



## Some nomenclatural adjustments and typifications for almond species in the genus *Prunus sensu lato* (Rosaceae)

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### Abstract

*Prunus dulcis* (common almond) is an important horticultural nut crop with an annual production value in the billions of U.S. dollars. The genus *Prunus* is taxonomically complex, and over the centuries treatments have ranged from splitting the genus into multiple genera, with *P. dulcis* and relatives being placed in the genus *Amygdalus*, to having a single, widely circumscribed *Prunus* s. l. Recent phylogenetic studies based on molecular data support the adoption of a broadly circumscribed *Prunus*, and the widespread acceptance and usage of *Prunus* s.l. warrants nomenclatural adjustments for *Amygdalus* species. Twenty-two new combinations, one nomen novum, and one new nothospecies are proposed. In addition, two lectotypes and three neotypes are here designated.

**Keywords:** *Amygdalus*, breeding, *comb. nov.*, *nom. nov.*, nut species

### Introduction

The common almond [*Prunus dulcis* (Miller 1768: without page) Webb in Heywood (1967: 24)] is one of the most important nut crops in the world, in both production yield and overall value (FAOSTAT 2014). California (USA) produces the majority of the world's almond crop, with this portion alone having a production value of over 4 billion US dollars (USDA-NASS 2013). Other countries having a significant amount of almond production are Iran, Italy, Morocco, Syria, and Spain (FAOSTAT 2014). *Prunus dulcis* has a long history of cultivation (Candolle 1890, Kester *et al.* 1991, Zohary & Hopf 2000, Gradziel 2010). Through the domestication process, humans have had a significant impact on the development and distribution of this and related species (Lansari *et al.* 1994, Martínez-Gómez *et al.* 2007). In addition to the cultivation of *P. dulcis*, the use of interspecific hybridization between this species and its related ones is a potentially valuable way to gain new desirable traits such as later flowering time, cold tolerance, disease resistance, and rootstock development (Denisov 1988, Gradziel *et al.* 2001).

*Prunus* Linnaeus (1753: 473) is a large and complex genus, and over the centuries botanists have proposed many classifications. Tournefort (1700) recognized six genera: *Amygdalus* Linnaeus (1753: 472), *Armeniaca* Scopoli (1754: 15), *Cerasus* Miller (1754: without page), *Laurocerasus* Duhamel du Monceau (1755: 345), *Persica* Miller (1754: without page), and *Prunus*. Linnaeus (1753, 1754) considered two separate genera, *Amygdalus*, into which he merged Tournefort's *Persica*, and *Prunus*, into which he merged Tournefort's *Armeniaca*, *Cerasus*, *Laurocerasus*, and *Padus* (Miller 1754: without page). Münchhausen (1770) and Batsch (1801) were two early authors who adopted *Prunus* s.l., recognizing distinct subgroups as the “untergeschlect” *Armeniaca* (Scop.) Münchhausen (1770: 237), *Cerasus* (Mill.) Münchhausen (1770: 237), *Padus* (Mill.) Münchhausen (1770: 239), and *Prunus* (L.) Münchhausen (1770: 234), and, “unterabtheilungen der gattung *Prunus*,” *Acacia* Batsch (1801: 26) [= *Prunus* s.str.], *Amygdalus* (L.) Batsch (1801: 29), *Armeniaca*, *Cerasus*, and *Padus*, respectively. There has been question as to the rank denoted by the words “untergeschlect” and “unterabtheilung”. Brizicky (1969) made a strong case for recognition of untergeschlect, untergattung, and unterabtheilung at the subgeneric rank, citing the specific usage of these words by Münchhausen (1770) and Du Roi (1771, 1772).

Miller (1754) and some later works, such as Candolle (1825), Kovalyov & Kostina (1935), Linczevski & Fedorov

(1941), Hutchinson (1964), Yü *et al.* (1986) and Takhtajan (1997), took a narrower approach, splitting *Prunus* sensu lato into multiple genera [*Amygdalopsis* Roemer (1847: 15), *Amygdalopsis* Carrière (1862: 91), *Amygdalus* L., *Armeniaca* Scop., *Cerasus* Mill., *Cerasedos* Siebold & Zuccarini (1843: 743), *Emplectocladus* Torrey (1851: 192), *Laurocerasus* Duhamel, *Louiseania* Carrière (1872: 34), *Maddenia* Hooker & Thomson (1854: 381), *Microcerasus* Roemer (1847: 93), *Padus* Mill., *Persica* Mill., *Prunus* L. sensu stricto, and *Pygeum* Gaertner (1788: 218)]. Others authors maintained the genus *Prunus* s.l., recognizing groups at sectional or subgenera levels (Batsch 1801, Bentham & Hooker 1865, Focke 1888, Koehne 1893, McVaugh 1951, Chin *et al.* 2010, Shi *et al.* 2013). Rehder (1940) considered five subgenera: *P.* subg. *Amygdalus* (L.) Batsch (1801: 29), *P.* subg. *Cerasus* (Mill.) Petermann (1846: 159), *P.* subg. *Laurocerasus* (Duhamel 1755: 345) Koehne (1893: 303), *P.* subg. *Padus* (Mill.) Petermann (1846: 159), and *P.* subg. *Prunophora* Focke (1888: 52) (= *Prunus* s.str.), and this general circumscription has subsequently been followed by many other authors and taxonomists (e.g. Robertson 1974). In Rehder's treatment, *P. dulcis*, *P. persica* (L.) Batsch (1801: 30) and related species, all fall within *Prunus* subgen. *Amygdalus*. Some botanists, particularly from regions in Europe and Asia, have maintained the generic status of *Amygdalus* (Zhukovsky 1971, Zohary 1972, Browicz 1989, Browicz & Zohary 1996, Czerepanov 2007, Vafadar *et al.* 2014).

Treatments for *Prunus* and its associated genera vary in different regional floras. *Flora Europaea* adopted Rehder's treatment for a broadly circumscribed *Prunus* with five subgenera, while other works (such as *Flora Iranica*, *Flora of Iran*, *Flora Palaestina*, *Flora of Turkey* and *Flora of the USSR*) recognized *Amygdalus* as a distinct genus (Linczevski & Fedorov 1941, Tutin *et al.* 1968, Browicz 1969, Zohary 1972, Davis 1979, Khatamsaz 1993). Even some recent floristic works, such as the *Flora of China*, have recognized *Amygdalus* at the generic level (in this case, with the inclusion of peach species), although the authors noted that their treatment was, "relatively traditional, with some of the generic treatments arguably out of date." (Lu & Bartholemew 2003).

Acceptance for the placement of almond species into *Prunus* has become widespread, even in regions where recognition of *Amygdalus* as a separate genus has traditionally been maintained (MirAli & Nabusi 2007, Sorkheh *et al.* 2009, 2012, Rahemi *et al.* 2010, Gradziel & Martínez-Gómez 2013). The draft *Prunus* treatment that has been prepared for the Flora of North America Project does not recognize *Amygdalus* as a separate genus (Joseph Rohrer, personal communication), and horticultural researchers throughout much of the world have also adopted the *Prunus* s.l. treatment (Kester *et al.* 1991, Arús *et al.* 2009, Madam *et al.* 2011, Potter 2011, Gradziel & Martínez-Gómez 2013). In the *Vascular Plant Families and Genera*, Brummitt (1992) listed *Amygdalus* as a synonym of *Prunus*, and Kalkman (2004) included *Amygdalus* in *Prunus* as well. Major taxonomic databases such as the USDA Plants Database, The Integrated Taxonomic Information System (ITIS), Euro+Med Plantbase, and Catalog of Life (<http://www.catalogueoflife.org/>) have also adopted the use of a more broadly circumscribed *Prunus* (Kurtto 2009, ITIS 2014, Roskov *et al.* 2014, USDA-NRCS 2014).

The most recent phylogenetic analyses of molecular data have shown *Prunus* s.l. to be monophyletic (Bortiri *et al.* 2001, 2002, 2006, Lee & Wen 2001, Potter *et al.* 2007, Wen *et al.* 2008, Yazbek 2010, Shi *et al.* 2013, Yazbek & Oh 2013). Although these studies have all supported the recognition of *Prunus* s.l., they have varied somewhat in their subgeneric and sectional circumscriptions. Using sequences of the internal transcribed spacers of nuclear ribosomal DNA (*ITS*) from forty different species, Lee & Wen (2001) found that clades formed in the *ITS* phylogeny were not congruent with Rehder's subgeneric classification of *Prunus*. Their data supported the recognition of two major groups, an *Amygdalus-Prunus* clade, and a *Cerasus-Laurocerasus-Padus* clade. Using a combined data set of sequences from *s6pdh*, *ITS* and *trnL-trnF*, Bortiri *et al.* (2002) found similar groupings. Most recently, Shi *et al.* (2013) conducted phylogenetic analyses using twelve chloroplast regions and three nuclear genes from eighty-four species representing *Prunus* s.l.. Based on their findings, they recognized three subgenera corresponding to three main clades: *Prunus* subg. *Padus* (Mill.) Peterm., *P.* subg. *Cerasus* (Mill.) Peterm., and *P.* subg. *Prunus*, with seven sections of subg. *Prunus* being circumscribed. Almond species accordingly are assigned to *Prunus* sect. *Amygdalus* (L.) Bentham & Hooker (1865: 610) and peach species are placed in *Prunus* sect. *Persica* Nakai (1916: 32).

The infrageneric classification of *Amygdalus* has also varied over time. Persoon (1806) divided the genus *Amygdalus* into two subgenera: *A.* subg. *Persica* (Mill.) Persoon (1806: 33) and the autonym *A.* subg. *Amygdalus* (L.) Persoon (1806: 34). Spach (1843) maintained *Amygdalus* as a separate genus and developed an infrageneric classification with two series: *A.* ser. *Icosandrae* Spach (1843: 107) with four sections [*A.* sect. *Spartioides* Spach (1843: 107), *A.* sect. *Chamaeamygdalus* Spach (1843: 110), *A.* sect. *Leptopus* Spach (1843: 113), *A.* sect. *Euamygdalus* Spach (1843: 114), and *A.* ser. *Dodecandrae* Spach (1843: 120)] with two sections [*A.* sect. *Lycioides* Spach (1843: 120), and *A.* sect. *Scorpius* Spach (1843: 122)]. Denisov (1988) and Browicz & Zohary (1996) proposed modifications to Spach's treatment, divided it into two subgenera, *A.* subg. *Amygdalus* and *A.* subg. *Dodecandra* (Spach) Browicz (1969), with subg. *Amygdalus* having four sections in Denisov's classification (*A.* sect. *Amygdalus*, *A.* sect. *Chamaeamygdalus*, *A.*

sect. *Spartioides*, and *A.* sect. *Leptopus*), while Browicz and Zohary maintained three sections (*A.* sect. *Amygdalus*, *A.* sect. *Chamaeamygdalus*, and *A.* sect. *Spartioides*). All these treatments excluded *Prunus persica* and its related species from the genus *Amygdalus*. Classifications that recognized *Prunus* subg. *Amygdalus* (L.) Focke (1888: 51) have also been based on Spach's treatment. Grasselly (1976) listed six sections within *Prunus* subg. *Amygdalus* [the invalid name *Euamygdalus* (Spach) Dippel (1893: 603), and *Spartioides* (Spach) Schneider (1906: 589), *Lycioides* (Spach) Schneider (1906: 599), *Emplectocladus* (Torr.) Gray (1874: 70), *Chamaeamygdalus* (Spach) Dippel (1893: 604), and *Amygdalopsis* (Carr.) Benth. & Hooker (1865: 610)], while Kester *et al.* (1991) recognized five taxonomic sections [the invalid name *Euamygdalus* (Spach) Dippel, and *Spartioides* (Spach) Schneider, *Lycioides* (Spach) Schneider, *Chamaeamygdalus* (Spach) Dippel, and *Leptopus* Spach]. More recently, Gradziel & Martínez-Gómez (2013) divided *Prunus* subg. *Amygdalus* into an "Almond group" with four sections [the invalid name *Euamygdalus* (Spach) Dippel, and *Spartioides* (Spach) Schneider, *Lycioides* (Spach) Schneider, *Chamaeamygdalus* (Spach) Dippel and a "Peach group."].

Roemer (1847) proposed *Amygdalopsis* Roemer (1847: 4, 15) assigning two sections to the genus, sect. *Lycioides* (Spach) Roemer (l.c., 4, 15) and sect. *Scoprpius* (Spach) Roemer (l.c., 4, 15). Later, Carrière (1862: 91) published a homonym, *Amygdalopsis*, with *A. lindleyi* Carrière (1862: 91) as a superfluous name for name for *Prunus triloba* Lindley (1857: 268). This illegitimate generic name is the basionym for *Prunus* sect. *Amygdalopsis* Benth. & Hooker (1865: 610), *Amygdalus* subg. *Amygdalopsis* (Benth. & Hook.f.) Popov (1929: 359) and *Amygdalus* sect. *Amygdalopsis* (Benth. & Hook.f.) Linczevski in Linczevski & Fedorov (1941: 545). Subsequently, Carrière (1872: 34) proposed the name *Louiseania*, stating that Roemer's *Amgdalopsis* had priority.

Depending on the treatment used, there are 24 to 45 accepted almond species (Browicz 1969, Yazbek & Oh 2013, Vafadar *et al.* 2014). The highest diversity of species occurs in southwestern and central Asia, in the Irano-Turanian phytogeographic region (Zhukovshy 1971, Browicz & Zohary 1996, Gradziel 2010, Vafadar *et al.* 2010). The taxonomy of species within this group is complicated because many species have the capability to hybridize and many nothospecies have been described (Browicz & Zohary 1996). Based on recently conducted molecular analyses, Yazbek & Oh (2013) and Yazbek & Al-Zein (2014) put forth a simplified classification for *Prunus* subg. *Amygdalus*, as their data did not support the more complex sectional classifications. Their circumscription has two sections, *Prunus* sect. *Persica*, the peach-type species, and *Prunus* sect. *Amygdalus*, the almond-type species. They also removed a number of species from *P.* subg. *Amygdalus*. Two of the species, *P. tenella* Batsch (1801: 29) and *P. petunnikowii* (Litvinov 1902: 16) Rehder (1926: 29), which have been traditionally assigned to *Prunus* sect. *Chamaeamygdalus*, were determined to fall outside the monophyletic clade representing species belonging to *P.* subg. *Amygdalus*.

The genus *Emplectocladus* Torrey (1851: 92) has been merged into *Prunus* at varying ranks. Its placement in *Prunus* is sometimes attributed to Sargent (1892: 7) at the sectional level, and Mason (1913: 153) for subgeneric placement, but *Prunus* sect. *Emplectocladus* (Torr.) Gray (1874: 70) and *Prunus* subg. *Emplectocladus* (Torr.) Focke (1888: 53) have priority (Bortiri 2002, Chin *et al.* 2010; Potter 2012; Shi *et al.* 2013). The individual species associated with *Emplectocladus* have also been included in *Amygdalus* as *A. andersonii* (Gray 1868: 337) Greene (1891: 49), *A. fasciculata* (Torrey 1851: 92) Greene (1891: 49), *A. fremontii* (Watson 1880: 442) Abrams (1910: 385), *A. glandulosa* Hooker (1840: 288), *A. harvardii* Wight (1913: 133), and *A. minutiflora* (Engelmann ex Gray 1850: 185) Wight (1913: 132)]. Some authors, such as Schneider (1906), placed section *Emplectocladus* in *Prunus* subg. *Amygdalus*. Rehder (1940) did not recognize *Emplectocladus*, but merely placed *P. fasciculata* (Torr.) Gray (1874: 70) in *Prunus* subg. *Amygdalus*. Alternatively, Mason (1913: 153–154) excluded these species from *P.* subg. *Amygdalus* and assigned them to *P.* subg. *Emplectocladus* and *P.* subg. *Prunus* which was subdivided into *P.* sect. *Piloprunus* Mason [1913: 153, typified by *P. texana* Dietrich (1842: 45)] and *P.* sect. *Penarmeniaca* Mason (1913: 154, untypified but included *P. andersonii*). Jepson (1936) placed *P. fasciculata* in subg. *Emplectocladus*, and placed *P. fremontii* and *P. andersonii* in subg. *Armeniaca*. Turczaninow was the first to propose *Prunus* sect. *Armeniaca* (Scop.) Turczaninow (1843: 587), while *Prunus* subg. *Armeniaca* is properly attributed to Koch (1869: 87). Although both Endlicher (1840) and Koch (1869) listed *Armeniaca* as a subdivision of the genus *Prunus*, they did so without designating a rank (Brizicky 1969). According to Article 37.3 (McNeill *et al.* 2012), these names are validly published, but non-operative in questions of priority except for homonymy. Therefore, rank was established by Jepson (1936), and as such, should be cited as *Prunus* subg. *Armeniaca* (Scop.) Jepson. Current molecular data supports the exclusion of *Emplectocladus*-associated species from *Prunus* subg. *Amygdalus*, but with varying placements. Most recent authors have recognized *Prunus* subg. *Emplectocladus* while Shi *et al.* (2013) adopted *Prunus* sect. *Emplectocladus* (Torr.) A. Gray (Bortiri *et al.* 2001, Shaw & Small 2004, Chin *et al.* 2013, Shi *et al.* 2013, Yazbek & Al-Zein 2014).

Although there is more work necessary to resolve the infrageneric classification of *Prunus s.l.*, molecular evidence strongly supports a broad generic circumscription, and the adoption of *Prunus s.l.* has become widespread. While

preparing a manuscript reviewing wild and cultivated almond germplasm available in the former USSR, it became evident that a number of new combinations were in need of valid publication (Zaurov *et al.* 2015).

## Materials and Methods

Species of *Amygdalus* were queried in multiple databases: Euro+Med PlantBase (<http://www.emplantbase.org/home.html>), International Organization for Plant Information Provisional Global Plant Checklist Rosaceae taxonomic database (<http://www.bgbm.fu-berlin.de/IOPI/GPC/query.asp>), The International Plants Name Index ([www.ipni.org/](http://www.ipni.org/)), The Plant list ([www.theplantlist.org/](http://www.theplantlist.org/)), Tropicos (<http://www.tropicos.org/>), Species 2000 & ITIS Catalogue of Life ([www.catalogueoflife.org/col](http://www.catalogueoflife.org/col)), the USDA, ARS Germplasm Resources Information Network—(GRIN) Online Database ([http://www.ars-grin.gov/cgi-bin/npgs/html/tax\\_search.pl](http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl)). Each species was assessed as to whether it had been transferred to *Prunus*. Standard floras, revisions, monographs and checklists were consulted to assess whether each species is currently accepted. This included the following references, Fedorov (1942), Browicz & Zohary (1996), Czerepanov (2007), Flora of Israel Online (<http://flora.org.il/plants/>) and Flora of Iran website (<http://flora-iran.com/>), as well as others detailed below. The literature citation and protologue for each basionym was verified in the original reference, and when available, digital images of type specimens were observed via online herbarium databases or by requesting images directly from herbaria.

## Results

Nomenclatural adjustments are required resulting in twenty-two new combinations, one nomen novum, and one new nothospecies. In addition, two lectotypes and three neotypes are here designated.

*Prunus* × *andarobi* Serafimov, *nothosp. nov.*

*Amygdalus* × *andarobii* Serafimov (1971a: 350), *nom. inval.*

**Type:**—AFGHANISTAN. N skl[onove] pl[anini] Hindukush, dolina Sard Darya, dolina r[eka] Andarob [North slopes of Hindukush Mountains, Sard Darya valley, Andarob River valley], 6 Jun 1969, *S. Serafimov* 598. (holotype SO 67050! [digital image], isotypes BM 000622001! [digital image], LE! [digital image]; image of the holotype is available at <http://www.nmnh.com/images/e-natura/photos-types/1200/so/2011-11-11-01-07.jpg>).

**Description:**—Serafimov (1971a: 350).

**Note:**—According to Article 40.1 of the ICN (McNeill *et al.* 2012) the name *Amygdalus* × *andarobi* was not validly published because two gatherings were indicated as types. Accordingly, the new nothospecies *Prunus* × *andarobi* is here described. The original epithet “*andarobii*” used by Serafimov (1971a), is corrected here because it is referable to a geographical name and not a personal name (Arts. 60.7, 60.12 of the ICN, McNeill *et al.* 2012).

*Prunus browiczii* (Freitag) Eisenman, *comb. nov.*

Basionym:—*Amygdalus browiczii* Freitag (1972: 470).

**Type:**—AFGHANISTAN. Dilaram, 56 km NW, N-exposed slopes, Syah Band mountains, 1350 m, 20 April 1968, *H. Freitag* 2530 (holotype GOET! [digital image], isotype W 1978-0004275! [digital image]; image of the holotype is available at <https://plants.jstor.org/stable/10.5555/al.ap.specimen.goet010005>).

*Prunus georgica* (Desf.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus georgica* Desfontaines (1809: 221)

**Type** (neotype, designated here):—Cultivated garden specimen, s.d., *without collector s.n.* [“*Amygdalus georgica* Desf. H[ort] Pari[s]. Herbarium Webbianum, ex Herb. Desfontaines”] (FI-W 055869! [digital image], specimen on right side of the sheet).

**Note:**—This species is currently accepted by botanists in the region of occurrence. The species is listed as endemic to Georgia in both the *Flora of Georgia* (Ketskhoveli *et al.* 1980) and *The Vegetation of Georgia (South Caucasus)* (Nakhutsrishvili 2013). It is also listed as an endangered species in the *Red Data Book of the Georgian SSR* (Kacharava 1982, Red List of Georgia 2006), and Browicz & Zohary (1996) accepted the species. *Amygdalus georgica* is regarded as a synonym of *Prunus tenella* Batsch (1801: 29) by Kurtto (2009) and by the Catalogue of life (Roskov *et al.* 2014). No specimens were mentioned by Desfontaines in the original description of this species. He does attribute, “MM. Olivier and Bruyère,” for introducing the plant into cultivation, and states that, “It is still rare in gardens” [translated from original French]. The herbarium of the National Museum of Natural History in Paris (P) MNHN collection-Paris, where Desfontaines’ *Flora Atlantica* herbarium is deposited, has a single specimen (P00509535) labeled *Amygdalus georgica* Desf. The only information on the hand-written label is the species name and “H[ort]. Par[is]. 1833,” which is fourteen years after the species was described, and the same year in which Desfontaines died. There are two stamped labels on the specimen, the first attributes the specimen to “Herb. E. Cosson,” and the second attributes the specimen to, “Herb. Cosson via Herb. E. Durand.” As such, there is no way to directly connect this specimen to Desfontaines. The Herbarium Universitatis Florentinae (FI), where Desfontaines’ main herbarium is deposited, has three herbarium sheets of *Amygdalus georgica*. Accession no. 055869 from the Herbarium Webbianum (FI-W) is a mixed collection. On the right hand side of the sheet is a label with “Herbarium Webbianum,” and “ex Herb. Desfontaines” printed on it, and, “*Amygdalus georgica* Desf. H[ort] Pari[s]” written by hand. Although this specimen is directly attributable to Desfontaines, the lack of a date on this specimen makes it possible that it was collected after 1809, and therefore, it may not be an original element. Thus, this specimen is here designated as neotype in accordance with Art. 9.11 of the ICN (McNeill *et al.* 2012).

***Prunus graeca*** (Lindl.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus graeca* Lindley in Sibthorp & Lindley (1840: 71).

**Type** (neotype, designated here):—*Without locality, s.d., s.coll., s.n.* [*“Amygdalus incana*. J. Sibthorp, M.D. *Flora Graeca*. t477. Prodrromus Fl. Graecae Vol I p. 337 n 1136”]. Herbarium Webbianum, ex Herb. Desfontaines”] (OXF! [digital image]; image of the neotype is available at <http://herbaria.plants.ox.ac.uk/bol/SIBTHORP/image/Sib-1136a.JPG/Zoom?dpi=1>).

**Note:**—The species is accepted by Browicz & Zohary (1996), and also included in the *Flora of Turkey*, wherein Browicz (1972) stated that it is closely related to *Amygdalus orientalis* Miller (1768: without page), but sufficiently distinct to merit specific recognition. The distribution is given as, “southwest Anatolia and in some of the adjacent Greek Islands, particularly Rhodos...Aleppo district, Syria and near Ankara, Turkey.” Kurtto (2009) synonymized *A. graeca* with *Prunus discolor* (Spach 1843: 119) Schneider (1905: 591), but *Prunus graeca* has priority under Art. 11.4 of the ICN (McNeill *et al.* 2012). Lindley in Sibthorp & Lindley (1840: 71) described *A. graeca* as a new species in a list of emendations to replace the misidentified *A. incana* (Sibthorp & Smith 1809: 337, Sibthorp & Smith 1825: 61). No type was designated for *A. graeca*. In the Herbarium Sibthorpium (OXF) two specimens are conserved under the name *Prunus graeca*. The first was identified as, “*Amygdalus incana*,” and labeled, “J. Sibthorp, M.D.” with additional annotations listing the *A. incana* citation of *Flora Graeca*. A second specimen with a “J. Sibthorp, M.D.” tag is annotated with “1136?”, the species number in *Flora Graeca*. The first one is here designated as neotype. No specimens of *Amygdalus graeca* were found at CGE, where Lindley’s general collection is housed.

***Prunus × insuenta*** (Seraf.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus × insuenta* Serafimov (1977: 134).

**Type:**—AFGHANISTAN. Tozy Mountain Range, 51 km NE of Kalat, 1200 m, 29 May 1969, *Serafimov 565* (holotype LE, isotype SO! [digital image]; image of the isotype is available at <http://www.nmnhs.com/images/e-natura/photos-types/1200/so/2011-11-11-01-08.jpg>).

***Prunus × iranshahrii*** (Khat.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus × iranshahrii* Khatamsaz (1988: 114).

**Type:**—IRAN. Fars: 36 km from Khonj to Lar, 700 m, *s.d.*, *Assadi and Sardabi 41672* (holotype TARI).

*Prunus* × *kalmykovii* (O.A.Lincz.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *kalmikovii* Linczevski (1951: 202).

**Type**:—UZBEKISTAN [formerly Kazakhstan]. Bostandyk region [Tashkent Province]: Chatkal River basin, Koxsu River gorge, 5 km above Brich-Mulla village, 29 July 1950, *Linczevski & Roshkova 142* (holotype LE).

*Prunus* × *kamiaranensis* (Khat. & Assadi) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *kamiaranensis* Khatamsaz & Assadi in Khatamsaz (1988: 113).

**Type**:—IRAN. Kordestan: 28 km from Sanandaj to Kamiaran, 1400 m, 15 June 1977, *Assadi 60582* (holotype TARI).

*Prunus kurdistanica* (Attar, Maroofi & Vafadar) Eisenman, *comb. nov.*

Basionym:—*Amygdalus kurdistanica* Attar, Maroofi & Vafadar (2009: 324).

**Type**:—IRAN. Kurdistan: ca 34 km from Saqqez to Baneh, Nakarouz Mountain, 1675 m, 8 May 2007, *Attar, Maroofi and Vafadar 3725* (holotype TUH).

*Prunus* × *mozaffarianii* (Khat.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *mozaffarianii* Khatamsaz (1988: 114).

**Type**:—IRAN. Baluchestan: east slope of Kuh-e Taftan from Sangan, 2300-2900 m, *s.d.*, *Mozaffarian 53243* (holotype TARI).

*Prunus nairica* (Fed. & Takht.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus nairica* Fedorov & Takhtajan in Fiodorov & Tachtadzian (1936: 288).

**Type** (lectotype, designated here):—ARMENIA. On the road between Meghri and Shvanidzor, 18 May 1935, *Fedorov, s.n.* (ERE 26331!).

**Note**:—Avetisian *et al.* (1999) stated that the syntypes (ERE 20775!, ERE 20776!, ERE 20792!, all *Takhtajan s.n.*, 20.IX.1934; ERE 26331! and ERE 26327!, both *Fedorov s.n.* 18.V.1935), toposyntypes and specimina authentica are held at ERE. These syntypes were later described as representing a number of different forms (Fedorov 1942). The specimen that fits with the original description is ERE 26331, which was later described as *Amygdalus nairica* f. *normalis* Fedorov (1942: 138). This specimen is here selected as lectotype.

*Prunus orazii* (Maroofi, Attar & Vafadar) Eisenman, *comb. nov.*

Basionym:—*Amygdalus orazii* Maroofi, Attar & Vafadar in Attar *et al.* (2009: 326).

**Type**:—IRAN. Kurdistan: Baneh, Nenor to Siranband village, 1656 m, 10 May 2007, *Maroofi, Attar and Vafadar 37225* (holotype TUH).

*Prunus pabotii* (Browicz) Eisenman, *comb. nov.*

Basionym:—*Amygdalus pabotii* Browicz (1984: 621).

**Type**:—IRAN. Persia: W Azerbaijan occidentalis: In declivibus australibus jugi Gardaneh-ye Zamziran S Mahabad versus Sardasht, 1400 m, 8 July 1974, *Rechinger 49086* (holotype W 1975-0007760! [digital image]; image of the holotype is available <http://herbarium.univie.ac.at/database/detail.php?ID=499301>).

*Prunus ramonensis* (Danin) Eisenman, *comb. nov.*

Basionym:—*Amygdalus ramonensis* Danin (1980: 283).

**Type**:—ISRAEL. Central Negev Highlands, Nahal Eliav, 4 km SW of Har Ramon, 34° 39'E/30° 38'N, banks of wadi with loessial alluvium. 16 April 1979, *Avinoam Danin s.n.* (holotype HUI).

**Note**:—The collection date in the original basionym description does not match the date on the labels of specimens

held at E and K (15 June 1979). According to Arts. 9.4 and 9.6 of the ICN (McNeill *et al.* 2012), these specimens should be considered paratypes, rather than isotypes.

*Amygdalus ramonensis* is endemic to Negev Highlands of Israel. The species is included by Shmida and Pollak (2007) in the *Red Data Book: Endangered Plants of Israel*, as well as in the *Flora Palaestina* (Zohary 1972), *Analytical Flora of Eretz-Israel* (Feinbrun-Dotan *et al.*, 1998), and *Distribution Atlas of Plants in the Flora Palaestina Area* (Danin 2004). Although Kurtto (2009) regarded *A. ramonensis* as a synonym of *Prunus dulcis* (Mill.) D.A. Webb, it is still maintained as a species on the flora of Israel website (<http://flora.org.il/plants/AMYRAM/>). Danin (1980), stated that *A. ramonensis* differs from *P. dulcis* [= *A. communis* Linnaeus (1753: 473)] by having smaller glabrous ovate fruits, subspinescent branches and apiculate leaves. Danin (2000) explained, “According to Browicz & Zohary (1996), who “summed up their views for tree breeders” (as D. Zohary explained the essence of their paper, pers. comm.) this taxon should be sunk into the complex of *Amygdalus communis* L. subsp. *microcarpa* (Post 1898: 302) Browicz & Zohary (1996: 236). I keep regarding this taxon as an independent species until more comprehensive study proves otherwise.”

**Additional specimens examined:**—ISRAEL. Central Negev Highlands, Nahal Eliav, 4 km SW of Har Ramon, 34° 39'E/30° 38'N, banks of large wadi with loessial alluvium. 15 April 1979, *Avinoam Danin s.n.* (paratypes E!, K! [digital images])

***Prunus* × *rhodia*** (Browicz) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *rhodia* Browicz (1985: 34).

**Type:**—GREECE. Rhodos Island, scattered in orchards and road-side places between Pefka and Lardos, 14 May 1983. *Boratynska, Boratynski, Browicz & Dolatowski 138* (holotype ATH, isotypes K barcode K000395333! [digital image], KOR; image of the K isotype is available at <http://www.kew.org/herbcatimg/221213.jpg>).

**Note:**—The isotype specimen, *Boratynska et al.* 138 (K000395333), has a different collection date (14 May 1959), which is a typographical error.

***Prunus runemarkii*** Eisenman, *nom. nov.*

Basionym:—*Amygdalus reticulata* Runemark in Khatamsaz (1985: 78).

**Type:**—IRAN. Fars Province, Bamu Protected Region, Darreh-chap, 1650–1900 m, 3 May 1975, *Wendelbo & Foroughi 17577* (holotype TARI).

**Blocking name:**—*Prunus reticulata* Sargent (1911: 151). **Type:**—UNITED STATES OF AMERICA. Texas, 23 June 1910, *Munson 4* (holotype GH).

***Prunus* × *saviczii*** (Pachom.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *saviczii* Pachomova (1954: 199).

**Type:**—UZBEKISTAN. Zapadnyi Pamiro-Alai, goryi Kara-Tyube, po kamenistyim sklonam na trakte Takhta-Karacha [Western Pamiro Alai, Kara-Tyube Mountains, on rocky slopes of Takhta-Karacha Pass], 1800 m, 9 May 1951 (flowering); 18–30 May 1951, *Pachomova 8* (holotype LE).

***Prunus susakensis*** (Vassilcz.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus susakensis* Vassilchenko (1961: 6).

**Type:**—KYRGYZSTAN. Na krasnyikh glinisto-kamenistyikh yugo-vostochnykh sklonakh suzaks koy gryadyi bliz g. Dzhalalabada (Yuzhnaya Kirgiziya) [On the red-clay, stony south-eastern slopes of the Suzak ridge near the town of Jalalabad (South Kyrgyzstan)], 950 m, 10 September 1954, *Vassilchenko s.n.* (holotype LE).

***Prunus urartu*** (Tamamsch.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus urartu* Tamamschjan (1935: 166).

**Type** (lectotype, designated here):—Erivan, 3 July 1933, *Tamamschian s.n.* [“Erivan. In faucib. m. Eranos.”]; (ERE 20787! [digital image]).

**Note:**—A holotype was not indicated by Tamamschjan. The following locality and dates are cited in the original protologue: “Habitat in Armenia, prope Erivan, in faucibus Gjarny—cai m. Eranos, 31. V. 31!!, 3. VII. 33!!, 13. V. 34!!.” Avetisian *et al.* (1999) noted that the following material is held in the herbarium of the Institute of Botany of the National Academy of Sciences of Armenia (ERE): a syntype (ERE 20787! *Tamamschjan s.n.*, 3.VII.1933), toposyntypes (ERE 20786!, ERE 20788!), and specimina authentica (ERE 496!, ERE 35023!, ERE 35024!). Among the original material traced in ERE, the specimen ERE 20787 is the only original material with both the correct collection locality and date, and is therefore designated as lectotype.

***Prunus urartu*** Tamamsch. subsp. *pseudopersica* (Tamamsch.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus urartu* Tamamsch. subsp. *pseudopersica* Tamamschjan (1935: 166).

**Type** (neotype, designated here):—Erivan, 11 May 1934, *Tamamschian s.n.* [“Erivan, in faucibus. m. Eranos.”] (ERE 20786! [digital image]).

**Note:**—A holotype was not designated by Tamamschjan. Following the original description of this subspecies, Tamamschjan stated, “Ibidem!,” referring to the locality and dates provided for specimens of *A. urartu*, which was published on the same page. Avetisian (1999) noted that no original material, but only a toposyntype (specimen authenticum) (ERE20786! Tamamschjan, s.n., 11.V.1933), is housed at ERE. The collection date of this specimen does not match those cited in the protologue. Because the specimen is from the type locality, and was labeled as *Amygdalus urartu* mihi subsp. *pseudopersica* m[ihi] by Tamamschjan, this specimen is selected as neotype.

***Prunus* × *uzbekistanica*** (Sabirov) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *uzbekistanica* Sabirov (1959: 230).

**Type:**—UZBEKISTAN. Zapadnyii Gissar (bassein p. Sangardaka) na skalakh, v srednem techenii r. Obi-Naurus [Western Gissar (Sangardak River basin) on rocks, in middle reaches of the Obi-Naurus River], 1600–1700 m, 30 July 1956, *Sabirov 420* (holotype LE).

***Prunus wendelboi*** (Freitag) Eisenman, *comb. nov.*

Basionym:—*Amygdalus wendelboi* Freitag (1977: 118).

**Type:**—IRAN. Bandar-Abbas Prov.: Top region of the Kuh-e Genou Mts., S. slope in limestone rocks, 2250 m, 4 May 1975, *Faroughi 16102* (holotype TARI, isotype GOET! [digital image]; image of the isotype is available at <https://plants.jstor.org/stable/10.5555/al.ap.specimen.goet010004>).

***Prunus* × *yasujensis*** (Khat.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus* × *yasujensis* Khatamsaz (1988: 116).

**Type:**—IRAN. Prov. Kohgiluyeh and Boyer-Ahmad, Yasuj, Sisakht, 2000 m, *s.d.*, *Foroughi 8114* (holotype TARI).

***Prunus zabulica*** (Seraf.) Eisenman, *comb. nov.*

Basionym:—*Amygdalus zabulica* Serafimov (1971b: 173).

**Type:**—AFGHANISTAN. Gornaya tsep Tozy, v 51 km k severu ot g. Kalat (Zabul), na izvestnyakovyikh skalakh levoberezhya r. Tarnak [Tozy Mountain Range, 51 km north of Kalat (Zabul), on limestone rocks on the left bank of the Tarnak River], 1200–1350 m, 29 May 1969, *Serafimov s.n.* (holotype LE, isotypes SO! [digital image], BM! [digital image]; image of the SO isotype is available at <http://www.nmnh.com/images/e-natura/photos-types/1200/so/2011-11-11-01-11.jpg> and the BM isotype at <http://data.nhm.ac.uk/dataset/collection-specimens/resource/05ff2255-c38a-40c9-b657-4ccb55ab2feb/record/2733357>).

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