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SYSTEMATICS

Aspidistra erecta (Asparagaceae), a new species from limestone areas in Guangxi, China

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ABSTRACT. *Aspidistra erecta* Yan Liu & C.-I Peng (Asparagaceae) is described and illustrated as a new species from the limestone areas in Guangxi Zhuang Autonomous Region, China. It resembles *A. fungilliformis* Y. Wan in floral shape, but differs in its longer pistil than perianth tube, curvulate style, and exserted stigma. In this amazingly diverse genus, *A. erecta* distinguishes itself as the only Chinese *Aspidistra*, of over 60 others, having an upright stem. A somatic chromosome count of $2n = 38$ and a karyotype formula $2n = 22m+4sm^{2SC}+12st$ were determined for *A. erecta*. The new species is known from only two localities in southwestern Guangxi Zhuang Autonomous Region, near the border with northern Vietnam. Color plates, line drawings and a distribution map are provided to aid in identification.

Keywords: Asparagaceae; *Aspidistra erecta*; *Aspidistra fungilliformis*; China; Chromosome number; Guangxi; Karyotype; Limestone flora; New species.

INTRODUCTION

In the course of investigating limestone plants in southwestern Guangxi Zhuang Autonomous Region, China in 2002, we discovered an unusual erect *Aspidistra* in Napo Xian, Guangxi, near the border with northern Vietnam. Similar specimens were found in 2008 in Jingxi Xian, Guangxi. The stem was upright to 1 m tall, supported by several stilt roots. Its flower was purplish-red, campanulate with an exserted stigma and was born singly in the middle part of the erect stem. The fruit was densely covered with soft, hooked hairs. Upon careful comparison with all *Aspidistra* species heretofore known (Lang et al., 1999; Li, 2004; Tillich, 2005, 2008; Tillich and Averyanov, 2008; Hou et al., 2009; Lin et al., 2010, 2011; Xu et al., 2010), we concluded that the plant is a new species, which we describe below.

NEW SPECIES

Aspidistra erecta Yan Liu & C.-I Peng, sp. nov. —TYPE: CHINA. Guangxi Zhuang Autonomous Region, Napo Xian (County), alt. 800 m, in a valley on limestone hill, 10 Nov 2002, *Yan Liu L0782* (holotype: IBK; isotype: HAST) 直立蜘蛛抱蛋 Figures 1, 2

Species nova forma florum A. fungilliformi Y. Wan similis, sed differt stylo leviter curvo, stigmate exserto ex tubo perianthii, lobis perianthii triangulari-ovatis, caule erecto.

Herbs perennial, evergreen. Stem erect, to 1 m high, supported by a few stilt roots, stem subterete, 4-7 mm thick, internodes unequal, to 4 cm long. Vaginal leaves 3-5, green with purple-brown spots, 1-6 cm long, becoming fibrous remnants covering the stem. Leaves 3-10 cm apart, petiole slightly stiff, 6-18 cm long, ca. 2 mm thick, somewhat thicker towards the base, adaxially sulcate; leaf blade usually oblong-lanceolate or ovate-elliptic, 12-23 cm long, 4-7 cm wide, green, base suborbicular, abruptly narrowed to the petiole, inequilateral, apex gradually acuminate, margin entire, midvein moderately prominent abaxially, each half of leaf blade with three stronger secondary veins, between them 5–8 weaker tertiary nerves with numerous anastomoses. Peduncle short, 5-15 mm long, bracts 3-4, two of them adnate to flower base, broadly ovate, ca. 6 mm long, 5 mm wide, green with purple spots, apex obtuse. Flowers solitary; perianth campanulate, slightly contracted at mouth, 10-12 mm long, shallowly 6-lobed apically; lobes subequal, triangular-ovate, 5-6 mm long and 4-5 mm wide at base, purplish red, reflexed after anthesis; tube ca. 8 mm high, 10-13 mm across, nearly white, adaxially purplish black at the mouth. Stamens 6, opposite to lobes, inserted at upper 1/3 of perianth tube, filaments horizontal, purplish black, ca. 1.5 mm long, anthers pale yellow, broadly elliptic, ca. 1.5 mm long, 1 mm wide, obtuse at both ends, versatile. Pistil mushroom-shaped, 8-10 mm long, longer than the perianth tube, ovary somewhat enlarged, style cylindric, ca. 2 mm across, not articulate, curved, stigma hemispheric, enlarged, 5-6 mm across, exserted, adaxially purplish red, smooth, the central part with

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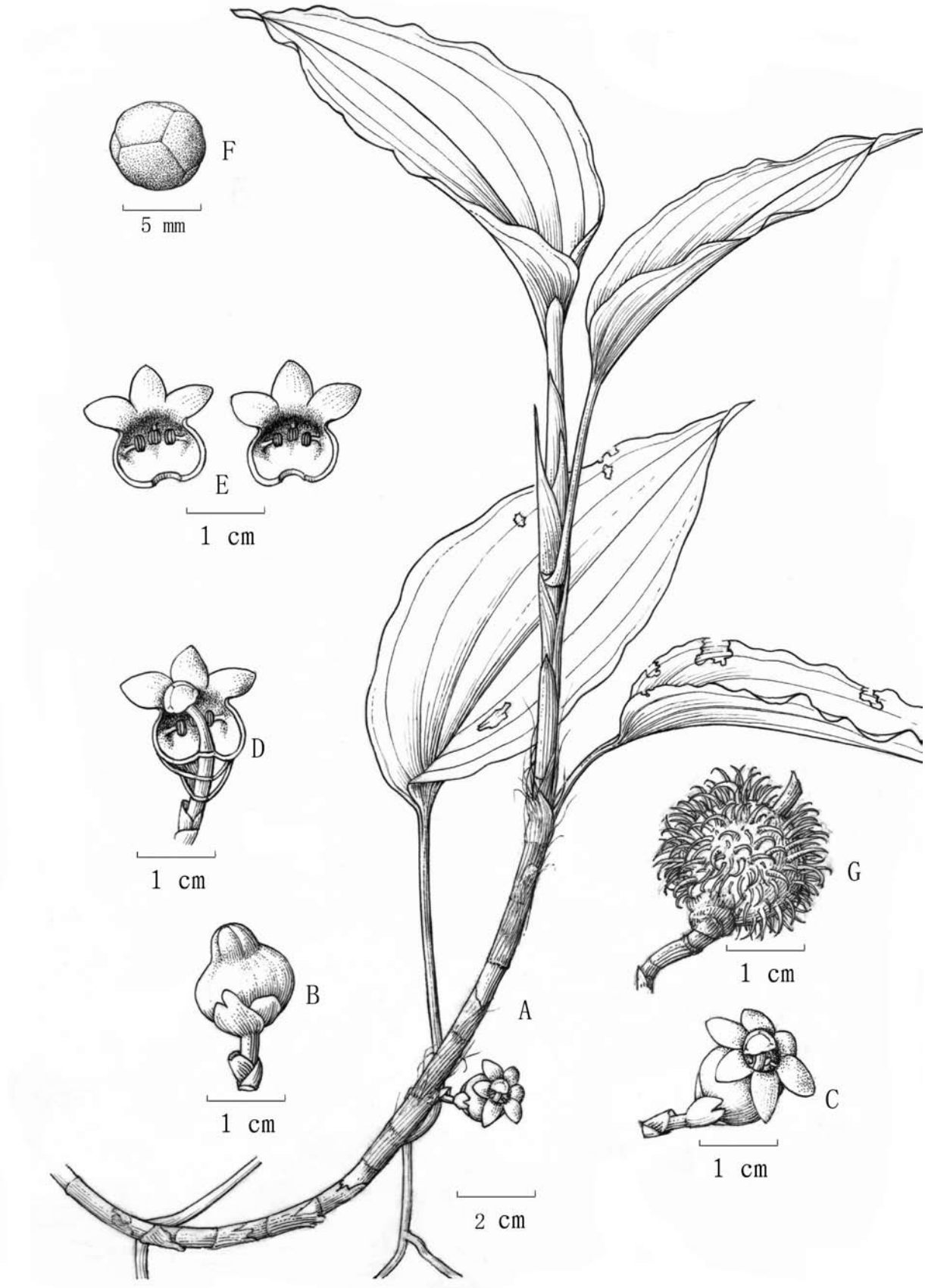

Figure 1. *Aspidistra erecta* Yan Liu & C.-I Peng. A, Flowering plant; B, Flower bud; C, Flower; D, Flower, half of perianth removed to show stamens and pistil; E, Perianth, dissected to show stamens; F, Stigma, adaxial view; G, Fruit. (Drawn by Shun-Qing He from the holotype)

Figure 2. *Aspidistra erecta* Yan Liu & C.-I Peng. A, Habit; B, C, Flowers; D, Flower, adaxial view; E, Flower, side view; F, G, Flower, dissected showing stamens and pistil; H, Fruit.

3 radial, fork-tipped or inconspicuous forking lines from center to margin, abaxially white, slightly concaved and undulate at margin. Berry subglobose, ca. 15 mm across, densely covered with soft hooked hairs, style persistent.

Additional specimens examined. CHINA. Guangxi Zhuang Autonomous Region, Napo Xian (County), Bainan Xiang, alt. 840 m, plant sterile when collected, 29 June 2008, *Ching-I Peng et al., 21609* (HAST); Guangxi Zhuangzu Autonomous Region, Jingxi Xian (County), alt. 790 m, 12 Nov 2008, *Wei-Bin Xu 08445* (IBK).

Chromosome cytology. Root tips were pretreated in 2 mmol/L 8-hydroxyquinoline at 15-18°C for about 8h, and fixed in 3:1 ethanol-acetic acid solution at about 4°C for overnight. Materials were stained by 2% acetic orcein with 1N hydrochloric acid and observed. Classification of chromosome morphology was based on the position of centromeres, following Levan et al. (1964).

The somatic chromosome number of *Aspidistra erecta* was determined to be $2n = 38$ (Figure 3). Chromosomes at mitotic metaphase showed a trimodal variation in chromosome length. Among the 38 chromosomes, the first two (ca. 8.3-8.5 μm) were longer than the rest; the next 14 gradually varied (4.3 to 6.7 μm); the remaining 22 shorter chromosomes also gradually varied (1.8-3.6 μm). Irrespective of the chromosome length, 22 (Nos. 1, 2 and 19-38 in Figure 3-B), 4 (Nos. 15-18 in Figure 3-B), 12 (Nos. 3-14 in Figure 3-B) had centromeres at the median (m), submedian (sm), and subterminal (st) positions respectively. Secondary constrictions (SC) were observed at the proximal regions of the short arms in two submedian chromosomes (Arrows in Figure 3-A; Nos. 17 and 18 in Figure 3-B). Thus, the karyotype formula of *Aspidistra erecta* was assignable as $2n = 38 = 22m+4sm^{2SC}+12st$.

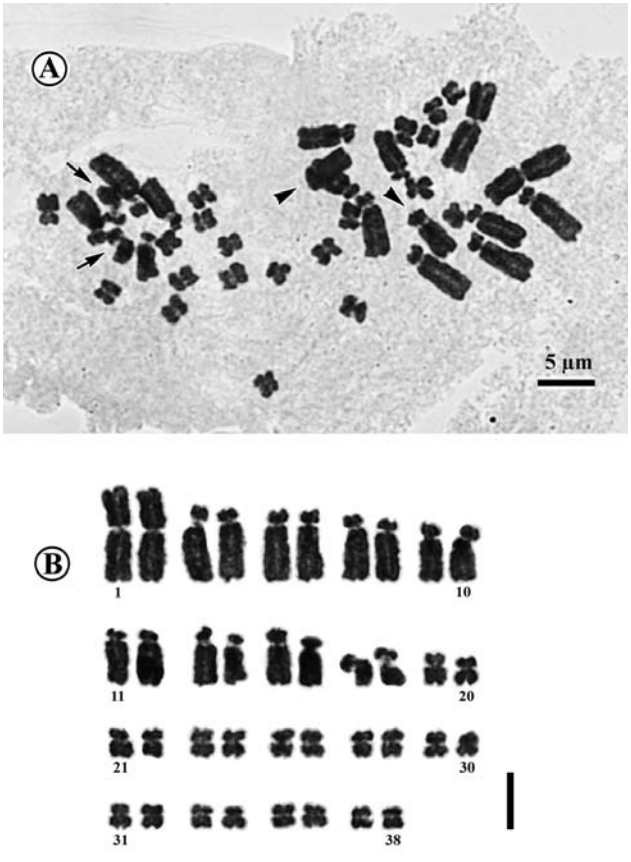

Figure 3. Somatic chromosomes at mitotic metaphase of *Aspidistra erecta* ($2n = 38$, from *Peng 21609*, HAST). A, Microphotograph. Arrowheads indicate the eighth submedian chromosomes. Arrows indicate the ninth submedian chromosomes with secondary constrictions; B, Somatic chromosomes serially arranged by their chromosome length and the position of centromeres. Scale bar = 5 μm.

Figure 4. Distribution of *Aspidistra erecta* Yan Liu & C.-I Peng (★) and *A. fungilliformis* Y. Wan (■) in Guangxi Zhuangzu Autonomous Region, China.

Cytological information of 41 species in the genus *Aspidistra* has been reported earlier (Bogner and Arnautov, 2004; Li, 2004; Yamashita and Tamura, 2004; Qiao et al., 2008; Hou et al., 2009, Lin et al., 2010). The majority of the *Aspidistra* species share several karyomorphological features (*see* Lin et al., 2010) in common. *Aspidistra erecta* is no exception in this regard.

Among the 19 species with $2n = 38$, *A. elatior* (Huang et al., 1997) and *A. marginella* (Wang et al., 2001) have the same karyotype formula as that of *A. erecta*. However, of the 38 chromosomes in *A. erecta*, the eighth and the ninth pairs of chromosomes were submedian (arrowheads and arrows in Figure 3), whereas in *A. elatior* (Huang et al., 1997: Table 11) and *A. marginella* (Wang et al., 2001: Table 2), the third and the ninth pairs of chromosomes had their centromeres in the submedian positions. Hence, *Aspidistra erecta* is karyotypically distinguishable from these two species.

Ecology and Distribution. Aspidistra erecta is only known from Napo Xian and Jingxi Xian, two counties in southwestern Guangxi Zhuang Autonomous Region, China (Figure 4) that borders northern Vietnam. It grows in valleys on shaded rocky limestone slopes at 800-850 m altitude.

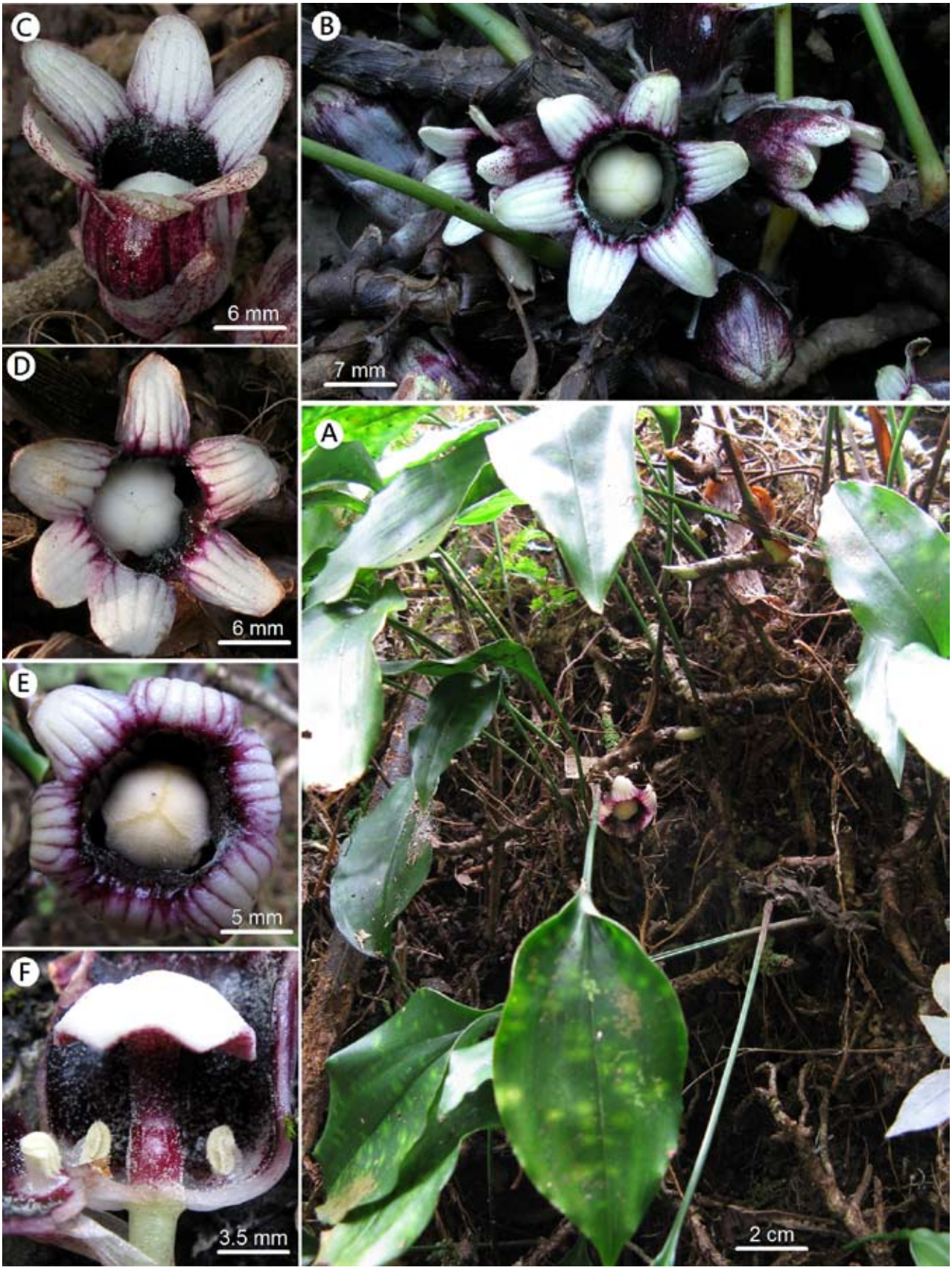

Figure 5. *Aspidistra fungilliformis* Y. Wan. A, Habit; B, Flowers; C, Flower, side view; D, E, Flower, adaxial view; F, Flower, longitudinally dissected to show stamens and pistil.

Phenology. Flowering from October to November, fruiting from November to December.

Etymology. The specific epithet '*erecta* ' is derived from its upright stem.

Notes. *Aspidistra erecta* (Figures 1, 2) resembles *A. fungilliformis* Y. Wan (Wan, 1984, Figure 5) in floral shape, differing in its longer pistil than the perianth tube, curved style, triangular ovate perianth lobes and purplish-red floral color. Furthermore, *Aspidistra erecta* is markedly distinct from its congeners in having a straight and vertical stem. By contrast, *A. fungilliformis* differs in its pistil being lower than its perianth tube, its oblong perianth lobes, the white exterior and pale purple interior of its flowers, and its creeping rhizome.

Aspidistra Ker-Gawler is a large genus of ca. 100 species (Tillich, 2008). Previously only three Vietnamese species were known to have vertical shoots, namely *A. locii* Arnautov & Bogner (Bogner & Arnautov 2004), *A. nikolai* L.V. Averyanov & H.-J. Tillich (Tillich and Averyanov, 2008) and *A. lateralis* H.-J. Tillich (Tillich, 2005). Our discovery of another erect *Aspidistra* is the first and only one of its kind in China. A key to the four *Aspidistra* species with vertical roots follows.

Key to *Aspidistra* with vertical stems

1. Peduncle 6-11 cm long; perigone pendulous, tepals completely connate, leaving a tiny opening of 1-1.5 mm on the summit (Vietnam: Quang Nam) .....*A. locii*

1. Peduncle 0.5-1.5 cm long; perigone horizontal, wide opening, 6-10-lobed.

   2. Stem woody, to 120 cm tall; perigone 6-9 cm across; pistil obconic (Vietnam: Thua Thien) .....*A. nikolai*

   2. Stem herbaceous, to 100 cm tall; perigone 1-3 cm across; pistil mushroom-shaped.

      3. Stem to 50 cm tall; perigone widely funnel shaped, 2.5-3 cm across; pistil lower than perianth tube; style upright; stigma flat, cream-white (Vietnam: Thua Thien) ..... *A. lateralis*

      3. Stem to 100 cm tall; perigone campanulate, 1-1.5 cm across; pistil exserting perianth tube; style curved; stigma hemispherical, red (China: Guangxi) .....*A. erecta*

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中國廣西石灰岩地區天門冬科蜘蛛抱蛋屬一新種植物：直立蜘蛛抱蛋

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本文報導特產中國廣西壯族自治區石灰岩地區的蜘蛛抱蛋屬一新種：直立蜘蛛抱蛋 (*Aspidistra erecta* Yan Liu & C.-I Peng)。該新種的花形態與傘柱蜘蛛抱蛋類似，但新種的雌蕊長於花被筒，花柱略彎曲，柱頭外露，明顯可以區別。直立蜘蛛抱蛋另一個重要辨識特徵是具有直立莖，目前已知產於中國的蜘蛛抱蛋屬六十多種植物中僅此一種的莖直立；自 2004 年以來，學者在越南陸續發現 3 種具直立莖的蜘蛛抱蛋，但與本新種的許多特徵截然不同，本文針對這 4 種具有直立莖的蜘蛛抱蛋屬植物製作檢索表以資區別。此外，本文報導直立蜘蛛抱蛋的染色體數目為 $2n = 38$，核型公式為 $2n = 22m+4sm^{2SC}+12st$，並提供直立蜘蛛抱蛋的線繪圖以及其與傘柱蜘蛛抱蛋的彩色照片與地理分布圖以利辨識。

關鍵詞：天門冬科；直立蜘蛛抱蛋；傘柱蜘蛛抱蛋 ; 中國；染色體數；廣西 ; 核型；石灰岩植物；新種。