

***STUBENDORFFIA* AND *WINKLERA* BELONG TO THE EXPANDED *LEPIDIUM* (BRASSICACEAE)**

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The genus *Stubendorffia* (Brassicaceae) is distinguished from *Lepidium* solely by the dehiscent vs. indehiscent angustiseptate fruits. By contrast, *Winklera* is separated from *Lepidium* by a combination of perennial habit, pinnatisect leaves, yellow flowers, and wingless fruits, characters all of which occur individually and in various combinations within *Lepidium*. Extensive molecular studies strongly show that *Winklera* and polyphyletic *Stubendorffia* are nested within the earlier-published *Lepidium* and, therefore, the three genera are herein formally united. The new name *Lepidium pavlovii* and 10 new combinations, *L. afghanicum*, *L. apterum*, *L. botschantzevii*, *L. curvinervium*, *L. lipskyi*, *L. olgae*, *L. orientalis*, *L. patrinooides*, *L. pterocarpum*, and *L. silaifolium*, are proposed. *Lepidium apterum* is lectotypified. A complete generic synonymy of *Lepidium* and an expanded generic description are presented.

Keywords. Brassicaceae, generic synonymy, *Lepidium*, new combinations, new name, *Stubendorffia*, typification, *Winklera*.

INTRODUCTION

Lepidium L. is a cosmopolitan genus distributed on all continents except Antarctica (Al-Shehbaz, 1986). It is easily distinguished from other genera of the Brassicaceae by the angustiseptate, often dehiscent fruits, one (rarely two) subapical ovules/seeds per locule, and (when present) simple trichomes. Nearly 50% of the species have flowers with two stamens, a feature not found elsewhere in the family. The three species previously assigned to *Cardaria* Desv. and now in *Lepidium* sometimes have two ovules per locule, and two of these species, *L. chalepense* L. and *L. appelianum* Al-Shehbaz, have inflated instead of angustiseptate fruits. For further discussion on these exceptions, see Al-Shehbaz *et al.* (2002).

Based on extensive molecular studies (e.g. Mummenhoff, 1995; Mummenhoff *et al.*, 1995, 2001; Bowman *et al.*, 1999; Brüggemann, 2000) and detailed morphological studies (Appel & Al-Shehbaz, 2003), the limits of *Lepidium* were expanded by Al-Shehbaz *et al.* (2002) and Al-Shehbaz (2003) to include all species of *Cardaria*, *Coronopus* Zinn, and *Stroganowia* Kar. & Kir. More recent molecular studies (e.g.

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Franzke *et al.*, 2009; German *et al.*, 2009; Mummenhoff *et al.*, 2009; Couvreur *et al.*, 2010) further confirmed the above taxonomic conclusions and clearly showed that *Winklera* Regel (two species) and *Stubendorffia* Schrenk ex Fisch. (nine species) are nested within *Lepidium*. These 11 species are transferred herein to *Lepidium*. As a result, the genus is further expanded to include about 250 species, compared to earlier estimates of 175 species (Al-Shehbaz, 1986) and 220 species (Appel & Al-Shehbaz, 2003). *Stubendorffia subdidyma* N.Busch was transferred earlier to *Isatis* L. by Avetisian (1982), a position with which we agree based on floral and fruit morphology.

The extensive molecular studies above, and others (e.g. Mummenhoff *et al.*, 2004), amply demonstrated that *Coronopus*, *Stroganowia*, and *Stubendorffia* are polyphyletic and each evolved from various lineages within *Lepidium*. Despite the overwhelming molecular evidence, some authors (e.g. Dorofeyev *et al.*, 2004; Holmgren, 2005; Dorofeyev, 2006; Karpova, 2006; Karpova & Grigoreva, 2007) still maintain a polyphyletic *Stroganowia*. In agreement with Rollins (1982) and Holmgren (2005), the western North American *Stroganowia tiehmii* Rollins (now *L. tiehmii* (Rollins) Al-Shehbaz) evolved from Central Asian ancestors (Mummenhoff *et al.*, 2009).

A comprehensive account of the generic synonyms of *Lepidium*, a detailed description of the expanded genus, and nomenclatural adjustments resulting from the merging of *Stubendorffia* and *Winklera* with *Lepidium* are presented below.

EXPANDED GENERIC DESCRIPTION AND SYNONYMY

- Lepidium** L., Sp. Pl. 2: 643 (1753). – Type: *Lepidium latifolium* L. (lecto designated by Britton & Brown, 1913: 164).
- Carara* Medik., Pflanzen-Gatt. 34 (1792). – Type: not designated.
- Cardaria* Desv., J. Bot. Agric. 3: 163 (1815). – Type: *Cardaria draba* (L.) Desv. (= *Lepidium draba* L.).
- Cardamon* (DC.) Fourr., Ann. Soc. Linn. Lyon ser. 2, 16: 338 (1868). – Type: *Cardamon sativum* (L.) Fourr. (= *Lepidium sativum* L.).
- Coronopus* Zinn, Cat. Pl. Hort. Gott. 325 (1757), nom. cons., non *Coronopus* Mill., Gard. Dict. Abr. ed. 4 (1754), nom. rej. – Type: *Coronopus ruellii* All. = *Cochlearia coronopus* L. (= *Lepidium coronopus* (L.) Al-Shehbaz).
- Cotylicus* Desv., J. Bot. Agric. 3: 164 (1815). – Type: *Cotylicus niloticus* (Delile) Desv. = *Cochlearia nilotica* Delile (= *Lepidium niloticum* (Delile) Sieber ex Steud.).
- Hymenophysa* C.A.Mey. ex Ledeb., Icon. Pl. Nov. 2: 20 (1830). – Type: *Hymenophysa pubescens* C.A.Mey. (= *Lepidium appelianum* Al-Shehbaz).
- Kandis* Adans., Fam. 2: 422 (1763). – Type: *Kandis perfoliata* (L.) Kerguélen (= *Lepidium perfoliatum* L.).
- Lepicocchia* Rojas Acosta, Bull. Acad. Int. Geogr. Bot. 28: 165 (1918). – Type: *Lepicocchia americana* Rojas Acosta (= *Lepidium didymum* L.).
- Monoploca* Bunge in Lehm., Pl. Preiss. 1: 259 (1845). – Type: not designated.

- Nasturtiohum* Medik., Pflanzen-Gatt. 82 (1792), non *Nasturtiohum* Gray, Nat. Arr. Brit. Pl. 2: 692 (1792). – Type: *Nasturtiohum castratum* Medik., nom. illeg. (= *Lepidium didymum* L.).
- Neolepia* W.A.Weber, Phytologia 67: 427 (1989). – Type: *Neolepia campestris* (L.) W.A.Weber (based on *Thlaspi campestre* L.) (= *Lepidium campestre* (L.) W.T.Aiton).
- Papuzilla* Ridl., Trans. Linn. Soc. London, Bot. ser. 2, 9: 17 (1916). – Type: *Papuzilla minutiflora* Ridl. (= *Lepidium minutiflorum* (Ridl.) Hewson).
- Physolepidium* Schrenk in Fisch. & C.A.Mey., Enum. Pl. Nov. 1: 97 (1841). – Type: *Physolepidium repens* Schrenk (= *Lepidium chalepense* L.).
- Senebiera* DC., Bull. Sci. Soc. Philom. Paris 1: 172 (1798). – Type: not designated.
- Sprengeria* Greene, Leaf. Bot. Observ. Crit. 1: 198 (1905). – Type: *Sprengeria flava* (Torr.) Greene (= *Lepidium flavum* Torr.).
- Stroganowia* Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 14: 386 (1841). – Type: *Stroganowia sagittata* Kar. & Kir. (lecto designated by Botschantsev, 1984: 73) (= *Lepidium sagittatum* (Kar. & Kir.) Al-Shehbaz).
- Stubendorffia* Schrenk ex Fisch., Index Seminum Hortus Petrop. 9: Suppl. 20 (1844), **syn. nov.** – Type: *Stubendorffia orientalis* Schrenk ex Fisch. (= *Lepidium orientale* (Schrenk) Al-Shehbaz & Mummenhoff).
- Uranodactylus* Gilli, Feddes Repert. Sp. Nov. Regni Veg. 61: 209 (1959). – Type: *Uranodactylus afghanicus* Gilli (= *Lepidium silaifolium* (Hook.f. & Thomson) Al-Shehbaz & Mummenhoff).
- Winklera* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 617 (1886), non *Winkleria* Rchb., Deutsch. Bot. Herbarienbuch 236 (1841), **syn. nov.** – Type: *Winklera patrinoides* Regel (= *Lepidium patrinoides* (Regel) Al-Shehbaz & Mummenhoff).

Herbs, annual, biennial, or perennial with caudex, sometimes subshrubs, rarely shrubs or lianas. *Trichomes* absent or simple. *Multicellular glands* absent. *Stems* erect or ascending, sometimes creeping, simple or branched basally and/or apically. *Basal leaves* rosulate or not, simple, entire or variously toothed or divided and 1–3-pinnatisect; cauline leaves petiolate or sessile, base cuneate, attenuate, auriculate, sagittate, or amplexicaul, margin entire, dentate, or dissected. *Racemes* often many flowered, ebracteate, corymbose, elongated or not in fruit; fruiting pedicels terete, flattened, or winged, erect to divaricate, persistent. *Sepals* ovate or oblong, rarely orbicular, free, caducous or persistent, erect to spreading, equal, base of lateral pair not saccate. *Petals* white, yellow, pink, or purple, erect or spreading, longer to shorter than sepals, sometimes rudimentary or absent; blade obovate, spatulate, oblong, oblanceolate, orbicular, linear, or filiform, apex obtuse, rounded, or emarginated; claw absent or distinct and shorter than sepals, glabrous, unappendaged, entire. *Stamens* 2 or 4 and equal in length, lateral or median, or 6 and usually tetradynamous; filaments wingless, unappendaged, glabrous, free; anthers ovate or oblong, not apiculate. *Nectar glands* 2, 4, or 6, distinct; median glands often present. *Ovules* 2(–4) per ovary; placentation apical. *Fruit* dehiscent silicles, rarely indehiscent and samaroid or schizocarpic and breaking into two 1-seeded, nutletlike

halves, oblong, ovate, obovate, cordate, obcordate, elliptic, orbicular, didymous, ovoid, obovoid, or globose, strongly angustiseptate or 4-angled, rarely inflated and terete, sessile, unsegmented; valves papery, leathery, or woody, veinless or prominently veined, glabrous or pubescent, strongly keeled or rarely rounded, apically winged or wingless, unappendaged, readily releasing or enclosing seed; gynophore absent; replum rounded, visible; septum complete or perforated, not veined; style absent, obsolete, or distinct, included or exerted from apical notch of fruit; stigma capitate, entire or rarely 2-lobed. *Seeds* 1(or 2) per locule, winged, margined, or wingless, oblong or obovate, plump or flattened; seed coat smooth, minutely reticulate, or papillate, copiously or rarely not mucilaginous when wetted; cotyledons incumbent, rarely accumbent or diplocolobal.

NEW COMBINATIONS AND NEW NAME

Lepidium afghanicum (Rech.f. & Köie) Al-Shehbaz & Mummenhoff, **comb. nov.**
– *Stubendorffia afghanica* Rech.f. & Köie, Anz. Österr. Akad. Wiss., Mat.-Naturwiss. 91: 60 (1954), non *Lepidium affghanum* Boiss., Fl. Orient. 1: 358 (1867). – *Winklera afghanica* (Rech.f. & Köie) Hedge, Fl. Iranica 57: 74 (1968). – Type: Afghanistan, Farakulum, 3200 m, 21 vii 1948, *M.E. Köie* 3007 (holo C; iso W!).

Distribution. Afghanistan.

Lepidium apterum (Lipsky) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Stubendorffia aptera* Lipsky, Trudy Imp. S.-Peterburgsk. Bot. Sada 18: 17 (1900). – Type: Tajikistan/Uzbekistan, Hissar Range, Sari Socho Pass, 7000 ft, 11 vi 1897, *V.I. Lipsky* 239 (lecto LE!, annotated by V.I. Dorofeyev and formally designated here; isolecto LE!).

Distribution. Tajikistan, Uzbekistan.

Lepidium botschantzevii (R.Vinograd.) Al-Shehbaz & Mummenhoff, **comb. nov.**
– *Stubendorffia botschantzevii* R.Vinograd., Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. S.S.R. 19: 7 (1974), non *Lepidium botschantzevianum* Al-Shehbaz, Novon 12: 8 (2002). – Type: Uzbekistan, Pamir Alaj, Alaisky Mt., slope of Yorgan River, Kara Zhora, 18 vi 1963, *Aigarova & Ubuneeva* s.n. (holo LE!).

Distribution. Uzbekistan.

Lepidium curvinervium (Botsch. & Vved.) Al-Shehbaz & Mummenhoff, **comb. nov.**
– *Stubendorffia curvinervia* Botsch. & Vved., Not. Syst. Herb. Inst. Bot. Acad. Sci. Uzbekistan 13: 14 (1952). – Type: Uzbekistan, Shakhimardan, Shaliang, 1650 m, 26 vi 1949, *Shafeev* s.n. (holo TASH).

Distribution. Uzbekistan.

Lepidium lipskyi (N.Busch) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Stubendorffia lipskyi* N.Busch, Trudy Bot. Muz. Imp. Akad. Nauk 10: 125 (1913). – Type: Kazakhstan, Tian Shan Mts., valley west of River Karakol, 23 vi 1908, *R. Roshevitz* 1359 (holo LE!).

Distribution. Kazakhstan, Uzbekistan.

Lepidium olgae (R.Vinograd.) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Stubendorffia olgae* R.Vinograd., Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. S.S.R. 19: 8 (1974). – Type: Uzbekistan, Pamir Alaj, Mt. Nuratau, 15 v 1941, *Momotov* s.n. (holo TASH).

Distribution. Uzbekistan.

Lepidium orientale (Schrenk) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Stubendorffia orientalis* Schrenk ex Fisch., Index Seminum Hortus Petrop. 9: Suppl. 21 (1844). – Type: Kazakhstan, Khantau Mts., steppes near Dala-Ghainar stream, *A.G. Schrenk* s.n. (holo LE!).

Distribution. Kazakhstan, Tajikistan, Uzbekistan.

Lepidium patrinoides (Regel) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Winklera patrinoides* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 617 (1886). – *Uranodactylus patrinoides* (Regel) Gilli, Feddes Repert. Sp. Nov. Regni Veg. 66: 194 (1962). – Type: Tajikistan? (as Turkestan), Bukhara, *Regel* s.n. (lecto LE!), designated by Jafri, 1973: 66).

Winklera patrinoides Regel subsp. *chitralica* Jafri, Fl. W. Pakistan 55: 66 (1973). – Type: Pakistan, Chitral, Shah Jinali, 3700 m, 28 vi 1958, *Bowes Lyon* 1024 (holo BM!).

Distribution. Pakistan, Tajikistan.

Lepidium pavlovii Al-Shehbaz & Mummenhoff, **nom. nov.** – *Stroganowia gracilis* Pavlov, Bot. Zhurn. (Moscow & Leningrad) 18: 365 (1933), non *Lepidium gracile* (Chodat & Hassl.) Boelcke, Parodiana 4: 36 (1986). – *Stubendorffia gracilis* (Pavlov) Botsch. & Vved., Bot. Mater. Gerb. Bot. Inst. Uzbekistansk. Fil. Akad. Nauk S.S.S.R. 3: 20 (1941). – Type: Kazakhstan, Karatau Mt., slopes facing Dschalanasch-ata, near Karnak, 21 v 1931, *N. Graz-Gusseva* s.n. (holo MW).

Distribution. Kazakhstan.

The species is re-named in honour of its discoverer Nikolai Vasilievich Pavlov (1893–1971).

Lepidium pterocarpum (Botsch. & Vved.) Al-Shehbaz & Mummenhoff, **comb. nov.** – *Stubendorffia pterocarpa* Botsch. & Vved., Bot. Mater. Gerb. Bot. Inst. Uzbekistansk.

Fil. Akad. Nauk S.S.S.R. 3: 20 (1941). – Type: Uzbekistan, W Tian Shan, Valley of river Shatkal, upper banks of river Sandalash, basin of river Ajik-Tash, 2650 m, 14 viii 1938, *Piyataeva & Momotov 727* (holo TASH).

Distribution. Uzbekistan.

Lepidium silaifolium (Hook.f. & Thomson) Al-Shehbaz & Mummenhoff, **comb. nov.**

– *Heldreichia silaifolia* Hook.f. & Thomson, J. Linn. Soc., Bot. 5: 176 (1861).

– *Winklera silaifolia* (Hook.f. & Thomson) Korsh., Bull. Acad. Petersb. ser. V, 9: 419 (1898). – *Uranodactylis silaifolius* (Hook.f. & Thomson) Gilli, Feddes Repert. Sp. Nov. Regni Veg. 66: 194 (1962). – Type: Afghanistan, Siahsung, *Griffith* s.n. (holo K!).

Uranodactylus afghanicus Gilli, Feddes Repert. Sp. Nov. Regni Veg. 61: 209 (1959).

– Type: Afghanistan, Band-e-Amir, 2950 m, 29 viii 1951, *A. Gilli* [1161-b] (holo W).

Lepidium hindukushense Kitam., Acta Phytotax. Geobot. 19: 97 (1963). – Type:

Pakistan, Hindukush, between Diwangar and Ghizar, 4200 m, 10 viii 1957, *K. Ogino 409* (holo KTO).

Distribution. Afghanistan, Pakistan, Tajikistan.

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