

THREE NEW SPECIES OF ARACEAE FROM BANGLADESH

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Keywords: *Alocasia hararganjensis*; *Alocasia salarkhanii*; *Typhonium elatum*; New species; Araceae; Bangladesh.

Abstract

Three new species belonging to two genera of Araceae from Bangladesh, namely *Alocasia hararganjensis* H. Ara & M.A. Hassan, *Alocasia salarkhanii* H. Ara & M.A. Hassan and *Typhonium elatum* H. Ara & M.A. Hassan are described and illustrated. Diagnostic morphological characters of each of the new species are provided. A comparative morphological characteristic for each new species with their closest described species has also been provided.

Introduction

The family Araceae de Juss. is represented globally by 3,645 species under 144 genera (Boyce and Croat, 2011). The family is represented in Bangladesh by 27 genera and 109 species, of which 80 species are wild and 29 are cultivated (Ara, 2016).

During revisionary work of the family Araceae from Bangladesh the first author made an extensive field survey (137 field trips) throughout the country, especially in the hilly forest areas during 1988-2014 and collected 2,698 aroid specimens. Most of the collected specimens were identified by the first author. However, fifteen specimens remain distinct from any previously described and named species by different morphological characters. Twelve specimens identified belonging to the genus *Alocasia* (Schott) G. Don were not identical to any other described species. However, nine specimens of *Alocasia* (Schott) G. Don are closely related to *Alocasia fallax* Schott and remaining three are closely related to *A. fornicata* (Roxb.) Schott. Rest three specimens were identified as to belong to the genus *Typhonium* Schott. These specimens are morphologically related to *Typhonium trilobatum* (L.) Schott. These specimens were critically examined and compared with the identified specimens of *Alocasia* (Schott) G. Don and *Typhonium* Schott available at BK, BKF, BM, CAL, DACB, K, DUSH (Dhaka University Salar Khan Herbarium), HCU (Herbarium of Chittagong University), BCSIRH (Herbarium, Bangladesh Council for Scientific and Industrial Research) and BFRIH (Herbarium, Bangladesh Forest Research Institute). Moreover, consultation of the relevant literatures (Wallich, 1829-1849; Roxburgh, 1832; Wight, 1843-1845; Hooker, 1893; Jackson, 1893-1955; Prain, 1903; Engler, 1920; Engler and Krause, 1920; Hu, 1968; Nicolson, 1976, 1979, 1987; Nasir, 1978; Nicolson and Sivadasan, 1981; Mayo, 1985; Karthikeyan *et al.*, 1989; Hay, 1991, 1993, 1998, 1999; Noltie, 1994; Sriboonma *et al.* 1994; Sookchaloem, 1995; Mayo *et al.*, 1997; Hettterscheid and Boyce, 2000; Toha, 2000; Boyce, 2007; Li *et al.*, 2010) on the family Araceae revealed that collected specimens differed from other described species of the genus *Alocasia* (Schott) G. Don and *Typhonium*

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Schott. After critical study these specimens were recognized as new species, *Alocasia hararganjensis* sp. nov., *Alocasia salarkhanii* sp. nov. and *Typhonium elatum* sp. nov. The new species are described and illustrated below.

Results and Discussion

1. *Alocasia hararganjensis* H. Ara & M.A. Hassan, **sp. nov.** (Figs 1 & 2).

Diagnosis: *Alocasia hararganjensis* H. Ara & M.A. Hassan is closely related to *A. fallax* Schott but readily differentiated by the leaf shape which are narrowly to ovate sagittate with acute tip; tip of the cataphylls c. 8 cm long; and no sterile male zone above the sterile interstice.

Holotype: Bangladesh, Moulvibazar district, Gazipur beat, Hararganj reserve forest, 21.05.2005, Hosne Ara HA 1740 (DACB).

Massive sub-arborescent pachycaul herb, c 3.5 m high. Stem erect to decumbent, c. 10 cm in diameter, c 2.3 m long, clothed in the brown remains of old leaf bases. Leaves several together in terminal crown, held almost erect or slightly curved; petiole c. 1.2 m long, sheathing c. 1/2 from the base of petiole, eglandular, light green, wing of sheath out-rolled; blade narrowly sagittate to ovate-sagittate, slightly glossy, leathery, glabrous, dark-green adaxially, pale green abaxially, usually bullate, 40-50 cm long, base 40-48 cm in diameter, margin entire to slightly sinuate; anterior lobes 35-42 cm long with apiculate tip c. 1 cm long; anterior costa prominent on both surfaces, glabrous, primary veins 7-11 on each side, prominent on both surfaces, diverging at 45^o-70^o; secondary veins flush on both surfaces; interprimary collective veins well-defined; sub-marginal vein c. 3 mm from the margin; glands in the axils of primary veins absent or extremely inconspicuous; posterior lobes 30-35 cm long, rounded, peltate, c. 1.9 cm long; posterior costae straight. Inflorescences 10 in the centre of the leafy crown, bloom one after another, subtended by cataphylls; cataphylls 66-68 cm long, tip of the cataphylls pointed, c. 8 cm long, green; peduncle smooth, 50-64 cm long, 1.0-1.5 cm in diameter at the base, green. Spathe 18.5-21.0 cm long, constricted at level of sterile zone of spadix; lower spathe 4.5-5.0 cm long, light green, broadly ovoid-cylindric; limb 14-16 cm long, 6.5-7.0 cm in diameter, light greenish yellow, thinly leathery. Spadix shorter than spathe, 12-15 cm long, sessile. Female zone 1.8-2.0 cm long, 1.5-2.0 cm in diameter at the base, with 120-200 close-packed pistils; ovary green, ovoid to subglobose, 2-3 x 2.0-2.3 mm, unilocular, with basal placenta; style 0.5-0.8 mm long, 0.6 mm in diameter, cream coloured; stigma subglobose, shallowly 3-4 lobed, the lobes rounded, creamy; sterile interstice 2.0-2.5 cm long, with 7-8 whorls of rhombohexagonal synandrodia, the lowermost whorls isodiametric with female zone and resembling connate staminodes; sterile male zone absent above the sterile interstice; male zone creamy, 2.5-3.5 cm long, 1.0-1.5 cm in diameter; synandria creamy, rhombo-hexagonal, 2.0-2.3 mm in diameter, opening through apical slits; appendix ivory, 5.5-7.5 cm long, slightly thicker than the male zone at the base, then tapering gradually to a fine point, smooth to faintly rugose. Fruits yellowish (usually does not mature), rather small, 3-4 mm in diameter; fruiting peduncles 40-59 cm long, bend, fruiting spathe whitish, pendulous, 5-6 cm long, the spathe dehiscing longitudinally.

Flowering period: March to October.

Ecology: Grows on the hill slopes as undergrowth.

Distribution: North-Eastern part of Bangladesh, Habiganj and Moulvibazar districts.

Specimens examined: **Habiganj:** Kalenga beat, Kalenga, 03.07.2005, Hosne Ara HA 1771 (DACB); **Moulvibazar:** Gazipur beat, Hararganj reserve forest, 07.05.2003, Hosne Ara HA 315 (DACB); Sreemongal, Lawachara reserve forest, 15.05.2005, Hosne Ara HA 1468 (DACB); Madhabkundo, 20.05.2005, Hosne Ara HA 1707 (DACB); Gazipur beat, Hararganj reserve forest, 21.05.2005, Hosne Ara HA 1740 (DACB); Lawachara reserve forest, 04.07.2005, Hosne Ara HA

1779 (DACB); Gazipur beat, Hararganj forest, 05.07.2005, Hosne Ara HA 1804 (DACB); **Dhaka:** Bangladesh National Herbarium garden (Cultivated), 22.06.2015, Hosne Ara HA 2885 (DACB) [Originally collected from Hararganj reserve forest under Moulvibazar district].

Etymology: The species is named after the type locality-Hararganj in Moulvibazar district, from where the species was first collected.

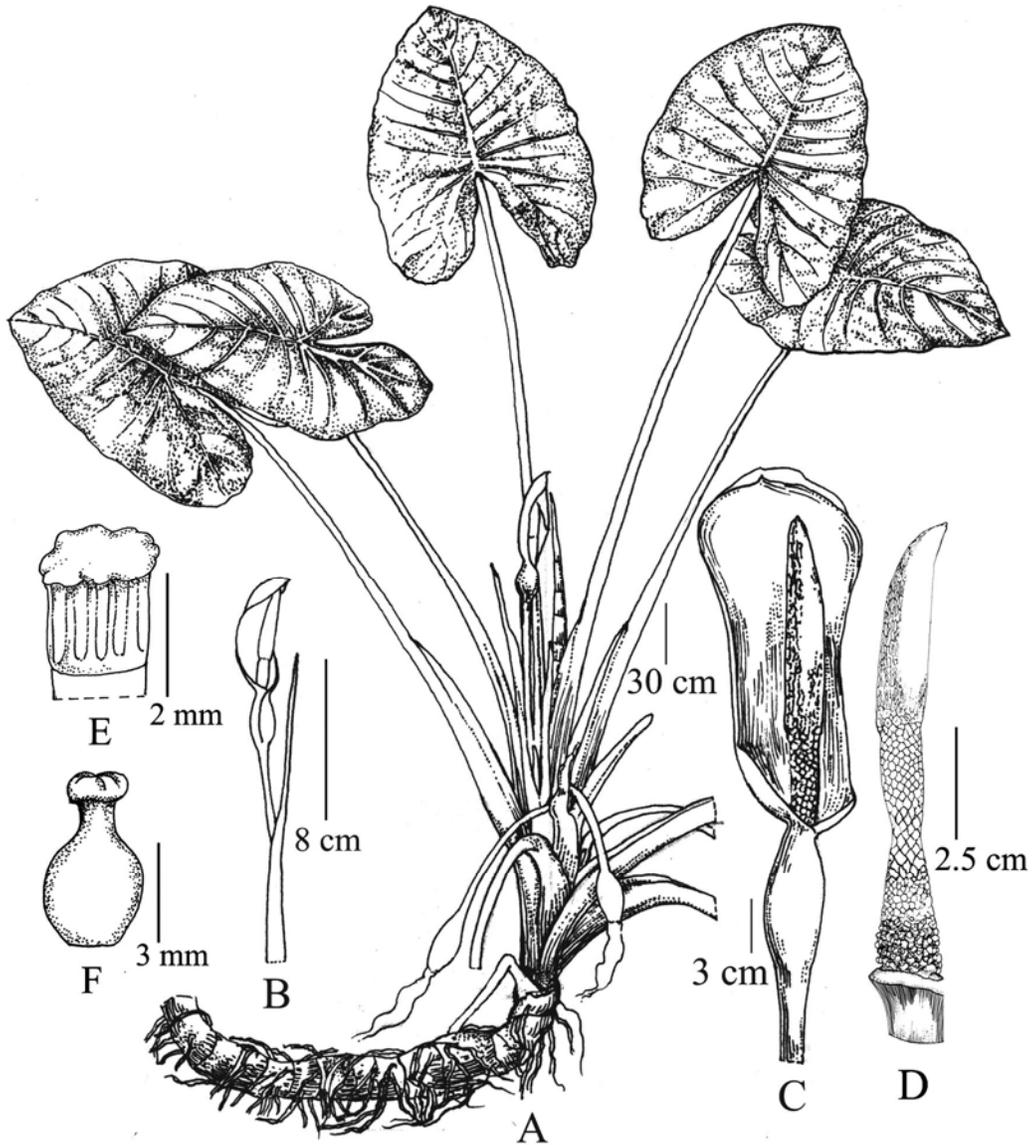


Fig. 1. *Alocasia hararganjensis* H. Ara & M.A. Hassan, **sp. nov.**: A. Habit; B. Cataphyll; C. Inflorescence; D. Spadix; E. Synandrium; F. Gynoecium.

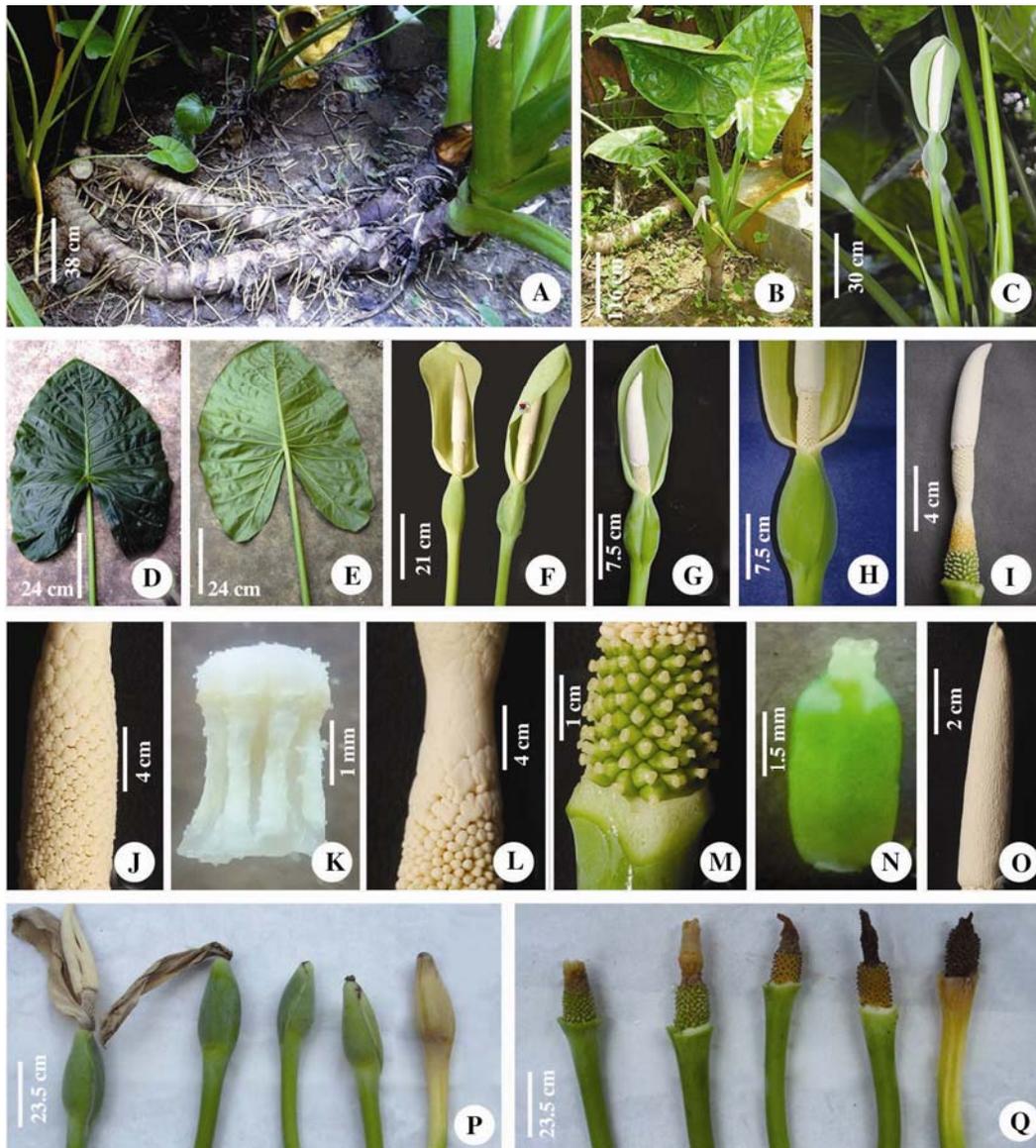


Fig. 2. *Alocasia hararganjensis* H. Ara & M.A. Hassan, **sp. nov.**: A. Tuber; B. Habit-at BNH garden; C. Flower with cataphyll; D. Upper portion of the blade; E. Lower portion of the blade; F-H. Inflorescence; I. Spadix; J. Male zone; K. Synandrium; L. Sterile interstice; M. Lower portion of the spadix; N. Gynoeceum, O. Appendix; P-Q. infructescence.

Note: The chromosome number has been determined for the new species *Alocasia hararganjensis*, and $2n$ chromosome number for this species appears to be 30.

The major morphological differences between the new species *Alocasia hararganjensis* H. Ara & M.A. Hassan and its closely allied species *Alocasia fallax* Schott are outlined in Table 1.

Table 1. Morphological comparison of *Alocasia hararganjensis* H. Ara & M.A. Hassan, sp. nov. with *Alocasia fallax* Schott.

Characters	<i>Alocasia hararganjensis</i> H. Ara & M.A. Hassan, sp. nov.	<i>Alocasia fallax</i> Schott
Leaf shape	Narrowly ovate to ovate sagittate, tip acute	Round and crisped, tip round
Cataphyll	Tip of the cataphylls long pointed, c. 8 cm long	Tip of the cataphylls shortly pointed, c. 2.8 cm long
Spadix	Male zone 2.5-3.5 cm long (not less than 2.5 cm long)	Male zone c. 1.8 cm long (not more than 2 cm long)
Sterile male zone	Absent above the sterile interstice	Present above the sterile interstice
Chromosome number (2n)	30	28 (Sultana <i>et al.</i> , 2011)

Conservation status: Near threatened (IUCN, 2017). Restricted distribution. Both *in situ* and *ex situ* conservation measures are suggested.

2. *Alocasia salarkhanii* H. Ara & M.A. Hassan, sp. nov.

(Figs 3 & 4).

Diagnosis: *Alocasia salarkhanii* H. Ara & M.A. Hassan is closely related to *Alocasia fornicata* (Roxb.) Schott but can be easily differentiated by the colour of petiole and peduncle deep purple; shape of lamina long elliptic; number of inflorescences groups less than 4; length of style c. 0.5 mm long; male zone c. 2.3 cm long; and width of the appendix base and male zone are equal.

Holotype: Bangladesh, Moulvibazar district, Lawachara reserve forest, 15.05.20005, Hosne Ara HA 1467 (DACB).

Small to moderately robust herb. Stem erect to decumbent, up to 4 cm in diameter, c. 60 cm long, clothed in the brown remains of old leaf bases. Leaves several together, held almost erect or slightly curved; petiole 35-52 cm long, sheathing c. 1/3 from the base of petiole, eglandular, deep purple, wings of the sheath out-rolled; blade hastato-sagittate, rather narrowly triangular, margin entire to slightly undulate, glossy, leathery, dark green, glabrous adaxially, pale green and pubescent abaxially, 31-51 cm long, 14.0-21.5 cm in diameter at the base; anterior lobes 18-33 cm long with apiculate tip 0.6-1.0 cm long; anterior costa prominent on both surfaces, glabrous on both surfaces, primary veins 6 on each side, prominent on both surfaces, diverging at 45⁰-90⁰, secondary venation flush on both surfaces, mostly arising from the primary veins at a wide angle, then deflected towards the margin, forming variously well-defined interprimary collective veins or these absent, interprimary collective veins when present weakly undulating to strongly zig-zag at base broad acute angles; submarginal vein 0.8-1.0 cm from the margin; glands in the axils of primary veins absent or extremely inconspicuous; posterior lobes 13-18 cm long, acute, peltate, 2.3-3.0 cm long; posterior costae straight to incurved. Inflorescences 3 in the center of the leaf crown, bloom one after another, subtended by a cataphyll, cataphyll up to 25 cm long, purple; peduncle deep purple, smooth, 26-31 cm long, 0.7-1.3 cm in diameter at the base. Spathe c. 15 cm long; lower spathe convolute, c. 4.2 cm long, green; limb c. 11.7 cm long, c. 4.8 cm in diameter, light yellowish with violet or pink mixed on both sides. Spadix shorter than spathe, c. 11.5 cm long. Lower fertile female zone c. 1 cm long; sterile female zone c. 0.5 cm long, c. 1.3 cm in diameter at the base; pistil closely packed; ovary sub-globose, green, c. 2 x 2 mm, unilocular, with basal placenta; style distinct, stout, c. 0.5 mm long, c. 0.8 mm in diameter, light yellow; stigma 3-4 lobed, lobes acute, light yellow; sterile interstice c. 2 cm long, narrower than the fertile zones,

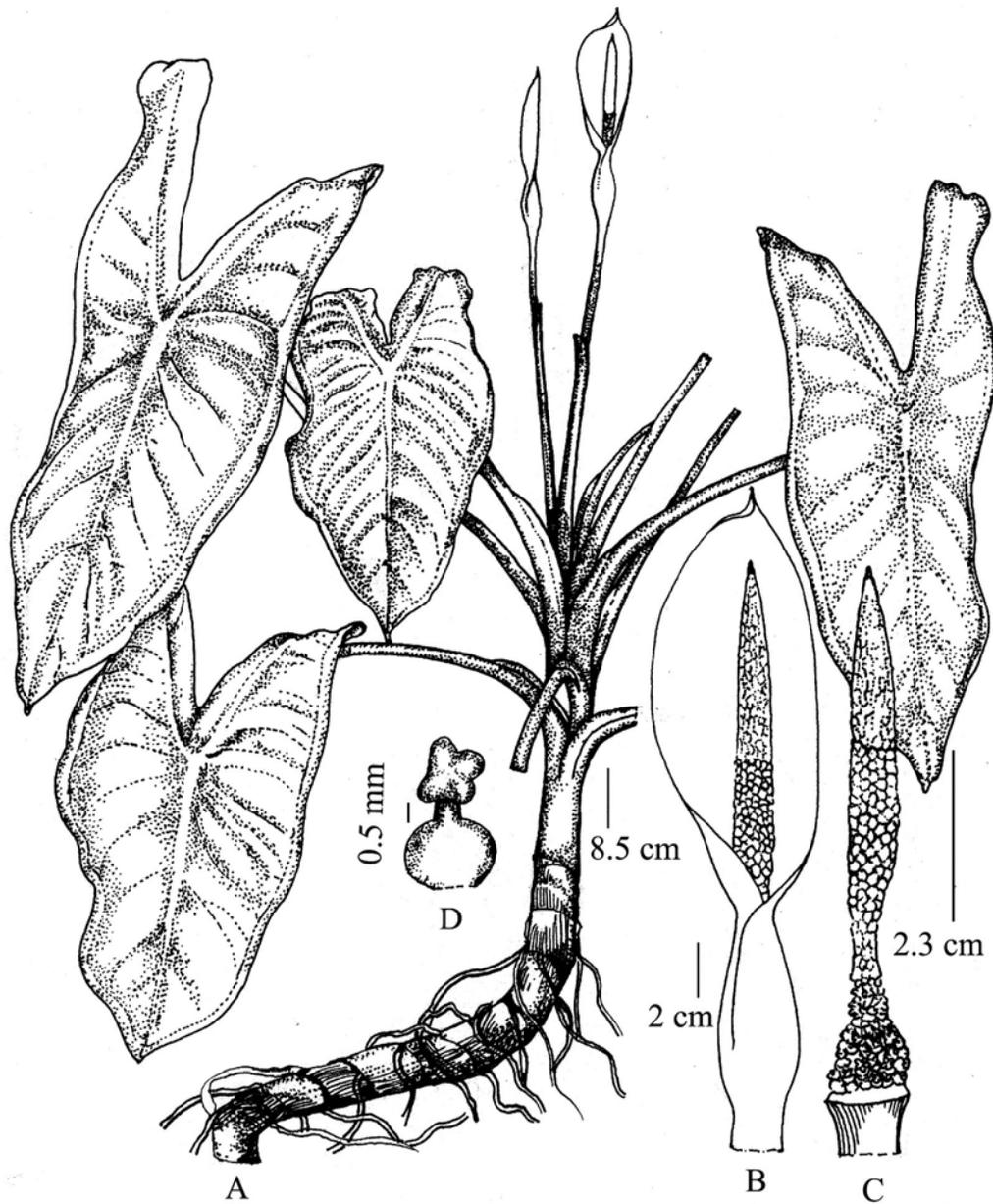


Fig. 3. *Alocasia salarkhanii* H. Ara & M.A. Hassan, *sp. nov.*: A. Habit; B. Inflorescence; C. Spadix; D. Gynoecium.

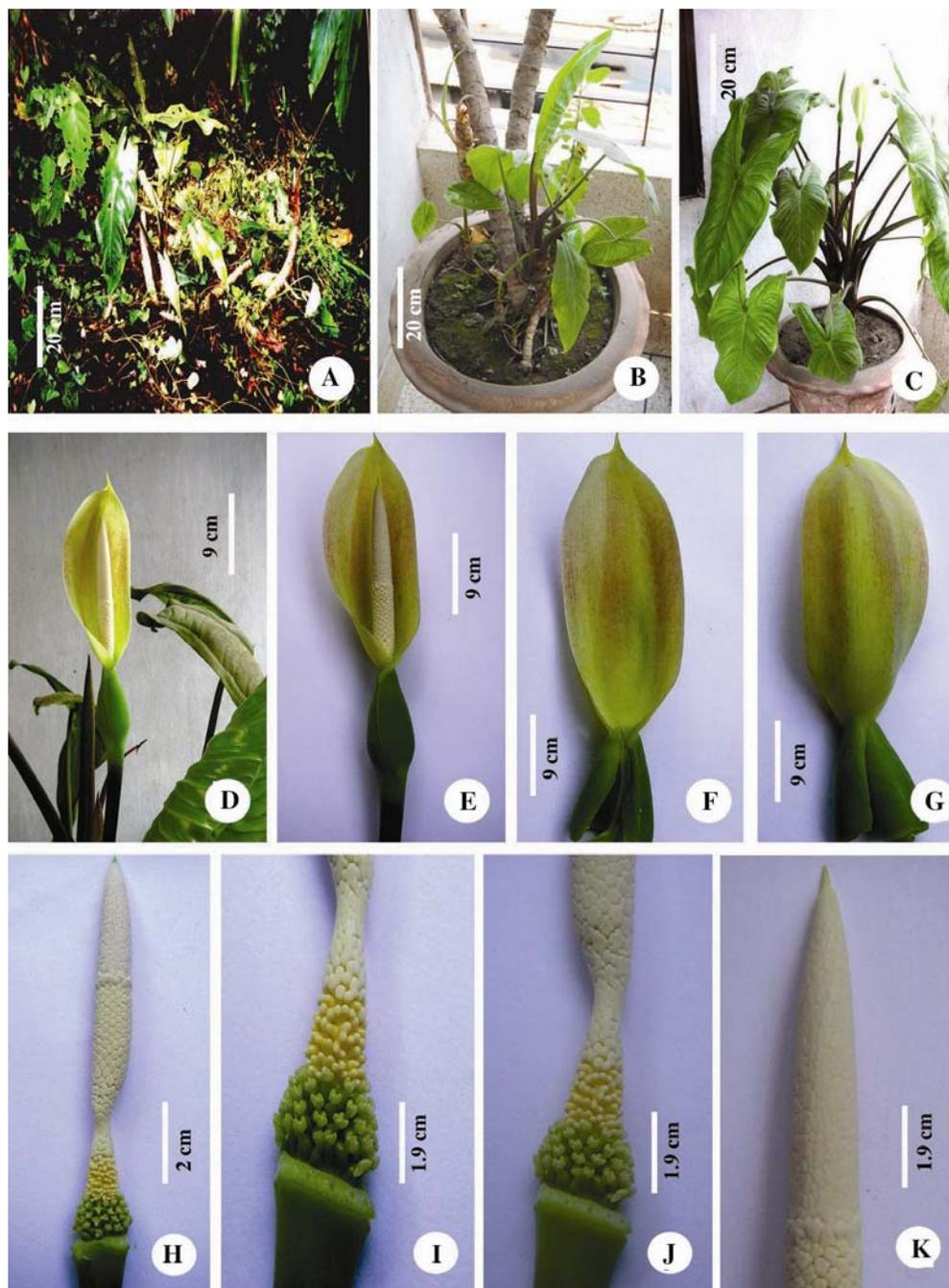


Fig. 4. *Alocasia salarkhanii* H. Ara & M.A. Hassan, **sp. nov.**: A. Wild habitat; B,C. Habit-at home garden; D,E. Inflorescence; F. Inside of the spathe; G. Outside of the spathe; H. Spadix; I,J. Lower portion of the spadix; K. Appendix.

corresponding with the spathe constriction; lower synandrodia often with incompletely connate staminodes, the rest elongate rhombo-hexagonal, flat-topped; male zone cylindric, somewhat tapered at the base, c. 2.3 cm long, c. 0.8 cm thick, ivory in colour; synandria more or less hexagonal, c. 2 mm in diameter, androus; appendix c. 3.5 cm long, c. 0.8 cm thick at the middle, about the same thickness at the male zone, gradually tapering to a pointed tip, cream coloured. Fruit orange-red; fruiting peduncle 33-35 cm long, fruiting spathe ovoid, 4-6 cm long.

Flowering and fruiting period: May - August.

Chromosome number: $2n = 28$ (Afroz *et al.*, 2013).

Ecology: Grows on the hilly area as undergrowth.

Distribution: North-Eastern part of Bangladesh, Moulvibazar district.

Specimens examined: **Moulvibazar:** Lawachara reserve forest, 15.05.2005, Hosne Ara HA 1467 (DACB); 04.07.2005, Hosne Ara HA 1781 (DACB); **Dhaka:** Khilgaon, Tilpapara (Cultivated), 07.05.2006, Hosne Ara HA 2630 (DACB); Bangladesh National Herbarium garden (Cultivated), 30.05.2006, Hosne Ara HA 2651 (DACB) [Originally collected from Lawachara reserve forest under Moulvibazar districts].

Etymology: The species is named in honour of Dr. Md. Salar Khan, known as the father of plant taxonomy in Bangladesh.

The major morphological and cytological differences between the new species *Alocasia salarkhanii* H. Ara & M.A. Hassan and its closely allied species *Alocasia fornicata* (Roxb.) Schott are outlined in Table 2.

Table 2. Morphological and cytological comparison of *Alocasia salarkhanii* H. Ara & M.A. Hassan, sp. nov. with its closely related *Alocasia fornicata* (Roxb.) Schott.

Characters	<i>Alocasia salarkhanii</i> H. Ara & M.A. Hassan, sp. nov.	<i>Alocasia fornicata</i> (Roxb.) Schott
Petiole and peduncle	Deep purple	Green
Leaf blade	Elliptic	Hastate
Inflorescence	In groups of up to 3	In groups of 12, up to 25
Style	c. 0.5 mm long	c. 1.0 mm long
Male zone	c. 2.3 cm long	c. 1.5 cm long
Appendix	Base of the appendix equal to the male zone	Base of the appendix wider than the male zone
Chromosome number	28 (22m+6sm)	28 (18m+10sm)
CMA and DAPI	CMA-band and DAPI band absent	CMA-band and DAPI band present

m = metacentric chromosome, sm = submetacentric chromosome.

Conservation status: Critically Endangered (IUCN, 2017). Located in a very restricted area, should be conserved both by *in situ* and *ex situ* methods.

3. *Typhonium elatum* H. Ara & M.A. Hassan, **sp. nov.**

(Figs 5 & 6).

Diagnosis: *Typhonium elatum* H. Ara & M.A. Hassan differs from its closely related species *T. trilobatum* (L.) Schott by its green colour petiole which is more than 50 cm long; peduncle colour light green; length of the spathe c. 40 cm long and shape narrowly lanceolate; spadix length c. 29 cm long; base of the appendix multifurcate and colour of the staminode yellow.

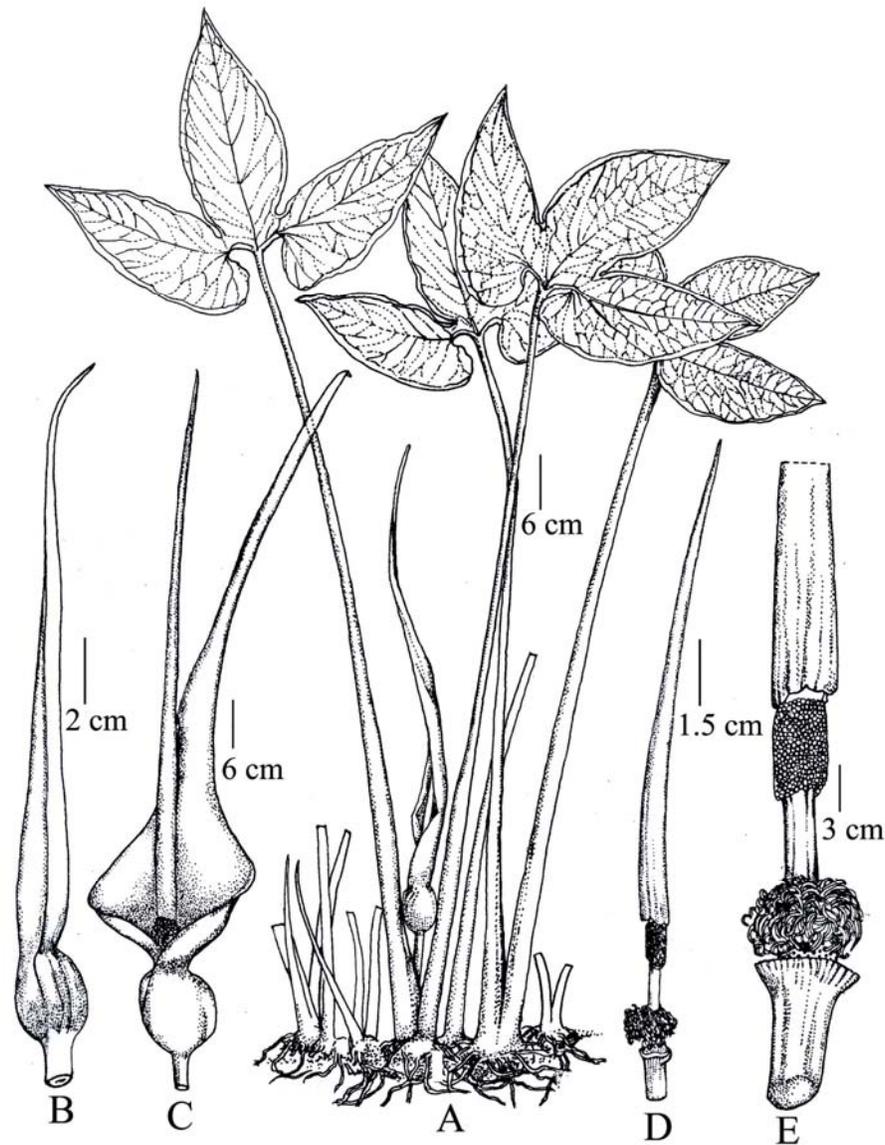


Fig. 5. *Typhonium elatum* H. Ara & M.A. Hassan, **sp. nov.**: A. Habit; B. Spathe; C. Inflorescence; D. Spadix; E. Lower portion of the appendix, male zone and lower portion of the spadix.

Holotype: Bangladesh, Sherpur district, Samaschura beat, 10.10.2003, Hosne Ara HA 701 (DACB).

Tuber c. 5 cm long, c. 4 cm in diameter, developing several offsets. Leaf paired; petioles up to 64 cm long, c. 1 cm in diameter, pale green. Leaf blade usually deeply trilobed, anterior lobe elliptic-lanceolate, up to c. 25 cm long, c. 13 cm in diameter, posterior lobe c. 19.5 cm long, c. 9 cm in diameter, bright pale green. Inflorescence paired. Peduncle c. 10 cm long, c. 0.8 cm in diameter, pale green. Spathe c. 40 cm long, tube and blade separated by a strong constriction; tube

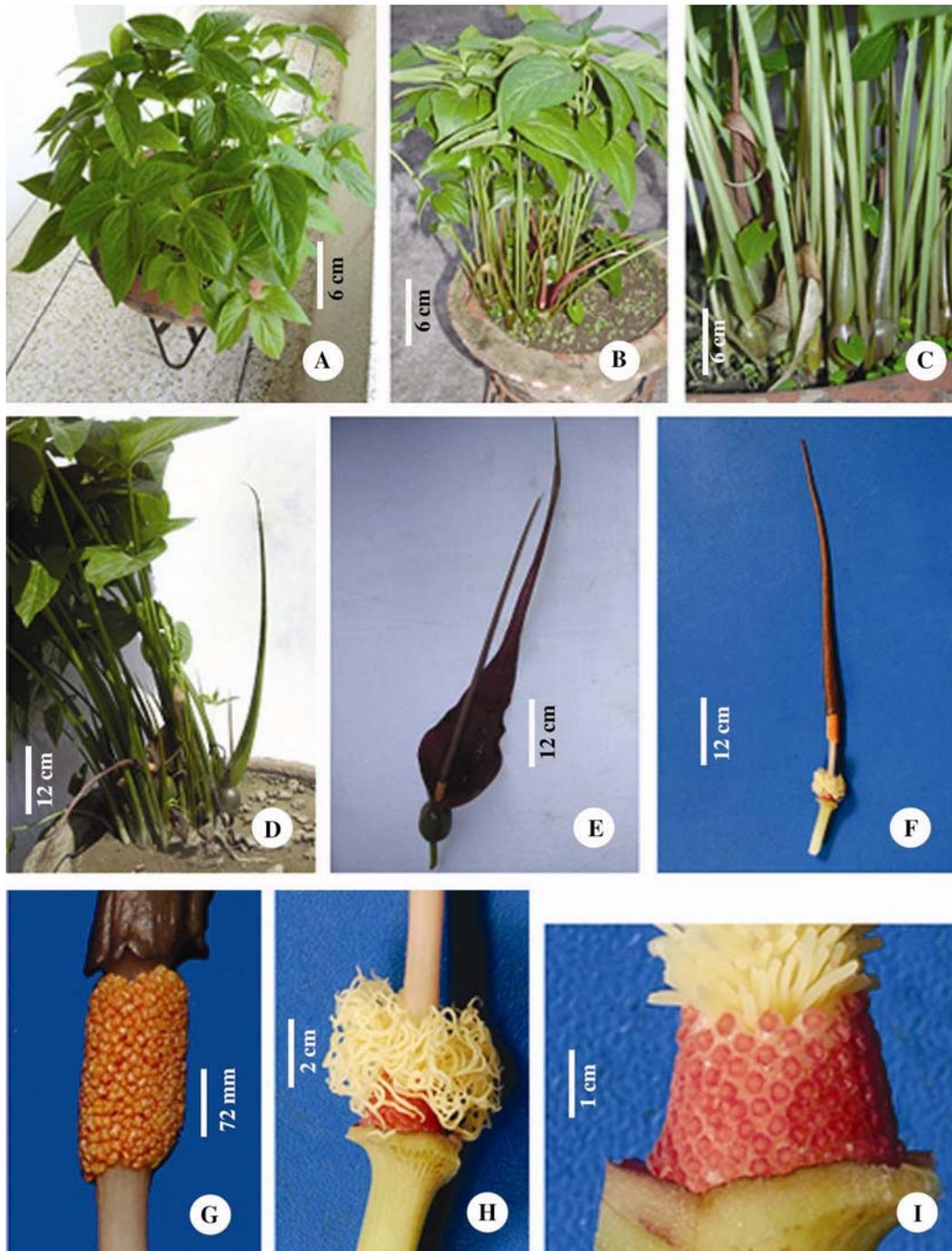


Fig. 6. *Typhonium elatum* H. Ara & M.A. Hassan **sp. nov.**: A,B,C. Habit - at home garden; D,E. Inflorescence, F. Spadix; G. Male zone and lower portion of the appendix; H,I. Lower portion of the spadix.

c. 3.5 cm long, outside pale green, inside glossy dark purple; blade c. 36.5 cm long, outside pale green, inside glossy dark purple. Spadix shorter than spathe, c. 29 cm long. Female zone c. 0.8 cm long, c. 0.8 cm in diameter, flowers congested; sterile zone between female and male zone, 2.7-4.0 cm long, the lower 0.5-2.2 cm with yellow staminodes, the remainder naked, light pink, longitudinally grooved; male zone cylindrical, c. 1.8 cm long, c. 1 cm in diameter, base and top oblique, flowers congested; appendix very shortly stipitate, narrowly lanceolate, 20-24 cm long, c. 1 cm in diameter at the base, top acute, base multifurcate, with surface shallowly and irregularly furrowed, dark purple, producing a strong unpleasant smell at female anthesis. Stamens 0.6-0.9 mm long, light pinkish. Staminodes filiform, c. 1.6 cm long, c. 0.5 mm in diameter, dark yellowish, curled. Ovary elongate, cylindric, c. 1.5 mm long, 1.1-1.2 mm in diameter, white with a faint pinkish flush near the top, unilocular, with one basal ovule; stigma sessile, depressed, hemispheric, c. 0.8 mm in diameter, c. 0.2 mm high, papillose, pink. Fruit not observed, usually die before fruit formation.

Flowering period: March - October.

Chromosome number: $2n = 18$ (Huq *et al.*, 2007).

Ecology: Grows on the hilly area as undergrowth.

Distribution: Central parts of Bangladesh (Sherpur district).

Specimen examined: **Sherpur:** Samaschura beat, 10.10.2003, Hosne Ara HA 701 (DACB); *ibid.*, 23.06.2004, Hosne Ara HA 1060 (DACB); **Dhaka:** Khilgaon, Tilpapara (Cultivated), 02.07.2015, Hosne Ara HA 2889 (DACB) [Originally collected from Samaschura beat under Sherpur district].

Etymology: The species is named after tallness of its habit.

The major morphological and cytological differences between the new species *Typhonium elatum* H. Ara & M.A. Hassan and its closely allied species *Typhonium trilobatum* (L.) Schott are presented in Table 3.

Table 3. Morphological and cytological comparison of *Typhonium elatum* H. Ara & M.A. Hassan, *sp. nov.* with *Typhonium trilobatum* (L.) Schott.

Characters	<i>Typhonium elatum</i> H. Ara & M.A. Hassan, <i>sp. nov.</i>	<i>Typhonium trilobatum</i> (L.) Schott
Petiole	Green, ≥ 50 cm long	Purple, ≤ 45 cm long
Leaf shape	Elliptic lanceolate	Ovate, ovate-lanceolate
Peduncle	Light green	Purple
Spathe	c. 40 cm long, narrow lanceolate	15-18 cm long, ovate to broadly ovate
Spadix length	c. 29 cm long	c. 13.5 cm long
Appendix	Base of the appendix multifurcate	Base of the appendix truncate
Staminodes	Yellow	White
Ovary	c. 1.5 mm long, c. 1.2 mm in diameter, white with a faint pinkish flush near the top	c. 1.0 mm long, c. 0.7 mm in diameter, cream colour
Chromosome number	18 (12m + 6sm)	18 (16m + 2sm)
DAPI band	DAPI band 5	DAPI band 3

m = metacentric chromosome, sm = submetacentric chromosome.

Note : Although the two species bear same chromosome number, they differ by the karyotype formulae and DAPI characters.

Conservation status: Endangered (IUCN, 2017). Collected from a single locality, now conserved through *ex situ* in a home garden.

Acknowledgements

The authors are grateful to the authorities of the BK, BKF, BM, CAL, DACB, K, DUSH, HCU, BCSIRH and BFRIH for providing facilities to consult aroid materials and their libraries. The authors express their gratitude to Professor Dr. M. Oliur Rahman, Department of Botany, University of Dhaka for his encouragement and enormous help during preparation of the manuscript. Thanks are also due to Ms. Mahmuda Akter, Senior Artist-cum-illustrator, Bangladesh National Herbarium for drawing the illustrations, and the researchers at Cytogenetics Laboratory of the Department of Botany, University of Dhaka for their cooperation in chromosomal investigation of the new species.

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(Manuscript received on 11 October 2018; revised on 9 November 2018)