

Euonymus duanensis (Celastraceae), a new species from Guangxi, China

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Abstract

The species *Euonymus duanensis* (Celastraceae), a small shrub, is newly described and illustrated from karst areas of Guangxi Autonomous Region, China. This species is similar to *Euonymus dielsianus* but is readily distinguished by its smaller leaves, obovate or elliptic-obovate, 2-2.5 × 5-6 cm (vs. 4.5-6 × 9-15 cm), blade margin crenulate, serrulate to serrate (vs. margin proximal 1/5-2/5 entire, distal 3/5-4/5 crenulate, serrulate to serrate, sometimes ciliate), reddish flowers and petals (vs. flowers and petals green, light yellow, or greenish yellow), short petiole, milk white seeds (vs. dark brown), and aril bright red partial covering seed (vs. aril bright red covering seed wholly). Phylogenetic study also revealed apparent phylogenetic position of the new species among *Euonymus* species, and the relationships between related species have also been discussed.

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Key words: Celastraceae, Critically Endangered, karst areas, morphology, phylogenetic, taxonomy

Introduction

The family Celastraceae contains about 60 genera with more than 850 species, and most of these species distributed in tropic, subtropic and temperate areas, with limited species radiated into cold temperate zone (Ma 2001, Ma et al. 2008, Li et al. 2014). The tribe Euomyneae is the majority of the family, containing eight genera with about 230 species in both the Old and New Worlds (Loesener 1942; Simmons et al. 1999, 2001, 2012). Tribe Euomyneae has been defined as those genera of Celastraceae with generally opposite leaves, isomerous carpels, loculicidally dehiscent capsules, and arillate seeds (Simmons et al. 2012). Phylogenetic

studies on tribe Euonymieae indicate that the tribe consists of at least six separate lineages within Celastraceae and that a revised natural classification of the family is needed (Simmons et al. 2012). Furthermore, *Euonymus* is the most diverse (129 species) and widely cultivated genus in the tribe, and its current intra-generic classifications of *Euonymus* are not completely natural and require revision (Simmons et al. 2012, Li et al. 2014).

Euonymus L. is a worldwide distributed plant group, with a total of about 130 species worldwide (Li 2014). It originated in Europe, and now most species are widely distributed in Southeast Asia, with China as the center of diversity, and a few species are distributed in the Americas, Australia and Africa (Simmons et al. 2012, Li 2014). Due to the wide distribution area of the genus, the ecological environment factors such as geography and climate change greatly, resulting in abundant morphological variation within the genus. Although many study works are published, there are still many problems in the system and classification of *Euonymus* (Li 2014), which have also resulted in diversity inventory of the genus remaining ambiguous and some new species published recently (Li et al. 2024, Savinov et al. 2024).

In recent years, we have carried out multiple intermittent field expeditions in the northwestern regions of Guangxi, where is biodiversity hotspot of China and currently being prepared for the Southwest Karst National Park (Myers et al. 2000, Hou et al. 2010), we document a distinct *Euonymus* species. After careful study morphological characteristics and molecular evidence with its related species, we find the species is a new species of *Euonymus* to science.

Material and methods

The morphological characteristics have been scrutinized in accordance with local flora (Cheng and Huang 1999, Mu 2012, Meng 2010). Herbarium specimens from PE, IBK, and GXMI herbarium were also carefully examined.

We included DNA sequences of 48 species of *Euonymus*. All sequences were downloaded from GenBank, except *E. duanensis* which was generated for this study. Vouchers and GenBank accession numbers are listed in Table S1. Three regions were used for DNA sequencing: *psbA-trnH*, *rp136-infA-rps8*, and *trnC-ycf6*. The protocol of total DNA extracting, Sequences alignment, and phylogenetic tree reconstruction are followed by previous studies (Yu et al. 2016, Qin et al. 2023, Xue et al. 2024, Yang et al. 2023).

Results and discussion

Euonymus duanensis Y.H. Qin, W.H. Wu & S.X. Yu, *sp. nov.* (Fig. 1, 2, 3)

Diagnosis

A species is similar to *Euonymus dielsianus* in evergreen shrub, but distinguished by its smaller leaves, 2-2.5 × 5-6 cm, blade margin crenulate, serrulate to serrate, reddish flowers and petals (vs. flowers and petals green, light yellow, or greenish yellow), short petiole, milk white seeds (vs. dark brown), and aril bright red partial covering seed (vs. aril bright red covering seed wholly).

Type: CHINA. Guangxi Autonomous Region: Du'an County, Yong'an Town, An'Lan village, summit of karst hills., 850 m a.s.l., 22.86°N, 108.22°E, 5th, Jul. 2020, Yonghua Qin YH2020103 (holotype: PE, isotype: IBK).

Eponymy:

The specific epithet is derived from the type locality, where karst mountains is prevalence with high species diversity and endemism.

Description:

Evergreen shrubs, 1.5-4 m tall; branches terete, young branches and twigs ridge, green or brown when dry. Leaves opposite; petiole sturdy, short, less than 0.5 cm; leaf blade leathery or thickly leathery, obovate or

elliptic-obovate, occasionally elliptic, 2-2.5 × 5-6 cm, base cuneate or attenuate, margin crenulate, serrulate to serrate, apex acute, acuminate, sometimes obtuse; lateral veins 5-6 pairs, inapparent, obscure to clear, curving forward, netting and disappearing before reaching margin. Cymes single, axillary; peduncle slender, 2-3 cm, dichotomously branched with 3 flowers; pedicel 7-9 mm. Flowers 4-merous, 5-6 mm in diam.; sepals broad ovate, small, greenish; petals reddish, ovate, top obtuse, ca. 1.9 × 2.1 mm. Capsule greenish when fresh, reddish when dry, 4-lobed, 1.2-1.5 cm in diam., sometimes only 2 or 3 lobes developed, lobes ovoid. Seeds milky white; aril bright red partial covering seed.

Phenology:

Euonymus duanensis has been observed to flower from April to July, and to fruit from July to November.

Distribution, habitat, and ecology:

Euonymus duanensis confined to the summits of karst mountains with the local vegetation belonging to southern subtropical evergreen broadleaf forests, at 850 m a.s.l. The species is only known from several summits of karst mountains nearby in Du'an County, Guangxi Autonomous Region, China (Fig. 3).

IUCN red list assessment

Euonymus duanensis is known from several karst summits of the type locality, with an estimated extent of occurrence of 10 km². In accordance with the IUCN (2022), the above-mentioned area corresponds to a single location. There are approximately 300-500 individuals counted at this site. The occurrence and the habitat of the new species are subjected to various anthropogenic disturbances. So, the species is assessed as Critically Endangered (CR) under the criteria B1ab(i)+C2a(i).

Taxonomic relationships:

Euonymus duanensis is similar to *Euonymus dielsianus* but is easily distinguished by its smaller leaves and reddish flowers. Further diagnostic morphological characters of the new species and two related species are presented in Table 1.

Traditionally *Euonymus* was divided into 5 sections in accordance with fruit characteristics (Cheng and Huang 1999), however, recently phylogenetic study showed that only two sections (sect. *Kalonymus* and sect. *Echinococcus*) were supported as monophyly, and the relationships of other sections remains ambiguous (Li 2014, Li et al. 2014). Our phylogenetic results also confirmed the complex relationship of the genus and found species from different sections mixed (Fig. 4). For example, in morphology the new species,

***Euonymus duanensis*, is similar to *Euonymus dielsianus*, however, the two species do not form sister relationships on our phylogenetic tree. On the contrary, *Euonymus verrucosus* and *Euonymus verrucosoides* formed a sister relationship first, and subsequently form sister relationship with *Euonymus duanensis*. So, we employed two related species during the discussion of the new species and its related species in morphological characters to distinguish the new species more clearly (Table 1). Due to the complexity of the relationship between species of *Euonymus*, much more extensively sampling representativeness and molecular data are needed to further reveal the phylogenetic relationship of the genus in the future.**

Vernacular name:

Euonymus duanensis is called *Du'an weimao* in Mandarin Chinese, which translates to 'du'an *Euonymus*'.

Additional specimens examined (paratypes):

CHINA. Guangxi Autonomous Region, Du'an County, Yong'an Town, An'lan village, in summit bushes of karst mountains, 850 m a.s.l., 108.22°N, 22.86°E, 17 July 2018, *Yonghua Qin YH2018001* (PE, IBK); CHINA. Guangxi Autonomous Region, Du'an County, Yong'an Town, An'lan village, in summit bushes of karst mountains, 850 m a.s.l., 108.22°N, 22.86°E, 11 August 2018, *Yonghua Qin YH2018005* (PE, IBK).

Data availability statement

There is no additional data for this paper.

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Table 1. Morphological comparison of *Euonymus duanensis* , *E. dielsianus* , and *E. verrucosoides* .

Characters	<i>E. duanensis</i>	<i>E. dielsianus</i>
Habit	Evergreen small shrubs	Evergreen woody vines
Blades	Asymmetrical, oblong-ovate or oblanceolate, 5-6 × 2-2.5 cm	Symmetrical, oblong-ovate or lanceolate,
Margin	Crenulate, serrulate to serrate	Partial entire and partial crenulate, serrulate
Veins	Lateral veins 5-6 pairs	Lateral veins 6-8 pairs
Flower size	5-6 mm in diam	Ca. 6 mm in diam
Flower color	Reddish	Green, light yellow, or greenish yellow
Capsule	1.2-1.5 cm in diam	1.8-2.4 cm in diam
Seed	Covered reddish aril partly	Covered reddish aril wholly
Phenology	Fl. Apr-Jul, fr. Jul-Nov.	Fl. Apr-Jul, fr. Sep-Nov.







