

# *Cryptocoryne* hybrids (Araceae) 2: Two *Cryptocoryne* (Araceae) hybrids from southern Peninsular Malaysia.

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## ABSTRACT

Southern Peninsular Malaysia has four well-known acidic water *Cryptocoryne* species, *C. cordata* var. *cordata*, *C. griffithii*, *C. nurii* var. *nurii*, and *C. schulzei* as well as three well-documented, naturally occurring interspecific hybrids, *C. ×purpurea* nothovar. *purpurea*, *C. ×timabensis* and *C. ×decus-silvae*. Here two additional hybrid combinations are presented and illustrated, viz. *C. ×griffithioides* and *C. ×schulzeioides*.

## KEY WORDS

*Cryptocoryne*, natural hybrids, Johor, Peninsular Malaysia, acidic water

## INTRODUCTION

The genus *Cryptocoryne* (Araceae) is a well-known and important element in the aquatic flora of southern Peninsular Malaysia, with seven species occurring in the states of Malacca, Johor and Pahang (Bastmeijer 2020; Othman et al. 2009):

1) The mangrove species *C. ciliata* (Roxb.) Schott ( $2n = 22, 33$ ).

2) The limestone species *C. affinis* Hook.f. ( $2n = 34$ ) in Kedah, Perak, Selangor, Negeri Sembilan, Pahang, and Kelantan and *C. nurii* Furt. var. *raubensis* Ganapathy & Siow in Pahang ( $2n = 34$ ).

3) The Gunong Pulai *C. longicauda* Engl., which is also found in Sumatera and northwestern Borneo ( $2n = 30$ ).

4) Towards the south, in Malacca, Johor and Pahang, the acidic water species dominate: *C. cordata* Griff. var. *cordata* (Negeri Sembilan, Malacca, Johor, and the east coast northwards to SE Peninsular Thailand), *C. griffithii* Schott (Malacca, Johor, Riau Islands, S Kalimantan), *C. nurii* Furt. var. *nurii* (Johor, Pahang, Terengganu, Riau Islands and Sumatera) and *C. schulzei* De Wit (Johor and Riau Islands).

These four acidic water species, all with a chromosome number of  $2n = 34$ , are accompanied by three hybrid combinations:

5) *C. ×purpurea* Ridl. nothovar. *purpurea* is a well-known recognized polymorphic hybrid between *C. cordata* var. *cordata* and *C. griffithii* which has arisen a number of times in Malacca, Johor and Pahang (Othman et al. 2009; Rosazlina et al. 2016; Jacobsen et al. 2016, 2019).

6) *C. ×timabensis* Bastmeijer was first recorded from Singapore (Bastmeijer & Kiew 2001) but has since been found in Johor (Jacobsen et al. 2016; Komala 2019) and Singkep Island, Riau Prov., Indonesia (Reitel 2017). It has been shown to be a hybrid between *C. nurii* var. *nurii* and *C. schulzei* (Jacobsen et al. 2016, 2019; Komala 2019).

7) *C. ×decus-silvae* De Wit has for some years been challenging with respect to its origin and identity, but recent fieldwork and subsequent cultivation of studied samples, chromosome counts and molecular work,

has shown it to be a hybrid: *C. cordata* var. *cordata* × *C. nurii* var. *nurii*, indicating that it has arisen independently a number of times in Johor and Pahang (Jacobsen et al. 2016, 2019, 2020; Komala 2019).

We present here two more of the possible six natural occurring *Cryptocoryne* hybrids, viz. *Cryptocoryne griffithii* × *C. nurii* var. *nurii* and *C. griffithii* × *C. schulzei*, *C. ×griffithioides* N. Jacobsen and *C. ×schulzeioides* N. Jacobsen.

## RESULTS

Four deviating plants of unknown exact origin, most likely originating from Johor, have turned up over the years: Three (A, B & C) with a short spathe tube and a backwards bent limb and one (D) with a long spathe tube and a strongly recurved limb.

**A)** The first of the three having a short tube appeared in 1977 in a shipment from Singapore to the aquarium plant nursery Tropica, Denmark (NJ 3044, 8 Dec. 1977: **Figure 1**). It is characterized by the narrowly cordate to ovate leaves, a short spathe tube with a dark purple, backwards bent spathe limb with somewhat irregular, rounded protuberances, and a pronounced, rather narrow collar. The morphological characters of the spathe suggest that NJ 3044 represents the hybrid combination *C. griffithii* × *C. nurii* var. *nurii*. Live material is no longer available for study. The pollen

fertility was 0%. Chromosome number -  $2n = 34$  reported here for NJ 3044.

**B & C)** Two rather similar samples were obtained in 1985 (NJ 85–30, 23 Aug. 1985, 36 km stone from Johor Bahru towards Pontian Kechil, by the aquarium plant nursery of Mr. Goh Ah Ji (**Figure 2**) and in 2001 (NJM 01–05G, 13 Feb. 2001, 4–5 km NE Kulai, by the Oriental Aquarium plant nursery (**Figures 3 & 4**) from localities in Johor, but both localities were secondary localities where the plants had escaped or were transplanted from the nurseries. These two were rather similar samples with narrowly cordate leaves, a dark red purple, backwards bent spathe limb with irregular protuberances covering the whole surface, and a rather narrow tube opening with a pronounced collar. The protuberances were irregular in contrast to the regularly rounded ones found in *C. griffithii*, and the irregularly branched ones found in *C. nurii* var. *nurii*. The morphological characters of the spathe suggest that NJ 85–30 and NJM 01–05G represent the hybrid combination *C. griffithii* × *C. nurii* var. *nurii*. The pollen fertility was 0% in both cases. Chromosome number -  $2n = 34$ , reported here for NJ 85–30 and NJM 01–05G.

**D)** In 2014 we obtained a cultivated plant from R. Strössner, Germany (NJ 3514, Oct. 2014, originally from a shipment from Oriental Aquarium, Singapore in 2006 named *C. “griffithii”* (**Figure 5**). Upon flowering, it turned out not to be *C. griffithii*, but a hitherto unknown *Cryptocoryne*. It had cordate leaves, a long spathe tube, and a dull

purplish spathe limb strongly recurved with small pointed, regular protuberances scattered over the whole limb surface, and a vertical, funnel shaped, purplish tube opening, with a broad, clearly demarcated collar zone. The long tube and the narrowly, recurved spathe limb suggest *C. schulzei* as one of the parents and the many, uniform protuberances on the spathe limb suggest *C. griffithii* as the other parent. The pollen fertility was 0%. Chromosome number -  $2n = 34$ , reported here for NJ 3514.

The exact localities of origin of these four hybrids are unknown, but most probably from Johor. Whether their original habitats still exist is unknown, but field observations over the past recent years have revealed that unexpected *Cryptocoryne* localities can still be located, while others are gone.

### Description of the hybrids

*Cryptocoryne* × *griffithioides* N. Jacobsen, **nothosp. nov.** – **Figure 2 (3 & 4)**

**Type:** Peninsular Malaysia, Johor, exact natural locality unknown; NJ 85–30, 23 Aug. 1985, 36 km stone from Johor Bahru towards Pontian Kechil, temporary ditch in a cacao plantation by the aquarium plant nursery of Mr. Goh Ah Ji (C holotype; additional sample from cultivated type collection USM).



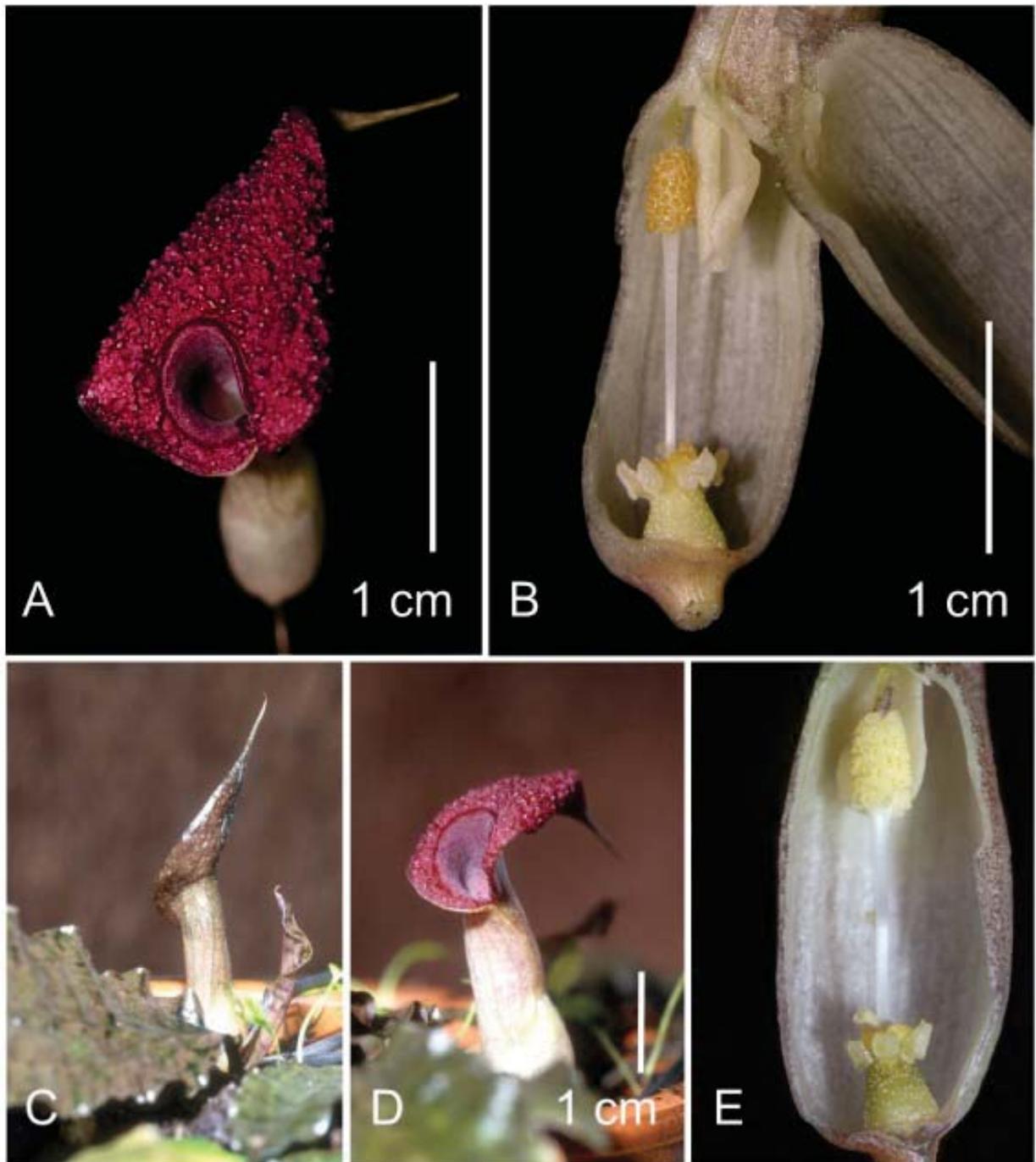
**Figure 1.** *Cryptocoryne* ×*griffithioides*, NJ 3044. **A.** cultivated specimen, showing the purple marbled leaf blades, and short spathe tube, and the dark purple spathe limb with irregular protuberances and a narrow, raised collar; **B.** Spathe seen from above, showing the broad purple limb with protuberances, and the distinct collar; **C.** Spathe with the kettle cut open, showing the female flowers with the broadly ovate, emarginate stigmas and the male flowers on top; **D.** herbarium specimen showing the narrowly-lanceolate leaf blade. Photographs by N. Jacobsen.



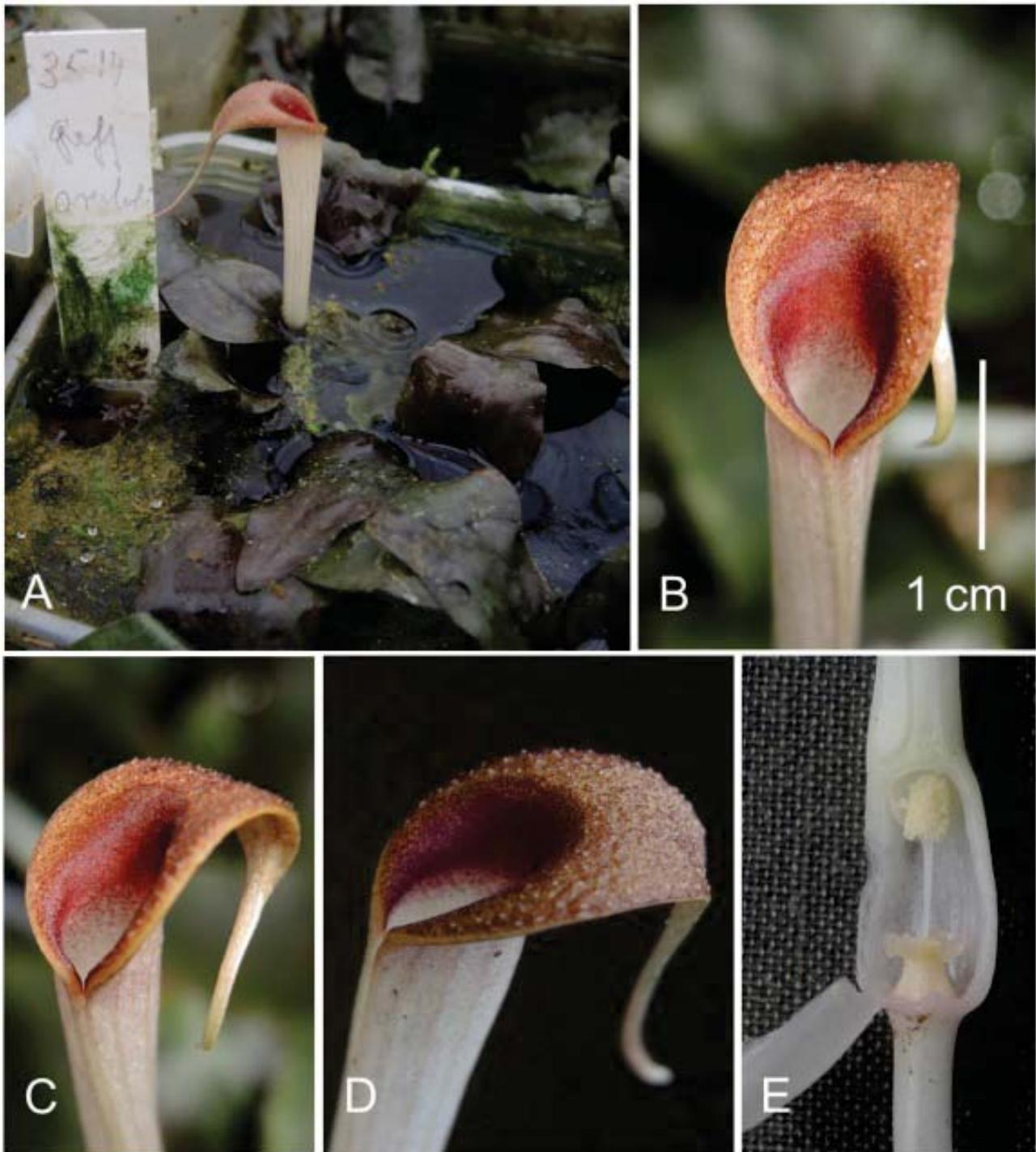
**Figure 2.** *Cryptocoryne* ×*griffithiioides*, NJ 85–30. **A.** cultivated in a tank showing a dense stand of plants with the green marbled leaves; **B.** close up of a flowering plant; **C.** cut off spathe showing kettle, a short tube and the broadly ovate, recurved limb also with recurved margins, the irregular protuberances, and the distinct collar. Photographs by N. Jacobsen.



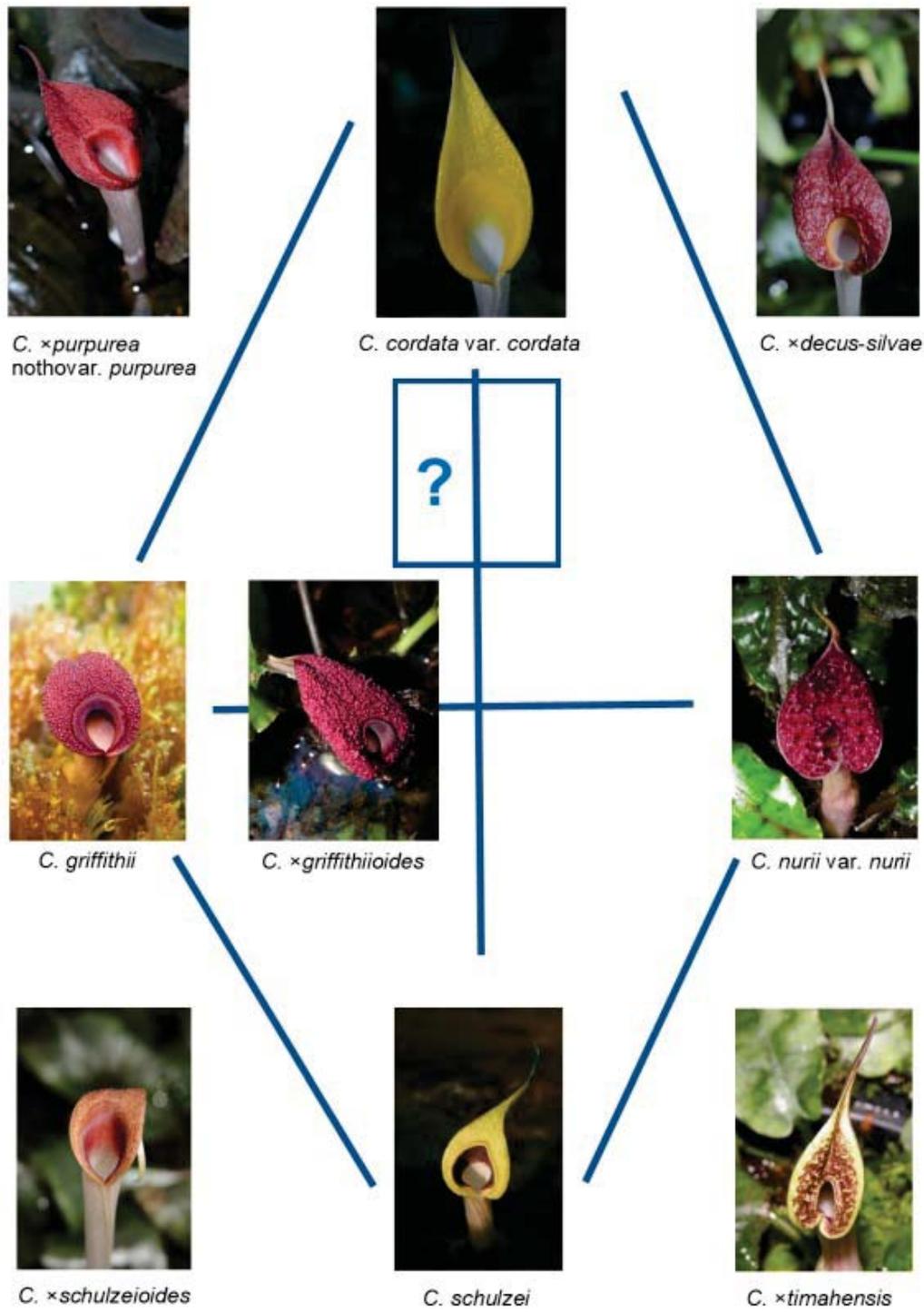
**Figure 3.** *Cryptocoryne*  $\times$ *griffithioides*, NJM 01–05G. **A.** cultivated in a tank showing a dense stand of plants with the green, somewhat bullate, marbled leaves; **B.** close up of a flowering plant grown in a pot. Photographs by N. Jacobsen.



**Figure 4.** *Cryptocoryne* × *griffithiioides*, NJM 01–05G. **A.** cut off spathe showing the kettle, the short tube and the broadly ovate, recurved limb also with recurved margins, the irregular protuberances, and the distinct collar; **B.** cut open kettle showing the female flowers at the base with ovate stigmas, the yellow olfactory bodies, the yellow male flowers and the white flap (not attached to the appendix and folded alongside the male flowers); **C.** young spathe seen from the side; **D.** opened spathe seen from the side; **E.** cut open kettle showing the female flowers at the base with ovate to emarginate stigmas, the yellow olfactory bodies, the yellow male flowers, the purple spotted appendix and the white flap. Photographs A – B by N. Jacobsen, C – E by J. D. Bastmeijer.



**Figure 5.** *Cryptocoryne* × *schulzeioides*, NJ 3414. **A.** cultivated in a 1 l tank showing a dense stand of plants with purplish leaf blades; **B.** close up of a spathe limb showing the reddish limb with small protuberances, an almost vertical tube opening with a broad, darker collar zone; **C.** as B, but seen a little from the side showing the recurved limb; **D.** like C, but seen more from the side with the small protuberances clearly seen on the spathe limb; **E.** cut open kettle showing the female flowers at the base with ovate stigmas, the light yellow olfactory bodies, the light yellow male flowers and the white flap. Photographs by N. Jacobsen.



**Figure 6.** Diagram showing the four acidic water *Cryptocoryne* parent species, and the five known hybrid combinations (of the possible six).

## Diagnosis

*Cryptocoryne* × *griffithioides* is characterized by its green to brownish ± smooth leaves, short spathe tube with a backwards bent, broad limb with a deep purple base colour and irregular protuberances, a narrow purple tube opening and a distinct collar rim: an interspecific hybrid suggested to be between *C. griffithii* and *C. nurii* var. *nurii*.

## Description

*Amphibious herb* with long, subterranean stolons. *Leaves* 5 – 8 in a rosette, 12 – 18 cm long, *lamina* up to 9 × 4 cm, ovate with a slightly cordate base, ± smooth, spreading ± upright, submerged or emergent, brownish greenish with darker markings on the upper surface, lighter on the lower surface. *Cataphylls* two-keeled, 1.5 – 2 cm long, whitish to greenish. *Spathe* 5 – 7 cm long, outside whitish in the lower part, purplish in the upper part; *kettle* c.1.5 cm long, inside white, *flap* white; *tube* c. 2 cm long; *limb* 2.5 – 4 cm long and 1.5 – 2 cm broad, ovate, backwards bent and margins ± reflexed, deep purple with a rough surface of irregular protuberances, a rather narrow but distinct purple collar. *Spadix* c. 1.5 cm long, with 5 – 6 white *female flowers* with ovate stigmas; *olfactory bodies* yellow, irregular; *male flowers* 45 – 55, yellow; *appendix* slightly yellowish. *Syncarp* not observed. *Chromosome number* –  $2n = 34$ , is reported here for NJ 3044, NJ 85–30 and NJM 01–5G.

*Distribution* — Endemic to Peninsular Malaysia, Johor with three known samples, but of unknown exact localities.

*Additional collections* — NJ 3044 (**Figure 1**), 8. Dec. 77, exported from Singapore to the aquarium plant nursery Tropica, Denmark (C); NJM 01–5G (**Figure 3 & 4**), 13 Feb 2001, 4–5 km NE Kulai, at oil palm plantation behind the Oriental Aquarium plant nursery (C, USM).

*Habitat* — Original habitat unknown, but likely in forest streams, now probably in oil palm, rubber or cacao plantations with mixed mineral soil and plant debris, submerged but also emergent on the stream banks where the plants may be deeply rooted with their rhizomes and stolons.

*Conservation status* — Data Deficient (IUCN/SPS, 2019): only known from three accessions of unknown exact natural localities. The present day habitat of *C. ×griffithioides* may be in oil palm plantations, in tertiary vegetation types, indicating that it can adjust to habitat changes.

*Etymology* — *griffithioides* – meaning resembling *Cryptocoryne griffithii*, a name used for the samples before it was realized that they represented hybrids.

*Cultivation* — *Cryptocoryne* × *griffithioides* is easily cultivated submerged or halfway emergent in leaf litter soil.

***Cryptocoryne* × *schulzeioides*** N. Jacobsen, **nothosp. nov.** – **Figure 5**

**Type:** Peninsula Malaysia, Johor, exact locality unknown; *NJ 3514*, cultivated plant from R. Strössner, Germany, originally shipped from Oriental Aquarium, Singapore in 2006 by the name of *C. “griffithii”* (*C* holotype; additional sample from cultivated type collection USM).

### Diagnosis

*Cryptocoryne* × *schulzeioides* is characterized by its green to brownish ± smooth leaves, long spathe tube with a sharply recurved, rather narrow limb with a dirty purplish base colour and small regular, pointed protuberances on the limb surface: an interspecific hybrid suggested to be between *C. griffithii* and *C. schulzei*.

### Description

*Amphibious herb* with long, subterranean stolons. *Leaves* 5 – 8 in a rosette, 12 – 18 cm long, *lamina* up to 8 × 4 cm, ovate with a slightly cordate base, ± smooth, spreading ± upright, submerged or emergent, brownish greenish with darker markings on the upper surface, lighter on the lower surface. *Spathe* about 10 – 12 cm long, outside whitish in the lower part, purplish in the upper part; *kettle* c.1.5 cm long, inside white, *flap* white; *tube* c. 8 – 9 cm long; *limb* c. 3 cm long and c. 1.2 cm broad, narrowly ovate, sharply recurved, dull purple with a rough surface of regular pointed protuberances, especially towards the margins, a rather broad but

distinct red-purple collar zone. *Spadix* c. 1.3 cm long, with 5 – 6 white *female flowers* with broadly ellipsoid to emarginate stigmas; *olfactory bodies* light yellow; *male flowers* 35 – 50, yellow; *appendix* white. *Syncarp* not observed. *Chromosome number* —  $2n = 34$ , is reported here for *NJ 3514*.

*Distribution* — Endemic to Peninsular Malaysia, Johor with one reported sample, which is of unknown exact natural location.

*Habitat* — Original habitat unknown, but no doubt in forest streams, now probably in streams in oil palm, rubber or cacao plantations in water with mixed mineral soil and plant debris, submerged but also emergent on the stream banks where the plants are deeply rooted with their rhizomes and stolons.

*Conservation status* — Data Deficient (IUCN/SPS, 2019): only one sample of unknown exact natural location. The present day habitat of *C. ×schulzeioides* may be in oil palm plantations, in tertiary vegetation types.

*Etymology* — *schulzeioides* – meaning resembling *Cryptocoryne schulzei*.

*Notes* — The morphology of the spathe with the long tube, the prominent, strongly recurved limb with irregular, pointed protuberances, the vertical funnel-shaped purplish tube opening, with a broad, clearly demarcated collar zone, suggests that the

plant represents the hybrid combination *C. griffithii* × *C. schulzei*.

*Cultivation* — *Cryptocoryne* × *schulzeioides* is easily cultivated submerged or halfway emergent in leaf litter soil.

## CONCLUSION

With the addition of two more hybrid combinations from southern Peninsular

Malaysia presented here, five of the six possible hybrid combinations between the  $2n = 34$  acidic water species of *Cryptocoryne* from Johor have now been recorded, only the *C. cordata* var. *cordata* × *C. schulzei* hybrid has yet to be located (**Figure 6**). Given our current knowledge of the distribution of the *Cryptocoryne* of Johor, it may exist and could be found.

**KEY TO THE ACIDIC WATER *CRYPTOCORYNE* OF JOHOR.**

1. Spathe limb yellow . . . . . 2
  2. Spathe limb with purple collar and tube opening . . . . . *C. schulzei*
  2. Spathe limb without any purple colour . . . . . 3
    3. Spathe limb smooth, collar zone broad . . . . . *C. cordata* var. *cordata*
    3. Spathe limb distinctly unevenly rough, collar zone narrow, raised . . . . . *C. × decus-silvae* (*C. cordata* var. *cordata* × *C. nurii* var. *nurii*)
1. Spathe limb ± purplish . . . . . 4
  4. Spathe limb with ± branched protuberances . . . . . 5
    5. Spathe limb ± evenly dark or light purple with a short, broad lamina . . . . . *C. nurii* var. *nurii*
    5. Spathe limb ± purple-red-yellow speckled with a relatively long, pointed limb . . . . . *C. × timahensis* (*C. nurii* var. *nurii* × *C. schulzei*)
  4. Spathe limb with rounded protuberances . . . . . 6
    6. Spathe with a short, 1–2 (–3) cm long tube . . . . . 7
      7. Spathe limb with very regular, rounded protuberances on the surface *C. griffithii*
      7. Spathe limb with somewhat irregular rounded protuberances on the surface . . . . . *C. × griffithioides* (*C. griffithii* × *C. nurii* var. *nurii*)
    6. Spathe with a longer tube, 5–10 (–20) cm long . . . . . 8
      8. Spathe limb strongly recurved, with rough, pointed protuberances, limb narrow . . . . . *C. × schulzeioides* (*C. griffithii* × *C. schulzei*)
      8. Spathe limb backwards bent, protuberances rounded or irregular rounded, limb broad . . . . . 9
        9. Spathe limb with regular, rounded protuberances . . . . . *C. × purpurea* nothovar. *Purpurea* (*C. cordata* var. *cordata* × *C. griffithii*)
        9. Spathe limb with irregular protuberances or otherwise irregular surface . . . . . *C. × decus-silvae* (*C. cordata* var. *cordata* × *C. nurii* var. *nurii*)

## ACKNOWLEDGEMENTS

Material used in this investigations has kindly been supplied by ‘Tropica’, ‘Oriental Aquarium’, Mr. Goh Ah Ji, and Mr. Roland Strössner. Jacob Weiner has kindly read the English text in an earlier version of this paper.

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