Postprint of Supplementary Description of Flowering Branch and Floral Characteristics of *Monocladus citriodorus* (Bambusoideae)

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Abstract

Reproductive organs hold significant importance in taxonomic research of bamboo plants. The research group observed Monocladus amplexicaulis in the genus Monocladus of subfamily Bambusoideae flowering in Mashan County, Guangxi. Based on observed flowering conditions and anatomical observations of collected specimens, this article provides detailed supplementary descriptions in both Chinese and Latin regarding the characteristics of its flowering branches and reproductive organs. Through comparative analysis of the reproductive organs between M. amplexicaulis and two congeneric species with known reproductive organ structures, M. saxatilis and M. parviflorus, the three bamboo species exhibit identical structural features of reproductive organs but differ in floret number and size. The comparative study of reproductive organs demonstrates that the reproductive organs of bamboo species in this genus possess special adaptations to karst topographic environments and also supports the classification of the three groups, divided based on vegetative organ differences, as independent bamboo species.

Full Text

Supplementary Description of Flowers and Flowering Branches of *Bonia amplexicaulis* (Poaceae: Bambusoideae)

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Abstract

Reproductive organs are of great significance in taxonomic studies of bamboo plants. In this paper, we provide detailed Chinese and Latin descriptions of the flowering branches and reproductive organs of *Bonia amplexicaulis* observed in Mashan County, Guangxi. Comparative analysis of the reproductive structures among three *Bonia* species with known floral morphology—*B. saxatilis*, *B. parviflosculа*, and *B. amplexicaulis*—reveals that they share identical reproductive organ architecture but differ in floret number and size. These reproductive characteristics demonstrate special adaptations to karst geomorphic environments and support the classification of these three taxa as distinct species based on vegetative differences.

Keywords: Bambusoideae, *Bonia*, *Bonia amplexicaulis*, inflorescences, supplementary description

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Introduction

Reproductive organ morphology constitutes the most important basis for species delimitation in angiosperms. However, due to the extremely rare flowering events in bamboos, taxonomic identification has traditionally relied on vegetative organ characteristics. Many bamboo species were originally described based solely on vegetative features, and the subtle differences among these structures often complicate species 界定 and subsequent systematic revision. Although bamboo flowering is infrequent, reproductive organ characteristics remain critically important for bamboo taxonomy and systematics. Because reproductive development occurs over relatively short periods and is less influenced by environmental conditions—and is directly related to plant reproduction—these features provide robust support for bamboo classification and evolutionary studies, particularly for tribal and generic delimitation and taxonomic revision (Wang and Ye, 1980; Keng, 1982; Stapleton, 1997; Yi et al., 2009).

Our research team observed flowering *Bonia amplexicaulis* (L. C. Chia et al.) N. H. Xia on limestone peaks in Mashan County, Guangxi. This population was distributed on exposed limestone mountain tops, with only a few clumps flowering. No new shoots were observed in flowering clumps, and flowering occurred on culms of different ages. Flowering culms bore normal branches and leaves on the lower portions of flowering branches, with persistent culm sheaths and fimbriae. We identified the species based on vegetative characteristics and conducted anatomical comparisons of its reproductive organs, which we describe herein as a supplementary characterization. Vegetative and flowering branch specimens are deposited in the Herbarium of Shaanxi University of Chinese Medicine.

The genus *Bonia* is endemic to karst mountains of southwestern China, centered in Guangxi, with additional distribution in Hainan Island, China, and northern Vietnam. These plants are specialists of limestone habitats. The genus currently comprises five species and one variety (Xia, 1996; Xia and Stapleton, 2006; Govaerts et al., 2021), primarily occurring on limestone peaks and residual hills, often on exposed limestone summits and crevices, demonstrating strong adaptation to limestone environments (Dong et al., 2011). *Bonia* species provide shelter for other plants and prevent soil erosion, conferring significant ecological value.

Bonia amplexicaulis is distributed in western and northern Guangxi' s limestone mountains. Within its range, the widely distributed congener *Bonia saxatilis* (L. C. Chia et al.) N. H. Xia also occurs. *Bonia saxatilis* has a broader distribution, extending to southern Guangxi, western Guangdong, southeastern Yunnan, and southern Guizhou. The two species share highly similar growth habits, appearance, and application values, with only minor diagnostic differences (Chia et al., 1988; Xia, 1996; Pan et al., 2016), making them easily confused. The description of *B. amplexicaulis* flowering branches and reproductive organs thus provides critical evidence for distinguishing these two species.

Taxonomic Description

Bonia amplexicaulis (L. C. Chia et al.) N. H. Xia (Plate I)

Synonym: *Monocladus amplexicaulis* Chia et al. in Act. Phytotax. Sin. 26 (3): 215. f. 2(1-3) 1988.

Rami floriferi laterales vel ex apicibus ramorum foliiferorum orientes. Rami florentes laterales 2-3-plo ramosi, longitudo ad 50 cm. Inflorescentiae iterauctantes. Terminales rami florentes fere 10-20 cm longi, 6-10 nodi, vaginiformium anthesim fere 20-25 mm longae, ad foliis metamorphosis subulatis 8-10 mm longae et 2-3 mm latae; rami florentes in utroque nodo 1 pseudospiculae. Pseudospiculae maturae 3.0-6.0 cm longae, internodia pseudospiculae 4-7 mm longae sunt, bracteae saepe 1, sed tot esse possunt 3. Bracteae fere 8-10 mm longi, lanceolati, apice acutus, dorsum laeve, venae non patentes, bracteae germen in axillis acuminatum, saepe non longius evolutum. Spiculae maturae 2.5-5.0 cm longae, 4-6 flora, tantum terminali flosculo sterili.

Glumae 2, lanceolatae, apice apice mucronatae, laeves, venis inconspicuis praeter mediumvein, primo gluma est 8-10 mm longa, secunda gluma fere 10-12 mm longa, uterque floretus gradatim maturescit, ita primus flosculus longissimus; rhachilla inter flosculos disarticulate. Cum spiculae immatura est, primum internodium et alia internodia spiculi perquam breves sunt, bases omnium florum glumis includuntur, et totum bracteis vaginis inclusum est; Cum spiculae maturae sunt, primum internodium valde elongatum est, usque ad 8-10 mm, ita ut flores omnes ultra glumas extendant, et flores etiam ultra bracteas vaginis extendunt, alia internodia longitudine similia, fere 4-5 mm longa. lemmata ovato-lanceolata, cuspidibus brevibus, 12-14 mm longis, subleatheriis,

subtus glabris, venis inconspicuis, palea ovato-lanceolata, 8-10 mm longa, apice obtusis, subtus cum 2 dorso pilis brunneolis; palea anguste lanceolate, apice obtuse, acuminata dorso pilis brunneis munita; lodiculae 3, longis rectangulis, glabrae; stamina 6, filamenta 2-3 mm longe florescentia, antherae 4-5 mm longae, ovario glabro circiter 1 mm longo, stylo brevissimo, stigmatibus 3, plumisis, 2-3 mm longis. Floret in Martio-Aprili. Fructus incogoiti.

Morphological Description in Chinese:

Flowering branches are lateral or arise from the apex of leafy branches, branching 2–3 times with total length reaching 50 cm. Inflorescences are iterauctant. Terminal flowering branches are typically 10–20 cm long with 6–10 nodes; each node bears one sheath-like bract containing a pseudospikelet. At anthesis, the sheath portion of the bract is approximately 20–25 mm long, with a subulate, modified leaf 8–10 mm long and 2–3 mm wide at the apex. Except for the basal 2–3 nodes that lack spikelets, each node bears one pseudospikelet. Mature pseudospikelets measure 3.0–6.0 cm in length, with internodes of the pseudospikelet peduncle 4–7 mm long. Bracts are usually 1 but may be up to 3, approximately 8–10 mm long, lanceolate with acute apices, smooth dorsally with inconspicuous veins; axillary buds within bracts are needle-like and often undeveloped.

Mature spikelets are 2.5–5.0 cm long, containing 4–6 florets, with only the terminal floret sterile. There are 2 glumes, lanceolate with short mucronate apices, smooth with inconspicuous veins except for the midvein; the first glume is 8–10 mm long and the second 10–12 mm long. Florets mature sequentially, with the first floret being the largest. The rachilla disarticulates below each floret. When the spikelet is immature, the first internode and other internodes are extremely short, with all floret bases enclosed within the glumes and the entire structure enveloped by sheath-like bracts. At maturity, the first internode elongates significantly to 8–10 mm, extending all florets beyond the glumes and sheath-like bracts; subsequent internodes are similar in length, approximately 4–5 mm. Lemmas are ovate-lanceolate with short cusps, 12–14 mm long, subcoriaceous, glabrous dorsally with inconspicuous veins; paleas are ovate-lanceolate with obtuse apices, 8–10 mm long, with two keels bearing brownish fine hairs dorsally. Lodicules are 3, transparent and membranous, nearly rectangular, approximately 1 mm long, glabrous. Stamens are 6, with filaments 2–3 mm long and anthers 4–5 mm long. The ovary is glabrous, approximately 1 mm long, with a very short style and 3 plumose stigmas 2–3 mm long. Flowering occurs in March–April; fruit unknown.

Specimen examined: Behind Mashan County Government, Guangxi, altitude 426 m, 6 April 2021, Yuqu Zhang 2021040601.

Plate I. *Bonia amplexicaulis*

A. Flowering branches; B. A segment of flowering branch; C. Flower; D. Pseudospikelet; E. Spikelet; 1. Spikelet; 2. Bracts; 3. Axillary bud; 4. First glume; 5. Second glume; 6. First rachilla internode; 7. First floret; 8. Second floret; 9. Lemma; 10. Palea; 11. Second rachilla internode. Scale bars = 1 cm.

Comparative Analysis and Discussion

Within the genus *Bonia*, reproductive organ information is known for *B. saxatilis* and *B. parvifloscula* (W. T. Lin) N. H. Xia (Chia et al., 1988; Lin, 1993). Comparative analysis of reproductive organs among *B. amplexicaulis*, *B. saxatilis*, and *B. parvifloscula* reveals identical structural organization. Compared with reproductive organs of other genera (Keng and Wang, 1996), these three species share the characteristic of pseudospikelets enclosed within nodal sheath-like bracts, with an elongated first rachilla internode at maturity that pushes the florets beyond the glumes and sheath-like bracts. This feature protects spikelets before anthesis while facilitating pollination during flowering and is diagnostic for *Bonia*.

The karst regions of Southeast Asia where *Bonia* occurs exhibit pronounced seasonal precipitation, with dry conditions in autumn–winter and wet conditions in spring–summer. Karst geomorphology creates microenvironments particularly prone to drought and temperature fluctuations (Song, 2015). During the suboptimal autumn–winter conditions of spikelet development, the non-elongating rachilla protects spikelets within sheath-like bracts. At spring flowering time, when conditions improve, the first internode elongates significantly, extending florets beyond the bracts to meet pollination requirements. This represents a clear adaptation to the climatic conditions of karst geomorphology.

Although the three species share identical reproductive organ structure, distinct differences exist: *B. saxatilis* produces multiple pseudospikelets within each nodal sheath-like bract, whereas *B. amplexicaulis* and *B. parvifloscula* produce only one. *Bonia saxatilis* spikelets contain 5–9 florets, while *B. amplexicaulis* and *B. parvifloscula* have 4–6 florets. *Bonia parvifloscula* and *B. amplexicaulis* differ markedly in pseudospikelet and floret size: the former has pseudospikelets 1.7–2.0 cm long and lemmas 6–8 mm long with obtuse apices, whereas the latter has pseudospikelets 3.0–6.0 cm long and lemmas 12–14 mm long with short cusps. Therefore, despite remarkable vegetative similarity among *Bonia* species, reproductive organ characteristics support the recognition of *B. saxatilis*, *B. parvifloscula*, and *B. amplexicaulis* as independent species based on vegetative distinctions.

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Note: Figure translations are in progress. See original paper for figures.