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A new record of the genus *Yua* (Vitaceae) from Vietnam

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Abstract

*Yua* C.L. Li (Vitaceae), a genus previously known from China, Nepal and India, is newly recorded from Vietnam. A specimen discovered in the rainforest of Lao Cai province, northern Vietnam was identified as *Yua austro-orientalis* (F.P. Metcalf) C.L. Li based on both morphological and molecular data. To improve our understanding of relationships between *Yua* and *Parthenocissus* Planch., we present diagnostic characteristics for these two genera. We discuss leaf, stem and seed features used to distinguish between *Y. austro-orientalis* and *Y. thomsonii* (M.A. Lawson) C.L. Li, a species widely distributed in China, Nepal and northern India. The opportunity is taken to review the typification of all *Yua* taxa. A lectotype is selected for *Vitis thomsonii* M.A. Lawson.

Key words: Vitaceae, *Yua*, *Yua austro-orientalis*, New record, Vietnam, *Parthenocissus*

Introduction

Vitaceae (the grape family) consist of 15 genera and ca. 900 species mainly distributed in tropical and subtropical regions of both the Old World and New World (Wen 2007, Wen et al. 2015). Members of the family can be easily recognized by their leaf-opposed tendrils and unique seed characteristics (Chen et al. 2007, Wen 2007, Zhang et al. 2015).

Generic circumscription has changed substantially as our understanding of phylogenetic relationships within Vitaceae has increased through the analysis of molecular data (Wen et al. 2015). The genus *Yua* C.L. Li (1990: 2) [type, *Yua thomsonii* (M.A. Lawson 1875: 657) C.L. Li (1990: 5)] was segregated from *Parthenocissus* Planch. (1887: 447) by Li (1990) based on its two-branched tendrils and its leaf-opposed inflorescence, which forms a compound dichasium (Table 1). *Yua* includes two species, *Y. austro-orientalis* (F.P. Metcalf 1948: 132) C.L. Li (1990: 7) and *Y. thomsonii*; the genus was previously recorded from central and southern China, central Nepal and northern India (Chen et al. 2007, Wen 2007).

| TABLE 1. Morphological comparison between *Parthenocissus* and *Yua*. |
|-----------------|-----------------|
| **Parthenocissus** | **Yua**          |
| Old stems       | With sparse lenticels | With dense lenticels |
| Tendrils        | Racemosely 4–12-branched with adhesive discs at tips | Bifurcate, without adhesive discs |
| Leaves          | Simple, 3-foliolate, or palmate 5(–7)-foliolute | Palmate 5-foliolate |
| Inflorescences  | Panicle or a loose corymbose polychasium, pseudoterminal | Compound dichasium, leaf-opposed |
| Seeds           | Obovoid; ventral infolds furrowed upward from base to apex | Flat, pyriform; ventral infolds furrowed upward 2/3 from base |
Vitaceae in Vietnam have been the subject of recent taxonomic studies by several authors (Pham 2003, Nguyen 2004, Nguyen 2012) who recognized seven genera: *Ampelopsis* Michx. (1803: 159), *Ampelocissus* Planch. (1884: 371), *Parthenocissus*, *Vitis* L. (1753: 202), *Cissus* L. (1753: 117), *Cayratia* Juss. (1818: 103) and *Tetrastigma* Planch. (1887: 423). During fieldwork in Lao Cai province of northern Vietnam in 2013, a collection, *Chen et al. VN0150*, was identified as *Yua austro-orientalis*, a genus and species previously unrecorded in Vietnam. The identity of this collection was confirmed based on both molecular and morphological data.

Materials & methods

Morphological analyses. We examined specimens from the following herbaria: A, CDBI, GH, HN, IBK, K, KUN, P, PE and VNM. The herbarium acronyms follow the Index Herbariorum (http://sweetgum.nybg.org/ih/). We also examined living material in the field. Leaf and stem characteristics of the new record and *Y. thomsonii* were observed under a microscope with camera attachment (Nikon SMZ1000 with a Nikon D700 digital camera). Photographs and measurements were taken using image software of NIS-Elements BR 3.1, Nikon Instruments Inc. Distribution of each species is based on herbarium labels (specimen labels) and published literature, such as Li (1990), Shetty & Singh (2000), *Chen et al.* (2007), and the Chinese Virtual Herbarium (http://www.cvh.org.cn/).

Molecular phylogenetic analyses. We extracted total genomic DNAs from silica gel-dried leaves of the collection, *Chen et al. VN0150*, and generated four new sequences (*atpB–rbcL*: KU923382, *rps16*: KU923383, *trnH–psbA*: KU923384, and *trnL–F*: KU923385). The primers and protocol used for PCR and sequencing in this study followed the protocols described in *Lu et al.* (2013).

We add the new sequences into a dataset with a global sampling scheme of Vitaceae from *Lu et al.* (2013) and expanded taxon sampling of *Parthenocissus* and *Yua*. The combined dataset was partitioned into five subsets corresponding to five chloroplast regions and was analyzed with the maximum likelihood (ML) and Bayesian Inference (BI) methods. ML analyses were conducted in RAxML 8.1.11 (Stamatakis 2006), applying 1,000 bootstrap replicates with the substitution model selected in MrModeltest 2.3 (Nylander 2004). The Bayesian analysis was conducted in MrBayes 3.2.6 (Ronquist *et al.* 2012) as implemented on the CIPRES Science Gateway Portal (Miller *et al.* 2010).

**FIGURE 1.** Maximum likelihood tree for Vitaceae; a) A phylogram overview based on the combined chloroplast data sets (*atpB–rbcL*, *rps16*, *trnC–petN*, *trnH–psbA*, and *trnL–F*); b) The clade including *Parthenocissus* and *Yua* with the newly recorded species *Y. austro-orientalis* highlighted. ML Bootstrap and Bayesian posterior probability values of major clades are indicated above branches.

Results

ML analyses of Vitaceae based on five chloroplast markers strongly supported *Yua* as sister to *Parthenocissus* (Fig. 1a). An enlarged figure of the clade *Parthenocissus-Yua* with support values is provided in Fig. 1b. The new specimen
collected from Vietnam (Chen et al. VN0150) grouped with *Y. austro-orientalis* with strong bootstrap support. Furthermore, by comparing specimens of *Parthenocissus* and *Yua* in the herbaria and the description in the Flora of China, we identified the collection as *Y. austro-orientalis*, a species previously unrecorded from Vietnam. *Y. austro-orientalis* is closely related to *Y. thomsonii*, but differs in having sub-leathery leaves (Fig. 2B; vs. papery leaves in *Y. thomsonii* in Fig. E), raised veinlets (Fig. 2C; vs. inconspicuously raised veinlets in *Y. thomsonii* in Fig. 2F), margins with angular teeth (Fig. 2D; vs. margins with rounded teeth in *Y. thomsonii* in Fig. 2G), dense lenticels (Fig. 2H; vs. relatively sparse lenticels in *Y. thomsonii* in Fig. 2L), and larger seed with rugose surface (Fig. 2I–K; vs. smaller seed with smooth surface in *Y. thomsonii* in Fig. 2M–O). *Y. thomsonii* is widely distributed in eastern, southern and central China and northeast India while *Y. austro-orientalis* only occurs in southeastern China and now, in northern Vietnam (Fig. 3). The new record of genus was collected from Lao Cai province of Vietnam and is indicated with an arrow in Fig. 3.

**FIGURE 2.** A. Habitat, Sapa, Lao Cai province, Vietnam. Comparative leaf characteristics between *Y. austro-orientalis* (B–D) and *Y. thomsonii* (E–G). Lenticels on stems of *Y. austro-orientalis* (H) and *Y. thomsonii* (L). Dorsal, ventral views and transverse sections of seed characteristics of *Y. austro-orientalis* (I–K) and *Y. thomsonii* (M–O). I–K. from Chen 2009.
Fig. 3. Distribution of *Y. austro-orientalis* (red dot) and *Y. thomsonii* (blue dot). An arrow indicates the locality of the new record from Vietnam.

**Taxonomic treatment**

*Yua* C.L. Li, (1990: 12). Type:—*Yua thomsonii* (M.A. Lawson) C.L. Li

Lianas, woody, hermaphroditic, with lenticels and white pith. **Stems** terete to slightly ridged, **tendrils** 2-branched. **Leaves** palmately penta-foliolate. **Inflorescence** a compound dichasium, leaf-opposed. **Flowers** 5-merous; calyx cupular, entire; petals coherent in bud, opening at anthesis and falling off separately; stamens usually 5; disk inconspicuous; style conspicuous; stigma inconspicuously enlarged. **Berries** spherical, sweet and sour in taste. **Seeds** flat, pyriform, base rostrate, apex retuse, ventral infolds furrowed upward 2/3 from base; cross-section of endosperm M-shaped.

*Yua austro-orientalis* (F.P. Metcalf) C.L. Li (1990: 7). *Parthenocissus austro-orientalis* F.P. Metcalf (1948: 132, Fig. 1). Type:—CHINA, Guangdong, Lung T’au Shan, Iu, 5 June 1924, To & Tsang 12378 (holotype A! (barcode A00051628)).

Deciduous woody climbers. **Stems** terete, branchlets brownish or gray-brownish, with many lenticels, glabrous; **tendrils** bifurcate, without adhesive discs. **Leaves** compound, palmately 5-foliolate; petiole 3–5 cm long; leaflets subleathery, terminal petiolules 0.2–1 cm, glabrous, longer than lateral ones; terminal leaflet obovate-lanceolate or obovate-elliptic, 4.5–9 × 2–5 cm, glabrous, abaxially usually glaucous, base cuneate, margin 2–5-toothed on each side, rarely teeth inconspicuous, apex acute, shortly acuminate, or obtuse; petiolule of lateral leaflet inconspicuous, lateral leaflet blade obovate-elliptic, 2–5 × 1.5–2 cm, base narrow cuneate, margin and apex as terminal leaflet; veinlets conspicuously raised when dry, lateral veins 6–9 pairs. **Inflorescences** a compound dichasium, leaf-opposed; peduncles 1.5–2 cm. **Flowers** bud elliptic, 2–3.5 mm; pedicels 3–6 mm; calyx cupular, entire or wavy at the margin; petals 5, ca. 3 mm long, filaments 3–3.8 mm, anthers yellow, elliptic, ca. 2 mm long; pistil 2–2.5 mm long, style attenuate. **Berries** 1.5–2.5 cm in diam., amaranthine, sweet and sour in taste, 1–4 seeded. **Seeds** slightly flattened, 6–8 × ca. 5 mm, rugose.

**Distribution:**—China and Vietnam.

Type:—INDIA, Assam Nunklow, Khasia, alt. 4–6000 ft., 10 July 1850, J.D. Hooker & T. Thomson 1585 (Lectotype (designated here) K! (barcode K000736314); islectotype K! (barcode K000736313)).

Residual Syntypes:—Assam Boga Panee, Khasia, 4–6000 feet, 29 June 1850, J.D. Hooker & T. Thomson s.n. (syntypes GH! (barcode GH-HUH00051639), K! (barcode K000736312), K! (barcode K000736315), P! (barcode P00697602)).


Yua chinensis C.L. Li (1996: 47). Type:—Sichuan, Qingcheng, alt. 1000 m, 13 June 1963, X.Q. Li 177 (holotype CDBI! (barcode CDBIO172485)).
Typification:—The diagnostic characteristics for the genus (two-branched tendrils and leaf-opposed inflorescence forming a compound dichasium) are only both present on the sheet selected as lectotype of *Y. thomsonii*. It is also one of only two sheets bearing fruit, important for recognition of the species.

Key to the genera of Vitaceae in Vietnam

1. Petals united at apex, shed as a cap-like calyptra; inflorescence a compact, paniculate thyrsus; bark on older twigs usually loose, peeling off in stripes ................................................................. *Vitis*
   - Petals free; inflorescence a loose thyrsus, panicule, dichasium, corymbose cyme, or umbel; bark intact, not peeling off in stripes ...

2. Inflorescence a loose thyrsus or panicule, base subtended by a tendril ....................................................................................................................... *Ampelopsis*
   - Inflorescence a loose dichasium, corymbose cyme, or umbel, base without tendrils ...................................................................................................................

3. Petals 5 ................................................................................................................................................................................................
   - Petals 4 ................................................................................................................................................................................................

4. Tendrils 4–12-branched, tips usually with adhesive discs ......................................................................................... *Parthenocissus*
   - Tendrils usually 2(–3)-branched or unbranched, tips without adhesive discs .......................................................................................

5. Disk inconspicuous; inflorescence a compound dichasium, without reduced inflorescences appearing on tendrils .................. *Yua*
   - Disk well developed, 5-lobed; inflorescence a corymbose cyme, reduced inflorescence often appearing at tips of tendrils .......... *Cayratia*

6. Inflorescence leaf-opposed; seeds with an encircling raphe near base; leaves simple ...................................................................... *Cissus*
   - Inflorescence usually axillary or pseudo-axillary, rarely leaf-opposed; seeds with 1 or 2 conspicuous ventral cavities nearly as long as seeds; leaves compound..............................................................................................................................

7. Style conspicuous, stigma undivided, slightly expanded ....................................................................................... *Columellia*
   - Style inconspicuous or short, stigma usually 4-divided, rarely irregularly divided ........................................................................... *Tetrastigma*

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