NOTE

Ceriops zippeliana Blume (Rhizophoraceae), a New Record of a Mangrove Species in Singapore

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ABSTRACT: Ceriops zippeliana Blume is here reported as a new record for the mangrove forests in Singapore. The botanical description of this new record with color plates and a key to the two Ceriops species in Singapore are provided. It is noteworthy that C. tagal (Perr.) C. B. Rob. is rarer than C. zippeliana in Singapore. Thus, special attention for conservation should be focused on C. tagal and a further survey of this genus would provide valuable information to better manage Singapore’s mangrove plant biodiversity.

KEY WORDS: Ceriops decandra (Griff.) Ding Hou, Ceriops tagal (Perr.) C. B. Rob., Ceriops zippeliana Blume, Mangroves, Rhizophoraceae, Singapore.

INTRODUCTION

‘Mangroves’ are the intertidal plants, mostly trees and shrubs, distributed in regions of estuaries, deltas and riverbanks or along the coastlines of tropical and subtropical areas. Various terms have been used to describe mangroves, such as coastal woodland, mangal, tidal forest or mangrove forest. It is noted that ‘mangrove’ has two different interpretations: it can refer to an individual plant or to an assemblage of plants that contains many species (Tomlinson, 1986; Saenger, 2002).

The members of mangroves consist of various kinds of plants from different genera and families, many of which are not related closely to one another phylogenetically. However, it is difficult to delineate precisely what constitutes the mangrove species (Tomlinson, 1986; Saenger, 2002).

According to Tomlinson’s definition (1986), 19 major species belonged to six families and nine minor species of seven families were recorded in the mangroves of Singapore in 1999 (Ng and Sivasothi, 1999). Recently, a rare mangrove species, Bruguiera hainesii C. G. Rogers, was added to the mangrove flora of Singapore (Sheue et al., 2005), thus, 20 major components of Singapore mangrove forest are recognized now (Tan et al., 2007).

In 1999, the first two authors discovered an uncertain taxon of Ceriops at Pasir Ris Park, which was
morphologically different from *C. tagal* (Perr.) C. B. Rob. in Singapore. At first, this taxon was identified as the so-called *C. decandra* (Griff.) Ding Hou according to Flora of Malesiana (Hou, 1958). However, the first author noticed that it is morphologically and anatomically different from the *C. decandra* collected from India (Sheue, 2003). It was then considered as an uncertain species by the first author awaiting further taxonomic research (Sheue, 2003). Recently, the authors have come to realize that the uncertain species should be *C. zippeliana* Blume, and this species also occurs in areas of southeastern Asia as well (Sheue et al., 2009a). However, the collection was not first made by the first two authors in Singapore, because several previous collections of *C. zippeliana*, misidentified as *C. tagal*, were found in SING herbarium. In this report, the botanical description with photos of the new record and a key to differentiate the species of *Ceriops* with a discussion in Singapore are provided.

**TAXONOMIC TREATMENTS**

**Key to the species of Ceriops in Singapore**

1a. Petal apex with 3 clavate appendages; inflorescence axis relatively long and slender (10-30 mm × 2 mm), bending downwards; inflorescence compound bifurcate cyme; hypocotyl 15-25 cm long at maturity, cotyledon collar yellow to yellowish green ..........

1b. Petal apex fringed with multi-cilia (13-17); inflorescence axis relatively short and stout (3-10 mm × 3-4 mm), erect; inflorescence simple head-like; hypocotyl 9-17 cm long at maturity, cotyledon collar scarlet .......... C. zippeliana

*Ceriops zippeliana* Blume, Mus. Bot. 1: 143. 1849. (named after Zippelius) (line illustration see f. 2 in Sheue et al., 2009a) Figs. 1 & 2

Small tree or shrub up to 12 m tall; bark brownish with some protruding lenticels, flaky at base. Leaves oval to elliptical-oval, 5.5-11 cm × 3.7-5.5 cm, apex obtuse, rounded to emarginate, base cuneate to attenuate; petiole 1-2.5 cm long. Stipules 1.5-2.5 cm long, with 18-20 layered collers inside adaxial base. Inflorescence head-like, usually bearing at the uppermost three nodes of a branch, axillary, 3-5(-7) flowered. Bracteole 2-lobed, disc-like, sessile, 2.6 mm in length, apex rounded, with 2-8 collers at adaxial base of each lobe. Calyx lobes 5, erect while in flowering and in fruiting, ovate, acute, 2-3 mm × 2 mm. Petals 5, white, turning brownish, linear-rectangular, 3.3-5 mm × 1.8 mm (including terminal cilia), with broad base, slightly elongated longitudinally, margins hairless, apex multiciliate with 13-17 cilia, 0.5-0.8 mm long. Stamens 10, almost equal in size; filament 1 mm long; anther 1 mm long, ovoid, dorsifixed, with one short connective protrusion. Ovary inferior, 3 chambered, 2-ovules in each chamber, style 2 mm long, stigma 1, very shortly trifid. Persistent calyx tube shallow disc, 3 mm in height, persistent lobes 5, 2-2.5 mm x 1.5-1.5 mm, slightly obliquely erect or patent. Fruit ovoid-conical, 1.2-1.5 cm × 1.0 cm, with reticulate ornament. Hypocotyl clavate, 9-17 cm × 0.7-0.8 cm, width unequal, gradually thickening with an acute sharp apex (root tip), sharply ridged and sulate, erect to pendant; epicotyl 2-3 mm long.

Specimens examined: SINGAPORE: Sungei Buloh Nature Reserve: Sheue 30-31 (CHIA); Jurong River: M. Ismail S-14 (SING); Changi: M. Shah MS868 (SING); Khatib Bongsu: J. Lai LJ58, LJ126 (SING); Pulau Ubin: E. Tang & H. Sidek 302 (SING); Pasir Ris Park: Sheue 46 (CHIA).

*Ceriops zippeliana* was discovered by the authors along the boardwalk at Pasir Ris Park (1°22'52.8″N, 103°57'7.2″E) at the north-eastern part in Singapore. This is a five-hectare patch of mature mangrove forest preserved during land reclamation and development (Ng and Sivasothi, 1999). Diverse species of mangrove members could be found in this area, including the more common species of *Avicennia alba* Blume, *A. rumphiana* Hallier f., *Bruguiera cylindrica* (L.) Blume, *B. gymnorrhiza* (L.) Sav., *Ceriops tagal*, *Rhizophora mucronata* Lam., *R. apiculata* Blume, *Scyphiphora hydrophyllacea* C. F. Gaertn., the ferns of *Acrostichum* L. and the shrubs of *Acanthus* L.; and the relative rare species of *Aegiceras corniculatum* (L.) Blanco, *Bruguiera parviflora* (Rosx.) Griff. and *Rhizophora stylosa* Griff. (Ng and Sivasothi, 1999). *Ceriops zippeliana* is a shrub about 2-4 m in height commonly found under the mangrove canopy of inner mangroves and growing with *Bruguiera*, *Rhizophora* and *Lumnitzera*. The leaf shape may appear more oval while it occurs at deep shade habitat.

**DISCUSSION**

This is an interesting and important botanical discovery despite significant decrease of mangrove land area from 13% in 1820’s (Corlett, 1987) to only 0.5% in 1993 (Hilton and Manning, 1995) and where seven mangrove species had been lost in Singapore during the past years (Turner and Yong, 1999). Our study may imply that a further extensive study of the mangrove ecosystem in Singapore (especially the offshore islands) is still warranted.

Despite the morphological similarity of the two species of *Ceriops* in Singapore, *C. zippeliana* can be differentiated from *C. tagal* by reproductive characteristics. The inflorescence has an important
diagnostic value for differentiating the two groups of Ceriops, namely C. australis (Sheue et al., 2009b) and C. tagal, and C. decandra, C. pseudodecandra (Sheue et al., 2010) and C. zippeliana (Sheue et al., 2009a). The former group has relatively long and slender peduncles and the latter group has short and stout ones. Moreover, for the genus Ceriops, the inflorescence of C. zippeliana is a simple head-like structure with a primary bract. Petal morphology and the inflorescence features can be used to divide the genus into the same two groups as mentioned above. The apex of petal of C. tagal has 3 clavate appendages (see f. 4e, Sheue et al., 2009b) while that of C. zippeliana has finger-like fringes containing 13-17 sinuate cilia (see f. 3d., Sheue et al., 2009a). Furthermore, the different open extent of sepals of Ceriops during flowering could be observed in the field. The flowers of C. zippeliana never open widely while blooming.

Different pollination systems were noted in the mangrove Rhizophoraceae (Tomlinson, 1986). Similar to those of the species of Bruguiera, the stamens of C. tagal with relatively long filaments are enclosed in pairs under tension within petals, and pollen grains are released when the flower is triggered by the pollinator (i.e. explosively). However, C. zippeliana is similar to Kandelia and Rhizophora which release pollen non-explosively. This phenomenon is related to the morphology of petal. There is a group of intertwined helical trichomes located at each middle margin of the petal of C. tagal. Thus, the entire petals of C. tagal link together strongly by these trichomes and they are sensitive to be triggered (Sheue, 2003). On the contrast, the petal margins of C. zippeliana are hairless (Fig. 2C) (Sheue et al., 2009a). In addition, C. tagal has long filament type (25 mm) with a terminal hook structure while C. zippeliana has short filament type (1 mm). These structures are associated with the two different blooming mechanisms mentioned above.

The ovoid fruit of Ceriops also has persistent calyx tubes and lobes. Although the fruits of the species in this genus are very similar, the detailed morphological features (including surface ornamentation patterns) can be used for interspecific differentiation (Sheue, 2003). The fruit with generally lift calyx lobes above the residue structure of floral disc of C. tagal is larger than that of C. zippeliana with ascending calyx lobes and netted decoration on fruit surface. The color of cotyledon collar seems quite constant of the mature
Fig. 2. Diagnostic characters of *Ceriops* in Singapore. Abbreviations: A: Anther. C: Cotyledon collar. F: Fruit. H: Hypocotyl. P: Petal. S: Sepal. St: Style. A: Branchlets with mature viviparous seedlings of *C. zippeliana* Blume (left) and *C. tagal* (Perr.) C. B. Rob. (right). B-C. Flower surface view and a petal of *C. zippeliana* showing multi-cilia (13-17) of petal apex. D: Flower surface view of *C. tagal* showing three clavate appendages on the apex of a petal (arrow heads). E: The fruit of *C. zippeliana* with netted surface decoration, ascending persistent calyx lobes and a scarlet hypocotyl collar. F: The fruit of *C. tagal* with generally lifted persistent calyx lobes and a yellow to yellowish green hypocotyl collar. Scale bars: A = 15 cm; B-D = 1 mm; E-F = 2 cm.
viviparous seedlings. The mature collar color of *C. tagal* appears yellow to yellowish green while that of *C. zippeliana* always shows scarlet (reddish). In addition, *C. zippeliana* has propagules pointing towards different directions while attached to the parent tree, whereas *C. tagal* propagules usually tend to point downwards (Sheue, 2003). These features could be confirmed from a recent Singapore’s mangrove book (Ng et al., 2008) photographic record.

According to the recent Singapore Red Data Book (Davison et al., 2008), seven species of the mangrove Rhizophoraceae were included, including *C. tagal* (remarked as vulnerable) and *C. zippeliana* (it was noted as *Ceriops* sp. nov., designated as endangered). Similarly, *C. zippeliana* were also found in Sungei Buloh Wetland Reserve, Changi Creek, Pulau Semakau, Woodlands Town Gardens Park, Lim Chu Kang, Sungei Seletar Reservoir causeway mangroves, Pandan mangroves (off Jalan Buroh), Pulau Ubin and Pulau Tekong. The previous collections of *C. zippeliana* deposited at SING herbarium (misidentified as *C. tagal*) were collected from Changi, Jurong River, Khatib Bongsu and Pulau Ubin.

It is not surprising that *C. zippeliana* occurs in Singapore; since the island of Singapore is separated from the Malay Peninsula by a narrow Johor Strait and the flora of Singapore naturally is a natural floristic extension of the southern part of the Malay Peninsula (Keng, 1990). Nevertheless, a detail field and population survey of this genus would provide more adequate information to better manage Singapore’s mangrove biodiversity. Moreover, further attention for conservation of this genus in Singapore may need to be focused on *C. tagal*.

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**LITERATURE CITED**


新加坡紅樹林植物的新紀錄種—齊氏細蕊紅樹

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摘要：本文報導作者於 1999 年於新加坡採集到的一種新紀錄之紅樹林植物。經數年的分類研究後，作者確認本種為 Ceriops zippeliana Blume (此譯為齊氏細蕊紅樹)，除新加坡外，本種亦分布於東南亞一帶。文中提供本種植物描述，含鑑別特徵的彩色圖片及新加坡當地本屬植物的檢索表，以供鑑定，並和原已知產於該地的細蕊紅樹 (C. tagal (Perr.) C. B. Rob.) 比較與分辨之。值得注意的是原產於新加坡的細蕊紅樹之族群比本新紀錄種相對地更加稀少。建議未來進一步廣泛調查本屬植物，並對細蕊紅樹特別加以關注，將有助於新加坡地區紅樹林植物多樣性之保育工作。

關鍵詞：印度細蕊紅樹 (Ceriops decandra (Griff.) Ding Hou)、細蕊紅樹 (Ceriops tagal (Perr.) C. B. Rob.)、齊氏細蕊紅樹 (Ceriops zippeliana Blume)、紅樹林、紅樹科、新加坡。