

# Phylogeny of *Tacca* (Taccaceae) and traits in reproductive structures, with description of a new Bornean species

WONG SIN YENG<sup>1,2,\*</sup>, CHUA KEK SHEN<sup>1</sup>

<sup>1</sup>Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia. Tel: +60-82583028, \*email: sywong@unimas.my.

<sup>2</sup>Research Associate, Harvard University Herbaria, 22 Divinity Avenue, Cambridge, MA 02138, United States of America

Manuscript received: 1 September 2019. Revision accepted: 3 October 2019.

**Abstract.** Wong SY, Chua KS. 2019. Phylogeny of *Tacca* (Taccaceae) and traits in reproductive structures, with description of a new Bornean species. *Biodiversitas* 20: 3096-3118. A phylogenetic study of 16 of the c. 20 *Tacca* species is presented using nuclear ITS and plastid *matK* gene regions. *Tacca leontopetaloides* and *T. maculata* are a sister clade to the rest of the *Tacca* species. *Tacca palmata* and *T. palmatifida* are strongly supported together in a clade with this clade sister to *T. bibracteata* and *T. plantaginea*. All endemic Bornean taxa except *T. bibracteata* formed a derived clade together with non-Bornean *T. cristata* and *T. sumatrana*. The Bornean taxa are separated into three clades with *T. borneensis* sister to the other two clades. Twelve morphological characteristics are coded and mapped onto the Maximum Parsimony tree to elucidate potential evolutionary patterns. Results indicated shifts from a geophytic (irregularly-) seasonally dormant to an evergreen mesophytic habit, a decomposed to a simple leaf blade, a long to a short peduncle, green to dark-colored inflorescences, numerous to few inner bracts, bracteoles, and flowers, and a low to an increased number of ovules. Within the Bornean taxa, there is a reversal from showy bracts and elaborate inflorescences to less showy bracts and simplified inflorescences. *Tacca cristata* Jack is resurrected from within *T. integrifolia* Ker Gawl. *sensu* Drenth. A new species, *Tacca havilandii* S.Y.Wong & K.S.Chua from Borneo is described.

**Keywords:** Borneo, ITS, *matK*, new species

## INTRODUCTION

*Tacca* J.R.Forst & G.Forst (Taccaceae, Stevens 2001 onwards) comprises about 20 species (Govaerts et al. 2007; Lim and Raguso 2017) of (irregularly-) seasonally dormant tuberous-stemmed geophytes or rhizomatous evergreen mesophytes of still uncertain relationship within Dioscoreales (Drenth 1976). *Tacca* is principally speciose in humid tropical and subtropical Asia, with about four species (*Tacca lanceolata* Benth. ex. Seem., *T. parkeri* Seem., *T. Sprucei* Benth., and *T. ulei* H.Limpr.) in the American tropics, and two species (*T. ankaranaensis* Bard.-Vauc. and *T. artocarpifolia* Seem.) on Madagascar. *Tacca leontopetaloides* (L.) Kuntze (treated *sensu* Drenth 1972) occurs in coastal beach-forest around much of the South China Sea, with extensions into northern Australia and the tropical western Pacific as far east as Fiji, and westwards across India, Madagascar, and throughout equatorial Africa. The remaining Asian species have more restricted distributions from northeast India and southern sub-tropical China, southeast to Peninsular Malaysia and the Indonesian archipelago, and the Philippines east to New Guinea and the Solomon Islands (Drenth 1976)

*Tacca* inflorescences are unique and readily distinguishable consisting of conspicuous sterile elements, including two pairs of showy involucral bracts and profuse filiform bracteoles subtending the umbelliform inflorescence (Lim and Raguso 2017). Flowers are colored white to yellow-gray to greenish-purple or black. There are

two infructescence types among *Tacca* spp. according to the manner in which the fruits are held: either the scape remains erect or bends over by means of swelling on the inner side of the scape (i.e., nearest to the plant) with the fruits maturing on the ground (Saw 1993).

Previous phylogenies recognized between two to seven families in Dioscoreales (Caddick et al. 2002a; Wilkin et al. 2005; Merckx et al. 2006; Merckx et al. 2009; Merckx and Smets 2014; Hertweck et al. 2015; Trias-Blasi et al. 2015). Taccaceae is recognized as a separate family in Dioscoreales (Stevens 2001 onwards; Mabberley 2017). For interspecific relationship in *Tacca*, Caddick et al. (2002a) included six *Tacca* taxa with *T. integrifolia* Ker Gawl. as sister to the other species, which is morphologically implausible. Wilkin et al. (2005) provided a topology more in keeping with morphological characteristics, and which by and large supported by the studies that followed (Merckx et al. 2009; Zhang et al. 2011; Merckx and Smets 2014). Zhang et al. (2011) included nine *Tacca* taxa (*T. ampliplacenta* L.Zhang & Q.J.Ling, *T. chantrieri* André, *T. subflabellata* P.P.Ling & C.T.Ting, *T. parkeri*, *T. plantaginea* (Hance) Drenth, *T. cristata* Jack (misidentified as *T. integrifolia*), *T. leontopetaloides*, *T. palmata* Blume, and *T. palmatifida* Baker) with the last four species from Malesia. Based on evolutionary trends inferred from molecular phylogenetic results, bracts and bracteoles in *Tacca* have become larger and more conspicuous, including a proliferation of bracteoles, from an ancestor with small and inconspicuous such features (Zhang et al. 2011).