



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

SASHA W. EISENMAN

Temple University, Department of Landscape Architecture and Horticulture, 201 Dixon Hall, 580 Meetinghouse Road, Ambler, PA 19002 USA; email: eisenman@temple.edu

### 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 “untergeschlecht” *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 “untergeschlecht” and “unterabtheilung”. Brizicky (1969) made a strong case for recognition of untergeschlecht, 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 *Amygdalopsis* 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.nmnh.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, Koxu 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 & Tachtadzhan (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. Zapadniy 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>).

## Acknowledgments

Thanks to Gerry Moore, Kanchi Gandhi, Fabrizio Bartolucci and an anonymous reviewer for providing useful comments on the manuscript, to Maya Czulewicz for helping with translation of French texts, and especially to the



late Jim Reveal who provided helpful feedback and encouragement. Many thanks to the staff at BM, C, CMB, ERE, FI, GOET, K, L, LE, OXF, P, S, SO, SOA and W. The online resources Biodiversity Heritage Library, GBIF, Index Herbariorum, and JSTOR Plants, were sources of important information. Numerous libraries, in particular those of Temple University, The Academy of Natural Sciences of Drexel University, and Morris Arboretum of the University of Pennsylvania, were consulted for access to essential literature. Much appreciation is extended to Marina Oganessian for providing images of specimens held at ERE. Finally, many thanks and best wishes to Serafim Serafimov.

## References

- Abrams, L. (1910) A phytogeographic and taxonomic study of the southern California trees and shrubs. *Bulletin of the New York Botanical Garden* 6: 300–485.  
<http://dx.doi.org/10.5962/bhl.title.13128>
- Arús, P., Gradziel, T., Margarida Oliveira, M. & Tao, R. (2009) Genomics of almond. In: Folta, K.M. & Gardiner, S.E. (Eds.) *Genetics and genomics of Rosaceae, Plant Genetics and Genomics: Crops and Models* 6. Springer-Verlag, New York, pp. 187–219.  
[http://dx.doi.org/10.1007/978-0-387-77491-6\\_9](http://dx.doi.org/10.1007/978-0-387-77491-6_9)
- Attar, F., Maroofi, H. & Vafadar, M. (2009) *Amygdalus kurdistanica* and *A. orazii* spp. nov. (Rosaceae) from Iran. *Nordic Journal of Botany* 27: 324–327.  
<http://dx.doi.org/10.1111/j.1756-1051.2008.00410.x>
- Avetisian, V.E., Safarian, A.D., Mkhitarian, Yu.A. & Asatrian, M.Ya. (1999) The type specimens of vascular plants kept in the herbarium of the Department of Taxonomy and Geography of Higher Plants, Institute of Botany, National Academy of Sciences of Armenia (ERE). 4. ROSACEAE (*Amygdalus*, *Pyrus*). *Botanicheskii Zhurnal [Moscow & Leningrad]* 84: 72–74.
- Batsch, A.J.G.K. (1801) *Beyträge und Entwürfe zur Pragmatischen Geschichte der Drey Natur-reiche nach ihren Verwandtschaften. Gewächsreich*, Pt. 1. *Gewächse mit fünfblättrigen blumen*. Verlage des Industrie-Comptoirs, Weimar, 96 pp.
- Bentham, G. & Hooker, J.D. (1865) *Genera Plantarum*, Vol. 1 (2). Reeve & Co, London, 735 pp.
- Bortiri, E.S., Oh, S.H., Jiang, J.G., Baggett, S., Granger, A., Weeks, C., Buckingham, M., Potter, D. & Parfitt, D.E. (2001) Phylogeny and systematics of *Prunus* (Rosaceae) as determined by sequence analysis of *ITS* and the chloroplast *trnL-trnF* spacer DNA. *Systematic Botany* 26: 797–807.
- Bortiri, E.S., Oh, H., Gao, F.-Y. & Potter, D. (2002) The phylogenetic utility of nucleotide sequences of sorbitol 6-phosphate dehydrogenase in *Prunus* (Rosaceae). *American Journal of Botany* 89: 1697–1708.  
<http://dx.doi.org/10.3732/ajb.89.10.1697>
- Bortiri, E.S., Vanden Heuvel, B. & Potter, D. (2006) Phylogenetic analysis of morphology in *Prunus* reveals extensive homoplasy. *Plant Systematics and Evolution* 259: 53–71.  
<http://dx.doi.org/10.1007/s00606-006-0427-8>
- Brizicky, G.K. (1969) Subgeneric and sectional names: Their starting points and early sources. *Taxon* 18: 643–660.
- Browicz, K. (1969) *Amygdalus* L. In: Rechinger, K.H. (Ed.) *Flora Iranica*, Vol. 66. Akademische Druck und Verlagsanstalt, Graz, pp. 166–187.
- Browicz, K. (1972) *Amygdalus* L. In: Davis, P.H. (Ed.) *Flora of Turkey and the East Aegean Islands*, Vol. 4. Edinburgh University Press, Edinburgh, pp. 21–28.
- Browicz, K. (1984) *Amygdalus pabotii* Browicz—a new species of almond from western Iran. *Fragmenta Floristica et Geobotanica. Materialy Floristiczne i Geobotaniczne* 28: 621–623.
- Browicz, K. (1985) *Amygdalus* × *rhodia* (Rosaceae), a new hybrid almond from Rhodes. *Annales Musei Goulandris* 7: 33–37.
- Browicz, K. (1989) Conspect and chorology of the genera *Amygdalus* L. and *Louiseania* Carriere. *Arboretum Kórnickie* 34: 31–54.
- Browicz, K. & Zohary, D. (1996) The genus *Amygdalus* L (Rosaceae): species relationships, distribution and evolution under domestication. *Genetic Resources and Crop Evolution* 43: 229–247.  
<http://dx.doi.org/10.1007/BF00123275>
- Brummitt, R.K. (1992) *Vascular Plant Families and Genera*. Royal Botanic Gardens, Kew, 810 pp.
- Candolle, A.P. de (1825) *Prodromus Systematis Naturalis Regni Vegetabilis*, Vol. 2. Treuttel and Würtz, Paris, 644 pp.
- Candolle, A.P. de (1890) *Origin of Cultivated Plants*. D. Appleton and Co., New York, 468 pp.
- Carrière, E.A. (1862) *Amygdalopsis lindleyi*. *Revue Horticole. Année 1862*: 91–93.
- Carrière, E.A. (1872) *Amygdalopsis lindleyi*. *Revue Horticole. Année 1872*: 33–34.
- Chin, S-W., Wen, J., Johnson, G. & Potter, D. (2010) Merging *Maddenia* with the morphologically diverse *Prunus* (Rosaceae). *Botanical Journal of the Linnean Society* 164: 236–245.

<http://dx.doi.org/10.1111/j.1095-8339.2010.01083.x>

- Chin, S.-W., Lutz, S., Wen, J., & Potter, D. (2013) The bitter and the sweet: inference of homology and evolution of leaf glands in *Prunus* (Rosaceae) through anatomy, micromorphology, and ancestral-character state reconstruction. *International Journal of Plant Sciences* 174: 27–46.
- Czerepanov, S.K. (2007) *Vascular Plants of Russia and Adjacent States (the Former USSR)*. Cambridge University Press, Cambridge, 532 pp.
- Danin, A. (1980) A new *Amygdalus* from Israel. *Notes from the Royal Botanic Garden, Edinburgh* 38: 283–285.
- Danin, A. (2000) The nomenclature news of Flora Palaestina. *Flora Mediterranea* 10: 109–172.
- Danin, A. (2004) *Distribution Atlas of Plants in the Flora Palaestina Area*. Israel Academy of Sciences and Humanities, Jerusalem, 519 pp.
- Davis, P.H. (1979) *Flora of Turkey and the East Aegan Islands*, Vol. 4. Edinburgh University Press, Edinburgh, 657 pp.
- Denisov, V.P. (1988) Almond genetic resources in the USSR and their use in production and breeding. *Acta Horticulturae. Technical Communications of ISHS [International Society for Horticultural Science]* 224: 299–306.
- Desfontaines, R.L. (1809) *Histoire des Arbres et Arbrisseaux qui Peuvent etre Cultives en Pleine Terre sur le Sol de la France*, Vol. 2. J.A. Brosson, Paris, 635 pp.
- Dietrich, D. (1842) *Synopsis Plantarum seu Enumeratio Systematica Plantarum*, Vol. 3. B.F. Voigtii, Vimariae, 730 pp.
- Dippel, L. (1893) *Handbuch der Laubholzkunde. Beschreibung der in Deutschland heimischen und im Freien kultivierten Bäume und Sträucher. Für Botaniker, Gärtner und Forstleute bearbeitet*, Vol. 3. Paul Parey, Berlin, 752 pp.
- Duhamel du Monceau, H.L. (1755) *Traité des Arbres et Arbustes qui se Cultivent en France en Pleine Terre*, Vol. 1. Guerin & Delatour, Paris, 368 pp.
- Du Roi, J.P. (1771) *Die Harbkesche Wilde Baumzucht Theils Nordamerikanischer und Anderer Fremder, Theils Einheimischer Bäume, Sträucher und Strauchartigen Pflanzen nach den Kennzeichen, der Anzucht, den Eigenschaften und der Benutzung Beschrieben*, Vol. 1. Fürstl. Waisenhaus-Buchhandlung, Braunschweig, 447 pp.
- Du Roi, J.P. (1772) *Die Harbkesche Wilde Baumzucht Theils Nordamerikanischer und Anderer Fremder, Theils Einheimischer Bäume, Sträucher und Strauchartigen Pflanzen nach den Kennzeichen, der Anzucht, den Eigenschaften und der Benutzung Beschrieben*, Vol. 2. Fürstl. Waisenhaus-Buchhandlung, Braunschweig, 502 pp.
- Endlicher, S. (1840) *Genera Plantarum Secundum Ordines Naturales Disposita*, Pt. 16. Apud F. Beck, Vindobonae, 45 pp.
- FAOSTAT. (2014) Food and Agriculture Organization of the United Nations. FAOSTAT (Database). (Latest update: 7 March 2014) Available from: <http://faostat.fao.org/> (accessed 22 June 2014)
- Feinbrun-Dothan, N., Danin, A. & Plitmann, U. (1998) *Analytical Flora of Eretz-Israel*. 2<sup>nd</sup> Ed. CANA Publishing House, Jerusalem, 1008 pp.
- Fedorov, A. (1942) Wild almonds of Armenia. *Izvestiya Armyanskogo Filiala Akademii Nauk SSSR* 1–2: 131–157.
- Fiodorov, A. & Tachtadzian, A. (1936) Nova species generis *Amygdalis* L. in Armenia sponte crescens. *Repertorium Specierum Novarum Regni Vegetabilis. Centralblatt für Sammlung und Veröffentlichung von Einzeldiagnosen Neuer Pflanzen* 40: 288.
- Focke, W.O. (1888) Rosaceae. In: Engler, A. & Prantl, K.A.E. (Eds.) *Die Natürlichen Pflanzenfamilien Nebst ihren Gattungen und Wichtigeren Arten Insbesondere den Nutzpflanzen, Bearbeitet unter Mitwirkung Zahlreicher Hervorragender Fachgelehrten*. Teil III, Abteilung 3. Wilhelm Engelmann, Leipzig, pp. 1–61.
- Freitag, H. (1972) Neue arten aus Afghanistan: *Amygdalus browiczii* und *Leontice silvatica*. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 91: 470–477.
- Freitag, H. (1977) *Amygdalus wedelboi* (Rosaceae), a new species from southern Iran. *Iranian Journal of Botany* 1: 117–120.
- Gaertner, J. (1788) *De Fructibus et Seminibus Plantarum: Accedunt Seminum Centuriae Quinque Priores cum Tabulis Aeneis LXXIX*, Vol. 1. Stutgardiae, typis Academiae Carolinae, 384 pp.
- Gradziel, T.M. (2010) Origin and dissemination of almond. In: Janick, J. (Ed.) *Horticultural Reviews*, Vol. 38. John Wiley & Sons, Inc., Hoboken, pp. 23–81. <http://dx.doi.org/10.1002/9780470872376.ch2>
- Gradziel, T.M. & Martínez-Gómez, P. (2013) Almond breeding. In: Janick, J. (Ed.) *Plant Breeding Reviews*, Vol. 37. John Wiley & Sons, Inc., Hoboken, pp. 207–258.
- Gradziel, T.M., Martínez-Gómez, P., Dicenta, F. & Kester, D.E. (2001) The utilization of related almond species for almond variety improvement. *Journal of the American Pomological Society* 55: 100–108.
- Grasselly, C. (1976) Les espèces sauvages d'amandiers. *Options Méditerranéennes; Revue des Problèmes Agricole Méditerranéennes* 32: 28–43.
- Gray, A. (1850) *Plantae Lindheimerianae, Part II. An account of a collection of plants made by F. Lindheimer in the western part of Texas, in the years 1845-6, and 1847-8, with critical remarks, descriptions of new species, &c.* *Boston Journal of Natural History* 6: 141–240.

- Gray, A. (1868) Characters of new plants of California and elsewhere, principally of those collected by H.N. Bolander in the State Geological Survey. *Proceedings of the American Academy of Arts and Sciences* 7: 327–401.
- Gray, A. (1874) Contributions to the botany of North America. 4. Characters of various new species. *Proceedings of the American Academy of Arts and Sciences* 10 (new series 2): 68–78.
- Greene, E.L. (1891) *Flora franciscana: an Attempt to Classify and Describe the Vascular Plants of Middle California*, Part 1. Cubery & Co, San Francisco, 280 pp.
- Heywood, V.H. (Ed.) (1967) Flora Europaea notulae systematicae ad Floram Europaeam spectantes. No. 6. *Feddes Repertorium. Zeitschrift für Botanische Taxonomie und Geobotanik* 74: 1–37.  
<http://dx.doi.org/10.1002/fedr.19670740102>
- Hooker, J.D. (1840) *Icones Plantarum; or Figures, with Brief Descriptive Characters and Remarks of New or Rare Plants*, Vol. 3. Longman, Orme, Brown, Green and Langmans, London, 90 pp. + plates.
- Hooker, J.D. & Thomson, T. (1854) On *Maddenia* and *Diplarche*, new genera of Himalayan plants. *Hooker's Journal of Botany and Kew Garden Miscellany* 6: 380–384.
- Hutchinson, J. (1964) *The Genera of Flowering Plants*, Vol. 1. Clarendon Press, Oxford, 516 pp.
- ITIS (2014) Integrated Taxonomic Information System on-line database. Available from: <http://www.itis.gov> (accessed 5 May 2014)
- Jepson, W.L. (1936) *A Flora of California*, Vol. 2. Associated Students Store, University of California, Berkeley, 689 pp.
- Kacharava, V.Ya. (Ed.) (1982) *The Red Book of the Georgian SSR* [Krasnaya Kniga Gruzinskoy SSR]. Sabchota Sakartvelo, Tbilisi, 256 pp.
- Kalkman, C. (2004) Rosaceae. In: Kubitzki, K. (Ed.) *The Families and Genera of Vascular Plants*, Vol. 6, *Flowering Plants – dicotyledons: Celastrales, Oxalidales, Rosales, Cornales, Ericales*. Springer, Berlin, pp. 343–386.
- Kester, D.E., Gradziel, T.M. & Grasselly, C. (1991) Almonds (*Prunus*). In: Moore, J.N. & Ballington, H.J. (Eds.) *Genetic Resources of Temperate Fruit and Nut Crops*. International Society of Horticulture and Science, The Netherlands, pp. 701–758.
- Ketskhoveli, N., Kharadze, A. & Gagnidze, R. (Eds.) (1980) *Flora of Georgia*, Vol. 6. 2<sup>nd</sup> Ed. Metsniereba, Tbilisi, 320 pp.
- Khatamsaz, M. (1985) A new species of *Amygdalus* (Rosaceae) from Iran. *Iranian Journal of Botany* 3: 77–80.
- Khatamsaz, M. (1988) Studies on the Rosaceae family in Iran, new taxa and new records. *Iranian Journal of Botany* 4: 111–125.
- Khatamsaz, M. (1993) Rosaceae. In: Ghahreman, A. (Ed.) *Flora of Iran*, Vol. 12. Research Institute of Forests and Rangelands Press, Tehran, pp. 88–140.
- Koch, K. (1869) *Dendrologie. Bäume, Sträucher und Halbsträucher, Welche in Mittel- und Nord-Europa im Freien Kultivirt Werden*. Ferdinand Enke, Erlangen, 735 pp.
- Koehne, E. (1893) *Deutsche Dendrologie*. Verlag von Ferdin and Enke, Stuttgart, 601 pp.
- Kovalyov, N.V. & Kostina, K.F. (1935) A contribution to the study of the genus *Prunus* Focke. Questions of taxonomy and plant breeding [in Russian]. *Trudy po Prikladnoi Botanike, Genetike i Seleksii* 8 (4): 1–76.
- Kurto, A. (2009) Rosaceae (pro parte majore). In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. Available from: <http://ww2.bgbm.org/EuroPlusMed/PTaxonDetail.asp?NameCache=Amygdalus&PTRefFk=7300000> (accessed 3 October 2014)
- Lansari, A., Kester, D.E. & Iezzoni, A.F. (1994) Inbreeding, coancestry, and founding clones of almonds of California, Mediterranean Shores, and Russia. *Journal of the American Society for Horticultural Science* 119: 1279–1285.
- Lee, S. & Wen, J. (2001) A phylogenetic analysis of *Prunus* and the *Amygdaloideae* (Rosaceae) using ITS sequences of nuclear ribosomal DNA. *American Journal of Botany* 88: 150–160.
- Lincevski, I.A. & Fedorov, A.A. (1941) Genus 763. *Amygdalus* L. In: Komarov, V.L., Shiskin, B.K. & Yuzepchuk, S.V. (Eds.) *Flora of the USSR*, Vol. 10: *Rosaceae-Rosoideae, Prunoideae* (translated from the Russian, 1971). Israel Program for Scientific Translation, Jerusalem, pp. 389–407.
- Lincevski, O. (1951) Generis Amygdali L. species nova ex Asia Media. *Botanicheskie Materialy Gerbariya Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR* 14: 202–205.
- Lindley, J. (1857) New plants. *Gardener's Chronicle and Agricultural Gazette* 1857: 268.
- Linnaeus, C. (1753) *Species Plantarum*, Vol. 1. Impensis Laurentii Salvii, Stockholm, 560 pp.
- Linnaeus, C. (1754) *Genera Plantarum Eorumque Characteres Naturales Secundum Numerum, Figuram, Situm, & Proportionem Omnium Fructificationis Partium*, Ed. 5. Impensis Laurentii Salvii, Stockholm, 500 pp.
- Litvinov, D.I. (1902) Florae Turkestanicae fragmenta. *Trudy Botanicheskogo Muzeya Imperatorskoi Akademii Nauk. Travaux du Musee Botanique de l'Academie Imperiale des Sciences de Saint Petersburg* 1: 12–22.
- Lu, L.T. & Bartholomew, B. (2003) *Amygdalus*. In: Wu, Z.Y., Raven, P.H. & Hong, D.Y. (Eds.) *Flora of China*, Vol. 9. Science Press, Beijing; and Missouri Botanical Garden, St. Louis, pp. 391–395.
- Madam, B., Rahemi, M., Mousavi, A. & Martínez-Gómez, P. (2011) Evaluation of the behavior of native Iranian almond species as rootstocks. *International Journal of Nuts and Related Sciences* 2: 29–34.

- Martínez-Gómez, P., Sánchez-Pérez, R., Dicenta, F., Howad, W., Arús, P. & Gradziel, T.M. (2007) Almonds. In: Kole, C.R. (Ed.) *Genome Mapping and Molecular Breeding*, Vol. 4: *Fruits & Nuts*. Springer, Heidelberg, pp. 229–242.
- Mason, S.C. (1913) The pubescent-fruited species of *Prunus* of the Southwestern States. *Journal of Agricultural Research* 1: 147–177.
- McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'Homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (2012) *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011*. [Regnum Vegetabile 154]. Gantner, Ruggell, 240 pp.
- McVaugh, R. (1951) A revision of the North American black cherries (*Prunus serotina* Ehrh. and relatives). *Brittonia* 7: 279–315.
- Miller, P. (1754) *The Gardener's Dictionary*. 4<sup>th</sup> Ed. In *Three Volumes*. Printed for the author, London, without page numbers.
- Miller, P. (1768) *The Gardener's Dictionary*. 8<sup>th</sup> Ed. Printed for the author, London, without page numbers.
- MirAli, N. & Nabusi, I. (2007) Genetic diversity of almonds (*Prunus dulcis*) using RAPD technique. *Scientia Horticulturae* 98: 461–471.
- Münchhausen, O. (1770) Ausführliches verzeichnis aller bäume und stauden, welche in Deutschland in freyer luft forkommen, oder als solche angesehen werden können. *Der Hausvater* 5 (1): 79–369.
- Nakai, T. (1916) *Flora Sylvatica Koreana*, Pt. 5. Forestal Experiment Station, Government General of Chosen, Keijo, 45 pp.
- Nakhutsrishvili, G. (2013) *The Vegetation of Georgia (South Caucasus)*. Springer, Heidelberg, 250 pp.
- Pachomova, M. (1954) Species nova generis *Amygdalus* L. e montibus Kara-Tube. *Botanicheskie Materialy Gerbariya Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR* 16: 198–206.
- Persoon, C.H. (1806) *Synopsis Plantarum: seu Enchiridium botanicum, Complectens Enumerationem Systematicam Specierum hucusque Cognitarum*, Vol. 2. Carol. Frid. Cramerum, Parisiis Lutetiorum, 656 pp.
- Petermann, W.L. (1846) *Deutschlands Flora: mit Abbildungen Sämmtlicher Gattungen auf 100 Tafeln*. Georg Wigand's Verlag, Leipzig, 248 pp.
- Popov, M.G. (1929) Wild growing fruit trees and shrubs of Asia Media. *Trudy Prikladnoi Botanike, Genetike i Seleksii* 22 (3–4): 241–483.
- Post, G.E. (1898) *Flora of Syria, Palestine, and Sinai*. Syrian Protestant College, Beirut, 919 pp.
- Potter, D. (2011) *Prunus*. In: Kole, C. (Ed.) *Wild Crop Relatives: Genomic and Breeding Resources*. Springer-Verlag, Berlin, Heidelberg, pp. 129–145.
- Potter, D. (2012) Basic information on the stone fruit crops. In: Kole, C. & Abbott, A.G. (Eds.) *Genetics, Genomics and Breeding of Stone Fruits*. CRC Press, Boca Raton, pp. 1–21.
- Potter, D., Eriksson, T., Evans, R.C., Oh, S., Smedmark, J.E.E., Morgan, D.R., Kerr, M., Robertson, K.R., Arsenault, M., Dickinson, T.A. & Campbell, C.S. (2007) Phylogeny and classification of Rosaceae. *Plant Systematics and Evolution* 266: 5–43. <http://dx.doi.org/10.1007/s00606-007-0539-9>
- Rahemi, A., Fatahi, R., Ebadi, A., Taghavi, T., Hassani, D., Gradziel, T. & Chaparro, J. (2010) Genetic variation of S-alleles in wild almonds and their related *Prunus* species. *Australian Journal of Crop Science* 4: 648–659.
- Red List of Georgia (2006) Presidential Order #303, Tbilisi, Georgia, May 2, 2006.
- Rehder, A. (1926) New species, varieties and combinations from the herbarium and the collections of the Arnold Arboretum. *Journal of the Arnold Arboretum* 7: 22–37.
- Rehder, A. (1940) *Manual of Cultivated Trees and Shrubs Hardy in North America Exclusive of the Subtropical and Warmer Temperate Regions*, 2<sup>nd</sup> Ed. MacMillan, New York, 996 pp.
- Robertson, K.R. (1974) The genera of Rosaceae in the southeastern United States. *Journal of the Arnold Arboretum* 55: 303–332.
- Roemer, M.J. (1847) *Familiarum Naturalium Regni Vegetabilis Synopses Monographicae seu Enumeratio Omnium Plantarum hucusque Detectarum Secundum Ordines Naturales, Genera et Sepcies Digestarum, Additas Diagnosibus, Synonymis, Novarumque vel Minus Cognitarum Descriptionibus Curante M. J. Roemer*. Fascicle III. *Rosiflorae*. Landes Industrie Comptoir, Vimariae, 249 pp.
- Roskov, Y., Kunze, T., Abucay, L., Paglinawan, L., Orrell, T., Culham, A., Bailly, N., Kirk, P., Bourgoin, T., Baillargeon, G., Decock, W., De Wever, A. & Didžiulis, V. (Eds.) (2014) *Species 2000 & ITIS Catalogue of Life*, 26th February 2014. Species 2000: Naturalis, Leiden, the Netherlands. Available from: <http://www.catalogueoflife.org> (accessed 26 June 2014)
- Sabirov, B. (1959) Amygdali generis species nova ex Uzbekistana. *Botanicheskie Materialy Gerbariya Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR* 19: 230–232.
- Sargent, C.S. (1892) *The Silva of North America; A Description of Trees which Grow Naturally in North America Exclusive of Mexico*, Vol. IV. Houghton Mifflin and Co, New York, 141 pp.
- Sargent, C.S. (1911) *Trees and Shrubs: Illustrations of New or Little Known Ligneous Plants / Prepared Chiefly from Material at the Arnold Arboretum of Harvard University, and Edited by Charles Sprague Sargent*, Vol. 2. Houghton Mifflin and Co., Boston and New York, 191 pp.
- Schneider, C.K. (1905) *Illustriertes Handbuch der Laubholzkunde: Charakteristik der in Mitteleuropa Heimischen und im Freien*

- Angepflanzten Angiospermen Gehölz-Arten und Formen mit Ausschluss der Bambuseen und Kakteen*, Vol. 1. Verlag Gustav Fischer, Jena, 143 pp.
- Schneider, C.K. (1906) *Illustriertes Handbuch der Laubholzkunde*, Vol. 1. Verlag Gustav Fischer, Jena, 217 pp.
- Scopoli, G.A. (1754) *Methodus Plantarum quam Divina Favente Clementia Decreto, Autoritate, et Consensu Illustrissimorum, Perillustrium, Magnificorum, Spectabilium & Clarissimorum Virorum Perillustris, ac Magnifici Domini Universitatis Rectoris, Illustrissimi, Magnifici, ac Clarissimi Domini Domini Inclytae Facultatis Medicae Praesidis, Perillustris Spectabilis, Clarissimi, Inclytae Facultas Medica Domini Decani, Venerabilis Domini Senioris*. Typis Joannis Petri van Ghelen, Vienna, 28 pp.
- Serafimov, S. (1971a) A spontaneous hybrid of *Amygdalus kuramica* Korsh. and *A. spinosissima* Bge. from Afghanistan. *Doklady Bulgarskoi Akademii Nauk* 4: 349–351.
- Serafimov, S. (1971b) Nova species generis *Amygdalus* L. ex .Afghanistania. *Novosti Sistematiki Vysshikh Rastenii. Moscow & Leningrad* 8: 173–175.
- Serafimov, S. (1977) Hybrida spontalis inter *Amygdalus zabulica* Seraf. et *A. erioclada* Bornm. Ex Afghanistania. *Novosti Sistematiki Vysshikh Rastenii. Moscow & Leningrad* 14: 134–136.
- Shaw, J. & Small, R.L. (2004) Addressing the “hardest puzzle in American pomology: ” Phylogeny of *Prunus* sect. *Prunocerasus* (Rosaceae) based on seven noncoding chloroplast DNA regions. *American Journal of Botany* 91: 985–996.
- Shi, S., Li, J., Sun, J., Yu, J. & Zhou, S. (2013) Phylogeny and classification of *Prunus* sensu lato (Rosaceae). *Journal of Integrative Plant Biology* 55: 1069–1079.  
<http://dx.doi.org/10.1111/jipb.12095>
- Shmida, A. & Pollak, K. (2007) *Red Data Book: Endangered Plants of Israel*, Vol. 1. Israel Nature and Parks Authority, Jerusalem, 482 pp.
- Sibthorp, J. & Smith, J.E. (1809) *Florae Graecae Prodromus*, Vol. 1. Typis Richardi Taylor, Londini, 442 pp.
- Sibthorp, J. & Smith, J.E. (1825) *Florae Graecae Sibthorpiana*, Vol. 5. Typis Richardi Taylor, Londini, 81 pp.
- Sibthorp, J. & Lindley, J. (1840) *Flora Graeca Sibthorpiana*, Vol. 10. Typis Richardi et Johannis E. Taylor, Londini, 106 pp.
- Siebold, P.F. & Zuccarini, J.G. (1843) Plantarum, quas in Japonia collegit Dr. Ph. Fr. de Siebold genera nova, notis characteristicis delineationibusque illustrata proponunt Dr. Ph. Fr. de Siebold et Dr. J. G. Zuccarini. Fasciculus primus. *Abhandlungen der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften* 3: 717–750.
- Sorkheh, K., Shiran, B., Rouhi, V., Asadi, E., Jahanbazi, H., Moradi, H., Gradziel, T.M. & Martínez-Gómez, P. (2009) Phenotypic diversity within native Iranian almond (*Prunus* spp.) species and their breeding potential. *Genetic Resources and Crop Evolution* 56: 947–961.  
<http://dx.doi.org/10.1007/s10722-009-9413-7>
- Sorkheh, K., Shiran, B., Rouhi, V., Khodambashi, M. & Sofu, A. (2012) Salt stress induction of some key antioxidant enzymes and metabolites in eight Iranian wild almond species. *Acta Physiologiae Plantarum, Warsaw* 34: 203–213.  
<http://dx.doi.org/10.1007/s11738-011-0819-4>
- Spach, E. (1843) Monographia generis *Amygdalus*. *Annales des Sciences Naturelles; Botanique, Ser. 2* 19: 106–128.
- Takhtajan, A. (1997) *Diversity and classification of flowering plants*. Columbia University Press, New York, 620 pp.
- Tamamschjan, S. (1935) Über einige pflanzen aus der umgebung von Eriwán. *Repertorium Specierum Novarum Regni Vegetabilis. Centralblatt für Sammlung und Veröffentlichung von Einzeldiagnosen neuer Pflanzen* 38: 162–171.
- Torrey, J. (1851) On some new plants discovered by Col. Fremont, in California. *Proceedings of the American Association for the Advancement of Science* 4: 190–193.
- Tournefort, J.P. (1700) *Institutiones Rei Herbariae*, vol. 1. E Typographia Regia, Paris, 697 pp.
- Turczaninow, N. (1843) Flora Baicalensi-Dahurica seu description plantarum in regionibus cis-et transbaicalensibus atque in Dahuria sponte nascentium. *Bulletin de la Société Impériale des Naturalistes de Moscou* 16 (4): 585–644.
- Tutin, T.G., Heywood, V.H., Bruges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (Eds.) (1968) *Flora Europaea*, Vol. 2. Cambridge University Press, Cambridge, 455 pp.
- USDA-NASS. (2013) 2013 California Almond Forecast. United States Department of Agriculture, National Agricultural Statistics Service. Available from: [http://www.nass.usda.gov/Statistics\\_by\\_State/California/Publications/Fruits\\_and\\_Nuts/201305almpd.pdf](http://www.nass.usda.gov/Statistics_by_State/California/Publications/Fruits_and_Nuts/201305almpd.pdf) (Released 2 May 2013 - 12: 00 p.m.)
- USDA-NRCS. (2014) The PLANTS Database. National Plant Data Team, Greensboro, NC 27401-4901 USA. Available from: <http://plants.usda.gov> (accessed 3 June 2014)
- Vafadar, M., Attar, F. & Maroofi, H. (2010) Trichome micromorphology in drupe of *Amygdalus* L. (Rosaceae) from Iran. *Acta Botanica Croatica* 69: 93–105.
- Vafadar, M., Kazempour Osaloo, S. & Attar, F. (2014) Molecular phylogeny of the genus *Amygdalus* (Rosaceae) based on nrDNA ITS and cpDNA *trnS-trnG* sequences. *Turkish Journal of Botany* 38: 439–452.  
<http://dx.doi.org/10.3906/bot-1303-46>

- Vassilczenko, I.T. (1961) Flora Asiae Mediae Novitates. *Botanicheskie Materialy Gerbariya Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR* 21: 3–9.
- Watson, S. (1880) *Geological Survey of California. Botany*, Vol. 2. John Wilson and Son, University Press. Cambridge, MA, 559 pp.
- Wen, J., Berggren, S.T., Lee, C.H., Ickert-Bond, S., Yi, T.S., Yoo, K.O., Xie, L. & Potter, D. (2008) Phylogenetic inferences in *Prunus* (Rosaceae) using chloroplast *ndhF* and nuclear ribosomal ITS sequences. *Journal of Systematics and Evolution* 46: 322–332.
- Wight, W. (1913) North American species of the genus *Amygdalus*. In: *Dudley Memorial Volume, Containing a Paper by William Russel Dudley and Appreciations and Contributions in His Memory by Friends and Colleagues*. Stanford University, California, pp. 130–137.
- Yazbek, M.M. (2010) Systematics of *Prunus* subgenus *Amygdalus* monograph and phylogeny. PhD Thesis, Cornell University, Ithaca, 230 pp.
- Yazbek, M.M. & Oh, S.-H. (2013) Peaches and almonds: phylogeny of *Prunus* subg. *Amygdalus* (Rosaceae) based on DNA sequence and morphology. *Plant Systematics and Evolution* 299: 1403–1418.  
<http://dx.doi.org/10.1007/s00606-013-0802-1>
- Yazbek, M.M. & Al-Zein, M.S. (2014) Wild almonds gone wild: revisiting Darwin’s statement on the origin of peaches. *Genetic Resources and Crop Evolution* 61: 1319–1328.
- Yü, T.T., Lu, L.T., Ku, T.C., Li, C.L. & Chen, S.X. (1986) Rosaceae (3) Prunoideae. In: Yü, T.T. (Ed.) *Flora Reipublicae Popularis Sinicae* 38. Science Press, Beijing, pp. 1–133.
- Zaurov, D.E., Eisenman, S.W., Ford, T., Khokhlov, S., Kenjebaev, S., Shalpykov, K.T. & Funk, C.R. (2015) Genetic resources of almond species in the former USSR. *HortScience* 50: 18–29.
- Zhukovsky, P.M. (1971) *Kulturnye Rasteniya i ikh Sorodichi [Cultivated Plant Species and Their Relatives]*. 3<sup>rd</sup> Ed. Kolos, Leningrad, 752 pp.
- Zohary, M. (1972) *Flora Palaestina*, Pt. II. Israel Academy of Sciences and Humanities, Jerusalem, 1146 pp.
- Zohary, D. & Hopf, M. (2000) *Domestication of Plants in the Old World*. Oxford University Press Inc., New York, 316 pp.