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A review of taxonomic research on Chinese wild grapes

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Summary

The taxonomy of Chinese wild grapes can be traced back to the end of the 18th century. However, most research in this field was performed in the last three decades. On the basis of the data from the Chinese wild grape germplasm collected in the last 25 years at the College of Horticulture, Northwest A&F University, Yangling, Shaanxi, China, and publications by other scientists in China, we concluded there were 40 species, 1 subspecies, and 13 varieties of Chinese wild grapes. These were classified into 1 subgenus, 5 sections and 4 series according to Fasong Wang *et al.*'s systematics. The systematics on Chinese wild grapes is discussed in this paper.

K e y w o r d s : *Vitis*, Chinese, Species, Wild germplasm, Taxonomy.

Introduction

The *Vitis* genus contains more than 70 species, with centers of origin in south Europe, Asia Minor, East Asia, and North and Central America (Alleweldt and Possingham 1988, He 1999 a, b). China is one of the major gene centers of *Vitis* species origination. More than 35 *Vitis* species have their origin in China (Wang *et al.* 1995 and 1998, He 1999 a, b). In recent years, Chinese wild grapes and their hybrids have been used for making wines in China. These wines have reached a certain scale (Li and He 2004, Wang *et al.* 2004, Peng *et al.* 2005). For example, the 2002 production of the wines in Northeast China, mainly made from *Vitis amurensis* or its hybrids from crosses with *Vitis vinifera,* was over 5 million liters (Wang *et al.* 2004). The 2003 production of the wines in Guangxi, mainly made from *Vitis heyneana*, was over 10,000 liters (Peng *et al.* 2005). Chinese wild *Vitis* has desirable disease resistance genes, including extremely high resistance to Anthracnose [*Elsinoë ampelina* (de Barry) Shear] and Ripe Rot [*Glomerella cingulata* (Ston.) Spauld et Schrenk], high resistance to Powdery Mildew [*Uncinula necator* (Schw.) Burr.], and resistance to Crown Gall (*Agrobacterium tumefaciens* Smith and Townsend) (Chai and He 1997, He 1999 a, b). This germplasm can also be easily crossed with *V. vinifera* and American *Vitis* species (He 1999 a, b). Additionally, the berries of Chinese wild *Vitis* species do not have the undesirable "foxy" flavor compounds commonly existing in the berries of American *Vitis* species (Alleweldt and Possingham 1988, Wang *et al.* 1995 and 1998, He 1999 a, b). These desirable characteristics of Chinese wild *Vitis* have captured grape breeders' attention (He 1999 a, b, Luo and He 2004). *Vitis amurensis*, *Vitis heyneana*, *Vitis davidii,* and *Vitis yeshanensis* are among the most widely used species for breeding in China, the United States, and Germany (He 1999 a, b)

Wild Chinese grape species have enormous economic potential for grape breeding. We review the systematics of Chinese *Vitis* species as they are treated in the Chinese scientific literature with the expectation that greater familiarity with the species will lead to more informed use of this germplasm.

The taxonomic history of Chinese wild grapes: Carl Peter Thunberg, a Swede and a pupil of Linnaeus, described and named *Vitis flexuosa* Thunb in 1793, the first Asian grape species to be annotated (Li 1998, Kong 2004). The first Chinese scientists who described Chinese wild grape species were Hsen-Hsu Hu and Wan-Chun Cheng who named *Vitis chunganensis* Hu in 1925 and *Vitis hui* Cheng in 1935 (Li 1998, Kong 2004, Ma and Barringer 2005). While botanists began to explore Chinese wild grapes in the late 18th century, research progress on Chinese wild grapes was slow before the 1970s because of the continuous wars in China and the politic affairs there (He 1999 b, Kong 2004). In the early 1980s, it was realized that China contains an unusually high diversity of wild grape germplasm resources after Chinese scientists surveyed the germplasm across the country in the five years from 1979 to 1984 (He *et al.* 1983, 1999 a, b, Niu and He 1996, Wang *et al.* 2000 a, b, Kong 2004). Since that time much progress has been made on the taxonomy of the Chinese wild grapes. Morphology, phytochemistry, and molecular biology were used to study the taxonomy of the Chinese wild grapes, to verify the genetic relationship between the species and to explore the origin of Chinese wild grapes (He 1983, 1999 a, b, He *et al.* 1996, Niu and He 1996, Wang *et al.* 2000 a, b, Kong 2004). In the last three decades, scientists including Chaoluan Li, Wen-Tscai Wang, Baolin Qiu, Puchao He, Xiansheng Sheng, and Fasong Wang's group, contributed significantly to the taxonomy of Chinese grapes (Wang 1979, Niu and He 1995, Li *et al.* 1996, Li 1998, Wang *et al.* 2000 a, b, Kong 2004). In 1979, Wen Tsai Wang published a taxonomic index covering 24 species and 5 varieties of Chinese wild grapes, including five new species and one variety he annotated at that time (Wang 1979, Kong 2004). In 1998, based on the research by the scientists above, Chaolan Li

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published a taxonomic index containing 37 species, 1 subspecies and 10 varieties of Chinese wild grapes (LI 1998). Later, FASONG WANG's group and QINGSHAN KONG revised the taxonomic index of Chinese wild *Vitis* (WANG *et al.* 2000 a, KONG 2004)

The species of Chinese wild grapes: There is disagreement as to the number of species of Chinese grapes because of intermediate types between species and the multiple types within some species. LI (1998) reported 37 species, 1 subspecies, and 10 varieties of Chinese wild grapes in China, WANG *et al.* (2000) reported 41 Chinese wild grape species, and yet KONG (2004) reported 38 species, 1 subspecies, 13 varieties and certain arguable species of Chinese wild grapes in China.

On the basis of the morphological traits from germplasm collected in the last 25 years by the grape research group led by Prof. HE PUCHAO at the College of Horticulture, Northwest A&F University, Yangling, Shaanxi, China, and publications by other scientists in China, we concluded there were 40 species, 1 subspecies, 13 varieties of Chinese wild grapes in China. These were classified into 1 subgenus, 5 sections and 4 series according to FASONG WANG *et al.*'s systematics (WANG *et al.* 2000 a).

Genus, Vitis L., *Subgen, Muscadinia* Planch., *Subgen. Euvitis* Planch.

Sect. Labruscoideae (Planch) F. S. Wang includes six species, a subspecies and a variety: *Vitis pentagona* Diels and Gilg., *Vitis heyneana subsp. ficifolia* (Bge.) C. L. Li., *Vitis bellula* **(**Rehd.) W. T. Wang, *Vitis bellula var. pubigera* C. L. Li, *Vitis retordii* Roman. Du Cail. Ex Planch, *Vitis hui* Cheng, *Vitis longquanensis* P. L. Qiu, *Vitis bashanica* P. C. He, *Vitis menghaiensis* C. L. Li.

Sect. Sinocineriae F. S. Wang et C. S. Zhu has one species: *Vitis sinocinerea* W. T. Wang.

Sect. Vitis Planch includes four series: *Ser. Vitis* contains fourteen species and two varieties: *Vitis amurensis* Rupr., *Vitis amurensis* Rupr. *var. dissecta* Skvorts, *Vitis betulifolia* Diels and Gilg, *Vitis wilsonae* Veitch, *Vitis flexuosa* Thunb., *Vitis pseudoreticulata* W. T. Wang, *Vitis yunnanensis* C. L. Li, *Vitis mengziensis* C. L. Li, *Vitis fengqinensis* C. L. Li, *Vitis balanseana* Planch, *Vitis chunganensis* Hu, *Vitis piloso-nerva* Metcalf, *Vitis chungii* Metcalf, *Vitis luochengensis* W. T. Wang, *Vitis luochengensis var. tomentoso-nerva* C. L . Li, *Vitis hekouensis* C. L. Li.

Ser. Piasezkianae F. S. Wang contains two species and one variety: *Vitis piasezkii* Maxim., *Vitis piasezkii var. pagnucii* (Planch.) Rehd, *Vitis lanceolatifoliosa* C. L. Li.

Ser. Davidianae F. S. Wang contains one species and two varieties: *Vitis davidii* (Roman. Du Caill.) Föex, *Vitis davidii* (Roman. Du Caill.) Föex *var. ferruginea* Merr. and Chun, *Vitis davidii* (Roman. Du Caill.) Föex *var*. *cyanocarpa* (Gagnep.) Gagnep.

Ser. Adstrictae F. S. Wang contains two species and one variety: *Vitis bryoniaefolia* Bge, *Vitis bryoniaefolia var. ternate* (W. T. Wang) C. L. Li, *Vitis zhejiang-adstricta* P. L. Qiu. *Sect. Romanetianae* F. S. Wang includes two species and one variety: *Vitis romanetii* Roman. Du Caill. ex Planch. *Vitis romanetii* Roman. *var. tomentosa* Y. L. Cao et Y. H. He, *Vitis shenxiensis* C. L. Li. *Sect. Wuhanenses* F. S. Wang et C. S. Zhu includes eight species: *Vitis wuhanensis* C. L. Li, *Vitis silvestrii* Pamp, *Vitis wenchouensis* C. Ling ex W. T. Wang, *Vitis tsoii* Merr, *Vitis ruyuanensis* C. L. Li, *Vitis jinggangensis* W. T. Wang, *Vitis erythrophylla* W. T. Wang, *Vitis hancockii* Hance.

The pattern that emerges is that often one Chinese grape species has two or more scientific names since scientists described the same species at different times, not recognizing that they were dealing with an already known entity. Other species were renamed or synonomized by further research. To clarify the situation, we list in the Tab. 1 the primer scientific names with their citation and their synonyms of Chinese wild grapes. The choice of the primer names for several species versus synonyms is based on the criteria that the earlier published entity is the primer name and the following published entities are the synonyms, or the more proper annotation is the primer name after Chinese scientists discussed the literature (LI 1998). For example, the annotation of *Vitis davidii* is thought to be more proper than that of *Spinovitis davidii*, therefore, *Vitis davidii* is dealt as the primer name though the annotation of *Spinovitis davidii* was earlier (in 1881) than that of *Vitis davidii* (in 1886).

Discussion

The classification scheme of Chinese *Vitis* species adopted by Chinese taxonomists, 'Genus-Subgenus-Sections-Series-Species-Varieties' (Li 1998, HE 1999 a, WANG *et al.* 2000 a), is somewhat different from that of American *Vitis* species usually used by Western taxonomists, 'Genus-Subgenus or Sections-Series-Species-Varieties' (MUNSON 1966, MOORE 1991). Further studies are necessary to unify these two kinds of schemes. *Vitis* species discovered in the world classified into a consensus scheme presenting the biological relationship between species will facilitate the use of *Vitis* germplasm.

The classification of Chinese *Vitis* species is in flux. A summary of differences among systematists is shown in Tab. 2. Species relationships and genetic diversity within and among Chinese *Vitis* species has been studied using molecular and morphological approaches to address both general questions of diversity as well as specific questions of synonymy (HE *et al.* 1996, MA and HE 1998, NIU and HE 1997). Allozyme analysis of genetic diversity in 12 Chinese grape species showed that *Vitis piasezkii* Maxim presented the highest intraspecific diversity of the studied species, followed by *Vitis pseudoreticulata* W. T. Wang, *Vitis davidii* (Roman. Du Caill.) Föex, and *Vitis romanetii* Roman. Du Caill. ex Planch also presenting high intraspecific diversity, and *Vitis pentagona* Diels and Gilg. presented less diversity (MA and HE 1998). Morphological traits such as the numbers of xylem and phloem cells contained in the main veins of the leaves, the connection patterns of vascular bundles in the petioles, and trichome patterns in the leaves have been studied to elucidate relationships of Chinese grape species. These morphological traits showed a close relationships between *V. yeshanensis* J. X. Chen and *Vitis amurensis* Rupr., between *Vitis ruyuanensis* C. L. L and *Vitis erythrophylla* W. T. Wang, and between *Vitis*

Table 1

The annotated species of Chinese wild grapes by morphological traits and their citations (Li 1998; Kong 2004). The citation appended the species names in the table is listed by the following form: 1999. Acta Phytotaxonomica Sinica 37, 603-604.

Species name and its original citation	Synonyms and their citations
Vitis davidii (Roman. Du Caill.) Föex. 1886: Cours Compl. Vitic. 44	*Spinovitis davidii* Roman. du. Cail.. 1881. Compt. Rend. Acad. Sci. Paris. 92, 1096. nom. nud. et 1883. Rev. Hort. 1883, 53.; *Vitis armata* Diels and Gilg. 1900. Engler's Bot. Jahrb. 29, 462.; *V. prunisapida* Lévl. and Vant., Fedde, Repert.1907. Sp. Nov. 3, 350. et 1914. Fl. Kouy-Tchéou. 28.
Vitis davidii (Roman. Du Caill.) Föex *var. ferruginea* Merr. and Chun. 1930: Sunyatsenia **1**, 69	-
Vitis davidii (Roman. Du Caill.) Föex var. *cyanocarpa* (Gagnep.) Gagnep, Sarg. 1911: Pl. Wils. **1**, 104	-
Vitis davidii (Roman. Du Caill.) Föex var. *hispida.* X. D. Wang et S. C. Chen, 1999: Acta Phytotaxonomica Sinica **37**, 603-604	-
Vitis romanetii Roman. Du Caill. ex Planch. 1887: D. C. Monogr. Phan. **5**, 365	*Vitis rutilans* Carr. 1890. Rev. Hort. 1890, 444.; *Ampelovitis romaneti* Carr. 1892. Rev. Hort. 1892, 94.
Vitis romanetii Roman. var**.** *tomentosa.* Y. L. Cao et Y. H. He, 1994: Key Vasc. Pl. Wul. Moun. 579	-
Vitis shenxiensis. C. L. Li, 1996: Chin. J. Appl. Environ. Biol. **2**, 239	-
Vitis balanseana Planch. 1887: D. C. Monogr. Phan. **5**, 612	*Vitis flexuosa* Thunb. var. *gaudichaudii* Planch. 1887. DC. Phan. 5, 348.
Vitis balanseana Planch. var**.** *tomentosa* C. L. L. 1996: Chin. J. Appl. Environ. Biol. **2**, 240	-
Vitis balanseana Planch. var**.** *ficifolioides* (W. T. Wang) C. L. Li, 1996: Chin. J. Appl. Environ. Biol. **2**, 240	*Vitis ficifolioides* W. T. Wang. 1979. Acta Phytotax. Sinica 17, 75 and 86.
Vitis yunnanensis C. L. Li, 1997: Acta Bot. Yun. **19**, 217	-
Vitis chunganensis Hu. 1925: J. Arn. Arb. **6**, 143	-
Vitis luochengensis. W. T. Wang, 1988: Guihaia 8, 110	-
Vitis luochengensis var. tomentoso-nerva. C. L . Li, 1996: Chinese J. Appl. Environ. Biol. **2**, 241	
Vitis chungii Metcalf, Lingn. 1932: Sci. J. **11**, 102	-
Vitis betulifolia Diels and Gilg. 1900: Engler's Bot. Jahrb. **29**, 461	*Vitis tricholada* Diels and Gilg. 1900. Engler's Bot. Jahrb. 29, 461.; *V. hexamera* Gagnep. 1947. Bull. Soc. Bot. Fr. 93, 233.; *V. shimenensis* W. T. Wang. 1989. Guihaia 9, 5.

Tab. 1, continued

Species name and its original citation	Synonyms and their citations
Vitis piasezkii Maxim. 1881: Bull. Acad. Sci. St. Pétersb. **27**, 461	*Parthenocissus sinensis* Diel. and Gilg. 1900. Engler's Bot. Jahrb. 29, 463. ; *Vitis piasezkii* Maxim. var. *baroniana* Diel. and Gilg. 1905. Engler's Bot. Jahrb. 36, 75.; *V. baihensis* He P C. 1995. Acta Univ. Agric. Boreali-occidentalis. 23(5),122. ; *V. tiubaensis* Niu L. X.. 1995. Acta Univ. Agric. Boreali-occidentalis. 23(5), 123.
Vitis piasezkii var. *pagnucii* (Planch.) Rehd. 1922. J. Arn. Arb. **3**, 223	
Vitis pilosonerva Metcalf. 1932: Lingn. Soc. J. **11**, 14	*Vitis davidii* (Roman. du Caill.) Föex var. *brachytricha* Merr. 1934. Sunyatsenia 1, 200.
Vitis wilsonae Veitch. 1909: Chron. **46**, 236	*Vitis reticulata* Pamp. 1920. Nuov. Giorn. Bot. Ital. 17, 429.; *V. marchandii* Lévl., Fedde. 1913. Repert. Sp. Nov. 7, 531.; *V. flexuosa* auct. non Thunb. (1793), Lévl. Fl. Kouytchéou. 27. 1914. non Thunb. (1793).
Vitis pseudoreticulata. W. T. WANG, 1979: Acta Phytotax. Sinica **17**, 73 and 8	-
Vitis zhejiang-adstricta. P. L. QIU, 1990: Bull. Bot. Res. **10**, 39	-
Vitis silvestrii Pamp, Nouv. Giorn.1910: Bot. Ital. 17, 430	-
Vitis wuhanensis. C. L. LI, 1996: Chinese. J. Appl. Environ. Biol. **2**, 243	-
Vitis wenchouensis. C. LING et W. T. WANG, 1979: Acta Phytotax. Sinica **17**, 74 and 85	-
Vitis jinggangensis. W. T. WANG, 1981: Bull. Bot. Res. (China) **1**, 167	-
Vitis erythrophylla. W. T. WANG, 1981: Bull. Bot. Res. (China) **1**, 168	-
Vitis ruyuanensis. C. L. LI, 1996: Chinese J. Appl. Environ. Biol. **2**, 244	-
Vitis mengziensis. C. L. LI, 1996: Chinese. J. Appl. Environ. Biol. **2**, 245	-
Vitis fengqinensis. C. L. LI, 1996: Chinese J. Appl. Environ. Biol. **2**, 245	-
Vitis hekouensis. C. L. LI, 1996: Chinese J. Appl. Environ. Biol. **2**, 246	-
Vitis hancockii Hance. 1882: J. Bot. **20**, 4	*Vitis fagifolia* Hu. 1925. J. Arn. Arb. 6, 142.; *V. wentsaiana* P. L. Qiu. 1990. Bull. Bot. Res. 10, 40.
Vitis tsoii Merr. 1932: Lingn. Sci. J. **11**, 101	*Vitis embergeri* Galet. 1988. Cep. Viqn. Fr. 1, 136.
Vitis xunyangensis. P. C. HE, 1995: Acta Univ. Agric. Boreali-occidentalis **23**, 121	-

Tab. 1, continued

Species name and its original citation	Synonyms and their citations
Vitis flexuosa Thunb. 1793: Trans. Linn. Soc. Lond. **2**, 103	*Vitis wallichii* 1824. DC. Prodr. 1, 634.; *V. purani* Don. 1825. Prondr. Fl. Nepal. 188.; *V. parvifolia* Roxb. 1832. Fl. Ind. ed. 2.1, 662.; *V. vulpina* L. var. *parvifolia* Regel. 1873. Acta Hort. Petrop. 2, 394.; *V. flexuosa* Thunb. f. *typica* Planch.1887. DC. Monogr. Phan. 5, 347.; *V. flexuosa* Thunb. f. *parvifolia* Planch..1887. DC. Monogr. Phan. 5, 348.; *V. flexuosa* Thunb. var. *chinensis* Veitch.1904. J. Hort. Soc. Lond. 28, 393. nom. subnud; *V. cavaleriei* Lévl. 1905. Bull. Soc. Agric. Sci. Arts Sarthe. 40, 36.; *V. flexuosa* Thunb. var. *parvifolia* (Roxb.) Gagnep.1911. Sarg. Pl. Wils. 1, 103.
Vitis amurensis Rupr. 1857: Bull. Acad. Sci. St. Pétersb. **15**, 266	*Vitis vinifera* L. var. *amurensis* Regel. 1861. Gartenfl. 10, 312. t. 339.; *V. amurensis* Rupr. var. *genuina* Skvorts.1931. Chinese J. Sci. Arts. 15, 200.; *V. thunbergii* auct. non Sieb. and Zucc. 1886. Hemsl., J. Linn. Soc. Bot. 23, 136.
Vitis amurensis Rupr. var**.** *dissecta* Skvorts. 1993: Chinese J. Sci. Arts. **15**, 200	*V. baihuashanensis* M. S. Kang et D. Z. Lu. 1993. Acta Phytotax. Sinica 31, 70.
V. yeshanensis J. X. Chen, 1979: Acta Phytotax. Sinica **17**, 74 and 85	*Vitis amurensis* Rupr. var. *yanshanensis* D. Z. Lu et H. P. Liang, 1993. J. Beijing. Forestry Univ. 15, 134.
V. pentagona Diels and Gilg. 1900: Engler's Bot. Jahrb. **29**, 460	*Vitis heyneana* Roem. and Schult. 1820. Syst. 5, 318; *Vitis lanata* Roxb.1824. Fl. Ind. 2, 474.; *V. thunbergii* Sieb. and Zucc. var. *yunnanensis* Planch. ex Franch. 1886. Bull. Soc. Bot. Fr. 33, 457.; *V. ficifolia* Bge. var. *pentagona* Pamp., Nuov. Giorn. 1910. Bot. Ital. 17, 116.; *V. pentagona* Diels and Gilg var. *honanensis* Rehd..1920. Bailey, Gent. Herb. 1, 36. ; *V. kelungensis* Momiyama, 1935. J. Jap. Bot. 11 (7), 827.; *V. quinquangularis* Rehd. 1945. J. Arn. Arb. 26, 480. ; *V. coignetiae* auct. non Pulliae ex Planch.(1883), Diels and Gilg. 1900. Engler's Bot. Jahrb. 29, 461. 1900; *V. betulifolia* auct. non Diels and Gilg (1900). 1986. Flora of Xizang 3, 225.
Vitis heyneana subsp.. *ficifolia* (Bge.). C. L. Li, 1996: Chinese. J. Appl. Environ. Biol. **2**, 234-253	*Vitis ficifolia* Bge. 1835. Mém. Div. Sav. Acad. Sci. St. Pétersb. 2, 86.; *V. thunbergii* Sieb. and Zucc. 1845. Abh. Math.-Phys. Cl. Akad. Wiss. Munch. 4 (2), 198.; *V. labrusca* L. var. *ficifolia* Regel. 1873. Gartenfl. 22, 203.; *V. labrusca* acut. non L.(1753), Hemsl.. 1886. J. Linn. Soc. Bot. 23, 134.
Vitis adenoclada Hand. and Mazz.1925: Naturw. K1.62, 145	-
Vitis retordii Roman. du Cail. Ex Planch. 1887: DC. Monogr. Phan. **5**, 613	*Vitis lanata* auct. non Roxb. (1824), Laws. 1875. Hook. Fl. Brit. Ind. 1, 651.
Vitis menghaiensis. C. L. Li, 1996: Chinese J. Appl. Environ. Biol. **2**, 250	-
Vitis longquanensis. P. L. Qiu, 1990: Bull. Bot. Res. **10**, 41	-
Vitis bellula **(**Rehd.) W. T. Wang, 1979: Acta Phytotax. Sinica **17**, 74 et 86	*Vitis pentagona* Diels and Gilg var. *bellula* Rehd. 1917. Sarg. Pl. Wils. 3, 428.; *V. quinquangularis* Rehd. var. *bellula* (Rehd.) Rehd. 1945. J. Arn. Arb. 26, 480.
Vitis bellula var. *pubigera.* C. L. Li, 1996: Chinese J. Appl. Environ. Biol. **2**, 251	*Vitis pentagona* Diels and Gilg var. bellula auct. non Rehd. (1917), Hand.-Mazz. 1933.Symb. Sin. 7, 678.
Vitis bashanica P. C. He, 1995: Acta Univ. Agric. Boreali-occidentalis **23** (5), 121	-

Tab. 1, continued

Species name and its original citation	Synonyms and their citations
Vitis hui Cheng. 1935: Contr. Biol. Lab. Sci. Soc. China. **10**, 78	-
Vitis sinocinerea. W. T. WANG, 1979: Acta Phytotax. Sinica **17** (3), 76 and 86	*Vitis thunbergii* Sieb. and Zucc. var. *cinerea* Gagnep. 1911. Sarg. Pl. Wils. 1, 105.; *V. thunbergii* Sieb. and Zucc. var. *taiwaniana* Lu. 1977. Flora of Taiwan 3, 679. pl. 773.; *V. thunbergii* Sieb. and Zucc var. *adstricta* auct. non (Hance) Gagnep. (1911), Li. 1963. Woody Fl. Taiwan. 531. f. 205.
Vitis bryoniaefolia Bge., Mém. 1835: Div. Sav. Acad. Sci. St. Pétersb. **2**, 95	*Vitis adstricta* Hance.1882. J. Bot. 20, 258. ; *V. flexuosa* Thunb. var. *mairei* Lévl., Fedde, Repert. Sp. Nov. 7, 340. 1909 et Cat. 1915. Pl. Yunnan. 8.; *V. thunbergii* Sieb. and Zucc. var. *adstricta* (Hance) Gagnep.1911. Bull. Soc. Hist. Nat. Autun. 24, 32. 1911 et, Sarg. Pl. Wils. 1, 105.; *V. novisinensis* Vass. 1957. Not. Syst. Herb. Inst. Bot. Acad. Sci. URSS 18, 167. f. 1.; *V. thunbergii* Sieb. and Zucc. var. *mairei* (Lévl.) Lauener. 1967. Notes Roy. Bot. Gard. Edinb. 27(3), 286.; *V. bryoniaefolia* Bge. var. *multilobata* S. Y. Wang et Y. H. Hu. 1988. Flora of Henan 2, 597.; *V. vinifera* auct. non L. (1753), Hemsl., J. Linn. Soc. Lond. Bot. 23, 136. 1886. p. p.; *V. thunbergii* auct. non Sieb. and Zucc.(1845), Franch. 1890. Pl. Delav. 137.
Vitis bryoniaefolia var. *ternate* (W. T. Wang). C. L. LI, 1996: Chinese J. Appl. Environ. Biol. **2**, 253	*Vitis adstricta* Hance var. *ternata* W. T. Wang. 1979. Acta Phytotax. Sin. 17(3), 76 and 87.
Vitis lanceolatifoliosa. C. L. LI, 1996: Chinese. J. Appl. Environ. Biol. **2**, 253	*Vitis piasezkii* Maxim. var. *angustata* W. T. Wang. 1988. Guihaia 8 (2), 112.

shenxiensis C. L. Li and *Vitis romanetii* Roman. Du Caill. ex Planch (He et al. 1996). Extending this morphological study to 110 traits and 22 Chinese grape species, NIU and HE (1996) found that most types of *Vitis piasezkii* Maxim were closely related to *Vitis amurensis* Rupr., but some types were close to *Vitis bashanica* P. C. He, suggesting *Vitis piasezkii* may be a polyphyletic species (NIU and HE, 1996). Some scientists consider that some types of *Vitis piasezkii* should be classified as a separate species, named *Vitis tibaensis* Niu L. X. (NIU and HE 1995), *Vitis lanceolatifoliosa* C. L. Li (LI *et al.* 1996, LI 1998)) and *Vitis shenxiensis* C. L. Li (LI *et al.* 1996, LI 1998).

The species of *Vitis xunyangensis* P. C. HE has slim shoots, tiny leaves and small round pollen that is far different from other *Vitis* species, suggesting that it may be a separate species (NIU and HE 1995). *Vitis yeshanensis* has been considered a variety of *Vitis amurensis* (LU and LIANG 1993) or was merged with *Vitis amurensis* Rupr. var. *dissecta* Skvorts (LI 1998, KONG 2004). But the leaf and shoot morphology as well as drought tolerance and cold hardiness of *Vitis yeshanensis* J. X. CHEN are different from those of *Vitis amurensis*, suggesting that it may be a separate species (HE 1999 a, NIU and HE 1996).

In terms of evolutionary relationships, it is thought that an erect, bush-like habit, narrow, unlobed elongated leaves and unbranched, exemplified by *Vitis hancockii* Hance, represent primitive character states (NIU and HE 1996, KONG 2004). Leaves that are wide or round, simple or compound as well as branched tendrils are thought to be derived characters making *Vitis amurensis* Rupr., *Vitis yeshanensis* J. X. Chen, *Vitis davidii* (Roman. Du Caill.) Föex, *Vitis romanetii* Roman. Du Caill. ex Planch, and *Vitis piasezkii* Maxim et al. derived species (NIU and HE 1996, HE *et al.* 1999 a, KONG 2004). Similarly, complex trichomes as seen in *Vitis davidii* (Roman. Du Caill.) Föex, *Vitis romanetii* Roman, and *Vitis wuhanensis* C. L. LI *et al.* are also thought to be derived (NIU and HE 1996, KONG 2004). Chinese grape species are highly diverse suggesting a possibly polyphyletic origin (NIU and HE 1996, KONG 2004).

As more Chinese grapes are discovered more questions on the taxonomy of Chinese grapes will be raised. But also, as molecular, morphological and breeding work continues to be applied to Chinese *Vitis* species the large gaps in current knowledge will gradually be filled, species will be better characterized and evolutionary relationships will be more fully elucidated.

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Table 2

Chinese wild grape species: Classification differences

Species	Classification differences
Vitis adstricta Hance	1) As one variety of *Vitis bryoniaefolia* Bge., named "*Vitis bryoniaefolia* var. *mairei* (Lēvl) W. T. Wang "(Wang 1988); 2) merged into *Vitis bryoniaefolia* Bge. (Li 1998); 3) *Vitis adstricta* Hance and *Vitis bryoniaefolia* Bge. were two separate species (Wang *et al.* 2000).
Vitis yuenlingensis W. T. Wang (Wang 1989)	1) Excluded in the *Vitis* taxonomic index of *China Flora* (Li 1998); 2) as a separate species (Wang 2000)
Vitis shimenensis W. T. Wang (Wang 1989)	1) Merged with *Vitis betulifolia* Diels and Gilg (Li 1998); 2) as a separate species (Wang *et al.* 2000)
Vitis piasezkii Maxiim. var. *angusta* W.T. Wang (Wang 1988)	1) Merged with *Vitis lanceolatifoliosa* C. L. Li (Li 1998)
Vitis wentsaiana P. L. Chiu (Chiu 1990)	Merged with *Vitis hancockii* Hance (Li 1998)
Vitis baihuashanensis M. S. Kang et D. Z. Lu	1) Merged with *Vitis amurensis* Rupr. var**.** *dissecta* Skvorts (Li 1998); 2) as a separate species (Wang *et al.* 2000)
Vitis amurensis Rupr. var. *yanshanensis* D. Z. Lu et H. P. Liang (Lu *et al.* 1993)	1) Merged with *Vitis amurensis* Rupr. var**.** *dissecta* Skvorts (Li 1998); 2) as a separate species, named "*Vitis yeshanensis* J. X. Chen"(He 1994),
Vitis jinzhanaiensis X. S. Shen (Shen 1989)	1) Was considered that its variations were within those of *Vitis amurensis* Rupr. (Li 1989); 2) as a separate species (Wang *et al*. 2000)
Vitis qinlingensis P. C. He (Niu and He 1995)	Excluded in the *Vitis* taxonomic index of *China Flora* (Li 1998)
Vitis xunyangensis P. C. He (Niu and He 1995)	Excluded in the *Vitis* taxonomic index of *China Flora* (Li 1998)
Vitis tiubaensis Niu L. X. (Niu and He 1995)	Merged with *Vitis piasezkii* Maxim (Li 1998)
Vitis davidii Foëx var. *ningqiangensis* Niu L. X. (Niu and He 1995)	Excluded in the *Vitis* taxonomic index of *China Flora* (Li 1998)
Vitis flexuosa Thunb. var. *parvifolia* (Roxb.) Gagnep	Was considered that its variations were within those of *Vitis flexuosa* Thunb. (Li 1998)

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