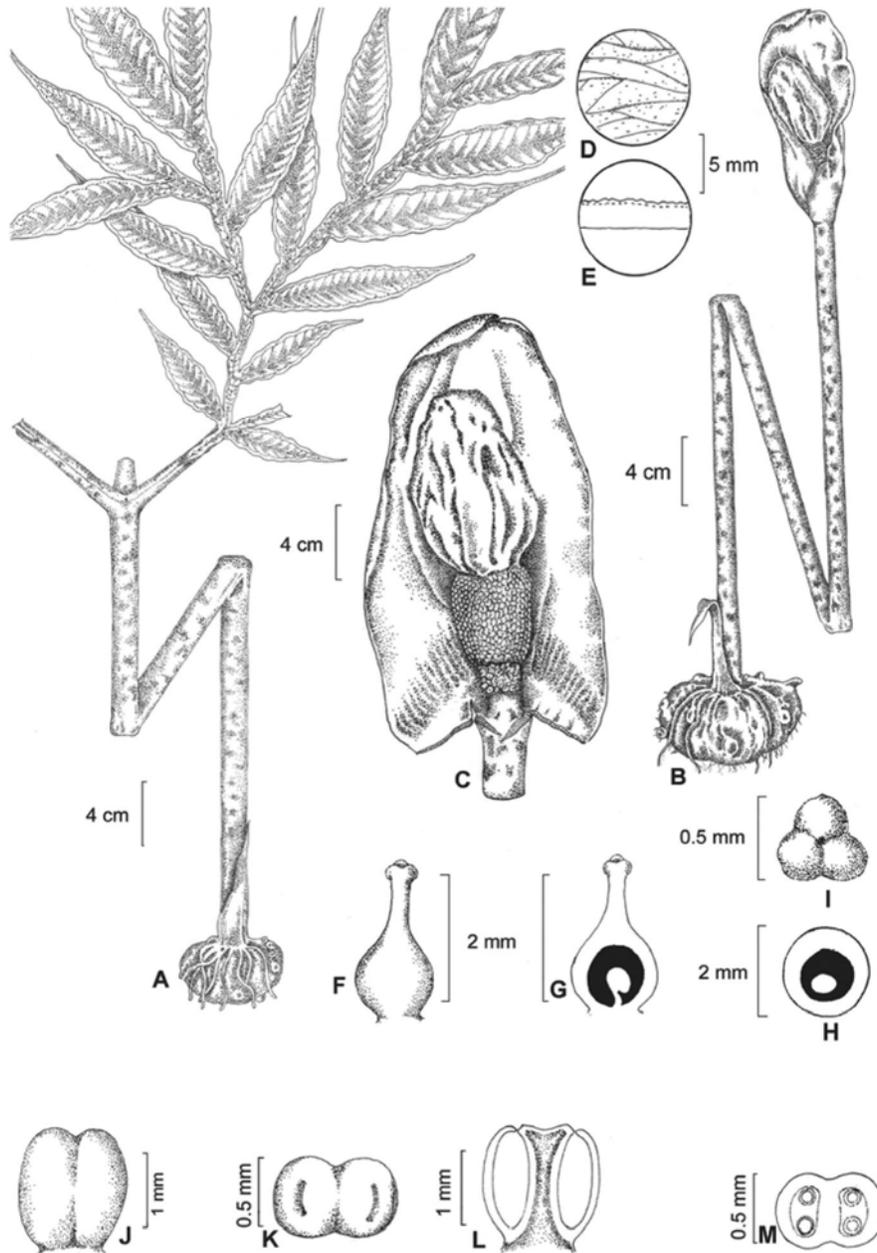


Fig. 2. *Amorphophallus kachinensis* Engl. & Gehrm. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe cut-opened showing spadix; D. A small basal portion of spathe; E. A small basal inside portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Male flower - view from broad side; K. Male flower - view from top; L. Male flower - l.s.; M. Male flower - c.s.

Notes: *Amorphophallus kachinensis* resembles *A. corrugatus* N. E. Br. and *A. yunnanensis* Engl. (1911) in general morphology but differs in the nature of spadix-appendix by having longitudinal irregular grooves. It also differs from *A. yunnanensis* in having female flowers with long style and smaller stigma.

Distribution: Northern Myanmar (Kachin state), Northern Thailand, Laos, China (Yunnan) and India. In India, it was collected from Arunachal Pradesh and present collection of the species forms a new distributional record for India.

Amorphophallus longistylus Kurz (Rep. Andaman 50.1866, *nomen*) ex Hook. f., Fl. Brit. India 6: 515 (1893); Engl., Pflanzenr. IV. 23 (48): 83 (1911); Sivad. & Jaleel, Rheedia 8(1): 103 (1998).

(Fig. 3).

Types: India, South Andaman, (no date), Kurz s.n. (*Holotype:* CAL; *Isotype:* K).

Tubers sub-globose, 5.0-6.5 cm diam. and 4-5 cm thick in vegetative phase, c. 6.2 cm diam. and 4.2 cm thick in reproductive phase. Petiole 43-71 cm long, surface uneven with white elongated or round thickened swellings or projections; pale greenish with greenish black and white mottles. Leaflets sessile, ovate to oblong, apex acuminate, 6.5-12.0 × 2.8-4.6 cm; base of leaflets on secondary rachises decurrent, leaflets on primary rachises usually not decurrent-based; greenish above, paler below with pinkish tinge along the veins, margins and tip; margin undulate. Peduncle 30.5-42.5 cm long, 1.0-1.2 cm diam. Spathe erect, ovate-lanceolate, 18.5-23.5 × 9.5-10.5 cm, tip acute, basal convolute tube 7.5-14.0 cm high and 3.5-4.0 cm diam.; upper expanded limb portion with longitudinal shallow folds on either side of mid-portion; light purplish with greenish black blotches and small dark spots on outside, more on basal tube; smooth, dark purplish and verrucose at base, pale purplish and smooth above with few light greenish-black blotches above within. Spadix longer than spathe, exerted, 24-26 cm long, stipitate; stipe short, 0.2-0.4 cm long; female zone 2.4-3.2 cm; male zone 3.2-3.7 cm long; appendix 17-20 cm long. Female flowers 60-80, loosely arranged, each 5-8 mm high, ovary 1.7-2.0 mm high, shallowly 3-5-lobed, greenish yellow, 3-5-locular, each locule with a single basal anatropous ovule; style 3-7 mm long, rarely with longitudinal ridges at upper portion, dark purplish; stigma 3-5-lobed, rarely 2-lobed, creamy. Male flowers dense, each c. 2 mm high, sessile, inconspicuously 2-lobed, yellowish-creamy with purplish tinge on connective at top. Spadix-appendix cylindrical, gradually tapering to tip.

Phenology: Flowering: May - June; fruiting: Fruits could not be collected.

Representative specimens examined: **Andaman and Nicobar Islands:** South Andaman, date nil, S. Kurz s.n. (CAL, K); Middle Andaman, Panchawati, 7.12.1997, Jaleel & Bobby Thomas RIA 224 (leaf) (CALI); North Andaman, Ray Hill, 26.5.1999, Jaleel RIA 357 (leaf) (CALI). **Kerala:** Calicut University Botanic Garden, 2.5.1998, Jaleel & Sivadasan RIA 275 (infl.) (CALI); *Ibid.*, 21.5.1998, Jaleel & Sivadasan RIA 227 (leaf) (CALI) (Originally collected by Jaleel and Bobby Thomas (RIA 224) on 7.12.1997 from Panchawati, Middle Andaman and introduced in the Calicut University Botanic Garden).

Notes: This is a very rare species and was left unknown until it was re-collected in 1997 from Middle Andaman about 131 years after it was first collected by Kurz (Sivadasan and Jaleel, 1998). The species is very distinct in having uneven surface of petioles and peduncles with bumps or swellings.

Distribution: Known to occur only in Andaman Islands.

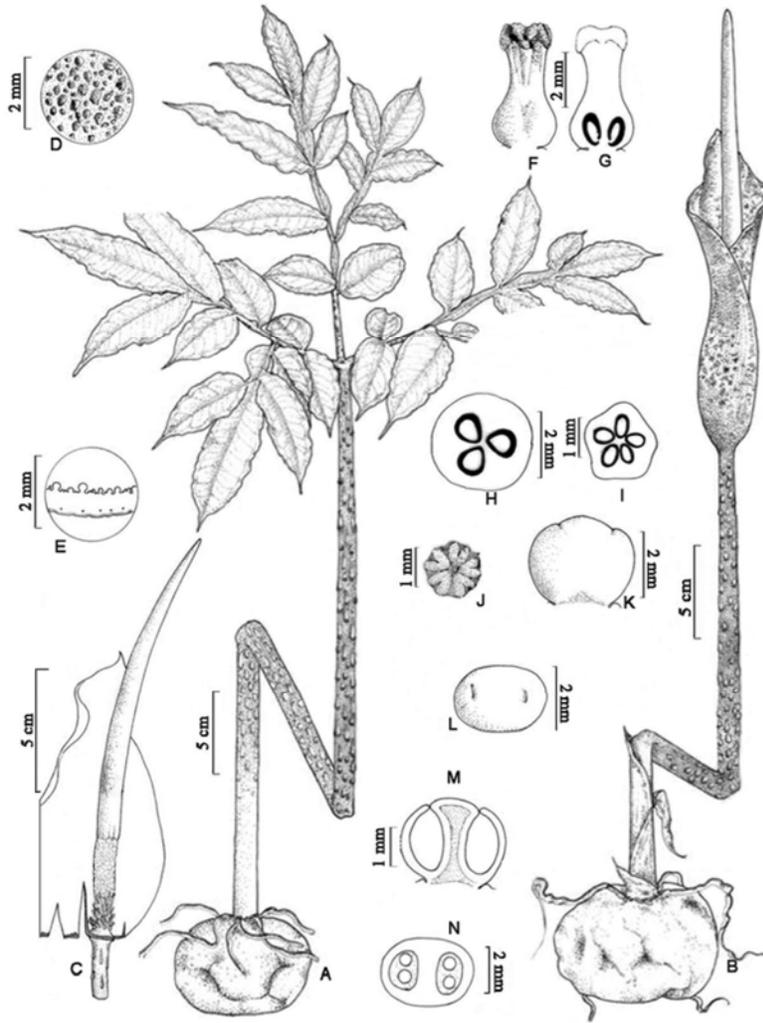


Fig. 3. *Amorphophallus longistylus* Kurz. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe cut-opened showing spadix; D. Small basal inside portion of spathe; E. A small basal portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary with three locules - c.s.; I. Ovary with five locules - c.s.; J. Stigma of five-loculed flower - view from top; K. Male flower - view from broad side; L. Male flower - view from top; M. Male flower - l.s.; N. Male flower - c.s.

Amorphophallus napalensis (Wall.) Bogner *et* Mayo in Bogner *et al.*, *Aroideana* 8(1): 19 (1985); Hett. & Ittenbach, *Aroideana* 19: 103 (1996). *Thomsonia napalensis* Wall., *Pl. Asiat. Rar.* 1: 83, t. 99 (1830); Hook. f., *Fl. Brit. India* 6: 518 (1893); Engl., *Pflanzenr.* IV. 23C (48): 56 (1911). *Pythonium wallichianum* Schott in Schott & Endl., *Melet. Bot.* 17 (1832). (Fig. 4).

Type: Nepal, in mountain forests, flowering in June, t. 99 (Wallich, *Pl. Asiat. Rar.*, 1830).

Tubers subglobose or depressed-globose, 5.0-8.5 cm diam. and 4.5-6.5 cm thick in vegetative phase, 7.5-10.0 cm diam. and 5-8 cm thick in reproductive phase, offsets produced from tuber

(observed only in tubers of vegetative phase), each offset 3.5-7.5 cm long. Petiole smooth, 41.5-78.0 cm long, pale green with more or less irregular or oval elongate, brown or dark brown patches. Leaflets sessile, ovate-lanceolate, large leaflets 12.2-19.2 × 5.3-6.0 cm, small leaflets 5.5-9.0 × 2.5-4.5 cm, marginal portion undulate, tip long-acuminate; upper surface green, lower surface pale green. Peduncle smooth, 67-76 cm long. Spathe elongate-ovovate with acute tip, 24-27 cm long, differentiated into a basal convolute tube and open limb; tube 4.5-6.0 cm long and 5.5-7.0 cm diam., pale green with greenish brown at base outside, pale green within, changes to

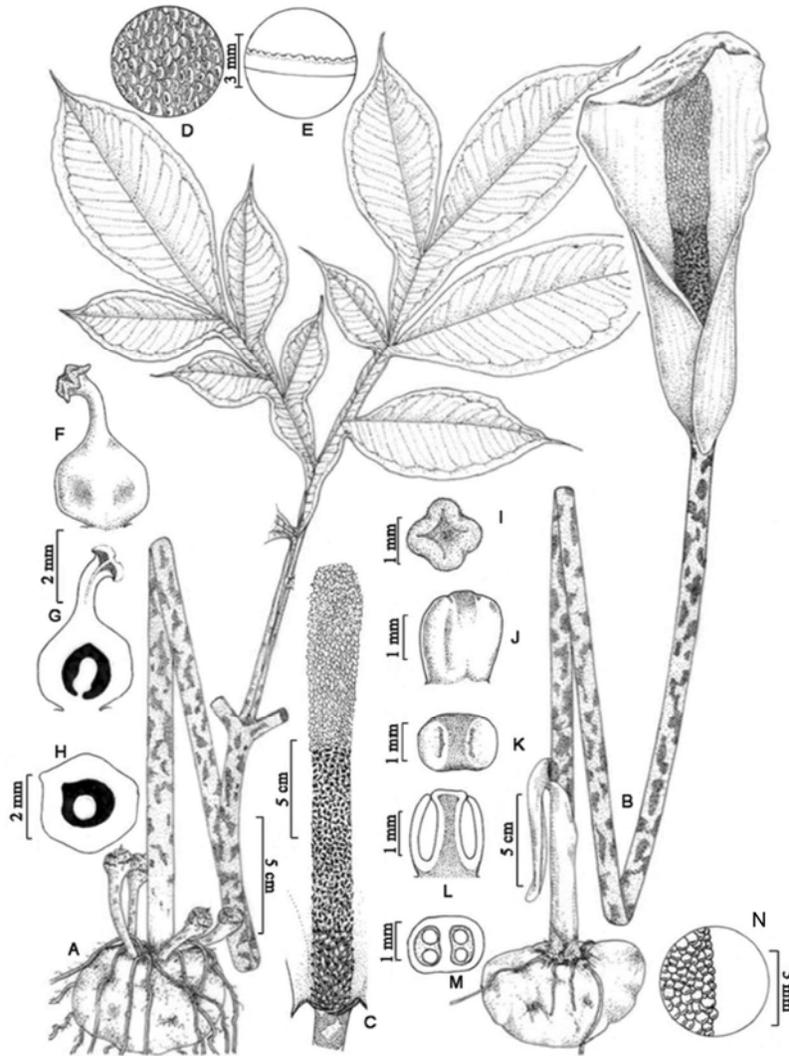


Fig. 4. *Amorphophallus napalensis* (Wall.) Bogner *et* Mayo. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed showing spadix; D. Small basal inside portion of spathe; E. Small basal portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Male flower - view from broad side; K. Male flower - view from top; L. Male flower - l.s.; M. Male flower - c.s.; N. A small lateral portion of spadix-appendix.

yellowish after male anthesis, mouth of tube wide, limb expanded, become apically cucullate. Spadix sessile, shorter than the spathe, 18-20 cm long; female zone 3-4 cm long; male zone 6-7 cm long; appendix 10-12 cm long. Female flowers dense, each 4-5 mm high, ovary sub-spherical, greenish, 2.0-2.5 mm high, unilocular with single basal anatropous ovule; style c. 2 mm long, apically bent towards spadix-axis; stigma 4-lobed. Male flowers dense, each 2.0-2.5 mm high, inconspicuously 2-lobed, pale yellowish with reddish brown tinge on connective at top. Spadix-appendix cylindrical with obtuse tip, rough with prominent, short cylindrical or obovoid warts, greenish when young, brownish yellow when mature, yellowish after anthesis. Fruits ovoid-elliptic, 1.4-1.5 cm long. Seeds ellipsoid, 1.2-1.3 cm long.

Phenology: Flowering: May - June; fruiting: July - September.

Representative specimens examined: **Sikkim**: Gangtok, Deurali, 23.9.1997, *Abdul Jaleel & Bobby Thomas* RIA 168 (leaf) (CALI); *Ibid.*, 24.9.1997, *Abdul Jaleel & Bobby Thomas* RIA 171 (infl.) (CALI). **Assam**: Assam, 29.5.1896, *Prain*, Acc. No. 496857 (leaf) (CAL); Chirapunji, 3.6.1956, *Rolla Seshagiri Rao* 2697 (infl.) (ASSAM). **Meghalaya**: Shillong, Woodlands, BSI Campus (Introduced; exact locality of original collection not known), 15.7.1967, *Verma* 35658 (infl.) (ASSAM); Shillong, Oakland, 24.6.1998, *Abdul Jaleel* RIA 289 (infl.) (CALI); **Arunachal Pradesh**: Sessa Orchid Sanctuary, 27.6.1998, *Abdul Jaleel* RIA 314 (leaf) (CALI).

Notes: *Amorphophallus napalensis* differs from other Indian species in having a verrucate appendix with short, prominent warts, style apically bent towards spadix-axis, and stigma 4-lobed.

Distribution: Bhutan, Nepal and India (Sikkim, Assam, Meghalaya and Arunachal Pradesh).

Amorphophallus paeoniifolius (Dennst.) Nicolson, *Taxon* 26: 338 (1977); Nicolson in Saldanha & Nicolson, *Fl. Hassan Dist. App. II* : 7 (1978) ("1976"). *Dracontium paeoniifolium* Dennst., *Schlüssel Hort. Malab.* : 13, 38 (1818); Manitz, *Taxon* 17: 449 (1968). *Arum campanulatum* Roxb., [*Hort. Beng.* : 66 (1814), *nom. nud.*] *Pl. Corom.* 3: 68 (1819), *nom. illegit.* (incl. type of *D. paeoniifolium* Dennst., 1818); Wight, *Icon. Pl. Ind. Or.* 3: 5 (1844). *Amorphophallus campanulatus* Decne., *Nouv. Ann. Mus. Hist. Nat. Paris* 3: 336 (1834).

Lectotype: Rheede's illustration of *Mulenschena* in *Hort. Malab.* 11: t. 19 (1692), vide Nicolson, *Taxon* 26: 338 (1977).

Tuber depressed-globose. Petiole up to 1.2 m long, smooth or muricate, mottled. Inflorescence short-peduncled, elongating after anthesis. Spathe broadly campanulate, c. 25 × 28 cm, convolute below and spreading above. Spadix sessile, differentiated into basal female portion, a subturbinate or subcylindrical male portion and an apical naked sterile, sessile subglobose or elongate-conoid appendix, wrinkled at maturity, spongy within. Ovary light purplish or pale yellowish, 2-3-loculed, each locule with single anatropous ovule; style elongate; stigma yellowish, reniform or 2-3-lobed. Male flowers creamy-yellow.

Notes: The close morphological similarities of *Schena* (*Hort. Malab.* 11: 35, t. 18. 1692) and *Mulenschena* (*Hort. Malab.* 11: 37, t. 19. 1692) of Rheede and unawareness of the existence of an earlier legitimate epithet for *Mulenschena*, the name *Amorphophallus campanulatus* Decne. had been used for both the cultivated and wild elements represented by *Schena* and *Mulenschena* respectively. Realizing the existence of an earliest epithet for *Amorphophallus campanulatus*, Nicolson (1977) made a combination of name, viz. *Amorphophallus paeoniifolius* (Dennst.) Nicolson, as applying to *Amorphophallus campanulatus* (*sensu lato*). The wild and cultivated elements differ in many respects even though they resemble in general appearance and many other characteristics; and hence they are treated as two distinct varieties of *A. paeoniifolius*. Backer (1920) recognized the wild and cultivated elements as belonging to two distinct subspecific taxa and assigned the rank 'hoofdgroep' which is not valid. Backer and Bakhuizen van den Brink

(1968) replaced the rank 'hoofdgroep' with 'forma'. Detailed accounts on the identity and nomenclature of Rheede's *Schena* and *Mulenschena* have been provided by Suresh *et al.* (1983).

Distribution: India, Sri Lanka and Pacific islands. In India, found in almost all States.

Key to the varieties of *Amorphophallus paeoniifolius*

1. Petiole usually purplish brown with light pinkish blotches, strongly muricate especially at basal half; leaflet-bases strongly decurrent on primary rachises to the main junction; spadix-appendix elongate-conoid, height more than breadth; style length about double the ovary height; stigma usually 2-lobed. var. *paeoniifolius*
- Petiole usually greenish with white blotches, smooth, rarely slightly rough at basal half; leaflet-bases not decurrent to the junction of the primary rachises; spadix-appendix subglobose, breadth more than height; style length 3-4 times the ovary height; stigma usually 3-lobed. var. *campanulatus*

Amorphophallus paeoniifolius (Dennst.) Nicolson var. ***paeoniifolius***. Sivad. in Suresh, Sivad. & Manilal, Taxon 32: 128 (1983); Karth., Jain, Nayar & Sanjappa, Fl. Ind. Enum. Monocot. : 6 (1989); Sivad. in Manoharan, Biju, Nayar & Easa, Silent Valley-Whisp. Reas.: 230 (1999). [*Mulenschena* Rheede, Hort. Malab. 11: 37, t. 19 (1692)]. *Dracontium paeoniifolium* Dennst., Schlüssel Hort. Malab.: 13, 21, 38 (1818) (*'paeoniaefolium'*); Manitz, Taxon 17: 499 (1968). *Arum campanulatum* Roxb. [Hort. Beng. 65 (1814)], Pl. Corom. 3: 68 (1820), *nom. illegit.*; Wight, Ic. Pl. Ind. Or. 3: 5, t. 785 (as to leaf) (1844). *Candarum hookeri* Schott in Schott & Endl., Melet. Bot.: 17 (1832), *nom. illegit.* *Kunda verrucosa* Raf., Fl. Tellur. 2: 82 (1837), *nom. illegit.* *Amorphophallus rex* Prain, J. Asiat. Soc. Bengal 62: 79 (Aug. 1893); Hook. f., Fl. Brit. India 6: 514 (Sept. 1893); Engl., Pflanzenr. IV. 23C (48): 75 (1911). *Amorphophallus campanulatus* hoofdgroep *sylvestris* Backer, Determ.-tab. Jav. *Amorphophallus*: 2 (1920), (rankless name). *Amorphophallus campanulatus* f. *sylvestris* Backer ex Backer & Bakh., Fl. Java 3: 112 (1968).

(Fig. 5).

Type: Same as of the species. [*Lectotype:* Rheede's illustration of *Mulenschena* in Hort. Malab. 11: t. 19 (1692), vide Nicolson, Taxon 26: 338 (1977)].

Tubers depressed-globose, 9-14 cm diam. and 8-11 cm thickness in vegetative phase; 13-20 cm diam. and 7-9 cm thickness in reproductive phase; skin pale brown to dark brown with prominent root scars. Petiole rough, 55-105 cm long, dark brownish green with round to ovoid green blotches, extreme base pinkish with minute pale greenish dots above. Leaflets sessile, large leaflets 17-20 × 5-6 cm, small leaflets 8-10 × 2.5-3.5 cm, obovate, tip acute, base unequal and decurrent on rachis, greenish above, paler below. Peduncle short, rough, 3-6 cm long. Spathe margin undulate, tip acute, 10-21 × 12-22 cm; outside greenish yellow with green blotches at base, pale brownish with pale yellow blotches above; brownish green with prominent murications at base within, pale green above. Spadix sessile, 15.5-16.0 cm long; female zone 4-5 cm long; male zone 3.5-4.5 cm long; appendix 9.5-10.5 cm long, 7-8 cm diam. at base. Female flowers dense, each with ovary c. 2 mm high, sub-globose, style 4-5 mm long, pinkish brown; stigma 2-lobed, rarely inconspicuously 3-lobed. Male flowers dense, each 4.0-4.5 cm high, cream-coloured. Spadix-appendix dark purplish red. Fruits green, reddish at maturity, each 1.6-1.8 cm long. Seeds 1-2, each 1.1-1.3 cm long.

Phenology: Flowering: May - June; fruiting: July - November.

Representative specimens examined: **Kerala:** Pathanamthitta Dist.: Sabarimala, 18.5.1997, *Sivadasan* CU 19152A (infl.) (CALI). Thrissur Dist.: Kuthiran, 20.5.1997, *Abdul Jaleel* RIA 55 (infl.) (CALI). Palakkad Dist.: Walayar, 28.7.1929, *Raju & Ratnavelu* 18644 (leaf & infr.) (MH); Walayar forest, 15.4.1979, *Sivadasan* CU 21442 (infl.) (CALI). Malappuram Dist.: Calicut University Campus, 26.6.1997, *Abdul Jaleel* RIA 96 (infl.) (CALI). Kozhikode Dist.: Mukkam, Pannicode, 30.3.1997, *Abdul Jaleel* RIA 65 (infl.) (CALI). Wayanad Dist.: Waithiri, 16.5.1977,

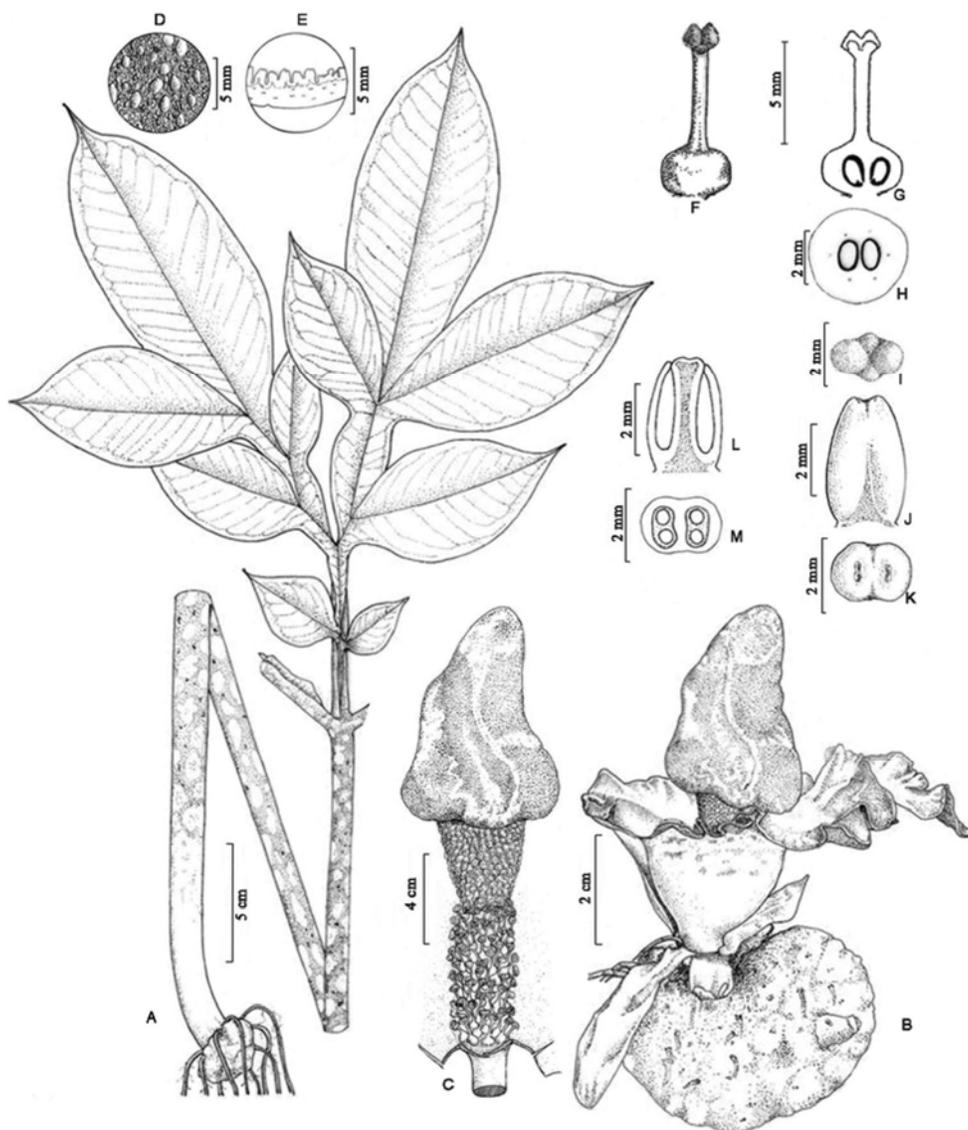


Fig. 5. *Amorphophallus paeoniifolius* (Dennst.) Nicolson var. *paeoniifolius*. A. Tuber with leaf; B. Tuber with inflorescence; C. Spadix; D. Small basal inside portion of spathe; E. A small basal portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma; J. Male flower - view from broad side; K. Male flower - view from top; L. Male flower - l.s.; M. Male flower - c.s.

Sivadasan CU 19175(CALI). Kannur Dist.: Taliparamba, 16.5.1982, *Nair* 73916 (infl.) (MH). **Karnataka:** Uduppi, Padigara, 25.5.1997, *Abdul Jaleel* RIA 58 (infl.) (CALI). **Andhra Pradesh:** Sreekakulam Dist.: 17.5.1979, *Subha Rao* 62460 (infl.) (MH). **Maharashtra:** Rajpurla, 11.9.1957, *Jain* 24248 (leaf) (CAL). **Madhya Pradesh:** Indore, Mandu, 20.9.1964, Acc. No. 5980 (BSA). **Orissa:** Dandarkarmya, Bichacakotta coffee plantation area, 27.5.1959, *Rao* 18585 (infl.) (ASSAM). **Bihar:** Borin HB, 13.12.1957, *Panigrahi* 11707 (leaf) (ASSAM); **Rajasthan:** Rajputana, Chitargo, 29.4.1896, *Prain* Acc. No. 496617 (infl.) (CAL). **West Bengal:** Botanical Garden, Calcutta (cultivated, originally collected from Bhitorgarh, Rajputana), 3.5.1895, *S. coll.*, s.n. (spathe) (CAL); Howrah Dist., Santra gatchi, 24.4.1896, *Prain*, Acc. No. 496599 (infl.) (CAL). **Assam:** Moshmai falls, 11.11.1938, *Biswas* 3928 (infr.) (CAL). **Tripura:** Agarthala, 10.5.1915, *Debbarmar*, Acc. No. 496616 (leaf) (CAL). **Andaman and Nicobar Islands:** South Andaman, Ograbraj, 30.11.1997, *Abdul Jaleel & Bobby Thomas* RIA 219 (leaf) (CALI); North Andaman, Kalipur, 13.12.1997, *Abdul Jaleel & Bobby Thomas* RIA 234 (infr.) (CALI); Nicobar islands: Car Nicobar, Lapathi – on the way to Tip Top, 12.5.1999, *Abdul Jaleel* RIA 339 (leaf) (CALI); Kamorta, Nancowry island, 13.5.1999, *Abdul Jaleel* RIA 342 (leaf) (CALI).

Note: A detailed account on identity of Rheede's (1692) *Mulenschena* was provided by Suresh *et al.* (1983) wherein nomenclatural history of *Amorphophallus paeoniifolius* var. *paeoniifolius* was elaborated.

Amorphophallus paeoniifolius (Dennst.) Nicolson var. **campanulatus** (Decne.) Sivad. in Suresh, Sivad. & Manilal, *Taxon* 32: 130 (1983); Nicolson in Dassan. & Fosb., *Rev. Handb. Fl. Ceylon* 6: 40 (1987); Nicolson, Suresh & Manilal, *An Interpr. Hort. Malab.* : 274 (1988); Karth., Jain, Nayar & Sanjappa, *Fl. Ind. Enum. Monocot.* : 6 (1989). [*Schena* Rheede, *Hort. Malab.* 11: 35, t. 18 (1692)]. *Dracontium polyphyllum* sensu Dennst., *Schlüssel Hort. Malab.*: 13, 38 (1818), non L. (1753). *Arum campanulatum* sensu auct. in part, not as to type of Roxb. (1820), *nom. illegit.*; Roxb., *Pl. Corom.* 3: t. 272 (1820); Hook., *Bot. Mag.* 55: t. 2812 (1828); Wight, *Ic. Pl. Ind. Or.* 3: 5, t. 782 (as to infl.) (1844). *Amorphophallus campanulatus* Decne., *Nouv. Ann. Mus. Hist. Nat. Paris* 3: 366 (1834); Blume, *Rumphia* 1: 139 (1837); Hook. f., *Fl. Brit. India* 6: 513 (1893); Engl., *Pflanzenr.* IV. 23C (48): 76 (1911). *Amorphophallus dubius* Blume, *Rumphia* 1: 142 (1837); Hook. f., *Fl. Brit. India* 6: 514 (1893); Engl., *Pflanzenr.* IV. 23C (48): 74 (1911). *Amorphophallus sativus* Blume, *Rumphia* 1: 145 (1837); Engl., *Pflanzenr.* IV. 23C (48): 109 (1911). *Amorphophallus campanulatus* var. *blumei* Prain, *Bengal Pl.*: 1109 (1903). *Amorphophallus campanulatus* hoofdgroep *hortensis* Backer, *Determ.-tab. Jav. Amorphophallus*: 2 (1920). *Amorphophallus campanulatus* f. *hortensis* Backer ex Backer & Bakh., *Fl. Java* 3: 112 (1968).

(Fig. 6).

Type: Timor, no date, *Gaudichaud* s.n. (P).

Tubers depressed-globose, 8-12 cm diam. and 7-10 cm thickness in vegetative phase; 16-23 cm diam. and 10-12 cm thickness in reproductive phase (huge-sized tubers are also produced); skin pale brownish, with prominent root scars. Petiole 75-150 cm long, green with ovoid to elongate ovoid pale green blotches and minute pale green spots in between, extreme base white. Leaflets sessile, long leaflets 18-22 × 5.0-6.5 cm; small leaflets 7.5-10.5 × 3.0-4.5 cm, obovate, tip acute, base unequal and decurrent on rachises, greenish above, paler below. Peduncle smooth, 6-8 cm long. Spathe tip acute, margin undulate, 19.0-23.5 × 16-19 cm, convolute portion greenish yellow, expanded portion purplish green with white blotches; dark purplish at base within with prominent mucifications, middle pale green, pale purplish above, margin pale green. Spadix sessile, 20.0-21.5 cm long, female zone 4.0-4.5 cm long; male zone 5.5-6.0 cm long; appendix 8.5-9.5 cm long. Female flowers dense, each with ovary sub-spherical, pale yellowish, 2.0-2.5 mm high;

style 7.0-7.5 mm long; stigma 3-lobed, rarely 2-lobed. Male flowers dense, each 2.5-3.5 mm high, yellowish-cream coloured. Spadix-appendix hemispherical.

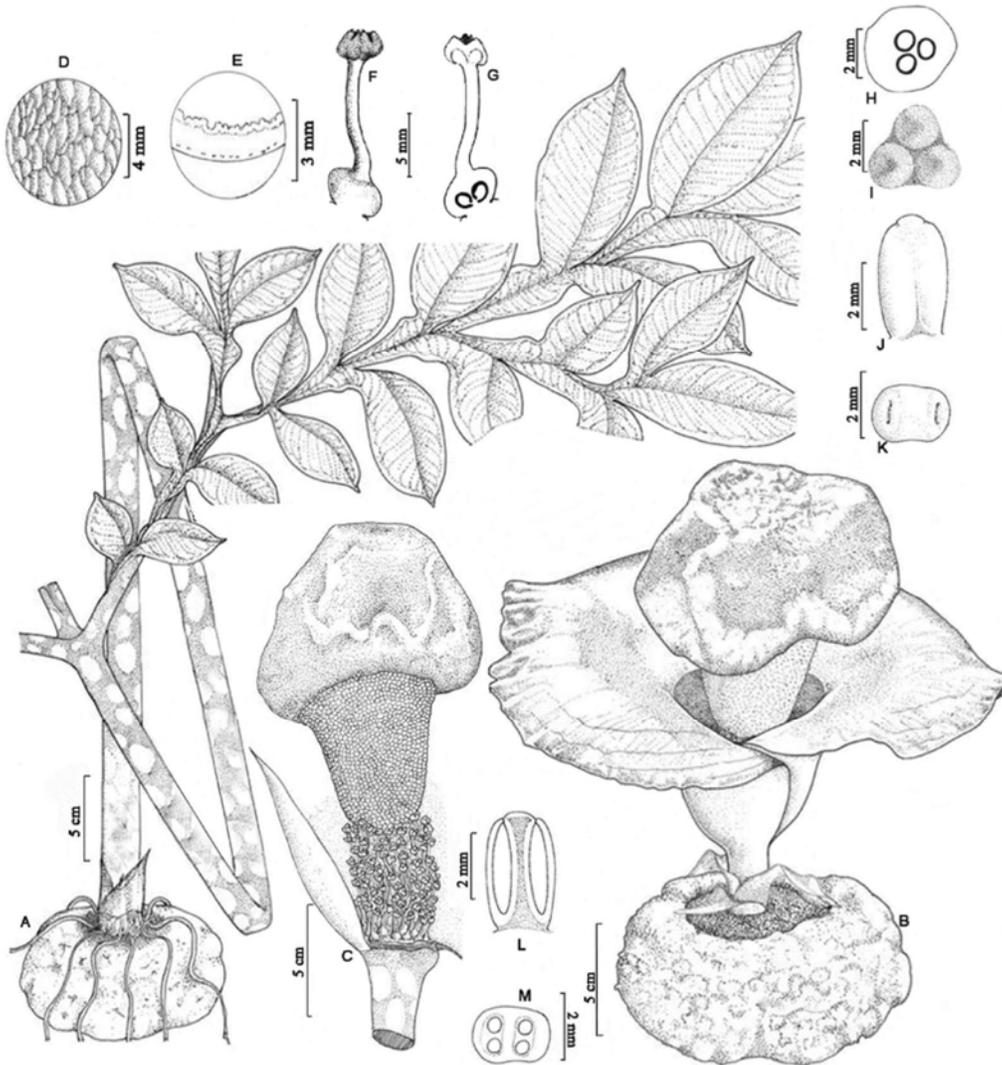


Fig. 6. *Amorphophallus paeoniifolius* (Dennst.) Nicolson var. *campanulatus* (Decne.) Sivad. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed showing spadix; D. Small basal portion of spathe; E. Small basal portion of spathe - c.s.; F. Female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma; J. Male flower - view from broad side; K. Male flower - view from top; L. Male flower - l.s.; M. Male flower - c.s.

Phenology: Flowering: May - June; Fruiting: No fruit-setting.

Representative specimens examined: **Kerala**: Kozhikode Dist.: Areecode, 16.5.1997, *Abdul Jaleel* RIA 46 (infl.) (CALI); Vadakara, Azhiyur, 9.8.1997, *Abdul Jaleel* RIA 119 (leaf) (CALI).

Malappuram Dist.: Calicut University Campus, 10.8.2000, *Abdul Jaleel* RIA 386 (leaf) (CALI). Palakkad Dist.: Athicode, Chittur, 10.4.1976, *Sivadasan* CU 13132 (infl.) (CALI); Kumbalakode, Elavancherry, 24.4.1997, *Sivadasan* CU 19170 (infl.) (CALI).

Notes: The confusion in nomenclature of the wild and cultivated varieties of *Amorphophallus paeoniifolius* has been sorted out by Suresh *et al.* (1983) while providing correct identity of aroids described by Rheede (1692).

Amorphophallus paeoniifolius var. *campanulatus* representing the cultivated variety differs from var. *paeoniifolius* in texture of petiole, characters of female flowers and spadix-appendix. The former is having smooth or slightly rough greenish petiole with white blotches, leaflet-bases not decurrent to the junction of the petiolules, style of pistil more than thrice the height of the ovary, spadix-appendix round-obtuse to broadly hemispherical with height less than its breadth, and no fruit-setting. The latter is having strongly muricate purplish petiole with light pinkish blotches, leaflet-bases strongly decurrent usually to the junction of the three main rachises, style more or less double the height of the ovary, spadix-appendix long-conoidal, height more than its breadth, and fruit-setting.

Distribution: India, Sri Lanka, Java and Myanmar. In India, common in all States. Widely cultivated for the edible tubers.

Taxonomic Analysis

In India the genus *Amorphophallus* comprises three sections, viz. *Amorphophallus* sect. *Amorphophallus*, sect. *Rhaphiophallus*, and sect. *Conophallus*. Jaleel *et al.* (2011) stated the genus to have three sections namely *A.* sect. *Candarum*, sect. *Conophallus* and sect. *Rhaphiophallus*. But Engler's (1911) inclusion of *A. campanulatus* (= *A. paeoniifolius*), the type of the genus under sect. *Candarum* ("*Cundarum*") rendered the sectional name illegitimate. The sectional name which included the type of the genus has been correctly recognized here as *A.* sect. *Amorphophallus*.

Amorphophallus sect. *Rhaphiophallus* is the largest of the three sections of the genus and is represented in India by eight species (Jaleel *et al.*, 2011), viz. *A. bonaccordensis* Sivad. & N. Mohanan, *A. hohenackeri* (Schott) Engl. & Gehrm., *A. konkanensis* Hett. *et al.*, *A. longiconnectivus* Bogner, *A. margaritifera* (Roxb.) Kunth, *A. mysorensis* E. Barnes & C. E. C. Fisch., *A. smithsonianus* Sivad., and *A. sylvaticus* (Roxb.) Kunth. *Amorphophallus mysorensis* is with two varieties, viz. var. *mysorensis* and var. *bhandarensis* (S. R. Yadav, Kahalkar & Bhuskute) Sivad. & Jaleel. *Amorphophallus* sect. *Conophallus* is the second largest of the genus in India and comprises six species, viz. *A. bognerianus* Sivad. & Jaleel, *A. bulbifer* (Sims) Blume, *A. carnosus* Engl., *A. commutatus* (Schott) Engl., *A. nicolsonianus* Sivad. and *A. oncophyllus* Prain *ex* Hook. f. The species *A. commutatus* forms a complex with three varieties, viz. var. *commutatus*, var. *anmodensis* Sivad. & Jaleel, and var. *wayanadensis* Sivad. & Jaleel. The third and the smallest section is *A.* sect. *Amorphophallus* comprising five species, viz. *A. hirsutus* Teysm. & Binn., *A. kachinensis* Engl. & Gehrm., *A. longistylus* Kurz, *A. napalensis* (Wall.) Bogner & Mayo and *A. paeoniifolius* (Dennst.) Nicolson. The species *A. paeoniifolius* is with two varieties, viz. *A. paeoniifolius* var. *paeoniifolius*, and var. *campanulatus* (Decne.) Sivad.

Among the species of *A.* sect. *Amorphophallus*, the two species, viz. *A. hirsutus* and *A. kachinensis* are new addition to the flora of India and they have been collected from Great Nicobar Island of Andaman and Nicobar Islands, and Arunachal Pradesh respectively, and their discoveries formed first reports of their distribution in India. *Amorphophallus longistylus* was rediscovered and collected from Andaman Islands after 131 years from the time of its first collection.

Amorphophallus paeoniifolius is the widely distributed species in India represented in all states. During the present study it was found that maximum number of species of the section occur

in Arunachal Pradesh and Andaman and Nicobar Islands. Arunachal Pradesh has 3 species, viz. *A. kachinensis*, *A. napalensis* and *A. paeoniifolius*, and Andaman and Nicobar Islands have 3 species, viz. *A. hirsutus*, *A. longistylus*, and *A. paeoniifolius*. *Amorphophallus longistylus* is strictly endemic to Andaman Islands with restricted distribution and according to the criteria D of section V of IUCN (2012), it is considered as Critically Endangered (CR).

The fast and indiscriminate deforestation and destruction of natural habitats of the species render most of the endemic species endangered and lead to extinction. Proper monitoring of habitats and distribution are essential for conservation of species of the genus *Amorphophallus* which comprised wild relatives of widely used and economically important cultivated species.

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