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

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Abstract

The genus *Amorphophallus* Blume *ex* Decne. (Araceae), with more than 200 species, is one of the most taxonomically difficult genera of the family, and in fact is one of the moderately understood of all Asian aroid genera. The 11 sections recognised by Engler have been currently reduced to 10, and out of the 10 sections three, viz. *Candarum* Engl., *Conophallus* (Schott) Engl. and *Rhaphiophallus* (Schott) Engl. are represented in India. *Rhaphiophallus* as recognized now including sect. *Synantherias* comprises eight species: *Amorphophallus bonaccordensis* Sivad. & N. Mohanan, *A. hohenackeri* (Schott) Engl. & Gehrm., *A. konkanensis* Hett., S. R.Yadav & K. S. Patil, *A. longiconnectivus* Bogner, *A. margaritifer* (Roxb.) Kunth, *A. mysorensis* E. Barnes & C. E. C. Fisch., *A. smithsonianus* Sivad., and *A. sylvaticus* (Roxb.) Kunth. Herein *A. bhandarensis* S. R.Yadav, Kahalkar & Bhuskute is recognized at the new rank of variety, as *A. mysorensis* var. *bhandarensis* (S. R. Yadav, Kahalkar & Bhuskute) Sivad. & Jaleel. The name *Amorphophallus sylvaticus* (Roxb.) Kunth is lectotypified here. All except *A. sylvaticus* (also occurring in Sri Lanka) are endemic to India.

Introduction

The genus *Amorphophallus* Blume *ex* Decne. (Araceae) is distributed in tropical Africa, Madagascar, tropical and subtropical Asia, the Malay Archipelago, Melanesia and Australasia (Mayo *et al.*, 1997), and comprises in excess of 200 species. The species of *Amorphophallus* exhibit variation in shape and size of tuber, petiole, spathe, spadix-appendix, and the individual female flowers (Hettersheid and Ittenbach, 1996).

Taxonomically and botanically it is one of the most difficult genera of the family due to various reasons including the timing of emergence of inflorescences and their relatively short active period of existence. The morphological similarity of the leaves of many species makes identification of the species with vegetative specimens difficult or impossible. Apart from these, the succulent and massive nature of the plant parts like tubers, petioles, peduncles and inflorescences, and the raphide contents in the plant body make collection and preservation of the specimens very difficult resulting in poor representation in Indian and International herbaria.

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Amorphophallus was first placed in the tribe "*Thomsonieae*" (Blume, 1835; Bogner *et al*., 1985). Tribe "*Thomsonieae*" consisted of two closely related genera, *Amorphophallus* and *Pseudodracontium*. Several attempts have been made to reveal the phylogenetic relationships within the genus *Amorphophallus sensu lato* (incl. *Pseudodracontium*). Hetterscheid *et al.* (1994) have provided a fairly good discussion on the probable monophyly and character evolution in the then known species of *Amorphophallus* sect. *Rhaphiophallus*.

Molecular evidences indicated that the two genera could be merged into a single genus, *Amorphophallus* (Grob *et al.*, 2002, 2004). A molecular study using a combination of *mat*K and *rbc*L sequences revealed the position of *Amorphophallus* and other Araceae as a monophyletic clade in a basal node of the Order Alismatales (Tamura *et al.*, 2004). The study of Araceae phylogeny by Cabrera *et al.* (2008) using a combination of *mat*K, *rbc*L, the *trn*K intron, *trn*L intron, and the *trn*L-*trn*F spacer, showed the tribe "*Thomsonieae*" as a basal sister clade consisting of the tribes "*Caladieae*" and "*Zomicarpeae*". Sedayu *et al.* (2010) attempted to interpret morphological character evolution in *Amorphophallus* based on a combined nuclear and plastid phylogeny that is more completely sampled than in previous studies.

Since Hooker's treatment of *Amorphophallus* (1893), several publications of *ad hoc* new taxa, rediscoveries, and reports of species new to India, e.g. Bogner *et al*. (1985), Sivadasan (1986, 1989), Sivadasan *et al*. (1994), Hetterscheid *et al*. (1994), Bogner (1995), Hetterscheid and Sarker (1996), Sivadasan and Jaleel (1998a, b, 2000a, b, 2001, 2009) and Yadav *et al*. (2009) have greatly expanded our knowledge of the genus in India, but to date a full but a revision of the genus in India has yet to be undertaken.

Taxonomic History of *Amorphophallus* sect. *Rhaphiophallus*

Engler (1911) in his monographic treatment of the family Araceae, treated the species presently recognized as belonging to the genus *Amorphophallus* under 3 genera, namely *Amorphophallus* Blume *ex* Decne., *Plesmonium* Schott and *Thomsonia* Wall., and recognized 11 sections under the genus *Amorphophallus*.

Bogner *et al.* (1985) treated the genus *Thomsonia* as congeneric with *Amorphophallus* and also presented a detailed account of the characteristic features of *Plesmonium margaritiferum* and a plea for its treatment under the genus *Amorphophallus* by sinking *Plesmonium* under *Amorphophallus*. This was followed by the treatments by Sivadasan (1989), Hetterscheid *et al.* (1994), Hetterscsheid and de Sarker (1996), Sivadasan *et al.* (1994) and Mayo *et al.* (1997) wherein *Plesmonium* has been recognized as congeneric with *Amorphophallus*. With the merger of *Amorphophallus* sect. *Synantherias* with sect. *Rhaphiophallus* (Sivadasan, 1989), the number of sections as recognized by Engler (1911) has been reduced to 10, and now in India the genus is represented by 3 sections, viz. *Candarum* Engl., *Conophallus* (Schott) Engl. and *Rhaphiophallus* (Schott) Engl.

The present article is limited to revision of *Amorphophallus* sect. *Rhaphiophallus* (Schott) Engl., the largest section of the genus in India, and characterized by having a staminodial zone between the male and female zones on the spadix.

Methodology

Intensive and extensive field explorations were made all over India including the Andaman and Nicobar Islands. Repeated collection trips during different seasons were essential to get the taxa both in reproductive and vegetative phases. All relevant data about the plants have been recorded in a field book. Photographs were taken, and collected a sufficient number of plants based on the population, for making herbarium specimens. Herbarium specimens were prepared following the wet method (Fosberg and Sachet, 1965). Tubers were collected and cultivated in Calicut University Botanical Garden for future observations and studies. Illustrations were made and camera lucida was used wherever necessary. Specimens, especially nomenclatural types at major Indian and international herbaria were examined.

Taxonomic treatment

Amorphophallus Blume [Bataviasche Courant 1825, descript. but no name] *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 sect. **Rhaphiophallus** (Schott) Engl., Pflanzenr. IV. 23C (Heft 48): 103 (1911).

Hydrosme sect. *Rhaphiophallus* (Schott) Engl., Bot. Jahrb. Syst. 15: 458 (1892). (*Rhaphiophallus* Schott, Gen. Aroid. t. 27. 1858).

Amorphophallus sect. *Synantherias* (Schott) Engl., Pflanzenr. IV. 23C (Heft 48): 102 (1911). (*Synantherias* Schott, Gen. Aroid. t. 28. 1858).

Tuberous herbs. Leaves solitary; petiole long, cylindrical; usually conspicuously and variously mottled, sheath very short. Lamina trichotomously decompound; leaflets oblong-elliptic to linear, tip acuminate or acute, base decurrent or not; venation reticulate with primary lateral veins pinnate; secondary lateral veins united below the margin forming a sub-marginal collective vein. Inflorescence solitary; flowering without leaves, peduncle long; spathe variously shaped and coloured, ultimately deciduous. Spadix usually stipitate; differentiated into a basal female zone, a sterile staminodial zone above which may be naked or bear sterile or neuter flowers, a male zone, and a terminal appendix. Appendix usually prominent, barren without differentiated sterile structures, rarely with sterile structures, or reduced to a stub; erect, sometimes horizontal, rarely pendent, very variable in shape. Female flowers usually crowded, spirally or sub-spirally arranged, ovary 1-4-locular, ovules anatropous or semi-anatropous, 1 per locule; style

absent, short or long; stigma variously shaped; male flowers 1-6-androus, stamens free or sometimes connate, dehiscence by apical pores or slits. Infructescence more or less cylindric. Berries, 1 to 4-seeded. Seeds ellipsoid, non-endospermous.

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

1.	Spadix without a naked appendix; neuter flowers between female and male zones large, elongate-obovoid, cream-coloured.	*A. margaritifer*
-	Spadix with a naked appendix; neuter flowers between female and male zones spherical, rhomboid, rounded, or short, stout-echinate, cream, dark pinkish, purplish, brownish red, or greenish.	2
2.	Spadix appendix very long, 16-25 cm long, cylindric, tapering to the tip, pendent; female flowers with stigma having 3-5 stout echinate lobes.	*A. smithsonianus*
-	Spadix appendix medium-sized, to 7.5-20 cm long or very short (less than 4 cm), cylindric, tapering to the tip, erect; female flowers with stigma without prominent echinate lobes.	3
3.	Neuter flowers short, stout, subulate and greenish; spadix appendix stalked, very short, c. 2 cm long, with irregularly formed sterile structures (resembling rudimentary male or female flowers); male flowers with long projected connectives (rarely staminodial zone and spadix appendix lacking).	*A. longiconnectivus*
-	Neuter flowers rhomboid, obovoid or oblong-gibbous or globose; spadix appendix sessile, barren; male flowers without projecting connectives.	4
4.	Spathe shorter than spadix appendix.	5
-	Spathe longer than spadix appendix.	6
5.	Neuter flowers oblong-gibbous, pinkish; stigma 2-lobed with irregular small warts at maturity; male flowers sparsely arranged in groups of 2-5; spadix appendix pale brownish yellow.	*A. sylvaticus*
-	Neuter flowers rhomboid, slightly convex, whitish or faintly purplish or dark purple; stigma 3-lobed, without irregular small warts at maturity; male flowers arranged loosely (especially at base), not in groups; spadix appendix dirty olive green or dark purple.	*A. konkanensis*
6.	Spathe differentiated into a basal convolute tube and an upper limb separated by a distinct shallow constriction, tip shortly acuminate; barren naked zone present between pistillate and staminodial zones; spadix appendix cylindric, apex rounded.	*A. bonaccordensis*
-	Spathe not differentiated into a tube and limb; naked barren zone between pistillate and staminodial zones absent; spadix appendix cylindric, tapering to tip.	7

7. Spathe fully convolute into a tube, limb not differentiated or indistinct; stigma sessile. *A. mysorensis*

- Spathe basally convolute and tubular at early stage, completely opens throughout and become boat-shaped at maturity; stigma very short-styled. *A. hohenackeri*

Amorphophallus bonaccordensis Sivad. & N. Mohanan, Blumea 39(1-2): 295 (1994).

(Fig. 1)

Type: India, Kerala State, Thiruvananthapuram Dist., Bonaccord on the Agasthyamala Hill ranges, 700 m, 20.4.1990, *N. Mohanan* TBG & RI 8219 (*Holotype* - K!; *Isotype* - CAL!, M!, TBGT!, US!).

Tubers sub-globose, 3-6 cm diam. and 1.5-2.5 cm thick in vegetative phase; 4.0-7.5 cm diam. and 3-4 cm thick in reproductive phase; stolons produced from the corms of fertile individuals. Petiole 40-80 cm long, 0.7-1.5 cm diam. at the base, green with dark greenish brown mottling, paler towards the tip. Lamina 70-90 cm diam., leaflets sessile, ovate-oblong, 4.5-14.0 cm long, 1.5-6.5 cm broad, acuminate at apex, base acute and unequal, decurrent on rachis, dark green above, paler below, slightly undulate. Peduncle smooth, 35-70 cm high, 0.8-1.5 cm diam. at the base, identical with petiole in colour and pattern of mottling. Spathe ovate-oblong, greenish-yellow, 13-20 cm long, 4.0-5.5 cm broad. Spadix more or less equal in length to the spathe, 11-16 cm long, comprising a basal stipe 6-10 mm long, c. 5 mm diam., pale greenish, a female zone 2.5-3.5 cm long, a barren naked zone c. 2 mm present in between the female and staminodial zones, a staminodial zone 8-13 mm long, a male zone 3.0-3.8 cm long, and a terminal appendix. Female flowers: ovary sessile, sub-globose, greenish, c. 2 mm high, 3 mm diam., 2 or 3-loculed, ovules sub-basal; unicellular trichomes present on funicle and on placenta around the area of funicular attachment; style very short, cylindric, c. 7 mm long, c. 8 mm diam.; stigma 2 or 3-lobed, cream-coloured; neuter flowers in 1-3 rows, creamy white, obovoid, each c. 5 mm long, c. 3 mm diam. Male flowers: in groups of 2-5, each group borne on a white cushion-like structure c. 1 mm thickness; each c. 1 mm long, inconspicuously 2-lobed. Spadix appendix cylindric, 7.5-10.5 cm long, c. 1 cm diam., rounded at the apex, cream-coloured, smooth, base rarely with very shallow rhomboidal projections.

Phenology: Flowering: April; fruiting may be in May, but fruiting specimens have not so far been collected.

Distribution: So far known only from the type locality.

Notes: *Amorphophallus bonaccordensis* differs from all other species by the ovate-oblong spathe with a prominent basal convolute tubular portion separated from the oblong erect limb by a slight constriction. The spadix appendix is cylindric with a rounded tip and is much shorter than the spathe. *Amorphophallus bonaccordensis* closely resembles *A. hohenackeri* in its general morphological features.

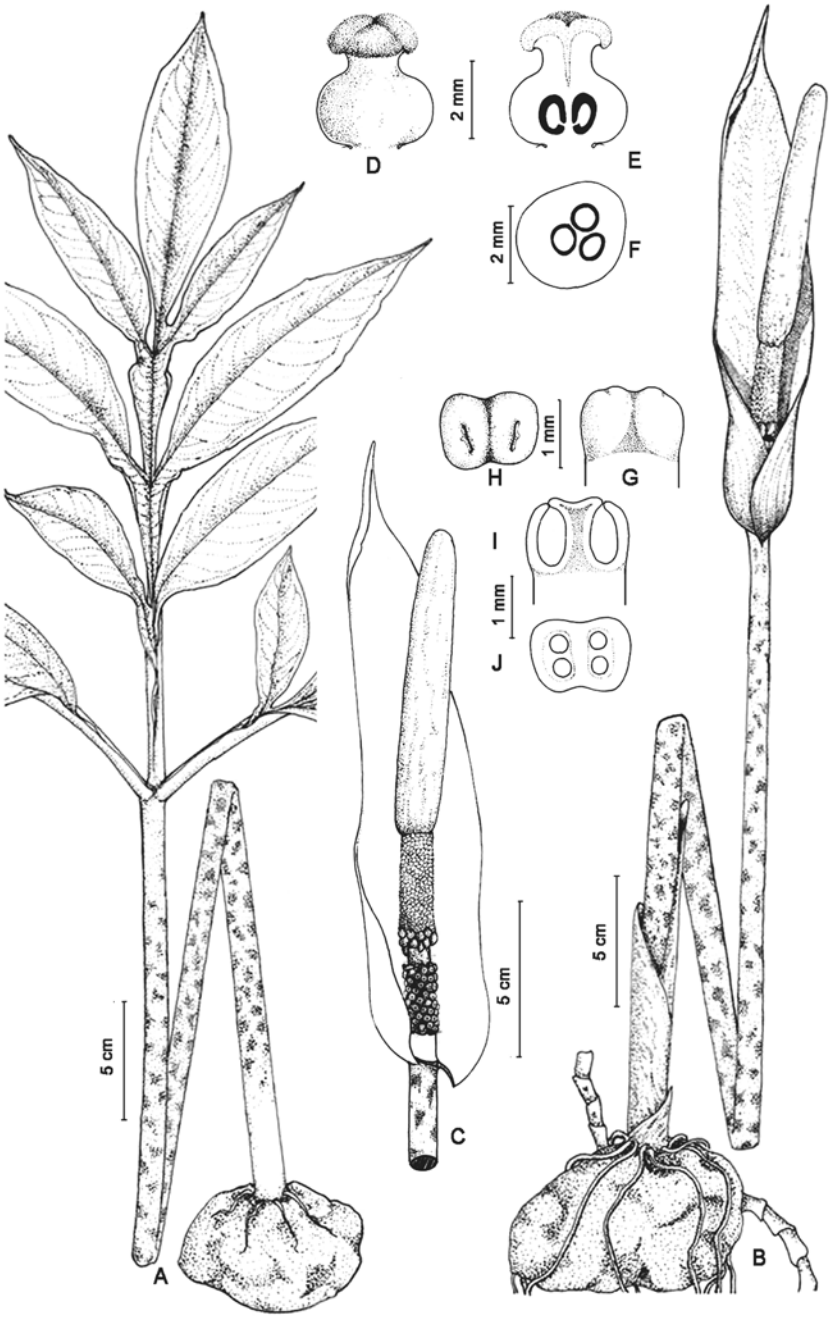

Fig. 1. *Amorphophallus bonaccordensis* Sivad. & N. Mohanan. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe cut-opened to show spadix; D. Female flower; E. Female flower - l.s.; F. Ovary - c.s.; G. Male flower - view from broader side; H. Male flower - view from top; I. Male flower - l.s.; J. Male flower - c.s.

Specimens examined: India. **Kerala**: Thiruvananthapuram Dist.: Bonaccord on the Agasthyamala Hill ranges, 700 m, 25.4.1990, *N. Mohanan* 8219 (infl.) (CALI); *Ibid.*, 26.4.1995, *N. Mohanan* 22326 (infl.) (TBGT).

Amorphophallus hohenackeri (Schott) Engl. & Gehrm. in Engl., Pflanzenr. IV. 23C(48): 103 (1911); C.E.C. Fisch. in Gamble, Fl. Pres. Madras : 1587 (1931); Karth., Jain, Nayar & Sanjappa, Fl. Indicae Enum. Monocot. : 6 (1989); Hettercheid & Ittenbach, Aroideana 19: 83 (1996). *Rhaphiophallus hohenackeri* Schott, Gen. Aroid. : t. 27 (1858). *Hydrosme hohenackeri* (Schott) Engl. in Engl. & Prantl, Pflanzenfam. II(3): 128 (1887).

(Fig. 2)

Type: India, Karnataka State, Mangalore, Canara, *R.F.Hohenacker* 21646 (B).

Tubers depressed sub-globose, 2.0-3.5 cm diam. and 2-3 cm high in vegetative phase, 3.5-6.5 cm diam. and 2.5-4.0 cm high in reproductive phase, skin pale brownish; offsets 2-3 cm long and 5-7 mm diam.; roots numerous, 5-20 cm long and 2-3 mm diam., pale yellowish. Petiole 35-68 cm long, 8-14 mm diam. at the base, smooth, pale yellowish green with dark green mottling and minute cream speckles, surrounded by 3-4 cataphylls, each cataphyll 10.5-30.0 cm long and 1.3-2.0 cm broad, pale pinkish with tiny green speckles. Lamina 30-45 cm diam., leaflets sessile, elliptic, 3.5-10.0 cm long and 1.5-3.5 cm broad, acuminate at apex, base unequal and decurrent on rachis, dark green above, paler below, margin slightly undulate. Peduncle 18-50 cm long, 6-10 mm diam. at base, identical with petiole in colour and pattern of mottling. Spathe light pinkish yellow with purplish black mottling and a pale purplish streak along the median outside, yellowish green within, 10.5-15.5 cm long and 4.0-5.5 cm broad. Spadix more or less equalling the length of the spathe, or slightly longer, with 5-8 mm long and 6-7 mm diam. cream stipe; female zone 1.0-1.5 cm long and 9-11 mm diam., staminodial zone 5-7 mm long and 8-10 mm diam., male zone 1.5-2.0 cm long and 8-9 mm diam. Female flowers: ovary sub-globose, c. 1.3 mm long, 1.8 mm diam., greenish, 2-3-loculed; style very short; stigma inconspicuously 2-3-lobed, c. 1 mm diam., yellowish. Staminodial zone with closely arranged rounded to elongate rhomboid, gibbous, cream; neuter flowers arranged in 1-3 rows, each 4-5 mm long, c. 3 mm diam. Male flowers: yellowish, each c. 1 mm high and 1.3 mm broad. Spadix appendix 8.5-12.5 cm long and 1.0-1.2 cm diam. at base, tapering towards the tip, base with inconspicuous rhomboid projections, smooth above, cream. Fruits oblong, green when young and turning scarlet-red when ripe, c. 8 mm long and 9 mm diam. Seeds ovoid, 2-3 per fruit, each c. 6 mm long and 6 mm diam.

Phenology: Flowering: March-May; fruiting: May-August.

Distribution: Very limited in distribution, known only from Kerala and Karnataka states.

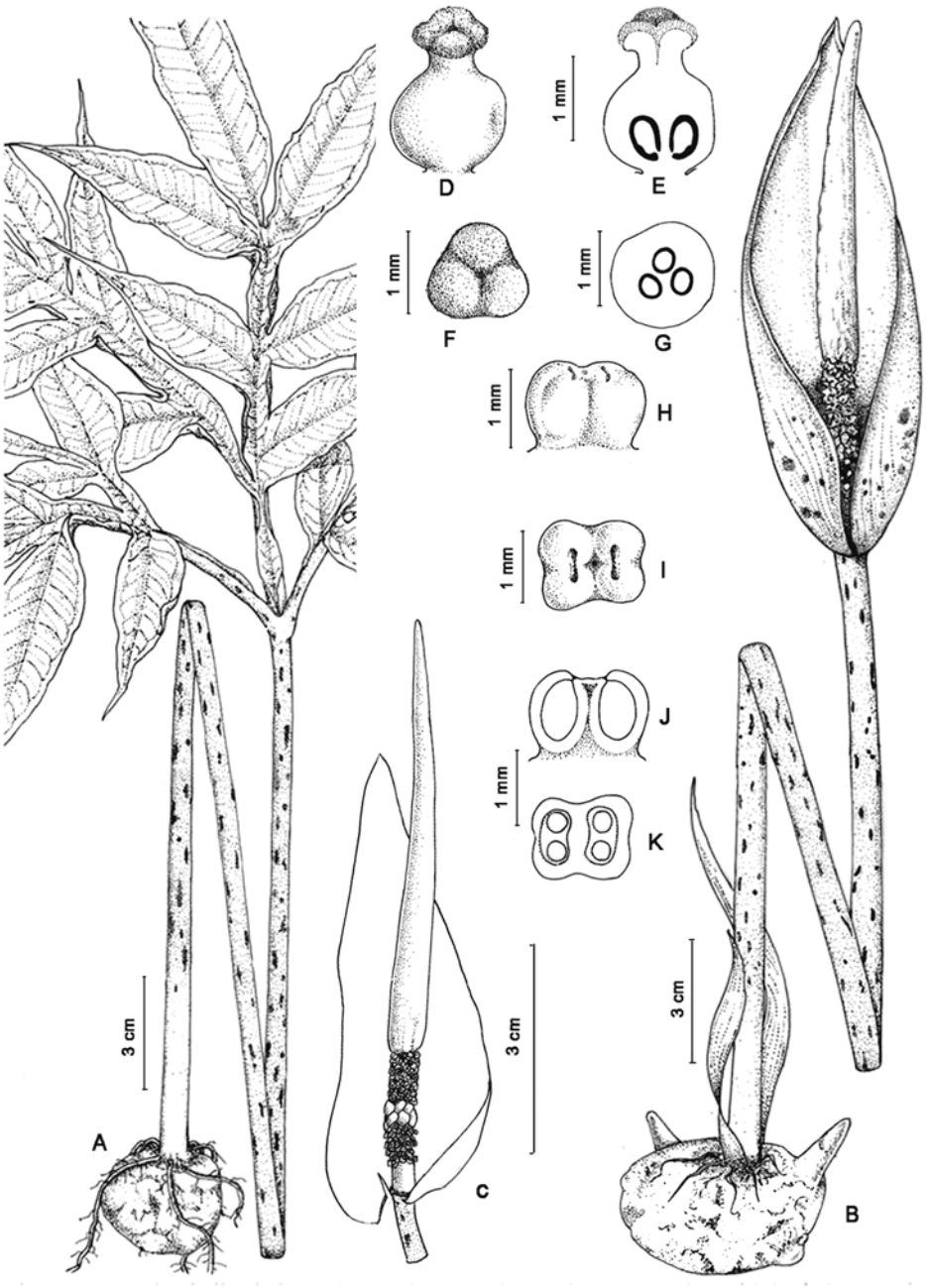

Fig. 2. *Amorphophallus hohenackeri* (Schott) Engl. & Gehrm. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe cut-opened to show spadix; D. Single female flower; E. Female flower - l.s. passing through two locules; F. Stigma - view from top; G. Ovary - c.s.; H. Male flower - view from broader side; I. Male flower - view from top showing opening of thecae; J. Male flower - l.s.; K. Male flower - c.s.

Notes: Amorphophallus hohenackeri differs from other species in the nature of the spathe. It is closely related to *A. bonaccordensis* but it differs in having a spadix shorter than the spathe, a barren zone below the sterile and female flower zones, and a more or less cylindric spadix appendix without terminal tapering.

Specimens examined: **Kerala**: Trivandrum Dist.: Attayar, 800 m, 3.3.1993, *S Coll*., 11342 (infl.) (TBGT). Ernakulam Dist.: Kalady, 5.11.1931, *S. Coll*., *Acc. No*. 0764 (infl.) (TBGT). Palakkad Dist.: Kavalod, Melarcode-Nemmara road, 20.5.1997, *A. Jaleel* RIA 51 (infl.) (CALI). Malappuram Dist.: Calicut University Campus, 17.3.1976, *M. Sivadasan* CU 13124 (infl.) (CALI, K, L, M, US); *Ibid*., 28.4.1976, *M. Sivadasan* CU 13124a (infl.) (CALI, K, M). Kozhikode Dist.: Ferok, 18.4.1978, *M. Sivadasan*, CU 21418 (M). Kannur Dist.: Vengad, 19.5.1997, *A. Kumar* RIA 50 (infl.) (CALI). **Karnataka** : Mangalore, 'Canara', *R. F. Hohenacker* 2164b (BM, GH, L) (Note: one of the sheets at L - *R. F. Hohenacker* 2164b - contains specimens of both *Amorphophallus hohenackeri* and an *Arisaema* sp.); Mangalore, July 1909, *C. D' Alleizette* 7792 (L); Belikeri, N. Kanara, 5.6.1883, *W. A. Talbot* 492 (BSI, CAL); Koddimalai State Forest, S. Kanara Dist., 28.7.1978, *C. J. Saldanha, Ramesh & Ravindra* KFP 1942 (JCB).

Amorphophallus konkanensis Hett., S. R.Yadav & K. S. Patil, Blumea 39: 289 (1994); Hett. & Ittenb. Aroideana 19: 90 (1996). **(Fig. 3)**

Type: India, Maharashtra State, Sindhudurg Dist., Maneri, 15.4.1992, *K. S. Patil* 4687A (*holotype* - CAL), *K. S. Patil* 4687-B (*paratype* - BLAT), *K. S. Patil* 4687-C (*paratype* - L).

Tubers globose or depressed globose, 3-4 cm diam. and 1.5-2.5 cm thickness in vegetative phase; 6-9 cm diam. and 4-5 cm thickness in reproductive phase, skin pale brownish; roots 3-10 cm long, c. 1 mm diam. Petiole 20-80 cm long, 0.8-1.5 cm diam. at base, pale brownish or greenish-brown with pale yellowish-green to white stripes and pinkish mottling. Lamina 38-80 cm diam., rachises winged, leaflets linear-lanceolate, 6.5-20 cm long and 1.5-4.5 cm broad, acuminate at apex, green above and paler below. Peduncle smooth, 28-60 cm long, 5-9 mm diam. at base, colour and pattern of mottling same as that of the petiole. Spathe broadly ovate in outline, when spread flat, completely convolute throughout the length with an opening at the top, 6-8 cm long and 5.0-6.5 cm broad, tip acute, limb poorly differentiated from the tube, dirty pinkish with a brownish hue, faint brownish spots, and dark purple brown veins outside, dark maroon within. Spadix much longer than the spathe, 17-21 cm long, with a greenish stipe c. 5 mm long; female zone 1.3-1.8 cm long, staminodial zone 0.8-1.2 cm long, male zone 3.7-4.2 cm long; spadix appendix 10.5-14.0 cm long and 5-10 mm diam. at base. Female flowers: ovary globose, c. 2 mm diam., 1 mm long, pale green, becoming purplish near the top, usually 3-locular, rarely 2 or 4-locular; style very short, c. 0. 3 mm long, 2 mm diam., purplish; stigma 3- or 4-lobed, c. 2 mm diam., 0. 8 mm long, verruculate, pale yellowish;

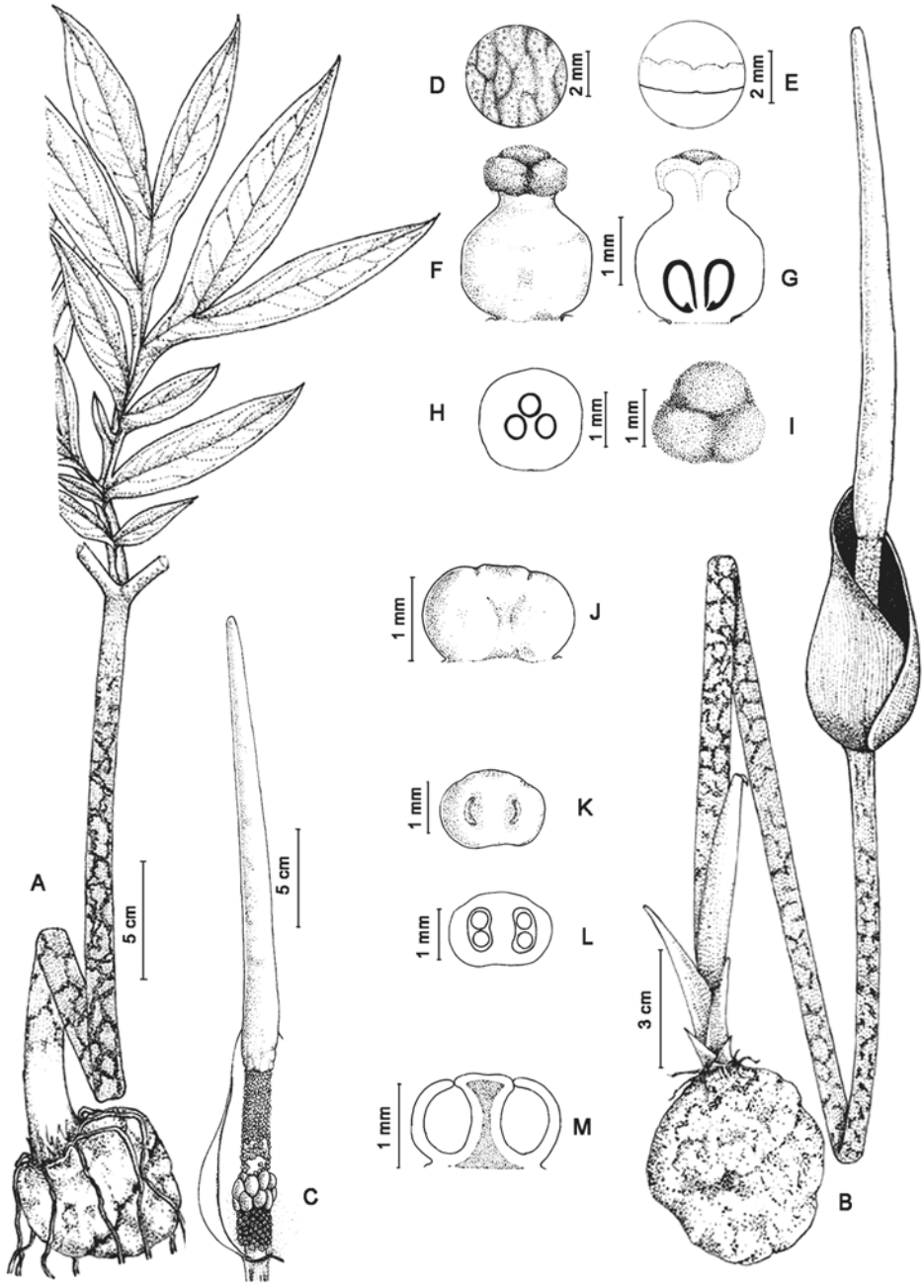

Fig. 3. *Amorphophallus konkanensis* Hett., S. R.Yadav & K. S. Patil. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed showing spadix; D. Details of basal interior portion of spathe; E. Basal interior portion of spathe - c.s.; F. Single female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Single male flower - view from broader side; K. Male flower - view from top showing openings of thecae; L. Male flower - c.s.; M. Male flower - l.s.

neuter flowers rhomboid, slightly convex, whitish or faintly purplish or dark purple. Male flowers: each c. 0.8 mm high, 1.3 mm broad, thecae whitish, connective brownish; spadix appendix cylindric, apically tapering, dirty olive green. Fruits turning pinkish-red at maturity, 8-10 mm diam.; usually 3-seeded, rarely 2 or 4-seeded. Seeds ovoid; each 7-8 mm long, c 5 mm diam.

Phenology: Flowering: April-May; fruiting: May-June.

Distribution: Restricted to Goa and Maharashtra states.

Notes: *Amorphophallus konkanensis* differs from other species in having the completely convolute spathe with maroon inside and the spadix with rhomboid, slightly convex neuter flowers with whitish, dark purple or faint purplish hue.

Specimens examined: **Goa**: Dodamarg, 5.6.1997, *A. Jaleel & B. Thomas* RIA 70a (infl.) (CALI).

Amorphophallus longiconnectivus Bogner, Kew Bull. 50(2): 397 (1995); Sivad. & Jaleel, Rheedea 8(2): 243 (1998). **(Fig. 4)**

Type: India, "Central Provinces", Piparia, June 1910, *H. Haines* 3590 (*holotype* - K!).

Tubers subglobose or depressed globose, 4.5-7.0 cm diam. and 2-5 cm thick in vegetative phase; 6.5-8.0 cm diam. and 4-6 cm thick in reproductive phase; roots numerous, 1-2 mm diam.; offsets small, globose or fusiform, 6-12 in number per tuber, each 8-10 mm diam. and 1.2-1.8 cm long. Petiole 35-77 cm long, 1.2-2.3 cm in diam. at base, smooth, light green with dark brownish, narrow-elongated stripes, paler towards the upper portion; leaflets sessile, linear-lanceolate, 14.0-7.5 cm long and 2-4 cm broad, acuminate at apex, base unequal and decurrent on rachis, pale green below; margin slightly undulate. Peduncle smooth, 62-110 cm long, 1.2-1.7 cm diam. at base, identical with petiole in colour and patterning. Spathe broadly ovate to broadly triangular, usually broader than long, 10-14 cm long, tip acute, completely convolute, not differentiated into basal tube and upper limb, pale green outside, pale purplish within with a dark purplish verrucose base. Spadix as long as or slightly shorter than the spathe, with a pale green stipe c. 1 cm long and c. 1.2 cm diam.; female zone 1.3-2.5 cm long and 1.2-1.4 cm diam.; staminodial zone 8-9 mm long and 1.2-1.4 cm diam.; male zone 3.2-4.0 cm long and 0.8-1.3 cm diam.; upper sterile zone 1.5-3.0 cm long, clothed with sterile flowers and rarely with a few scattered fertile stamens; without or (usually) with a stipitate appendix. Female flowers: ovary subglobose, c. 2 mm high, c. 2.5 mm diam., greenish, 2-3-locular; style very short, c. 1 mm long; stigma 2-3-lobed, 1-2 mm diam., papillate. Staminodial zone with loosely arranged thick-based echinate fleshy sterile flowers, each 3-5 mm long, c. 1 mm broad at base, rarely a few with forked tips. Male flowers: golden-yellow, each 2-3 mm long, 1-2 mm broad, filaments short, flat, thecae lateral, ellipsoid, 1.5-2.5 mm long; connective elongated to 1.0-1.5 mm above the level of the thecae tips. Sterile flowers

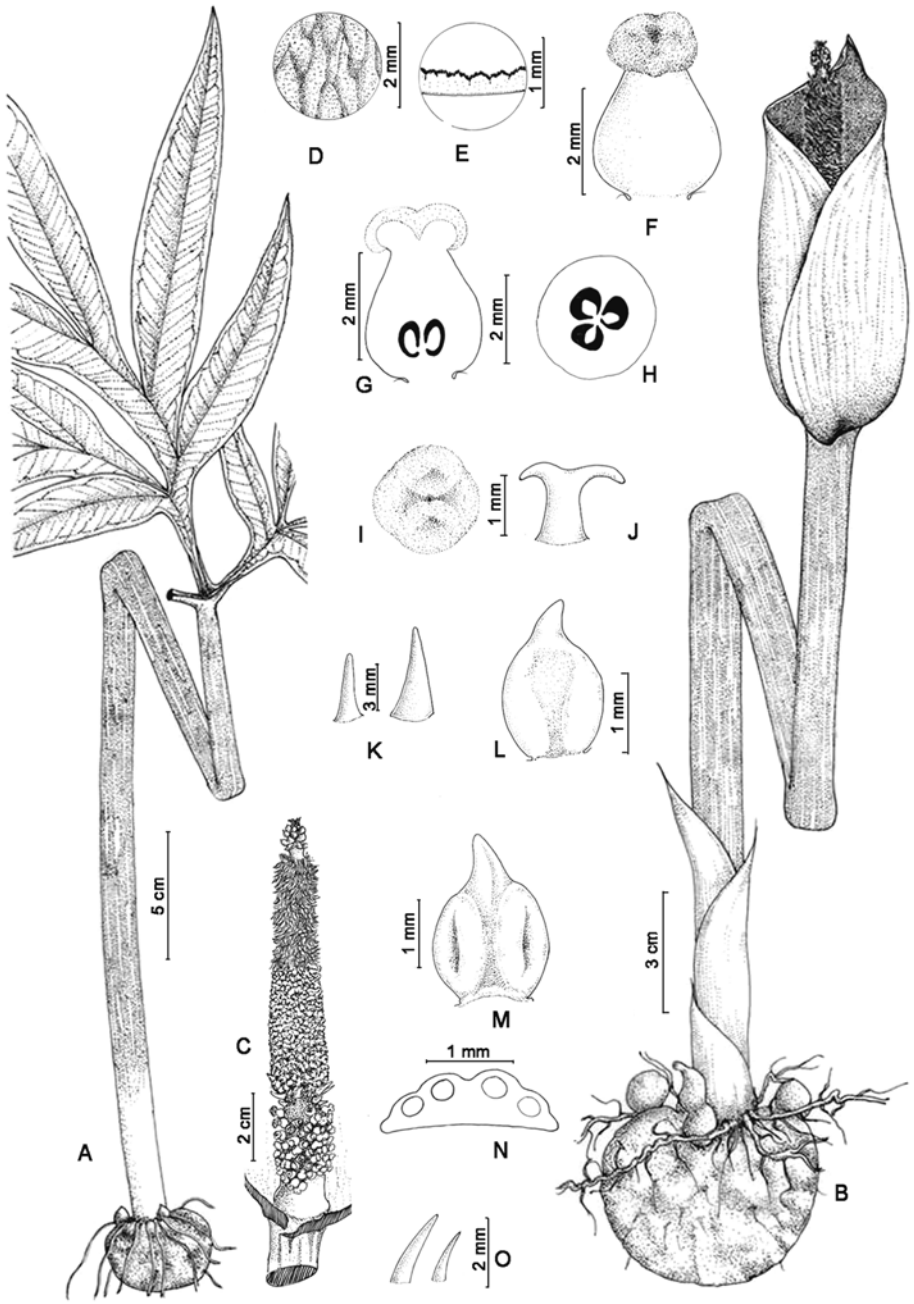

Fig. 4. *Amorphophallus longiconnectivus* Bogner. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe removed showing spadix; D. Details of basal interior portion of spathe; E. Basal portion of spathe - c.s.; F. Single female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J & K. Sterile flowers; L. Single male flower - dorsal view; M. Male flower - ventral view; N. Male flower - c.s.; O. Appendix sterile flowers.

more or less subulate, cream. Spadix appendix stipitate, stipe 3-8 mm long, 2.5-4.0 mm diam., green, terminal part 7-8 mm long, c. 3 mm diam., bearing irregularly formed cream-coloured rudimentary male or female flowers or irregular protuberances. Rarely plants without neuter flowers and lacking a spadix appendix are observed. Fruits ellipsoid, 8-10 mm long, 6-8 mm diam. Seeds 2-3, ellipsoid, 6-8 mm long and 4-6 mm diam.

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

Distribution: So far known to occur only in Piparia, Madhya Pradesh state.

Notes: *Amorphophallus longiconnectivus* Bogner has been rediscovered (Sivadasan and Jaleel, 1998) at its type locality in Madhya Pradesh, for the first time since Haines's original gathering in 1910. *Amorphophallus longiconnectivus* is unique in various aspects and is highly variable in its spadix structure. Usually the spadix has a stipe, followed by a zone of female flowers, a staminodial zone, a zone of male flowers, an upper sterile flower zone, and a spadix appendix with a stipe. But variations from the typical condition have also been noted. In some specimens the spadix appendix is completely lacking. In some, both basal staminodial zone and spadix appendix are lacking, but this condition is very rare or may be abnormal. Variations in morphology and size of other floral organs such as connectives of male flowers, neuter flowers and spadix appendix are also noticed.

Specimens examined: **Madhya Pradesh**: "Central Provinces", Piparia, June 1910, *H. Haines* 3590 (*holotype* – K); Piparia, 28.8.1997, *A. Jaleel* & *B. Thomas* RIA 131 (leaf) (CALI); *Ibid*., 16.7.1998, *A. Jaleel* RIA 316 (infl.) (CALI).

Amorphophallus margaritifer (Roxb.) Kunth, Enum. Pl. 3: 34 (1841); Hett. & De Sarker, Aroideana 19: 131 (1996). *Arum margaritiferum* Roxb., Fl. Ind. (Ed., Carey) 3: 512 (1832); Wight, Ic. 3(1): 6, t. 795 (1844). *Plesmonium margaritifer* (Roxb.) Schott, Syn. Aroid. : 34 (1856) ("*margaritiferum*"); Hook. f., Fl. Brit. India 6: 518 (1893); Engl., Pflanzenr. IV 23C (48): 49 (1911); C. E. C. Fisch. in Gamble, Fl. Pres. Madras : 1588 (1931). **(Fig. 5)**

Lectotype: Wight, Ic. Pl. Ind. Or. 3(1) (1844), Plate 765. (Hetterscheid and de Sarker, 1996).

Tubers more or less sub-globose to depressed globose, 2.5-5.0 cm diam. and 1.8-3.5 cm thick in vegetative phase, 7-13 cm diam. and 5.0-6.5 cm thick in reproductive phase, seasonally producing numerous small globose to fusiform offsets, varying from 7-11 per tuber, each 5-7 mm diam. and 8-14 mm long; skin pale brown to yellowish brown. Petiole smooth, 24-84 cm long, 1.0-3.3 cm diam. at base; green with numerous narrowly elongated black-margined pale green stripes, with small spots between, petiole paler towards the tip, dark green to blackish green at the extreme base. Lamina 32-76 cm diam., the primary rachises smooth, and coloured as for petiole, 3-9 cm long, 4-12 mm

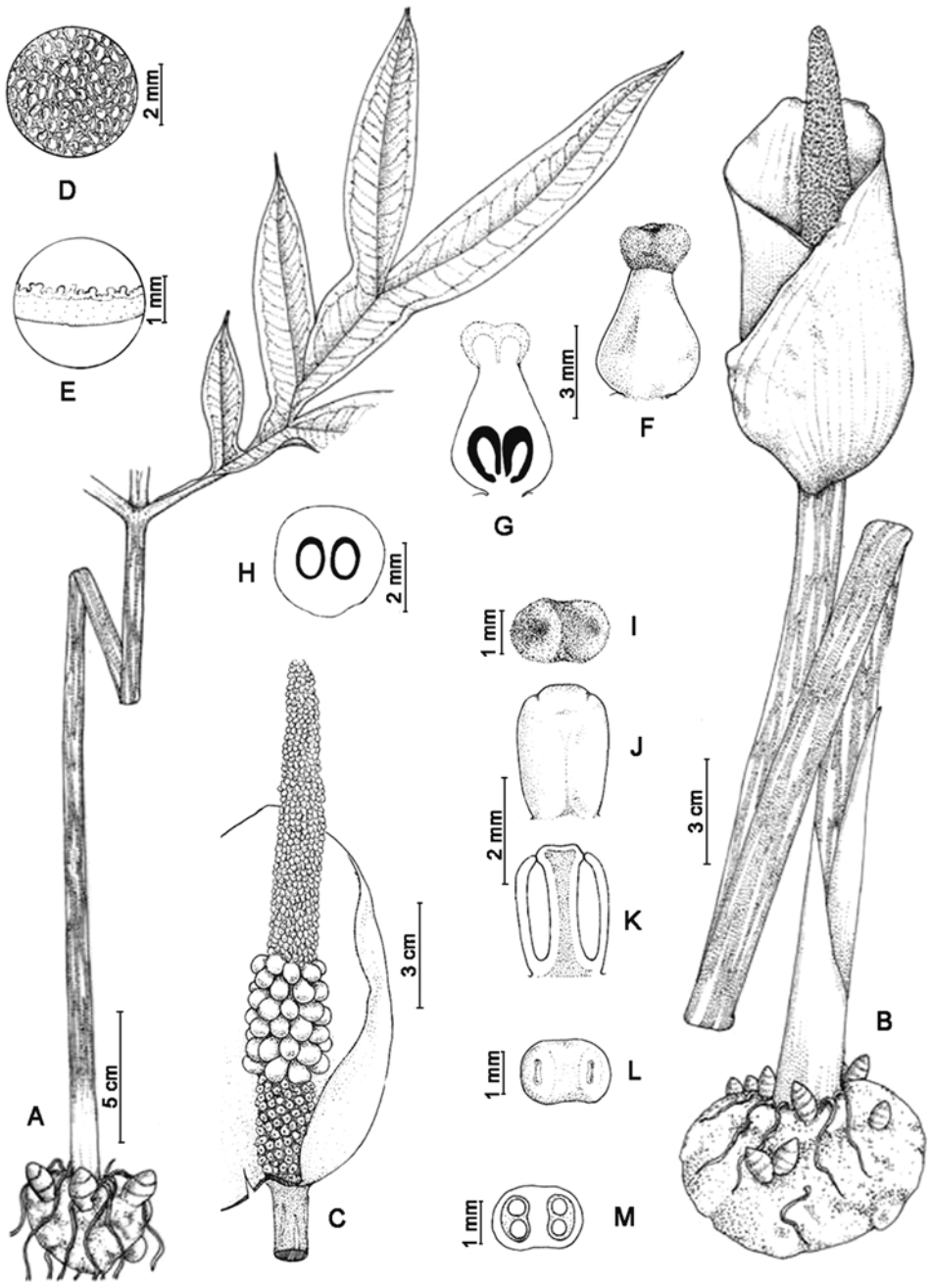

Fig. 5. *Amorphophallus margaritifer* (Roxb.) Kunth. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed showing spadix; D. Details of basal interior portion of spathe; E. Basal portion of spathe - c.s.; F. Single female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Male flower - view from broader side; K. Male flower - l.s.; L. Male flower - view from top showing openings of thecae; M. Male flower - c.s.

diam., leaflets linear to lanceolate, 8-24 cm long, 1.1-3.5 cm broad, decurrent at base, upper surface green, paler below. Peduncle smooth, 50-70 cm long, 2-4 cm diam., colour same as that of the petiole. Spathe broader than long, broadly ovate or broadly triangular, 11.0-17.5 cm long, 13-20 cm broad, tip acute, not differentiated into basal tube and upper limb; pale greenish outside, pale purplish within, dark purplish, prominently verrucate at base within. Spadix as long as or slightly longer than the spathe, 14-20 cm long, lacking a sterile appendix; stipe 6-11 mm, greenish; female zone 1.1-2.8 cm long, 9-18 mm diam.; staminodial zone 2.0-3.5 cm long; male zone elongate-conoidal, 6-9 cm long, 1.0-1.5 cm diam. at base. Female flowers: each 5-6 mm high, ovary pale green, slightly broader than stigma, 2.5-3.0 mm long, c. 2.5 mm diam., 2-locular; style very short, 0.5-1.0 mm long, c. 1 mm diam., colour same as that of ovary; stigma yellowish, capitate, distinctly 2-lobed, rarely 3-lobed, c. 2 mm high, 2 mm diam., surface verrucate. Neuter flowers loosely arranged, large, elongate-obovoid, 7-9 mm long, 4-5 mm diam. at top, cream, tip obtuse or subtruncate. Male flowers: each 2-3 mm high, 1.5-2.0 mm broad, pale brownish yellow. Fruit subglobose, red at maturity, c. 8 mm long.

Phenology: Flowering: May-June; fruiting: August.

Distribution: Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan, Bihar, West Bengal, Sikkim and Assam.

Notes: Amorphophallus margaritifer resembles *A. longiconnectivus* in its general appearance of greenish spathe that is not differentiated into tube and limb, and the nature of the spadix. But the former differs from the latter in having large elongate-obovoid, cream-coloured neuter flowers, and the lack of a spadix-appendix. *A. longiconnectivus* has a short stipitate appendix and in some cases the appendix bears irregularly formed structures, some of which resemble rudimentary sterile male or female flowers; and the neuter flowers are greenish, short, stout and subulate. Rarely in some of the specimens of *A. longiconnectivus* the neuter flowers and spadix-appendix are lacking and hence there might be a chance of gradual reduction in appendix size and its complete absence.

Specimens examined: **Maharashtra**: Chorbush, Nagpur, *H. Haines* 3675 (K). **Madhya Pradesh**: Hoshangabad, Mahaba, 16.7.1964, *G. Panigrahi & Singh* 4205 (BSA); "Central Prov.", Raipur, 24.10.1896, *Martin*, Acc. No. 496881 (leaf) (CAL). **Uttar Pradesh**: Dehra Dun, June 1895, *Mac Kurin* s.n. (Infl.) (DD). **Bihar**: Purneah Dist., Purneah, 9.8.1906, *I. H. Burkill* 27322 (CAL). **West Bengal**: Uttar Dinajpur, 14.9.1997, *A. Jaleel & B.Thomas* RIA 149 (leaf) (CALI); *Ibid*., 21.6.1998, *A. Jaleel* RIA 287 (infl.) (CALI).

Amorphophallus mysorensis E. Barnes & C. E. C. Fisch., Bull. Misc. Inform. 10: 661 (1939). Sivad. & Jaleel, Aroideana 24: 94 (2001).

Type: India, Karnataka State ("Mysore State"), Punjur Ghat, Billigirirangan Hills, 3500', 22 April 1939, *E. Barnes* 2133 (holo K!).

Key to the varieties of *A. mysorensis*

1. Spathe dull purplish; neuter flowers globose, brownish red; spadix appendix dark purplish, inconspicuously irregularly furrowed at base, smooth above, tip blunt, c. 8.5 cm long. var. *mysorensis*

- Spathe brownish-pale green with vertical prominent veins; neuter flowers rhomboid-conical with usually purplish apex; spadix appendix pale yellow, with irregular furrows and small protuberances, tip pointed, 3.5-4.0 cm long var. *bhandarensis*

Amorphophallus mysorensis E. Barnes & C. E. C. Fisch., Bull. Misc. Inform. 10: 661 (1939). var. **mysorensis** (**Fig. 6**)

Tubers normally depressed globose, 2.5-9.0 cm in diam. and 2-5 cm thick in vegetative phase; c. 8.5 cm diam. and 3 cm thick in flowering phase, skin cream-coloured. Petiole smooth, 37.5-54.0 cm long, 0.5-1.5 cm diam. at base, slightly tapering to the tip, pale greenish with dark olive-green and brownish-black mottling, paler towards the tip, extreme base whitish or pale pink in colour; leaflets sessile, linear-lanceolate, large leaflets 9.0-18.5 cm long and c. 1.8 cm broad, small leaflets 1.8-4.0 cm long and c. 8 mm broad, acuminate at apex and decurrent at base, light green above and paler below, lateral nerves 7-11 pairs. Peduncle slender, smooth, c. 63 cm long, and c. 1 cm diam. at base, identical with petiole in colour and pattern of mottling. Spathe broadly-ovate, c. 12.5 cm long, and c. 12 cm broad; tip acute, fully convolute, c. 4.5 cm diam. at base and 3.7 cm diam. at top just below the mouth; mouth dilated, 4.8 cm diam., not differentiated into a tube and limb; dull purplish outside with numerous fine, raised parallel veins; inside purplish at top, dark purplish and verrucose at base. Spadix longer than the spathe, c. 18 cm long with a stipe of c. 6 mm long and 12 mm diam.; female zone c. 2 cm long and 1.2 cm diam., male zone c. 5.8 cm long and 1 cm diam., staminodial zone c. 1 cm long, terminal sterile appendix of c. 8.5 cm long, and 7 mm diam. at base, narrowed to the tip. Female flowers: ovary spherical, c. 2 mm diam., yellowish-green, 2-4-locular; stigma 2-4-lobed, pale yellow in colour. Neuter flowers closely arranged, each flower spherical, brownish-red, glossy, c. 6 mm diam. Male flowers: each c. 1.8 mm long, c. 1.5 mm broad, 4-celled, opening by 2 apical elongated pores, yellowish flushed with red at top along the connective. Spadix appendix c. 8.5 cm long, cylindrical, tapering towards the tip, dark purplish, inconspicuously irregularly furrowed at the base, smooth above, becoming warty and wrinkled after anthesis. Infructescence not observed.

Phenology: Flowering: March-April; fruiting specimens have not been observed, fruiting may be during May-June.

Distribution: Known only from the type locality.

Notes: A rare taxon with very restricted distribution.

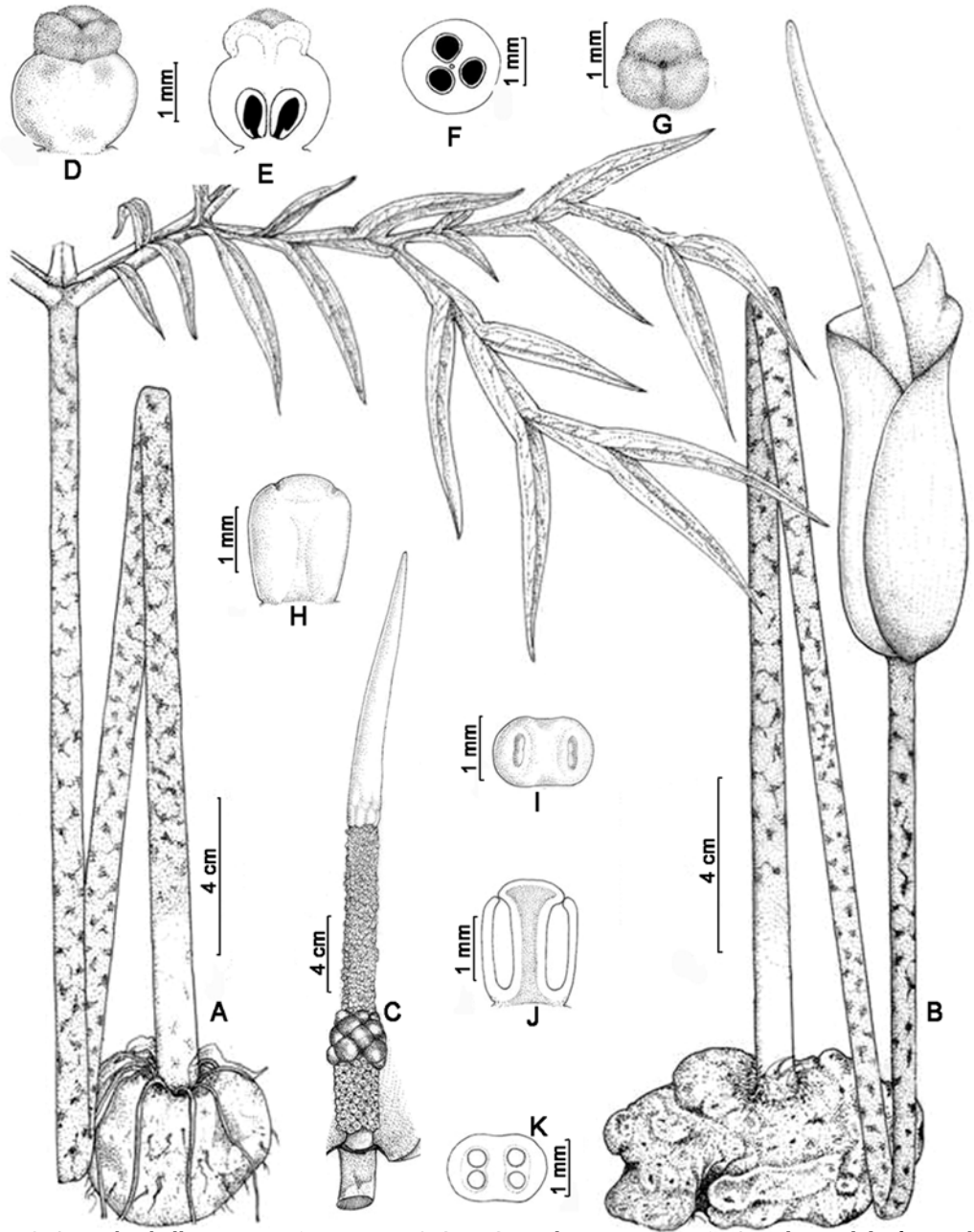

Fig. 6. *Amorphophallus mysorensis* E. Barnes & C. E. C. Fisch. var. *mysorensis.* A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe removed showing spadix; D. Single female flower; E. Female flower - l.s.; F. Ovary - c.s.; G. Stigma - view from top; H., Male flower - view from broader side; I. Male flower - view from top showing openings of thecae; J. Male flower - l.s.; K. Male flower - c.s.

Specimens examined: **Karnataka**: Mysore Dist.: Billigirirangan Hills, Punjur Ghat, 3500 ft., 22.4.1939, *E. Barnes* 2131 (2 inflorescences) (K); *Ibid.*, 22.41939, *E. Barnes* 2133 (Spirit Collection 6914/5) (K), *E. Barnes* 2167 (Spirit collection 16862) (K); *Ibid*., 12.9.1999, *A. Jaleel* RIA 378 (tuber with leaf) (CALI).

Amorphophallus mysorensis var. **bhandarensis (**S. R.Yadav, Kahalkar & Bhuskute) Sivadasan & Jaleel, stat. *et* comb. nov. Basionym: *Amorphophallus bhandarensis* S.R. Yadav, Kahalkar & Bhuskute, Aroideana 32: 134 (2009).

Type: India, Maharashtra State, Bhandara Dist., Tumsar, 2.7.2008, *V. I. Kahalkar* 5372 (*holotype* - CAL; *isotype* - BSI & Shivaji University Herbarium, Kolhapur, Maharashtra!).

Tubers depressed sub-globose, 5-7 cm diam. and 3-4.5 cm thick; with stolon-like offsets produced from the tubers. Petiole 40-55 cm long, 1.5-2.0 cm diam., smooth, with small black lines and dots forming mottling all over except at the apical portion. Leaflets sessile, lanceolate, 7-19 cm long and 3-5 cm broad, base unequal and decurrent on rachis. Peduncle 35-55 cm long, and 1.5-2.0 cm diam., identical with petiole in colour and mottling. Spathe convolute; brownish-pale green with prominent veins outside, purplish within, dark brown at base, 14.0-15.5 cm long and 3.5-4.0 cm diam., broadly ovate when spread, flat, tip acute. Spadix longer than the spathe, with a stipe c. 1.2 cm long and 1 cm diam.; female zone 3.5-4.0 cm long and c. 1.2 cm diam., staminodial zone 1.5-2.0 cm long and c. 1.4 cm diam., male zone 4.5-5.5 cm long and c. 1 cm diam. Female flowers: ovary sub-globose, c. 1.6 mm high, c. 2 mm diam., greenish, 2-4-loculed; stigma sessile, 2-4-lobed, c. 1.3 mm diam., pale yellowish. Staminodial zone with closely arranged rhomboid-conical, gibbous, apex purple-tinged; neuter flowers arranged in c. 6 spiral rows. Male flowers: yellowish, each c. 1.8 mm high and 1.6 mm broad, dehiscing by two apical pores. Spadix appendix 3.5-4.0 cm long and c. 8 mm diam. at base, tapering to a pointed tip, with irregular small furrows and ridges, pale yellowish. Fruits ovoid, bright red when ripe. Seeds 2-4, globose.

Phenology: Flowering and fruiting: July-August.

Distribution: Known only from the type locality.

Notes: *Amorphophallus bhandarensis* was published recently (Yadav *et al.*, 2009) during the preparation of the present article, the description is primarily based on the protologue of the species. A thorough study of the characteristic features of the species revealed that although it exhibits similarities with *A. konkanensis, A. mysorensis* and *A. sylvaticus*, it mostly resembles *A. mysorensis* in several morphological features including the general shape of spathe and spadix. The shape of neuter flowers and length of the spadix appendix are stated as being different from those of *A. mysorensis* by Yadav *et al.* (2009). The neuter flowers usually exhibit variation in their shape and colour. Even though the spadix appendix also exhibits variation in length, the relatively short sized

appendix of the species is a striking character. However, gross morphological similarities among the two species indicate the close relationship between the two and hence *A. bhandarensis* deserves only the status of a variety of *A. mysorensis* which is herein treated accordingly.

Specimen examined: **Maharashtra**: Bhandara Dist.: Tumsar, 2.7.2008, *V. I. Kahalkar 5372* (*isotype* - Shivaji University Herbarium, Kolhapur).

Amorphophallus smithsonianus Sivad., Willdenowia 18: 435 (1989). **(Fig. 7)**

Type: India, Kerala state, Thiruvananthapuram Dist., near Attayar on the way to Agasthyamala peak from Bonaccord, 590 m, 25.12.1985, *M. Sivadasan* CU 21547 (*holotype* - K; *isotype* - B!, CAL!, M!, US!).

Tubers compressed-globose or irregularly sub-globose, 2.5-4.0 cm diam. and 1.8-2.3 cm thick in vegetative phase; 4-6 cm diam. and 2.8-3.5 cm thick in reproductive phase; skin smooth, glossy. Petiole smooth, 25-55 cm long and 1.0-1.7 cm diam. at base; green with white specks and mottles, extreme base whitish and apical portion green, basally surrounded by 4-6 cataphylls, each cataphyll 8-11 cm long and 2.2-3.0 cm broad, tip acute with a stiff projection terminating in bifid apex, pale pinkish. Lamina 30-40 cm diam., leaflets obovate-oblong, 3.5-13.8 cm long and 1.5-4.5 cm broad, apex acuminate, lower surface pale green, margin erose, glossy, venation closely pinnate. Peduncle smooth, 9.0-10.5 cm long and 6-7 mm diam. at the base, colour same as that of the petiole surrounded by 4-6 cataphylls. Spathe funnel-shaped, broadly obovate when spread with round or obtuse base, apex entire or notched, 4.0-4.5 cm long and 4.5-5.0 cm broad, basally convolute with broadened mouth, pale green with minute purplish specks outside, dark purplish with minute truncate projections at the base within for about one third of the length, pale yellowish green or creamy and smooth above. Spadix sessile, c. 4 times longer than the spathe; female zone 6-9 mm long; staminodial zone 5-6 mm long, followed by a male zone of 2.0-2.2 cm long, and a terminal sterile appendix. Female flowers: each with ovary c. 1.5 mm high and c. 2 mm diam., cream-coloured; style very short c. 0.5 mm long; stigma sub-equalling the ovary in diameter with 3-5 stout echinations, pale green becoming cream in colour after anthesis. Neuter flowers in 2-5 rows, each obovoid or ellipsoid, dark-purplish or sometimes pale green, c. 5 mm high and c. 3 mm diam., becoming shrunken and thin at maturity. Male flowers: each 1.0-1.3 mm high and 1.5-1.8 mm broad, sub-rectangular in outline with rounded corners, cream-coloured or pale greenish to yellowish-green with pale purplish tinge at the top, dehiscence by apical confluent pores. Spadix appendix 12.5-21.0 cm long, c. 8 mm diam. at the base and tapering to the tip, bent or hanging from the middle, dark purplish, tip sometimes purplish green, with irregular longitudinal shallow furrows and few small spinescent projections at the base.

Phenology: Flowering: December; fruiting specimens have not been observed.

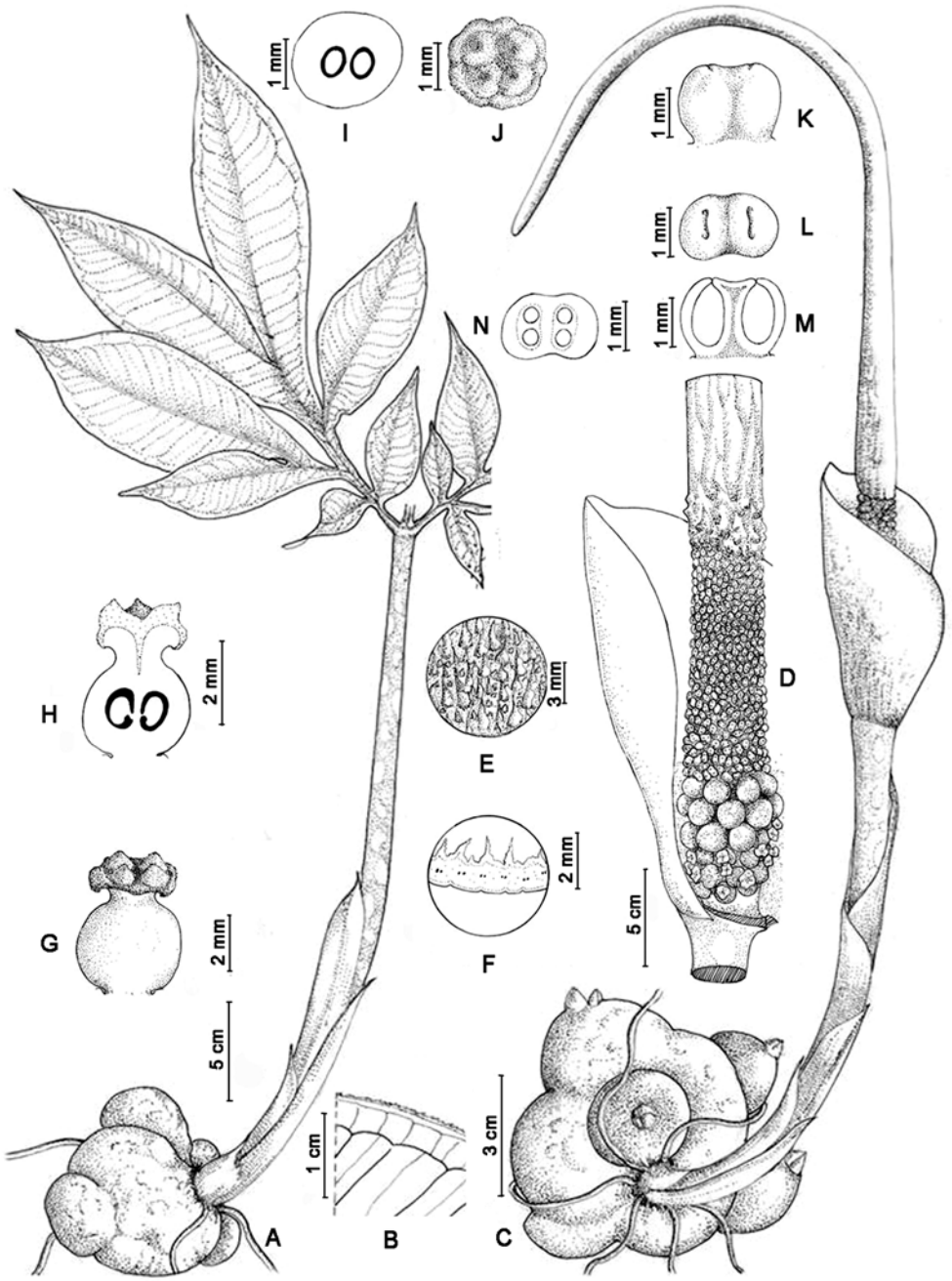

Fig. 7. *Amorphophallus smithsonianus* Sivad. A. Tuber with leaf; B. Marginal portion of a leaflet; C. Tuber with inflorescence; D. Inflorescsence - spathe partially removed showing basal portion of spadix; E. Details of basal interior portion of spathe; F. Basal interior portion of spathe - c.s.; G. Single female flower; H. Female flower - l.s.; I. Ovary - c.s.; J. Stigma - view from top; K. Single male flower - view from broader side; L. Male flower - view from top showing openings of thecae; M. Male flower - l.s.; N. Male flower - c.s.

Distribution: Endemic to Kerala state. Confined to a very small area in the state.

Notes: *Amorphophallus smithsonianus* differs from other species in having a long bent or pendent spadix appendix, echinate stigma and erose leaflet-margins. It resembles with *A. sylvaticus* and *A. konkanensis* only in the general organization of the spadix. It is quite unusual to find specimens of *Amorphophallus* in vegetative and reproductive phases during December with the only known exception of *A. nicolsonianus* Sivad. (1986), but belonging to *Amorphophallus* sect. *Conophallus* (Schott) Engl.

Specimens examined: **Kerala**: Thiruvananthapuram Dist.: near Attayar on the way to Agasthyamala peak from Bonaccord, 590 m, 25.12.1985, *M. Sivadasan* CU 21547 (*holotype* - K; *isotype* – B, CAL, CALI, M, US). *Ibid.*, 30.12.1997, *A. Jaleel* RIA 268 (infl.) (CALI); Karamanayar, 700 m, 18.5.1991, *N. Mohanan* 10824 (leaf) (TBGT); *Ibid.*, 700 m, no date, *N. Mohanan* 11596 (infl.) (TBGT).

Amorphophallus sylvaticus (Roxb.) Kunth, Enum. Pl. 3: 34 (1841); Engl., Pflanzenr. IV. 23C(48): 103 (1911); C. E. C. Fisch. in Gamble, Fl. Pres. Madras : 1587 (1931); Sivad. & Nicols. in Matthew, Fl. Tamilnadu Carnatic 2: 1687 (1983); Karth., Jain, Nayar & Sanjappa, Fl. Ind. Enum. Monocot. : 6 (1989). *Arum sylvaticum* Roxb., Fl. Ind.: 511 (1832); Wight, Ic. Pl. Ind. Or. 3: 7, t. 802 (1844). *Brachyspatha sylvatica* (Roxb.) Schott, Syn. Aroid. : 35 (1856). *Synantherias sylvatica* (Roxb.) Schott., Gen. Aroid.: t. 28 (1858); Hook. f., Fl. Brit. India 6: 518 (1893). **(Fig. 8)**

Lectotype: Wight, Icon. Pl. Ind. Or. 3(1) 1844, Plate 802. (selected and designated here).

Tubers depressed sub-globose, 3-5 cm diam. and 1.5-3.0 cm thick in vegetative phase; 5-6 cm diam. and 3-4 cm in thick in reproductive phase; skin smooth, whitish or cream-coloured; roots numerous, 6-12 cm long and c. 0.1 cm diam. Petiole smooth, 31-65 cm long and 0.5-1.5 cm diam. at the base, greenish with pale green ovate-elongate irregular blotches with white margin, or pale green with pale yellowish ovate-elongate blotches, or pale green with whitish blotches, or light brown with pale brown blotches, and in all with minute mottling in between the blotches. Lamina 32-60 cm diam., leaflets glabrous, ovate-elliptic, lanceolate or linear lanceolate, 4.0-7.5 cm long and 2.5-3.5 cm broad, decurrent at the base, tip acute, or acuminate in the case of linear lanceolate leaflets, ventral side pale green, margin slightly undulate. Peduncle smooth, 40-50 cm long and c. 1 cm diam. at the base, identical with petiole in colour and pattern of blotches. Spathe ovate, 3.0-5.5 cm long and 4.0-6.5 cm broad, completely convolute and open at the top; pale pinkish or greenish-purple outside, purple and verrucose within. Spadix 5-6 times than the spathe, 14-22 cm long; stipitate; stipe 3-5 mm long, pale greenish; female zone 0.8-1.2 cm long, staminodial zone 4-8 mm long; male zone 1.6-3.0 cm long; terminal spadix appendix c. 18 cm long and 6-9 mm diam. at the base. Female flowers: each with ovary sub-globose, c. 2 mm long and c. 2 mm diam., 2-locular with

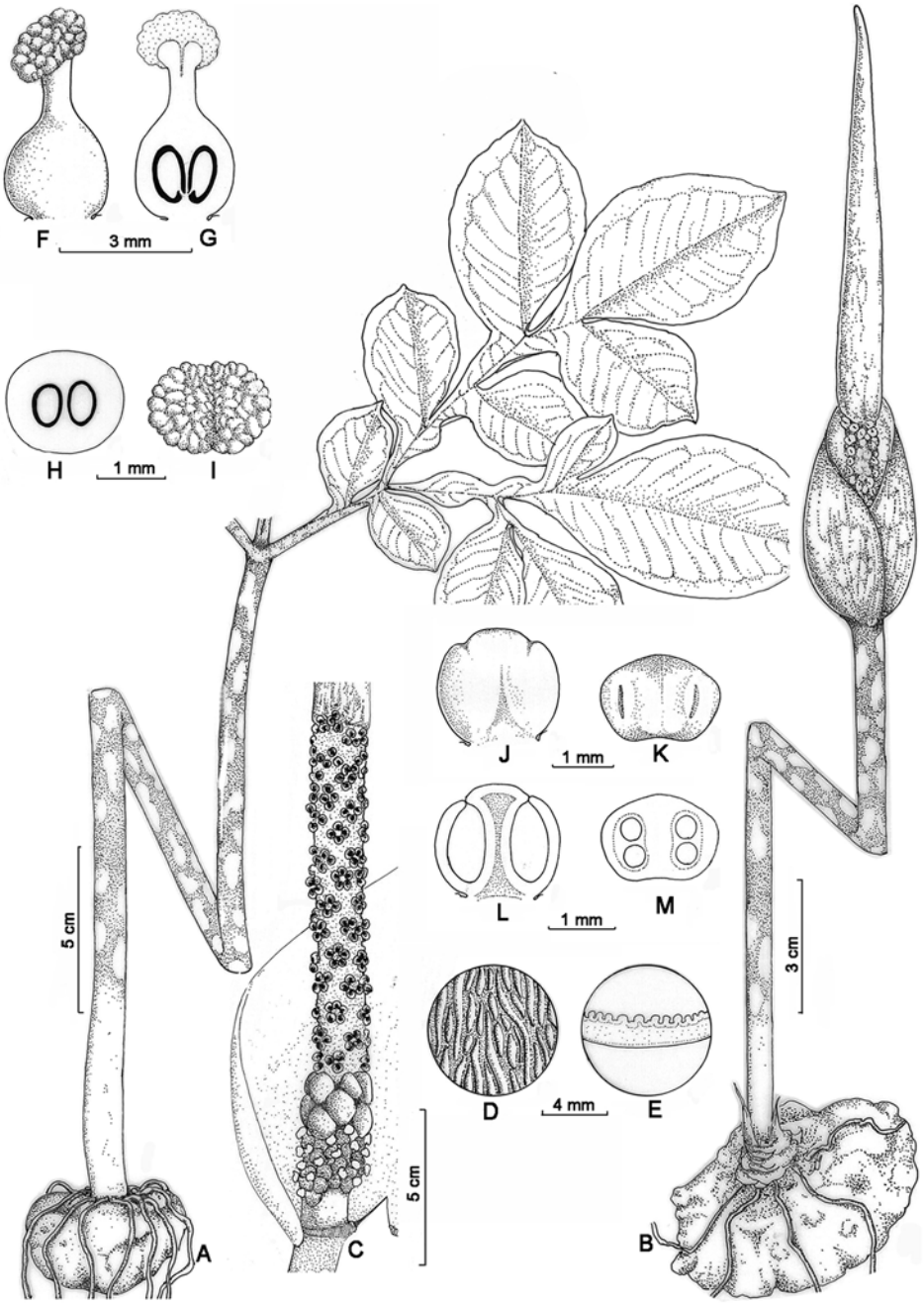

Fig. 8. *Amorphophallus sylvaticus* (Roxb.) Kunth. A. Tuber with leaf; B. Tuber with inflorescence; C. Inflorescence - spathe partially removed to reveal basal portion of spadix; D. Details of basal interior portion of spathe; E. Basal interior portion of spathe - c.s.; F. Single female flower; G. Female flower - l.s.; H. Ovary - c.s.; I. Stigma - view from top; J. Single male flower - view from broader side; K. Male flower - view from top showing openings of thecae; L. Male flower - l.s.; M. Male flower - c.s.

single ovule in each locule; style short, 1-1.5 mm long, pale yellowish; stigma c. 1.5 mm broad, 2-lobed, sometimes obliquely oriented at the tip of the style; smooth at early stage but with irregular small warts at maturity. Neuter flowers oblong-gibbous, 4-5 cm long, 3-4 mm diam., dark brown. Male flowers: in groups, each group with 2-5 flowers, each flower c. 1.3 mm long and c. 1.5 mm broad. Spadix appendix purplish. Berries usually 2-seeded, scarlet when mature.

Phenology: Flowering: April-June; fruiting: July-August.

Distribution: Sri Lanka and India (Kerala?, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra and Gujarat). One specimen at K (*R.H. Beddome, s.n.)* is labelled as collected from 'Wynad' and forms the only record of the species in Kerala.

Notes: The name *Arum sylvaticum* was first published in William Roxburgh's 'Flora Indica' (511:1832) based on a specimen collected from 'Circars' and the illustration (Plate 802) was published in Robert Wight's 'Icones Plantarum Indiae Orientalis' (1843-1845). This being the first published illustration based on Roxburgh's collection, it is selected and designated here as the lectotype of the name. The leaflets are highly variable in shape from ovate-elliptic to lanceolate or long linear lanceolate.

Amorphophallus sylvaticus resembles *A. konkanensis* in general morphology of the spathe and spadix. But in *A. konkanensis* the style is more or less sessile or very short (c. 0.3 mm), and stigma is 3-4-lobed whereas in *A. sylvaticus* the style is comparatively long (1.0-1.5 mm) and stigma is 2-lobed which usually is obliquely oriented on the style.

Specimens examined: **Kerala?**: 'Wynad', 1873, *R. H. Beddome*, s.n. (K). **Tamil Nadu**: Tamabaram, Vandalur, 'Chingleput' Dist., Aug. 1934, *E. Barnes* 880 (K); Tambaram, W. tank bund, 3.8.(19)34, *E. Barnes* 824(K); Nedumkundram, 'Chingleput' Dist., 4.8.(19)34, *E. Barnes* 823 (K); 934, *E. Barnes* 825 (K). Tamabaram, Vandalur, 'Chingleput' Dist., Aug. 1934, *E. Barnes* 880 (K); Maruthamalai, 15.4.1970, *M .V. Viswanathan* 524 (infl.) (MH); Chengalpet Dist., Maduranthakan Taluk, Pillathikkuppam near Vedanthangal Bird Sanctuary, 25.12.1986, *M. Sivadasan* CU 21560C (infl.) (CALI); *Ibid*., 3.7.1998, *A. Jaleel* RIA 315 (infl.) (CALI). **Karnataka**: Ainurmarigudi forest, 11.8.1981, *C. R. Suresh* CU 21493a (part of a leaf) (CALI). **Andhra Pradesh**: Kurnool Dist.: Dhongabhavikota-Chelma, 6.7.1963. *J. S. Ellis* 16772 (MH). **Maharashtra**: Bombay, (No date), *Nimmo* 259 (K); Forest near Chormuli, Naoli, 6 miles north of Bhimanoli, 13.7.1941, *McCann & H. Santapau* 214-9 (BLAT). **Madhya Pradesh**: Raipur, 6.6.1972, *Verma* 17572 (BSA).

Taxonomic analysis

Hooker in his *Flora of British India* (1893) included seventeen species of *Amorphophallus* of which seven are listed for India and actually they belong to five species. Additionally, *Plesmonium margaritiferum* (Roxb.) Schott (= *Amorphophallus margaritifer*) and *Synantherias sylvatica* (Roxb.) Schott (= *A. sylvaticus*), the only

representatives then known of sect. *Rhaphiophallus*, are also listed. Fischer (1931) in Gamble's 'Flora of the Presidency of Madras' described six species of which *A. hohenackeri*, *Plesmonium margaritiferum (= A. margaritifer*) and *A. sylvaticus* are the ones representing *Amorphophallus* sect. *Rhaphiophallus*. After the publication of the important works of Hooker (1893), Engler (1911) and Fischer (1931), a total of six new taxa, viz. *A. bhandarensis* S. R. Yadav *et al.* (= *A. mysorensis* var. *bhandarensis* (S. R. Yadav *et al*.) Sivad. *et* Jaleel, *A. bonaccordensis*, *A. longiconnectivus*, *A. konkanensis*, *A. mysorensis* and *A. smithsonianus* belonging to this section have been published, thereby enhancing the total number of taxa of this section in India to nine.

The endemic taxa with very restricted distribution confined to one State alone are *A. bonaccordensis* (Kerala), *A. longiconnectivus* (Madhya Pradesh), *A. mysorensis* (Karnataka), *A. mysorensis* var. *bhandarensis* (Maharashtra), and *A. smithsonianus* (Kerala). *Amorphophallus hohenackeri* occurs in Kerala and Karnataka states, and *A. konkanensis* in Goa and Maharashtra states. *A. margaritifer* and *A. sylvaticus* are the species having wider distribution in the country with the latter having extended distribution outside India occurring in Sri Lanka.

A. mysorensis var. *mysorensis* has been rediscovered during the course of the present investigation after about 60 years of its first collection in 1939 by Barnes. *A. longiconnectivus* was described by Bogner (1995) based on a single specimen collected by Haines in the year 1910 and available at the Kew herbarium (K). No other earlier or later collections are known to be available in any Indian or foreign herbaria other than the collections made during the present investigation which formed the second collection of the species after 87 years of its first collection.

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