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半耳箬竹(竹亚科)的形态补充描述

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摘　要: 半耳箬竹[*Indocalamus semifalcatus* (H. R. Zhao et Y. L. Yang) T. P. Yi]在原始文献中仅有部分营养器官的描述。该文通过野外居群调查、室内体视解剖和扫描电子显微镜(SEM)观察,新增了半耳箬竹的花器官描述和叶下表皮微形态特征,完善了其营养器官的性状描述,更新了其地理分布。结果表明:(1)繁殖器官性状:花序为圆锥状,小穗及小穗轴密被白色短柔毛,颖片、外稃及内稃光滑无毛,雄蕊3枚,花药紫红色,柱头2,白色,羽毛状。(2)营养体性状:秆高达4.5 m,径达2 cm,箨耳半镰形或微弱,箨片直立紧贴秆,叶耳微弱或无,叶舌上具较发达的纤毛;叶片两面同色且无毛。(3)叶下表皮微形态特征:气孔器凹陷不可见,8~10个长乳突平铺覆盖气孔,硅质体马鞍形,未见有大毛和刺毛。(4)新分布区域1个,即贵州省贵阳市观音山。该种与箬叶竹(*I. longiauritus* Hand.-Mazz.)最为相似,主要区别在于该种的箨鞘和叶鞘上具有半镰形的箨耳或箨耳缺失,秆高达4.5 m,径达2 cm。

关键词: 竹类, 箬竹属, 描述, SEM, 地理分布

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Morphological supplementary description of *Indocalamus semifalcatus* (H. R. Zhao et Y. L. Yang) T. P. Yi (Bambusoideae)

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Abstract: In the protologue of *Indocalamus semifalcatus* (H. R. Zhao et Y. L. Yang) T. P. Yi, there were only parts of vegetative organs reported. Based on field population investigation, indoor stereoscopic anatomy and scanning electron microscope (SEM), its reproductive organs, complete vegetative organs and micromorphological features of the abaxial leaf epidermis, were described and illustrated herein, and its geographical distribution was also updated. The results

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were as follows: (1) Reproductive organ features: panicle, spikelet and spike densely white pubescent, glume, pelea and lemma both smooth and glabrous, stamens 3, anthers purple, stigmas 2, white, feathery. (2) Vegetative features: culms up to 4.5 m tall, up to 2 cm in diameter, culm sheath auricle semifalcate or weak, culm sheath erect close to culm, foliage auricle weak or absent, ligule margin with densely ciliate; both sides of leaf blade homochromatic and glabrous. (3) Micromorphologic characteristics of the abaxial leaf: stomatal apparatus invisible, eight to ten elongated papillae covered the stomatal apparatus, silica bodies saddle-shaped, micro-hairs and macro-hairs both absent. (4) The new distribution area was Guanyin Mountain of Guiyang in Guizhou. The species is the most similar to *I. longiauritus* Hand.-Mazz., differed by culm sheath and leaf sheath with auricles semifalcate or rare, culm up to 4.5 m tall and 2 cm in diameter.

Key words: Bamboo, *Indocalamus*, description, SEM, geographical distribution

箬竹属(*Indocalamus* Nakai)是一类灌木状木本竹子,地下茎复轴型,叶片宽大常用于食品包装(耿伯介和王正平,1996;Wang & Stapleton,2006)或竹叶黄酮提取(赖炘等,2013;李夏冰,2017;张亚兰等,2022)。本属很多竹种对铬、铅、镉、铜等重金属污染有较强的耐受性和抗性(杨胜香等,2012;马迎莉等,2019;张颖等,2022),抗寒和抗旱性强(李娟和高健,2016;刘思奇,2019),适用于矿区等重金属污染严重土壤的修复。

箬竹属是由日本学者中井猛之进于1925年建立的,属建立的核心依据是源自与赤竹属(*Sasa* Makino & Shibata)花器官的比较,即箬竹属雄蕊3、柱头2而明显有别于赤竹属花器官雄蕊6、柱头3(Nakai, 1925)。属建立至今,发表在属下的有效双名共计78个,经耿以礼、赵奇僧、赵惠如、杨雅玲、Vorontsova等国内外竹类分类学家不断地研究,目前最新资料记录该属包含33种。除了*Indocalamus petelotii* (A. Camus) Ohrnb.分布于越南,该属其余种均分布于中国(耿以礼, 1959;赵奇僧等,1980;赵惠如和杨雅玲,1985;杨雅玲,1987;杨雅玲和赵惠如,1990;Vorontsova et al., 2017),但有花部性状描述的种类仅占该属的1/4(Wang & Stapleton,2006)。可见,完善箬竹属种类花部性状的工作任重而道远。

半耳箬竹[*Indocalamus semifalcatus* (H. R. Zhao et Y. L. Yang) T. P. Yi](2000: 26),基名为*Indocalamus longiauritus* var. *semifalcatus* H. R. Zhao et Y. L. Yang (1985: 464),均无生殖器官性状特征的描述且营养器官描述较为简单,其基名的原文仅有特征集要"A typo culmorum vaginarum auriculis et foliorum auriculis omnibus semifalcatis, laminis subtus secus costam utrinque glabris differt"(本变种与原变种的区别在于箨耳和叶耳均为半镰形,叶片下面的中脉两侧无毛)(赵惠如和杨雅玲,1985)。其模式标本"赵惠如无号"(H. R. Zhao s. n.; N)馆藏于南京大学,采自四川省灌县(1988年5月改为都江堰市)二王庙附近。2000年,该分类群被易同培先生提升为种(易同培,2000),已收录在《中国竹类图志》(易同培等,2008)和《中国竹亚科属种检索表》(易同培等,2009)。

为了完善该分类群的描述和特征集要,2019—2020年,笔者在半耳箬竹模式产地四川省灌县进行了比较详细的野外居群调查,在崇州市三郎镇意外发现正在开花的半耳箬竹居群,在贵州省贵阳市观音山见到成片的野生群落。基于室内解剖和叶下表皮电镜扫描观察,本文在此对半耳箬竹的形态描述和地理分布予以补充完善,并增加叶下表皮微形态特征。

半耳箬竹　图版Ⅰ、图版Ⅱ和图版Ⅲ

Indocalamus semifalcatus (H. R. Zhao et Y. L. Yang) T. P. Yi in J. Bamboo. Res. 19(1): 26. 2000. ≡ *Indocalamus longiauritus* var. *semifalcatus* H. R. Zhao et Y. L. Yang in Acta. Phytotax. Sin. 23(6): 464. 1985. Type: — China. Sichuan, Dujiangyan, Guanxian, Erwangmiao, 12 Oct. 1979, *H. R. Zhao s. n.* (holotype: N).

Description. Rhizomes leptomorph. Culms 1.2–4.5 m tall; internodes terete, 15–76 cm long, 0.8–2.0 cm in diameter, hollow, sparsely strigose, and with a ring of brown velvet at the infranodal region; wall 1.0–3.0 mm thick; supranodal ridge slightly

raised; intranodes 7 – 11 mm long; culm branches from the base at nodes 3 to 5, usually solitary, nearly as thick as culms. Culm sheaths purple-green, persistent, usually shorter than internodes, leathery; dark brown strigose and white tomentose, base with raised corky ring; margin densely reddish-brown ciliate; auricles short semifalcate, purple-green, becoming brown when dry, occasionally inconspicuous or absent; oral setae radiate, brown, ca. 0.5–1 cm; ligules 0.5–1.0 mm tall, truncate, margin sparsely or not ciliate; blades purple-green, narrowly triangular to ovate-lanceolate, base abruptly rounded, apex acuminate. Foliage leaves 3 – 7 per ultimate branch; leaf sheath rigid, glabrous or abaxially initially finely strigose, outer margin smooth; auricles developed or inconspicuous; oral setae radiate, short; ligules truncate, 2–3 mm tall, margin densely ciliate; blades oblong-lanceolate, 30.0 – 50.0 × 5.0 – 9.0 cm, both surfaces glabrous, longitudinal veins 10 – 15 pairs, base cuneate, apex long-acuminate, margin entire. Panicles 8 – 25 cm, loose and spread, axis densely white tomentose. Spikelets greenish or straw-colored at maturity, 2 – 6 cm; florets 3 – 5. Rachilla internodes compressed-clavate, 4–5.5 mm, angular, densely white tomentose. Glumes 2, lanceolate; first glume 3 – 5 mm, second glume 8 – 12 mm; lemma oblong-lanceolate, apex awnlike, smooth hairless, the first lemma subequal to the second lemma, 1–1.2 cm long; lodicules 3, oblong-lanceolate, ciliate, distally sparsely pilose. Anthers purple, 8 – 9 mm; filaments white, 8–12 mm; stigmas 2, white, feathery, ca. 5–7 mm. Caryopsis unknown.

Phenology. New shoots Apr. –May, fl. Jul. –Aug.

Distribution and habitat. *Indocalamus semifalcatus* is endemic to China, distributed in Guangxi, Sichuan, Fujian and Guizhou, cultivated in Zhejiang. It usually grows in mountain slopes, hillsides or roadsides at elevations of 600–1 100 m.

Leaf micromorphology. One to two rows of stomatal apparatuses are usually distributed between veins (Plate IV: A). Stomatal apparatuses are suborbicular; eight to ten elongated papillae overarch the stomatal apparatus, and short papillae are rare (Plate IV: C, D); micro-hairs distributed in the intercostal region (Plate IV: B); saddle-shaped silica bodies (Plate IV: B) are distributed in the costal and intercostal regions.

Additional specimens examined. China. **Sichuan**: Guanxian, Erwangmiao, *T. P. Yi* 76008 (SIFS!), *L. Q. Gao et L. Cui SCGX*1904 (JXAU!), *L. Q. Gao et al. SCGX*2022 (JXAU!); Chongzhou, Sanlangzhen, *L. Q. Gao et L. Cui SCCZ*1905 (FL., JXAU!), *L. Q. Gao et al. SCCZ*2023 (FL., JXAU!). **Guizhou**: Guiyang, Guanyinshan, *L. Q. Gao et al. GZGY*2024 (JXAU!). **Guangxi**: Shanglin, Damingshan, *L. Q. Gao et al. GXSL*2025 (JXAU!).

根状茎细长型。秆高 1.2~4.5 m,秆径 8~20 mm,节间长 15~76 cm,幼秆节下被稀疏疣基刺毛和一圈棕色的绒毡毛。秆壁厚 1~3 mm;秆环略隆起,较箨环略高;节内长度 7~11 mm;秆自基部第 3~5 节处开始分枝,秆每节 1 分枝,与主秆近等大或略小。新鲜秆箨紫红色带绿色,革质,背面被棕黄色伏贴的疣基刺毛,尤以基部为甚,靠近上部光滑无毛,宿存或脱落,基部常具一圈或半圈木栓质圈;箨耳半镰形,紫色略带绿色,干后呈棕色,偶微弱或缺失;鞘口疏生 0.5~1 cm 的短缝毛。每小枝具叶片 3~7 枚;叶耳微弱或无,鞘口缝毛稀疏且短;叶舌高 2~3 mm,上面具较发达的纤毛;叶片长 30~50 cm,宽 5~9 cm,两面无毛,叶绿色,叶两面同色,次脉 10~15 对(图版 I)。圆锥花序疏松开展,长 8~25 cm,花序轴密被白色绒毛;小穗长 2~6 cm,绿色或成熟后呈稻草色,含 3~5 朵小花;小穗轴节间长 4~5.5 mm,呈扁棒状,有纵棱,密被白色短绒毛;颖片 2,披针形,第一颖长 3~5 mm,第二颖长 8~12 mm;外稃卵状披针形,长 10~12 mm,光滑无毛,具 8(10)脉;内稃与外稃近等长,上部被微毛,具 2 脊;鳞被 3,卵状披针形,长 2~2.5 mm,边缘具纤毛;雄蕊 3 枚,花药紫红色,长 8~9 mm,花丝白色,长 8~12 mm;柱头 2,白色,羽毛状,长 5~7 mm(图版Ⅱ,图版Ⅲ)。颖果未见。笋期 4—5 月,花期 6—8 月。

叶下表皮的气孔器呈近圆形,周围被 8~10 个长乳突且有规律地环绕;长乳突先端相接且平铺覆盖气孔,基部偶具 1~2 个短乳突分枝;短乳突分布稀疏;未见大毛、刺毛分布;微毛伏贴,在脉间广泛分布;硅质体马鞍形(图版 IV)。

A. 居群和生境；**B**. 地下茎；**C**. 笋；**D**. 节下；**E**. 箨片及箨鞘；**F**, **G**. 箨耳、箨舌及繸毛；**H**. 叶鞘、叶舌及叶基等；**I**. 节；**J**. 分枝、髓心等。比例尺：1 m（**A**）；1 cm（**B**–**J**）。

A. Population and habitat; **B**. Rhizome; **C**. Shoot; **D**. Infranodal region on culm; **E**. Culm blade and sheath; **F**, **G**. Sheath auricle, ligule and setae; **H**. Leaf sheath, ligule and leaf basal, etc.; **I**. Node; **J**. Mature culm and its longitudinal section, etc. Scale bars: 1 m (**A**); 1 cm (**B**–**J**).

图版 I　半耳箬竹营养体形态特征

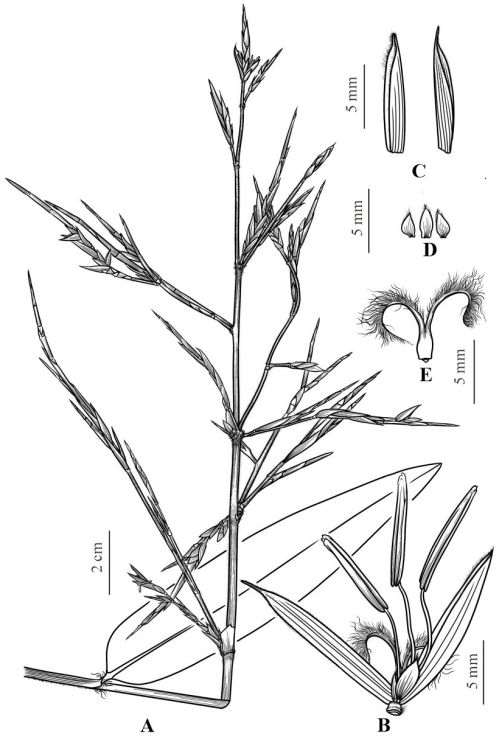
Plate I　Nutrient morphological characteristics of *Indocalamus semifalcatus*

A. 花序; **B**. 小穗和小花; **C**. 小花; **D**. 第一颖(左)和第二颖(右); **E**. 内稃(左)和外稃(右); **F**. 雄蕊; **G**. 浆片(左)和 雌蕊(右)。比例尺: 1 cm (**A**, **B**); 5 mm (**C**–**G**)。

A. Inflorescence; **B**. Spikelets and florets; **C**. Floret; **D**. The first glume (left) and the second glume (right); **E**. Palea (left) and lemma (right); **F**. Anthers; **G**. Lodicules (left) and stigmas (right). Scale bars: 1 cm (**A**, **B**); 5 mm (**C**–**G**).

图版 Ⅱ 半耳箬竹花形态特征

Plate Ⅱ Floral morphological characteristics of *Indocalamus semifalcatus*



A. 花序; **B**. 小花; **C**. 内稃(左)和外稃(右); **D**. 浆片; **E**. 雌蕊。绘画:郭蓉 (引自标本 *L. Q. Gao et al. SCGX*2022, JXAU)。

A. Inflorescence; **B**. Floret; **C**. Palea (left) and lemma (right); **D**. Lodicules; **E**. Stigmas. Illustrated by GUO Rong (from specimen *L. Q. Gao et al. SCGX*2022, JXAU).

图版 Ⅲ 半耳箬竹花形态墨线图

Plate Ⅲ Flower morphology ink line diagram of *Indocalamus semifalcatus*

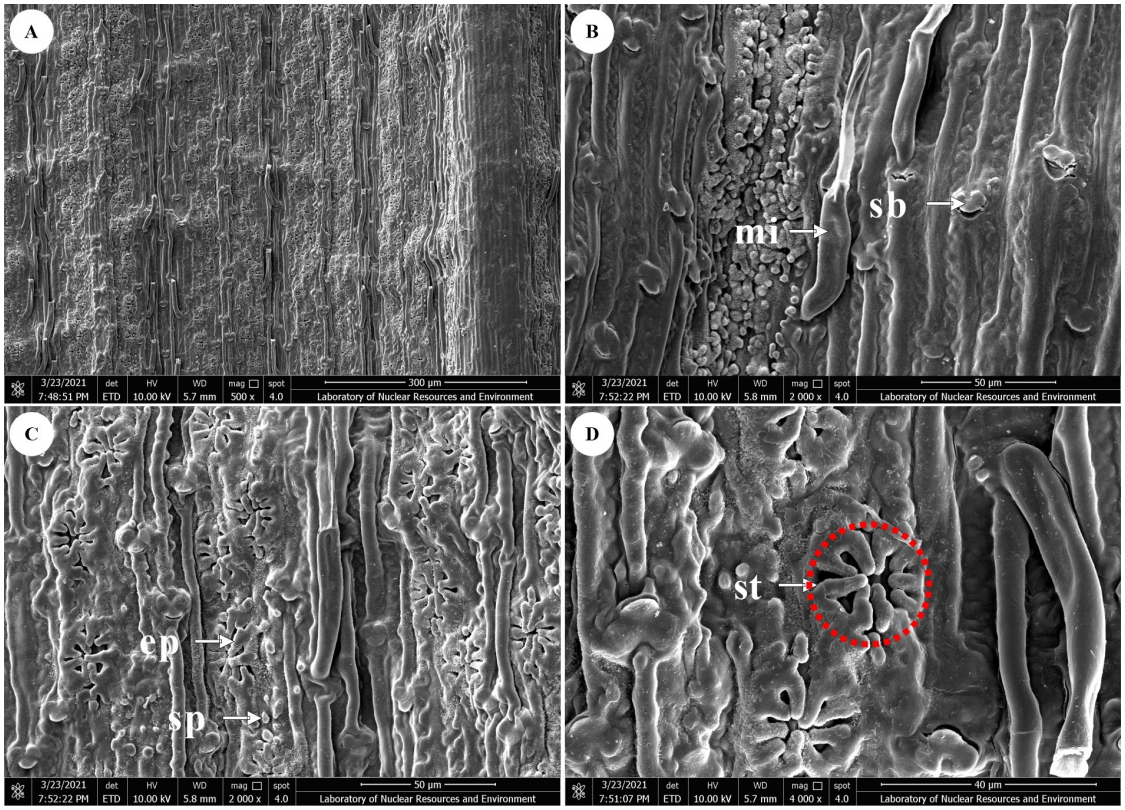
本种与箬叶竹最为相似,但主要区别在于本种的箨鞘和叶鞘上具有半镰形的箨耳或箨耳缺失,秆高可达 4~5 m,秆径可达 2 cm。

地理分布: 四川的都江堰二王庙、崇州三郎镇;贵州贵阳观音山;广西上林县大明山。

箬竹属竹类营养体的典型特征是灌木状竹类,秆高通常 2 m 左右,秆径常不超过 1.0 cm,如箬竹、箬叶竹等种(耿伯介和王正平,1996;Wang & Stapleton,2006),但在半耳箬竹的居群中发现该种秆高可达 4.5 m,秆径 1.8~2 cm,在箬竹属中实属少见,更新了该属中竹种秆高、秆径的传统认知。该种营养体形态特征与箬叶竹最主要区别在于该种的箨鞘和叶鞘上具有半镰形的箨耳或箨耳缺失,秆高达 4.5 m,秆径达 2 cm。

半耳箬竹花序呈圆锥状,疏松开展,生于主枝或侧枝顶上,花序轴和小穗轴密被白色短绒毛,小穗含小花 3~5 朵、颖片 2、鳞被 3、雄蕊 3 枚、柱头 2 裂且呈羽毛状,这与箬叶竹无显著差异。此外,其叶下表皮气孔器呈近圆形、周围被 8~10 个长乳突平铺覆盖气孔的特征与箬叶竹十分相似,这与 Zhang 等(2014)和冀雪楠(2019)的研究结果一致。

形态学研究是经典植物分类学的重要基础。本文基于半耳箬竹的原始描述, 通过测量形态性



A. 叶下表皮；**B**. 微毛和硅质体；**C**. 长乳突和短乳突；**D**. 气孔器。**ep**. 长乳突；**sp**. 短乳突；**mi**. 微毛；**sb**. 硅质体；**st**. 气孔器。
A. Abaxial epidermis; **B**. Micro-hairs and silica bodies; **C**. Elongated papillae and short papillae; **D**. Stomatal apparatus. **ep**. Elongated papillae; **sp**. Short papillae; **mi**. Micro-hairs; **sb**. Silica bodies; **st**. Stomatal apparatus.

图版 IV　半耳箬竹叶下表皮微形态特征

Plate IV　Leaf epidermis micromorphological characteristics of *Indocalamus semifalcatus* under SEM

状、扫描叶下表皮微形态、考察并明确了一部分地理分布点，完善并补充了营养体、花部性状数据和图谱，新增了叶下表皮微形态性状，更新了其地理分布，使半耳箬竹的研究资料更加准确，为物种鉴定、箬竹属属内分类修订及系统演化提供重要参考依据。

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