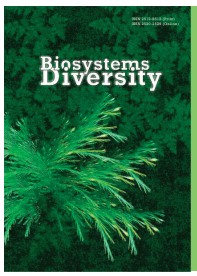

Biosystems Diversity

ISSN 2519-8513 (Print)
ISSN 2520-2529 (Online)
Biosyst. Divers.,
2020, 28(4), 445–454
doi: 10.15421/012057

Taxonomy of the wild species of genus *Crataegus* (Rosaceae): An updated review for the flora of Nakhchivan Autonomous Republic (Azerbaijan)

A. M. Ibrahimov*, A. V. Matsyura**, K. Jankowski***

*Institute of Bioresources of Nakhchivan Section of Azerbaijan National Academy of Sciences, Nakhchivan, Azerbaijan
**Altai State University, Barnaul, Russian Federation
***Siedlce University on Natural Science and Humanities, Siedlce, Poland

Article info

Received 08.09.2020
Received in revised form 14.10.2020
Accepted 18.10.2020

Institute of Bioresources of Nakhchivan Section of Azerbaijan National Academy of Sciences, AZ 7000, Babek St. 10, Nakhchivan, Azerbaijan

Altai State University, Lenin St. 61, Barnaul, 656049, Altai Krai, Russian Federation
E-mail: amatsyura@gmail.com

Siedlce University on Natural Science and Humanities, Stanisława Konarskiego 2, 08-110, Siedlce, Poland

Ibrahimov, A. M., Matsyura, A. V., & Jankowski, K. (2020). Taxonomy of the wild species of genus Crataegus (Rosaceae): An updated review for the flora of Nakhchivan Autonomous Republic (Azerbaijan). Biosystems Diversity, 28(4), 445–454. doi:10.15421/012057

We clarified the current state of genus *Crataegus* L. in the flora of the Nakhchivan Autonomous Republic (Azerbaijan) using a comparative analysis of herbarium specimens from the Azarbaijan herbariums and data collected during the expeditions in 2004–2018. We succeed in adding some important data on the flora of Nakhchivan Autonomous Republic and Azerbaijan, we also enhanced the previous research with chromosome and morphological analysis. We identified 17 wild species of *Crataegus* genus in the Nakhchivan Autonomous Republic (*C. pentagyna* Waldst. et Kit. ex Willd., 1800, *C. zangezura* Pojark., 1939, *C. orientalis* Pall. ex Bieb., 1808, *C. pojarkoviae* Kossych, 1964, *C. tournefortii* Griseb., 1843, *C. szovitsii* Pojark., 1939, *C. pontica* C. Koch, 1853, *C. meyeri* Pojark., 1939, *C. eriantha* Pojark., 1939, *C. atrosanguinea* Pojark., 1939, *C. caucasica* C. Koch, 1853, *C. pallasii* Griseb., 1843, *C. rhipidophylla* Gand. (*C. curvisepala* Lindm.; *C. kyrtostyla* Pojark.) 1871, *C. pseudoheterophylla* Pojark., 1939, *C. monogyna* Jacq., 1775, *C.* x *armena* Pojark., 1939, and *C.* x *cinovskisii* Kassumova), which will contribute to five introduced cultural species used in the greenery. We also clarified the status of interserial and intersection hybrids using the chromosome and morphological analysis. The article includes the complete list of *Crataegus* L. species with information about synonyms of the species, patterns of distribution, habitat, latitude and elevation, flowering and fruiting phenology.

Keywords: flora; Azerbaijan Republic; systematic; rare species; distribution.

Introduction

Nakhchivan Autonomous Republic (AR) is a part of the Azerbaijan Republic, situated in the southwestern region of the Lesser Caucasus Mountains. The overall length of the republic's boundaries is 398 km. The region occupies 5,363 km^2 and borders Armenia in the east and north (221 km), Iran in the south and west (179 km), and Turkey in the northwest (15 km). Its highest point is the Gapudzhik peak (3,906 m), and the lowest point of the autonomous republic (600 m) is located on the left bank of the Aras River, at the foot of the steep Soyugdag ridge (Fig. 1). The Republic of Nakhchivan is considered a distinct climate and physical-geographical area of Azerbaijan (Mirzeyev, 1952). AR has a continental climate with cold winters and dry summers. The mean annual temperature is about 10–14 °C. Areas above 2,300–2,400 m have a mean annual air temperature of less than 4 °C. In the lower part of the Republic, the mean air temperature is 18 °C in January and 41–43 °C in July–August. Relative humidity ranges significantly, accounting for 74–76% in the city of Nakhchivan in December–February and 39–40% in July–August. In the middle mountain zone in December–February and July–August, it equals 69–78% and 52–55% respectively, which is similar to the Lesser Caucasus foothills area. The greatest share of precipitation is registered in spring (March–May), while July–August is the minimum precipitation period. The annual precipitation volume is 210–310 mm in the lowland region, 365–550 mm in the mid-mountainous area, and 660 mm in the alpine region.

Nakhchivan Autonomous Republic territory has abundant flora and plant diversity. Initially that is due to the territory's environmental and highly dynamic geological and geomorphological composition. The territory, which forms the boundary of the Caucasian, Central Asian and Iranian migration flora, contains several botanical-geographical areas. A total of 2,963 species of higher plants have been found in the territory, identified to 880 genera and 168 families (Talibov & Ibragimov, 2008).

Some of the oldest representatives of the Rosaceae family are the species included in the genus *Crataegus* L. Research conducted in the field of paleobotany has confirmed the antiquity of the genus *Crataegus*. According to Kryshtofovich (1957), *Crataegus* representatives initially appeared during the Cretaceous period in the Mesozoic Era, and were widespread in the Tertiary Period. The traces found in the former USSR, in the Upper Oligocene, Miocene, and Pliocene sediments, may also confirm this. In modern times the genus *Crataegus* is distributed in hot and subtropical and temperate provinces located at latitudes from 30° to 60° (Takhtajan, 1978). While in temperate Europe there are fewer *Crataegus* species compared with North America, those few species are very widespread and common in grassland and forest ecosystems. They are found mostly in the American flora, while the genetic diversity center of the section *Crataegus* ranges from Turkey to Iran (Albarouki & Peterson, 2007; Dönmez, 2014; Dönmez & Özderin, 2019).

We considered a few taxonomic studies on the Turkish *Crataegus* species, while some new taxa have been described from Asia and Europe (Dönmez, 2007, 2014; Rajeb et al., 2010). Many new species have been described from North America (Christensen, 1992). Nowadays, the *Crataegus* species number is estimated by some authorities to be as high as 1,200. Nevertheless, the widely accepted species number is almost 200, some species being considered to be synonyms (Fineschi et al., 2005; Talent & Dickinson, 2005; Lo et al., 2007, 2009).

Studies related to wild species of the *Crataegus* genus were also performed by Riedl (1959), Cinovskis (1971), Browics (1972), Donmez

(2004, 2007, 2014), Gabrielian & Sargsyan (2009), and Sargsyan (2011). Pojarkova (1939) reported the distribution in the *Caucasus* of 16 species from three sections, namely *C. pentagyna* Waldst. et Kit., *C. orientalis* Pall. ex Bieb., *C. szovitsii* Pojark., *C. pontica* C. Koch, *C. meyeri* Pojark., *C. eriantha* Pojark., *C. caucasica* C. Koch, *C. atrosanguinea* Pojark., *C. kyrtostyla* Finger, *C. beckeriana* Pojark. (*C. pallasii* Griseb.), *C. monogyna* Jacq., *C. pseudoheterophylla* Pojark., *C. microphylla* C. Koch, *C. zangezura* Pojark., *C. schraderiana* Ledeb., and *C. armena* Pojark. Considering that *C. zangezura*, *C. schraderiana* and *C. armena* are of hybridogenic origin, Pojarkova included them in the list of hybrid species.

Fig. 1. Study area

Grossheim (1952) described the distribution of 14 hawthorn species in the Caucasus and grouped them (at section level) as follows: *pentagynae* Zbl. (*C. pentagyna*, *C. colchica* Grossh.); *azaroli* Loud. (*C. orientalis*, *C. szovitsii*, *C. pontica*), *oxyacantha* Zbl. (*C. meyeri*, *C. eriantha*, *C. caucasica*, *C. atrosanguinea*, *C. kyrtostyla*, *C. pallasii*, *C. monogyna*, *C. pseudoheterophylla*, *C. lagenaria*). Besides, the author reported new species of hybridogenic origin and mentioned regular hybridization between the species of *Crataegus* genus. Among them were *C. zangezura* (*C. pentagyna* x), *C. armena* (*C. kyrtostyla* x *C. meyeri*) and *C. schraderiana* (*C. orientalis* x *C. pentagyna*) that were described as hybridogenic species.

Poletiko (1954) changed the systematic composition of the *Crataegus* genus on the basis of available herbarium specimens and his data, confirming that 15 species – *C. pentagyna*, *C. zangezura*, *C. orientalis*, *C. szovitsii*, *C. pontica*, *C. meyeri*, *C. eriantha*, *C. caucasica*, *C. atrosanguinea*, *C. kyrtostyla*, *C. pseudoheterophylla*, *C. armena*, *C. pallasii*, *C. monogyna*, and *C. microphylla*, were distributed in the Caucasus. The author also mentioned that *C. zangezura* and *C. armena* were not found in cultivation. He classified *C. schraderiana* (*C. orientalis* x *C. pentagyna*) as a hybrid *C. tournefortii* Griseb. and suggested it was distributed only in Minsk and Crimea as a cultural species.

Information related to the distribution of hawthorns throughout the Nakhchivan Autonomous Republic was summarized by Prilipko (1939, 1954), Grossheim (1952), Gurbanov (1996), Isayev & Kasumova (1976), Kasumova (1983, 1985, 1991), Ibragimov (2005), K. S. Asadov & A. K. Asadov (2001), Talibov & Ibrahimov (2013), Talibov & Ibragimov (2008, 2010) and Ibrahimov et al. (2018).

Prilipko (1939, 1954, 1965) reported the distribution of *C. orientalis*, *C. pentagyna*, *C. pectinata*, *C. monogyna*, *C. szovitsii*, *C. meyeri*, *C. caucasica*, *C. pseudoheterophylla*, and *C. kyrtostyla* for the area of Nakhchivan AR. K. S. Asadov et al. (2008, 2014) have also substantiated this information. Prilipko (1954) showed that nine species of hawthorn – *C. pentagyna*, *C. orientalis*, *C. szovitsii*, *C. meyeri*, *C. eriantha*, *C. caucasica*, *C. kyrtostyla*, *C. pseudoheterophylla*, and *C. lagenaria* are distributed in the territory of Azerbaijan. *C. zangezura* (*C. pentagyna* x), *C. armena* (*C. kyrtostyla* x *C. meyeri*), and *C. schraderiana* (*C. orientalis* x *C. pentagyna*) were described as species of hybridogenic origin.

Kasumova (1981, 1983, 1985) conducted fundamental research on the hawthorns in Azerbaijan, later specifying the systematic content of the *Crataegus* genus, and expanding the list from nine to 19 species (Kasumova, 1985, 1991, 2004). Among them, she mentioned *C. atrosanguinea*, *C. armena*, *C. zangezura*, *C. pontica*, *C. tournefortii* for Azerbaijan; *C. monogyna*, and *C. pallasii* for the South Caucasus (Transcaucasia); *C. pojarkovae* Kossych was indicated for the Caucasus flora for the first time. Kasumova (1991) also described a new species – *C. cinovskisii* Kassum and identified 13 species (*C. atrosanguinea*, *C. armena*, *C. caucasica*, *C. cinovskisii*, *C. curvisepala* (*C. kyrtostyla*), *C. meyeri*, *C. pojarkoviae*, *C. pontica*, *C. pseudoheterophylla*, *C. szovitsii*, *C. tournefortii*, *C. zangezura*) in the Nakhchivan Autonomous Republic.

Askerov (2006) confirmed the presence of 17 hawthorn species for the territory of Azerbaijan and showed the problematic independent status of *C. atrofusca* in relation to *C. pentagyna*, which was suggested by Kasumova. According to Askerov, *C. atrofusca* differs from *C. pentagyna* mainly by leaves, sepal and fruit, which, in our opinion, is not sufficient for species status. Thus, Askerov (2006) suggested the hawthorn species list for the territory of Azerbaijan including *C. pentagyna* (incl. *C. atrofusca*), *C. orientalis* (*C. laciniata*), *C. szovitsii*, *C. meyeri*, *C. eriantha*, *C. caucasica*, *C. curvisepala* (*C. kyrtostyla*), *C. microphylla* (*C. lagenaria*), *C. pseudoheterophylla*, *C. atrosanguinea*, *C. armena*, *C. zangezura*, *C. pallasii*, *C. pontica*, *C. monogyna*, *C. pojarkoviae*, and *C. tournefortii*. Further research on hawthorns has been continued by Ufimov (2011), and initially *Crataegus talyschensis* Pojark. ex Ufimov was added to the Caucasian flora and later Ufimov (2013) reported 30 species of *Crataegus* for the Caucasus.

Talibov & Ibragimov (2008) determined the latest systematic composition of species belonging to the *Crataegus* genus. The authors reported 20 species of hawthorn for Nakhchivan AR, among them 15 species – *C. armena*, *C. caucasica*, *C. cinovskisii*, *C. curvisepala*, *C. eriantha*, *C. meyeri*, *C. monogyna*, *C. orientalis*, *C. pallasii*, *C. pentagyna*, *C. pojarkoviae*, *C. pontica*, *C. pseudoheterophylla*, *C. szovitsii*, and *C. zangezura* were found in the wild, while five species – *C. chlorocarpa*, *C. ferganensis*, *C. sanguinea*, *C. songarica*, and *C. turkestanica* were cultivated. However, Kasumova (1985) did not include *C. atrosanguinea* and *C. tournefortii* for this area due to the problematic taxonomy. Later, Talibov & Ibrahimov (2013) presented detailed information about distributions of these species in the Nakhchivan Autonomous Republic. Sargsyan (2011) also indicated the presence of *C. tournefortii* in the Nakhchivan Autonomous Republic.

Thus, though there is some research concerning the distribution of *Crataegus* throughout the Autonomous Republic, the species structure of the genus is still unclear.

Material and methods

We analyzed the specimens from the Herbarium Fund of the Botany Institute of the Azerbaijan National Academy of Sciences, Bioresources İnstitute of the Nakhchivan Section of the Azerbaijan National Academy of Sciences, Nakhchivan State University. We performed the field research during 2004–2018, partially reported in Ibrahimov et al. (2018) and

Ibragimov (2005) within the Nakhchivan Autonomous Republic. We applied standard methods for collecting and storing the plants, particularly the methods according to Baranec (1986), and Metsger & Byers (1999). We used the GPS Garmin to determine the locality coordinates and altitudes during the field trips.

The species were identified according to Christensen (1992), Kasumova & Akhundov (2004), Askerov (2006), Christensen & Zielinski (2008), Ufimov (2011, 2013). We used data from Gladkova (1968) and Byatt & Murray (1977) for chromosome analysis to detect the parentage of some hybrids. Since there is some interspecies variation in chromosome numbers we also used data from Gladkova (1967, 1968), Magulaev (1976), Byatt & Murray (1977), Baranec (1983, 1986), and Donmez (2007, 2014) for the identification of *Crataegus* species karyotypes. We enhanced our previous research data (Ibrahimov, 2017; Ibrahimov et al., 2018) with more detailed chromosome analysis, which resulted in interserial and intersection hybrids status clarification.

To collect the flowering and fruiting materials, we visited most of the localities two or three times. We also performed observations on habitat, lifeform, phenology and some morphological features with notation and photographs. We presented the taxa, families, and author citations in accordance with Christensen (1992) and Phipps et al. (2003); we also arranged alphabetically the family and species names in our article. All collected herbarium materials were deposited in the Herbarium of the Bioresources İnstitute of the Nakhchivan Section of the Azerbaijan National Academy of Sciences.

Results

We reported 17 wild species of *Crataegus* L. for the flora of Nakhchivan Autonomous Republic. The identified species are listed in alphabetic order of family names.

Genus *Crataegus* L., L. 1753, Sp. Pl. 1: 475.

Type: C. rhipidophylla Gandoger (*C. oxyacantha* L., nom.rejic.)

Subgen. 1. *Crataegus*

Type: *Crataegus* L.

Sect. *Crataegus* – sect. *oxyacantha* Loud. 1838, Arbor Fruit. Brit. 2: 829; Poyarkova 1939, Fl. USSR 9: 436. – sect. *oxyacanthae* Zabel ex C. K. Schneider, 1906, Ill. Handb. Laubholzk 1:768.

Crataegus species are shrubs or small trees, mostly growing to 5–15 m tall, with small pome fruits and usually thorny branches. The most common type of bark is smooth grey in young individuals, developing shallow longitudinal fissures with narrow ridges in older trees. The thorns are small sharp-tipped branches that arise either from other branches or from the trunk, and are typically 1–3 cm long (once recorded as up to 11.5 cm). The leaves grow spirally arranged on long shoots, and in clusters on spur shoots on the branches or twigs. The leaves of most species have lobed or serrate margins and are somewhat variable in shape. The fruit, sometimes known as a "haw", is berry-like but structurally like a pome, containing 1–5 pyrenes that resemble the "stones" of plums or peaches, which are drupaceous fruits in the same subfamily.

Type: *C. rhipidophylla* Gand.

Subsect. 1. *pentagynae* (C. K. Schneid.) Ufimov, 2013, Novitates Systematicae Plantarum Vascularium, 44: 117 – *Crataegus* sect. *pentagynae* C. K. Schneid., 1906, Ill. Handb. Laubh. 1: 768. – *pentagynae* Zabel Pojarkova, 1939, Flora of the USSR 9: 430; – *melanocarpae* Zabel, 1903, Beissn., Schelle and Zabel Handb. Laubh.-Benenn.: 178.

Type: *C. pentagyna* Waldst. et Kit. ex Willd

The branches of the trees are covered with short thorns. The leaves are egg-shaped or ovary-rhombic; the lower surface is clean or fuzzy. The flower group is bare or hairy. Blackish fruits pulp are slightly red. Seeds 2–5, flank side is smoother; the backside is scarce furrow. The fruits are in a spherical shape and black coloured, with blue spots on them and 3–5 seeds.

Ser. l. *pentagynae* (C. K. Schneid.) Russanov

1. *C. pentagyna* Waldst. et Kit. ex Willd., 1800, Sp. Pl. 2, 2: 1006; Regel, 1871, Acta Horti Petropol. I: 113; Trautvetter, 1882, Fl. Ross., 1: 279; Grossheim, 1934, Flora of the Caucasus. 4: 290; Pojarkova, 1939, Flora of the USSR 9: 430; Grossheim, 1952, Flora of the Caucasus 2, 5: 40; Prilipko, 1954, Flora of Azerbaijan 5: 71; Poletiko, 1954, Trees and shrubs of the USSR 3: 537; Fedorov, 1958, Flora of Armenia. 3: 296; Prilipko, 1965, Dendroflora of the Caucasus. 4: 144; Franco, 1968, Fl. Europ. 2: 76; Browicz, 1972, Fl. Turk. 4: 135; Khatamsaz, 1992, Flora of Iran 6: 246. – *C. pentagyna* subsp. *pentagyna* Christensen, 1992, Syst. Bot. Monogr. 35: 53 – *C. melanocarpa* M. Bieb., 1808, Fl. Taur.-Cauc. 1: 386; Hohenacker, 1836, Enum. Pl. Talysh: 130; Ledebour, 1844, Fl. Ross. 2, 1: 89; Boissier, 1872, Fl. Or. 2: 661 p. p. (excl. var. *heterophylla* et var. *atrofusca*); Lipskiy, 1899, Flora of the Caucasus.: 297; Medvedev, 1919, Trees and Shrubs of the Caucasus: 110; Riedl, 1969, Fl. Iran. 66: 53 – *C. oliveriana* Bosc., 1825, in DC., Prodr. 2: 630; Hohen., 1838, Enum. Pl. Talysh: 130 – *C. oxyacantha* L. var. *oliveriana* (Bosc.) Lindl., 1837, Bot. Reg. 23 tab. 1933. – *C. elbursensis* Rech. f., 1942, Ann. Naturhist. Mus. Wien 53: 343. – *C. melanocarpa* subsp. *elbursensis* (Rech. f.) Riedl, 1969, Flora Iran. 66: 54. – *Mespilus pentagyna* K. Koch in Schmalh., 1895, Flora of Central and Southern Russia 1: 350. – *C. colchica* Grossh., 1934, Flora of the Caucasus. 4: 290.

Flowering from May–June, fruiting from September.

Chromosome number: 2n (2x) = 34 (Gladkova, 1968; Byatt & Muraym, 1977; Donmez, 2004); 2n (3x) = 51 (Gladkova, 1967), as *C. atrofusca* (K. Koch) T. A. Kasumova.

Type: "Hungary/Yugoslavia. In Dunato et Syrmio (Danube and Serbia), Kitaibel s. n.", holotype: B-W 9718.

Distribution and habitat: From Hungary and Yugoslavia through Romania and Bulgaria to Ukraine, Crimea, Moldavia, Northeastern Greece, Turkey, Caucasia, Iran, Kopet Dagh, and Northeastern Iraq; on limestone, serpentine, rocky mountain slopes, in scrubs with *Rosa* and *Quercus* along rivers.

Locality: The species is found in adjacent forrests and mountain slopes of Bichanak village of Shahbuz region (1,836 m a.s.l., 39°31′01″ N, 45°46′16″ E), in Nasirvaz (1,956 m a.s.l., 39°09′55″ N, 45°55′34″ E) and Nurgut (2,079 m a.s.l., 39°13′52″ N, 45°54′30″ E) village of Ordubad district, in low and middle mountain zones at the height of 1,400–2,200 m a.s.l., and in the brushwoods, forest glades, rarely in oak forests and well lit places in mixed forests (Fig. 2a).

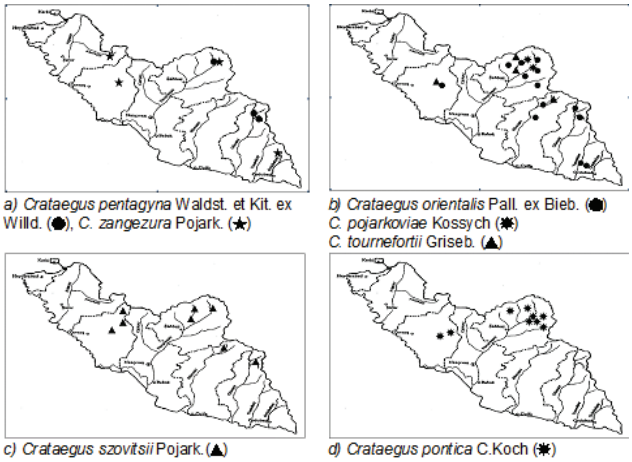

Fig. 2. Distribution of *Crataegus* species in Nakhchivan Autonomous Republic: *a* – *C. pentagyna* Waldst. et Kit. ex Willd. and *C. zangezura* Pojark.; *b* – *C. orientalis* Pall. ex Bieb., *C. pojarkoviae* Kossych and *C. tournefortii* Griseb.; *c* – *C. szovitsii* Pojark.; *d* – *C. pontica* C. Koch.

Ser. 2. *digynae* Ufimov, Novitates Systematicae Plantarum Vascularium, 2013, 44: 117

2. *C. zangezura* Pojark. 1939, Flora of the USSR 9 Addenda 8: 508 (*C. pentagyna* x *C. pseudoheterophylla*); Fedorov, 1958, Flora of Armenia 3: 300; Prilipko, 1965, Dendroflora of the Caucasus 4: 144. – *C. zangezura* Pojark. nothosubsp. *zangezura* Christensen, 1992, Syst. Bot. Monogr. 35: 134.

Flowering from May, fruiting from September–October.

Chromosome number: 2n (4x) = 68 (Christensen, 1992).

Type: U.S.S.R., Armenia, Zangezur, prope opp. Goris (Genjuri), in parte inferiore faucium Goris-Czaj, 21.09.1936, Pojarkova n 540 (holotype: LE; isotype: LE).

Distribution and habitat: Kopet-Dagh in Turkmenia, Iran, and Caucasia; on rocky mountain slopes and in scrub.

Locality: It was found on stony slopes and sparse forests of the surrounding areas of Nusnus village (1,409 m a.s.l., 38°58′05″ N, 46°01′48″ E), Ordubad district and Chalkhangala village (1,793 m a.s.l., 39°29′06″ N, 45°17′40″ E), Babak region. We collected it around the Bichanak village (1,888 m a.s.l., 39°30′52″ N, 45°46′22″ E), Shahbuz region and in Havush village (1,957 m a.s.l., 39°35′59″ N, 45°14′44″ E), at the altitudes of 1,200–2,000 m a.s.l., on the rocks, in sparse forests, in the bushes, and in valleys (Fig. 2a).

Subsect. 2. *azaroli* (Loudon) Ufimov, 2013, Novitates Systematicae Plantarum Vascularium 44: 117 – *Crataegus* sect. *azaroli* Loudon, 1838, Arbor. Frutic. Brit. 2: 826. – Sect. *orientales* Zabel, 1903 in Beissn., Schelle and Zabel, Hand. Laubh.-Benenn.: 179, nom. nud; Schneid. 1906, Ill. Handbuch der Laubh. 1: 781, in clavem.

Small tree or shrubs. The thorns are usually short. The leaves are oblong-egg shaped, hairy and fragmentary. The base is narrowed, wedge or rhombic-shaped. The flower buds are felted. Anthers are white. Large fruits are yellowish, pink, red-pink, round, smooth and hairy.

Type: *C. orientalis* Pall. ex M. Bieb.

Ser. 1. *orientales* (C. K. Schneid.) Pojark.

3. *C. orientalis* Pall. ex Bieb., 1808, Fl. Taur. – Caucas. 1: 387. – Ibid., 1819, 3: 332; Medvedev, 1919, Trees and Shrubs of the Caucasus: 112; Lipskiy, 1899, Flora of the Caucasus: 297; Grossheim, 1934, Flora of the Caucasus 4: 290; Pojarkova, 1939, Flora of the USSR 9: 433; Grossheim, 1952, Flora of the Caucasus 2, 5: 41; Prilipko, 1954, Flora of Azerbaijan 5: 71; Poletiko, 1954, Trees and shrubs of the USSR 3: 538; Fedorov, 1958, Flora of Armenia 3: 296; Prilipko, 1965, Dendroflora of the Caucasus 4: 145; Riedl, 1969, Fl. Iran 66: 55; Browicz, 1972, Fl. Turk. 4: 136; Khatamsaz, 1992, Fl. Iran 6: 249. – *C. orientalis* Pall., 1796, Ind. Taur.: 107, nom. nud. – *C. orientalis* subsp. *orientalis* Christensen, 1992, Syst. Bot. Monogr. 35: 41, p.p. – *C. laciniata* Ucria, 1793, Nuovo Rocc. opusc. Aut. Sic. 6: 251; Franco, 1968, Fl. Europ. 2: 77; Ledeb., 1843, Fl. Ross. 2, 1: 90; Steven, 1856, Bull. Soc. Nat. Moscou 29, 1: 248. – *C. tanacetifolia* var. *orientalis* Regel, 1871, Acta Horti Petropol. 1: 114; Schmalh., 1895, Flora of Central and Southern Russia 1: 350.

Flowering from June, fruiting from September–October.

Chromosome number: 2n (4x) = 68 (Gladkova, 1968; Donmez, 2007).

Type: "frequens in Tauria meridionalis collibus Ponto euxino adjacentibus, U.S.S.R., the Crimea, Marshall von Bieberstein s. n.", holotype: BM.

Distribution and habitat: the Mediterranean region, Turkey, Caucasia, the Crimea, and Western Iran; on calcareous rocks, quartzite and other siliceous rocks; in rocky places, steppe, meadows, along rivers, and in open forest with *Quercus*, *Fagus*, *Pyrus*, *Carpinus*, *Cornus*, *Abies*, *Pinus*, *Cedrus*, and *Juniperus*.

Locality: the samples stored in the Herbarium of the Botany Institute of the Azerbaijan National Academy of Sciences were collected from the surroundings of Anagut (08.V.1947, Rzazade) village of Ordubad district, Khoshkeshin village of Julfa region (13.VIII.1938, Novruzova, 1970). *C. orientalis* Pall. ex Bieb. Was sampled in Kuku village (1,886 m a.s.l., 39°32′02″ N, 45°37′00″ E), Kechili village (1,884 m a.s.l., 39°22′00″ N, 45°43′16″ E), Kolani village (1,702 m a.s.l., 39°30′48″ N, 45°37′35″ E), Guney Gishlag village (1,789 m a.s.l., 39°30′38″ N, 45°34′56″ E), Yukhary Gishlag village (1,855 m a.s.l., 39°30′23″ N, 45°41′47″ E), Bichanek village (2,047 m a.s.l., 39°32′06″ N, 45°46′11″ E) of Shahbuz region, Chalkhangala village (1,944 m , 39°29′08″ N, 45°17′45″ E) of Kengerli region, Anagut village (1,347 m a.s.l., 38°58′37″ N, 45°57′56″ E), Nusnus village (1,374 m a.s.l., 38°57′59″ N, 46°01′59″ E), Nasirvaz village (1,863 m a.s.l., 39°09′50″ N, 45°55′05″ E), and Nurgut village (2,035 m a.s.l., 39°14′33″ N, 45°54′12″ E) of Ordubad district, Khoshkeshin village (1,241 m a.s.l., 39°10′28″ N, 45°42′26″ E), Arafsa village (2,048 m a.s.l., 39°20′22″ N, 45°46′45″ E) of Julfa region at 1,200–2,100 m above sea level individually or in small groups, at the edges of forest, in glades, well lit oak forests, and sparse arid forests. Sometimes, along with other species of hawthorn, they form brushwood on dry slopes of the mountains (Fig. 2b).

4. *C. pojarkoviae* Kossych, 1964, Novitates systematicae plantarum non vascularium: 147. – *C. laciniata* Ucria subsp. *pojarkovae* (Kossych) Franco 1968, Feddes Repert. 79: 37. – *C. orientalis* Pall. subsp. *pojarkovae* (Kossych) Byatt, 1977, Contrib. Crataeg. Eur.: 89; Christensen, 1992, Syst. Bot. Monogr. 35: 43.

Flowering from June, fruiting from September.

Chromosome number: 2n (3x) = 51 (Gladkova, 1968).

Type: U.S.S.R., the Crimea, Karadag, in parte inferiore declitatis australis jugi Sjurju-Kaja, 14.06.1960, 22.09.1960, Kossych s.n. (holotype: YALT; isotype: LE!).

Distribution and habitat: Caucasian, Crimea.

Locality: It was found in stony-gravel slopes of Yukhari Gishlag village (1,745 m a.s.l., 39°29′49″ N, 45°41′40″ E) and Gizil Gishlag village (1546 m a.s.l., 39°29′35″ N, 45°36′32″ E), Shahbuz region, in the middle and high mountain zones at 1,300–2,000 m a.s.l. in sparse arid forests (Fig. 2b).

5. *C. tournefortii* Griseb. 1843, Spicil. Fl. Rumel. Et Bithyn. 1: 90. – Pojarkova, 1950, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 12: 108; Poletiko, 1954, Trees and shrubs of the USSR 3: 539; Prilipko, 1965, Dendroflora of the Caucasus. 4: 145. – *C. sanguinea* auct. Schrad. 1834, Index Sem. Hort. Gotting.: 2, non *C. sanguinea* Pall. – *C. orientalis* auct. non Pall.: Lindl., 1836, Bot. Reg. 22: t. 1852. – *C. orientalis* var. *sanguinea* (Schrad.) Loud., 1838, Arb. Brit. 2: 828. – *C. orientalis* var. *tournefortii* (Griseb.) Schneider, 1906, Ill. Handb. Laubholzk. 1: 787. – *C. schraderiana* Ledeb., 1844, Fl. Ross. 2, 1: 91; Pojarkova, 1939, Flora of the USSR 9: 464; Fedorov, 1958, Flora of Armenia. 3: 299; Franco, 1968, Fl. Europ. 2: 76. – *C. orientalis* Pall. subsp. *orientalis* Christensen, 1992, Syst. Bot. Monogr., 35: 41, p.p.

Flowering in June, fruiting from September–October.

Chromosome number: 2n (3x) = 51; 2n (4x) = 68 (Gladkova, 1967, 1968); as *C. schraderiana* Ledeb.).

Type: Tab. 1852 in Lindley, Bot. Reg. 22. 1836 (lectotype, here designated).

Distribution and habitat: Europe, Caucasus, Sicily (Nebrodi Mts), Albania, Southern Yugoslavia, Greece, Bulgaria, Turkey, Ukraine (near Odessa), and the Crimea.

Locality: T. A. Kasumova collected the specimens from Chalkhangala village of Kengerli region and Bichanek forest of Shahbuz region. The species is distributed in Khanbulagi areas of Sharur region, in the middle and upper mountain zones, at 1,300–1,400 m above sea level, at the edges of the forests, on stony slopes or individually or in groups. During our research samples of *C. tournefortii* were collected from Kuku village (1,888 m a.s.l., 39°32′02″ N, 45°36′39″ N), Ayrinj village (1,320 m a.s.l., 39°26′08″ N, 45°35′03″ E) of Shahbuz region, Chalkhanqala village (1,678 m a.s.l., 39°25′55″ N, 45°20′44″ E) of Kangarli region, Khazinedere village (2,121 m a.s.l., 39°20′39″ N, 45°46′36″ E) of Julfa region (Fig. 2b).

6. *C. szovitsii* Pojark., 1939, Flora of the USSR, 9, Addenda 8: 499. – Grossheim, 1952, Flora of the Caucasus 5: 41; Poletiko, 1954, Trees and shrubs of the USSR 3: 540; Prilipko, 1954, Flora of Azerbaijan 5: 72; Fedorov, 1958, Flora of Armenia 3: 297; Prilipko, 1965, Dendroflora of the Caucasus 4: 147; Riedl, 1969, Fl. Iran 66: 55; Browich, 1972, Fl. Turk. 4: 138; Khatamsaz, 1992, Fl. Iran 6: 250. – *C. orientalis* Pall. subsp. *szovitsii* (Pojark.) Christensen, 1992, Syst. Bot. Monogr. 35: 47. – *C. orientalis* var. *connecta* Diapulis, 1934, Feddes Repert. 34: 56, p. p. – *Mespilus monogyna* var. *armeniaca* Wenzig, 1874, Linnaea 38: 157.

Flowering from June, fruiting from September–October.

Chromosome number: Unknown.

Type: U.S.S.R., Azerbaijan: Nagorno-Karabagh, in collibus prope Shusha, Hohenacker n 3423 (holotype: LE,; isotypes: BM! G! W!).

Distribution and habitat: Caucasus, European and Asian Turkey, western Iran.

Locality: According to Isaev & Kasumova, this species is present on the dry stony slopes between the Payiz and Buzgov villages of Babek region and Kolani village of Shahbuz region. We collected specimens around the Payiz and Ashagi Buzgov villages (1,289 m a.s.l., 39°27′36″ N, 45°22′59″ E) of Babek region, Arafsa village (2,182 m a.s.l., 39°20′22″ N, 45°46′45″ E) of the Julfa region, Kuku village (1,762 m, 39°31′08″ N, 45°37′33″ E), Kolani village (1,399 m a.s.l., 39°26′47″ N, 45°40′32″ E) and Ayrinj village (1,318 m a.s.l., 39°26′27″ N, 45°35′06″ E) in Shahbuz region, in the middle mountainous zones, at 1,300–2,200 m a.s.l., from

stony slopes of mountains, rocks, brushwoods, arid sparse forests and edges of forests (Fig. 2c).

Ser. 2. *ponticae* Pojark.

7. *C. pontica* C. Koch, 1853, Verh. Ver. Beford. Gartend. Konigl. Preuss. N.R. 1: 269. – ejusd. 1854, Weissdorn: 49, Grossheim, 1934, Flora of the Caucasus 4: 290; Pojarkova, 1939, Flora of the USSR 9: 435; Grossheim, 1952, Flora of the Caucasus 5: 41; Poletiko, 1954, Trees and shrubs of the USSR 3: 541; Prilipko, 1965, Dendroflora of the Caucasus 4:147; Riedl, 1969, Fl. Iran 66: 57; Browicz, 1972, Fl. Turk. 4: 138; Khatamsaz, 1992, Fl. Iran 6: 251. – *C. azarolus* var. *pontica* (C. Koch) Christensen, 1992, Syst. Bot. Monogr. 35: 38.

Flowering in June, fruits ripen in September–October.

Chromosome number: 2n (4x) = 68 (Gladkova, 1967, 1968; Donmez, 2004).

Type: Turkey. Prov. Coruh, in der Niihe von Ardanuc, 28.08.1843, Koch n 187 (holotype: B, destroyed).

Neotype, here designated: drawing of holotype, according to Pojarkova's classification (1939).

Distribution and habitat: Israel, Jordan, Turkey, Caucasus, Georgia, Iraq, Iran, Turkmenia (Kopet-Dagh), Southern Kazakhstan, Uzbekistan, Tadzhikistan, and Kirgizstan.

Locality: According to Kasumova (1981, 1983, 1985, 1991), the species is distributed around Yukhary Gishlag in Shahbuz region. We collected samples around Chalkhangala village (1,626 m a.s.l., 39°25′52″ N, 45°20′56″ E) of Kangarli region, around Ashagi Gishlag village (1,533 m a.s.l., 39°28′27″ N, 45°41′58″ E), Yukhary Gishlag village (1,807 m a.s.l., 39°30′08″ N, 45°41′46″ E), Guney Gishlag village (1,870 m a.s.l., 39°30′59″ N, 45°34′40″ E), Nursu village (1,737 m a.s.l., 39°24′48″ N, 45°41′06″ E), Kolani village (1,421 m a.s.l., 39°27′11″ N, 45°41′55″ E), and Agbulag village (1,918 m a.s.l., 39°26′29″ N°, 45°43′33″ E) of Shahbuz region and in the Lizbirt area (1,646 m a.s.l., 39°25′24″ N, 45°21′52″ E) (Fig. 2d). We also registered this species in Nursu and Agbulag villages of Shahbuz region, in the low and middle mountain zones, at heights of 1,300–1,800 m a.s.l., on dry banks of mountain rivers and in arid forests (Talibov & Ibrahimov, 2013).

Subsect. 3. *Crataegus* L.

Type: type of the genus.

Ser. l. *ambiguae* Pojark.

8. *C. meyeri* Pojark. 1939, Flora of the USSR 9, Addenda 8: 500; Grossheim, 1952, Flora of the Caucasus. 2, 5: 42; Prilipko, 1954, Flora of Azerbaijan 5: 72; Poletiko, 1954, Trees and shrubs of the USSR 3: 546; Fedorov, 1958, Flora of Armenia. 3: 299; Prilipko, 1965, Dendroflora of the Caucasus 4: 148; Riedl, 1969, Fl. Iran., 66: 58; Browicz, 1972, Fl. Turk. 4: 140; Khatamsaz, 1992, Fl. Iran 6: 253; Christensen, 1992, Syst. Bot. Monogr. 35: 59 p. max p., incl. typ. – *C. pectinata* auct. non Bosc.: C. A. Mey. ex Hohen., 1838, Enum. Pl. Talysch: 130, nom. nud., p. p.; Ledeb., 1843, Fl. Ross. 2, 1: 91, p. p.; Boiss., 1872, Fl. Or. 2: 663, p. p.; Grossheim, 1934, Flora of the Caucasus 4: 291. – *C. pectinata* Bosc. Lipskiy, 1899, Flora of the Caucasus: 297. – *C. oxyacantha* var. *pectinata* Schmalh., 1895, Flora of Central and Southern Russia 1: 350, p. p. – *C. tournefortii* auct. non Griseb.: C. Koch, 1854, Crat. et Mesp.: 47. – *C. ambigua* var. *hohenackeri* C. K. Schneider, 1906, Illustr. Handb. Laubh. 1: 785, p. p.

Flowering from May–June, fruiting from September–October.

Chromosome number: 2n (3x) = 51; 2n (4x) = 68 (Gladkova, 1967, 1968; Donmez, 2004, 2007).

Type: U.S.S.R., Armenia, in vicinitate urbis Jerevan, in faucibus fl. Gjarni-Czai, prope monasterium Gehart, 11.10.1936, Pojarkova n 792 (holotype: LE).

Distribution and habitat: South Caucasus, Talish, Ukraine, the Crimea, Asian Turkey, Northern Iraq, Armenia, Azerbaijan, and Iran; dry meadows and woodlands; 1,200–2,800 m a.s.l.

Locality: the distribution area of Meyer hawthorn is Chalkhanqala village of Kangarli region, Kolany village, Guney Gishlag village, Bichanak suburb of Shahbuz region (Kasumova, 2004). During our investigations, we found *C. meyeri* growing individually or in groups on stony slopes, in arid sparse forests and bushy habitats at altitudes of 1,300–2,000 m a.s.l. in the low, middle and high altitudes around Havush village (1,918 m a.s.l., 39°35′57″ N, 45°14′37″ E) of Sharur districts, Chalkhanqala village (1,518 m a.s.l., 39°27′19″ N, 45°16′52″ E) of Kangarli region, Kulus village (1,494 m a.s.l., 39°21′35″ N, 45°39′17″ E), Kuku village (1,911 m a.s.l., 39°32′13″ N, 45°36′56″ E), Kolany village (1,396 m a.s.l., 39°26′48″N, 45°40′50″ E), Guney Gishlag village (1,905 m a.s.l., 39°30′57″ N, 45°34′33″ E), and Bichanek village (2,030 m a.s.l., 39°32′06″ N, 45°46′11″ E) of Shahbuz region. We occasionally registered it in woodlands, at 2,200 m altitude above sea level in the woods and on the edges of the roads in the territory of Nakhchivan AR (Fig. 3a).

This species which is broadly distributed in the South Caucasus was described as *C. pectinata* C. A. Mey. by Grossheim (1952). According to Pojarkova (1939), some authors incorrectly identified *C. meyeri* with 2–3 seeded fruits as *C. caucasica*, and some of them misidentified it as *C. orientalis* confused by the dense fuzzy upper and undersides of the leaves.

9. *C. eriantha* Pojark. 1939, Flora of the USSR 9, Addenda 8: 500; Grossheim, 1952, Flora of the Caucasus 2, 5: 42; Prilipko, 1954, Flora of Azerbaijan 5: 73; Poletiko, 1954, Trees and shrubs of the USSR 3: 546; Prilipko, 1965, Dendroflora of the Caucasus 4: 148. – *C. pectinata* auct. Non Bosc.: C. A. Mey. ex Hohen., 1838, Enum. Pl. Talysch: 330, p. p.; Ledeb., 1843, Fl. Ross. 2: 91, p.p. – *C. melanocarpa heterophylla* Boiss., 1872, Fl. Or. 2: 662, p. p.; Lipskiy, 1899, Flora of the Caucasus: 297. – *C. meyeri* Pojark. Christensen, 1992, Syst. Bot. Monogr. 35: 59 (p. min. p.).

Flowering from May–June, fruiting from September–October.

Chromosome number: Unknown.

Type: "In declvibus prope fluvium Gandscha, disrictus Airum, 01.05.1844. n 1399 Flora Transcauc. Legit. Dr. Koilenati", holotype: LE; isotype: LE!.

Distribution and habitat: Caucasia, South Caucasus endemic.

Locality: Species was registered in Bichenek village (1,969 m a.s.l., 39°30′52″ N, 45°46′34″ E), Kuku village (1,922 m a.s.l., 39°32′19″ N, 45°36′55″ E), Ayrinj village (1,306 m a.s.l., 39°26′05″ N, 45°35′07″ E) of Shahbuz region, in Nurgut village (1,982 m a.s.l., 39°13′52″N, 45°54′17″ E), Nasirvaz village (1,921 m a.s.l., 39°09′50″ N, 45°55′22″ E), and Bist village (1,548 m a.s.l., 39°08′43″ N, 45°52′43″ E) of the Ordubad region, in low and middle mountain zones, at 1,300–2,000 m a.s.l., on the stony slopes of the mountains, in bushy locations and in arid sparse forests (Fig. 3a).

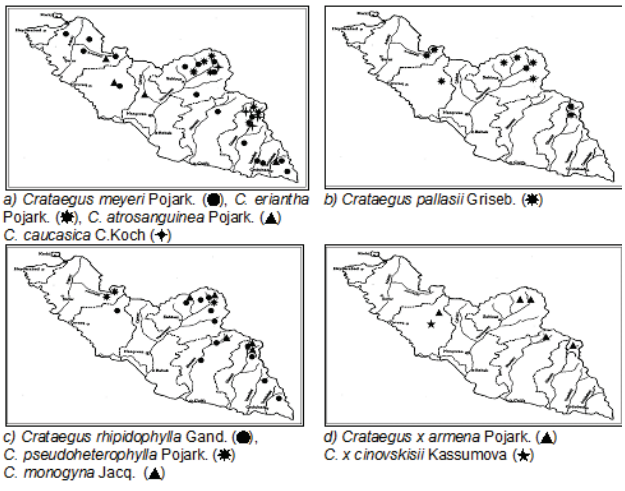

Fig. 3. Distribution of *Crataegus* species in Nakhchivan Autonomous Republic: *a* – *C. meyeri* Pojark., *C. eriantha* Pojark., *C. atrosanguinea* Pojark. and *C. caucasica* C. Koch; *b* – *C. pallasii* Griseb.; *c* – *C. rhipidophylla* Gand., *C. pseudoheterophylla* Pojark. and *C. monogyna* Jacq.; *d* – *C.* x *armena* Pojark. and *C.* x *cinovskisii* Kassumova

10. *C. atrosanguinea* Pojark., 1939, Fl. USSR 9, Addenda 8: 504; Grossheym, 1952, Flora of the Caucasus, 5: 43; Poletiko, 1954, Trees and shrubs of the USSR 3: 549; Fedorov, 1958, Flora of Armenia 3: 299; Prilipko, 1965, Dendroflora of the Caucasus 4: 149; Riedl, 1969, Fl. Iran 66: 59; Browicz, 1972, Fl. Turk. 4: 142; Khatamsaz, 1992, Fl. Iran 6: 256; – *C. ambigua* subsp. *ambigua* (auct. non Meyer ex Becker) Christensen 1992, Syst. Bot. Monogr. 35: 73, p. min. p., excl. typ.

Flowering from May–June, fruiting from September–October.

Chromosome number: 2n(3x)=51; 2n(4x)=68 (Gladkova, 1967, 1968).

Type: "Nork prope Jerevan, 14.10.1937, n 380, A. Pojarkova", holotype: LE., isotype: LE.

Distribution and habitat: South Caucasus, Eastern Turkey, Central and Northern Iran.

Locality: This plant is distributed in the surroundings of Chalkhangala village (1,763 m a.s.l., 39°29′08″ N, 45°17′45″ E) of Kangarli region in the areas between vineyards, in Jahri village (1,057 m a.s.l., 39°20′50″ N, 45°24′31″ E) of Babak region, in the area of Nusnus village (1,355 m a.s.l., 38°57′39″ N, 46°01′12″ E) of the Ordubad region, in low and middle zones at the height of 1,300–1,800 m a.s.l., on the slopes of the mountains, at the edges of the rivers and in the valleys, among shrubs (Fig. 3a).

11. *C. caucasica* C. Koch, 1853, Verh. Ver. Beford. Gartenb. Konigl. Preuss. Staaten, N. R. 1: 286; idem, 1854, Crat. et Mespilus: 66; Pojarkova, 1939, Flora of the USSR 9: 447; Grossheim, 1952, Flora of the Caucasus, 2, 5: 42; Prilipko, 1954, Flora of Azerbaijan 5: 73; Poletiko, 1954, Trees and shrubs of the USSR 3: 549; Fedorov, 1958, Flora of Armenia 3: 299; Prilipko, 1965, Dendroflora of the Caucasus 4: 149; Riedl, 1969, Fl. Iran 66: 59; Christensen, 1992, Syst. Bot. Monogr. 35: 69. – *C. oxyacantha* L. var. *caucassica* (K. Koch) Boiss., 1872, Fl. Or. 2: 664; Lipskiy, 1899, Flora of the Caucasus: 297; Medvedev, 1919, Trees and Shrubs of the Caucasus: 112. – *C. oxyacantha* auct. non L.: Ledeb., 1843, Fl. Ross. 2: 89. Medvedev.

Flowering from May, fruiting from September–October.

Chromosome number: 2n (3x) = 51 (Gladkova, 1968; Donmez, 2004).

Type: U.S.S.R., Caucasus, Wilhelms s.n. (holotype: B, destroyed).

Neotype, here designated, following suggestion by Riedl in Rechinger, 1969, Fl. Iran 66: 59: U.S.S.R., Azerbaijan, Kirovabad (Ganja), 27.09.1937, leg. et det. Pojarkova, n 288 (LE).

Distribution and habitat: South Caucasus, Talysh, easternmost Turkey, Iran, Georgia, Nakhichevan, Armenia and Azerbaijan; on rocky mountain slopes and at roadsides (Christnsen, 1992).

Locality: The samples stored in the Herbarium of the Botany Institute of the Azerbaijan National Academy of Sciences were collected from Bist vilalge (1,602 m a.s.l., 39°09′00″ N, 45°53′02″ E) of Ordubad district and the surroundings of Bichanak village (1,783 m a.s.l., 39°29′45″N, 45°46′04″ E) of Shahbuz district. We also collected samples from Nasirvaz village (1,922 m a.s.l., 39°09′49″ N, 45°55′23″ E) and Nürgüt village (2,040 m a.s.l., 39°13′53″ N, 45°54′23″ E) of Ordubad district, in low and middle zones at altitudes 1,500–1,800 (2,000) m a.s.l., in arid sparse forests, in dry stony slopes of rivers, among the shrubs near the forest , singly or in groups (Fig. 3a).

Ser. 2. *pallasianae* Pojark.

12. *C. pallasii* Griseb., 1843, Spicil. Fl. Rumel. et Bithyn. 1: 89; Trautvetter, 1882, Fl. Ross. 1: 279; Poletiko, 1954, Trees and shrubs of the USSR 3: 553; Wulf, 1960, Flora Kryma, 2: 30; Prilipko, 1965, Dendroflora of the Caucasus 4: 151; Franco, 1968, Fl. Europ. 2: 75; Christensen, 1992, Syst. Bot. Monogr. 35: 80. – *C. monogyna* var. *nigra* Pall. 1784, Fl. Ross. 1, 1: 26, tab. XII. – *C. beckeriana* Pojark., 1939, Flora of the USSR 9: 505, 453, nom. Superfl.

Flowering from May, fruiting from September–October.

Chromosome number: Unknown.

Type: U.S.S.R., Sarepta [Krasnoarmeiski Gorod], Pallas s.n. (holotype: LE!).

Distribution and habitat: Southeastern Europe, Caucasus, Turkey, Checheno-Ingushskaya ASSR, Dagestan, mouth of the Kuban River, and near Volgograd (Krasnoarmeiski Gorod); on mountain slopes, along rivers, and in scrub.

Locality: The plant grows on rocky slopes and sparse woods in Akhura village (1,141 m a.s.l., 39° N, 45°08′36″ E) and Havush village (1,429 m a.s.l., 39°36′01″ N, 45°14′39″ E) of Sharur region. During our investigations, we found the species around Bichanek village (1,913 m a.s.l., 39°30′53″ N, 45°46′26″ E) and Kuku village (1,910 m a.s.l., 39°32′14″ N, 45°36′54″ E) of Shahbuz region, Nasirvaz village (1,943 m a.s.l., 39°10′02″ N, 45°55′37″ E) and Nurgut village (2,137 m a.s.l., 39°13′44″ N, 45°55′01″ E) of Ordubad region at 1,300–2,200 m a.s.l. in middle mountain zones, growing separately on dry rocky slopes, on the edges of the forest, among shrubs and bushes and below rocky slopes (Fig. 3b).

Ser. 3. *Crataegus*

13. *C. rhipidophylla* Gand., 1871 (*C. curvisepala* Lindm.; *C. kyrtostyla* Pojark.), Bull. Soc. Bot. France 18: 447; Christensen, 1992, Syst. Bot. Monogr. 35: 88; Tsvelev, 2000, Manual of the Vascular Plants of North-West Russia: 457. – *C. oxyacantha* L., 1753, Sp. Pl.: 477, nom. rej. – *C. curvisepala* Lindm., 1918, Svensk Fanerogamfl.: 307 – idem, 1926: 332; Galushko, 1980, Flora of the North Caucasus 2: 89. – *C. calicina* Peterm. subsp. *curvisepala* (Lindm.) Franco, 1968, Feddes Repert. 79: 39; Wiedem. et Weber, 1852, Fl. Balt.: 260. – *C. monogyna* var. *rubra* Pall., 1784, Fl. Ross. 1, 1: 26. – *C. laciniata* Steven ex Besser, 1822, Enum. Pl. Volhyn.: 56, non *C. laciniata* Ucria, 1793. – *C. monogyna* var. *laciniata* (Besser) Ledeb., 1844, Fl. Ross. 2, 1: 89, non *C. monogyna* var. *laciniata* K. Koch 1853. – *C. kyrtostyla* Fingerh., 1829, Linnaea 4: 372; Rupr., 1860, Fl. Ingrica: 349; Pojarkova, 1939, Flora of the USSR 9: 450; Poletiko, 1954, Trees and shrubs of the USSR 3:350; Fedorov, 1958, Flora of Armenia. 3: 300. – *C. kyrtostyla* auct. non Fingerh.: Schmidt, 1859, Arch. Naturk. Liv.-Ehst.- u. Kurlands, ser. 2, 1: 210.

Flowering from May–June, fruiting from September–October.

Chromosome number: 2n (2x) = 34 (Baranec, 1983, 1986), as *C. rosiformis* Janka (Donmez, 2004); 2n (3x) = 51 (Baranec, 1983), as *C. curvisepala* Lindm. (Donmez, 2004); 2n (4x) = 68 (Gladkova, 1968), as *C. curvisepala* Lindm.; Ptak, (1986), as *C. curvisepala* Lindm.).

Type: France, Rhone, Liergues, a la Combe, 2 Oct. 1870, Gandoger, holo.: LY.

Neotype: Luxembourg, a 50 m de la frontiere belge, en face du pont de Romeldange surla Sure, 11 Aug 1960, Lawalree 11088 (BR).

Type: France, Rhone, Liergues, a la Combe, 2 Oct. 1870, Gandoger 3 (holotype: LY!).

Distribution and habitat: from Southern Scandinavia and the Baltic Region to France, the Balkan Peninsula, Asian Turkey, Caucasia, the Crimea, and Ukraine, rarely planted as an ornamental within its natural range; on limestone, granite, volcanic rocks; in open woodlands with *Platanus*, *Fagus*, *Fraxinus*, *Pinus*, *Acer*, *Sambucus*, *Salix* and *Sorbus*.

Locality: although it was distributed only in Kuku village of Shahbuz region, according to the literature data, this species was collected by Kasumova (2004) in Bichanak village. During our expeditions, this species was found on the rocky slopes around Nasirvaz village (2,010 m a.s.l, 39°10′13″ N, 45°55′39″ E), Nurgut village (1,971 m a.s.l., 39°13′52″ N, 45°54′16″ E) of the Ordubad district, in Kuku village (1,910 m a.s.l., 39°32′14″ N, 45°36′54″ E) of Shahbuz region, Khazinedere village (2128 m a.s.l., 39°20′24″ N, 45°46′51″ E) of Julfa region and Garagush mountain range (1,930 m a.s.l., 39°33′55″ N, 45°14′58″ E) of Sharur region, at the height of 1,400–2,200 m above sea level, growing individually or in small groups, in forests, glades, well lit oak forests and sparse arid woods. Sometimes, along with other species of hawthorns, they form brushwood on riverbeds and on dry slopes of the mountains (Fig. 3c).

14. *C. pseudoheterophylla* Pojark., 1939, Flora of the USSR 9, Addenda 8: 506; Grossheim, 1952, Flora of the Caucasus 5: 43; Prilipko, 1954, Flora of Azerbaijan 5: 74; Poletiko, 1954, Trees and shrubs of the USSR 3: 556; Fedorov, 1958, Flora of Armenia 3: 303; Prilipko, 1965, Dendroflora of the Caucasus 4: 152; Browicz, 1972, Fl. Turk. 4: 145; Khatamsaz, 1992, Fl. Iran 6: 262; Christensen, 1992, Syst. Bot. Monogr. 35: 96.

Flowering from May, fruiting from September.

Chromosome number: 2n (3x) = 51; 2n (4x) = 68 (Gladkova, 1967, 1968; Donmez, 2004).

Type: U.S.S.R., Armenia, distr. Jerevan, prope monas terium Gehart, in faucibus fl. Gjarni-Czai, 11.10.1936, Pojarkova n 793 (holotype: LE; isotype: LE!).

Distribution and habitat: Eastern Europe, Caucasus, Asian Turkey, Caucasia, Crimean, Dagestan, Iran, Turcomania, Uzbekistan, Kazakhstan, Kirgizistan, Tadzikistan, Afghanistan, Pakistan, Northern India, and Tibet; in scrub, rocky mountainous tracts, gorges, along rivers, and at field edges (Christensen, 1992).

Locality: It is one of the rare species in the autonomous republic. It is distributed in Ayrinj, Bichenek, South Gishlag Gishlag, and Gold Gishlag Gishlag of Shahbuz region, in Chalkhangala villages of Kangarli region and foothills near Ordubad city (Kasumova & Akhundov, 2004). We collected samples in Bichanek village (1,778 m a.s.l., 39°29′47″ N, 45°46′03″ E)

of Shahbuz region, in Akhura village (1,204 m a.s.l., 39°33′29″ N, 45°09′34″ E) and Havush village (1,903 m a.s.l., 39°35′54″ N, 45°14′36″ E) of Sharur district, in middle and high mountain zones, at 1,400–2,000 m a.s.l. of the steep slopes of the mountains, in bushes, on the banks of rivers, and on broad-leaved forest slopes (Fig. 3c).

15. *C. monogyna* Jacq., 1775, Fl. Austr. 3: 50; Willd. Sp. pl. II, 1799, 2: 1006; Ldb. Fl. Ross., II, 1, 89 (ex parte). – *Mespilus monogyna* Willd. Enum. Pl. berol. I (1809) 524. – *Mespilus oxycantha* var. *monogyna* Schmalhausen (1895), Flora of Central and Southern Russia, Crimea and the North Caucasus, 350 (ex parte) 1: 89; Pojarkova, 1939, Flora of the USSR, 9: 454; Poletiko, 1954, Trees and shrubs of the USSR, 3: 554; Franco, 1968, Fl. Europ. 2: 429; Cinovskis, 1971, Crataegi Baltici: 95; Browicz, 1972, Fl. Turk. 4: 145; Christensen, 1992, Syst. Bot. Monogr. 35: 100; 38 Fl. Iberica, 1998, 6: 412; Grossheim, 1952, Flora of the Caucasus 5: 41.

Flowering from June, fruiting from September.

Chromosome number: 2n = 32 (Gladkova, 1968); 2n (2x) = 34 (Byatt & Murray, 1977; Baranec, 1983, 1986; Ptak, 1986; Donmez, 2004); 2n (3x) = 51 (Gladkova, 1968).

Type: Austria, Jacquin s. n. (lectotype, here designated: BM!; isolectotype: TO).

Distribution and habitat: from Southern Scandinavia to Northern Africa, Caucasia, the Crimea, Turkey, the Middle East, Northern Iraq, and Northwestern Iran (Christensen, 1992); on calcareous rocks, micaceous schist, volcanic rocks, as well as on granite and other siliceous rocks; in forest clearings with *Fagus*, *Quercus*, *Pinus*, and *Cedrus*, in macchie, garrigue, meadows, along the rivers, in rocky places, at field edges, in hedges, and on roadsides.

Locality: it was found in arid sparse forests, on stony slopes and in forest fronts at 1,500–2,000 m a.s.l. in middle and high mountainous zones, in suburb area of Bichanek village (1,937 m a.s.l., 39°30′57″ N, 45°45′29″ E) of Shahbuz region, in Nasirvaz village (1,904 m a.s.l., 39°09′49″ N, 45°55′19″ E) and Nurgut village (2,068 m a.s.l., 39°13′47″ N, 45°54′31″ E) of Ordubad district (Fig. 3c).

Interserial hybrids

16. *C.* x *armena* Pojark., 1939, Flora of the USSR, 9, Addenda 8: 509 (*C. meyeri*, *C. rhipidophylla*); Fedorov, 1958, Flora of Armenia. 3: 300; Poletiko, 1954, Trees and shrubs of the USSR 3: 552; Prilipko, 1965, Dendroflora of the Caucasus 4: 151; Riedl, 1969, Fl. Iran 66: 62; Khatamsaz, 1992 Fl. Iran 6: 266; Christensen, 1992, Syst. Bot. Monogr. 35: 138.

Flowering June, fruiting September–October.

Chromosome number: 2n (3x) = 51 (Gladkova, 1967, 1968).

Type: U.S.S.R., Armenia, distr. Megri, prope opp. Lishk, 01.10.1936, Pojarkova n 754 (holotype: LE; isotype: LE!).

Distribution and habitat: South Caucasus, Northern Iran, in scrub and on rocky mountain slopes; 1300–2500 m.

Locality: *C. armena* Pojark. was found on gravelly-stony slopes of Gizilgishlag village (1,627 m a.s.l., 39°09′53″ N, 45°35′57″ E) and Bichenek forest (2172 m a.s.l., 39°32′40″ N, 45°44′47″ E) of Shahbuz region. Generally, this species is seen in the low, medium and high mountain zones at 1,100–2,000 (2200) m a.s.l., in arid woodlands and between the bushes (Fig. 3d). *C. armena* was added to the flora of Azerbaijan by Kasumova (1983) according to the samples collected from Bichenek forest (20.X.1980) and Gizil Gishlag village (10.X.1980, stony-gravel slopes) of Shahbuz region.

Intersection hybrids

17. *C.* x *cinovskisii* Kassumova, 1985, Bot. Zurn. (Moscow, Leningrad) 70, 2: 266. – *C. pseudoazarolus* Popov, 1929, Bulletin of Applied Botany, of Genetics and Plant Breeding 22: 442, Fig. 101 (*C. azarolus* var. *pontica*, *C. pentagyna*); Christensen, 1992, Syst. Bot. Monogr. 35: 123, p.p. (*C. pontica* x *C. pentagyna*).

Flowering from May, fruits ripen in September.

Chromosome number: unknown.

Type: Azerbaijan. Nakhichevan, Babek district, Aznaberd (Chalkhangala) village, along the road, among vineyards, 11.10.1973, Kassumova s. n. (holotype: BAK; isotype: LE).

Distribution and habitat: Nakhichevan and Kopet-Dagh in Turkmenia; on mountain slopes, in scrub with *Cerasus*, *Cotoneaster*, and *Rhamnus*, in vineyards and at roadsides.

Locality: it was found in Çalkhanqala village (1401 m a.s.l., 39°26′37″ N, 45°16′17″ E) in Kangarli region at 1,000–1,400 m a.s.l. along the roadside and vineyards (Fig. 3d).

Discussion

Grossheim (1934) distinguished *C. pentagyna* Waldst. et Kit. ex Willd. from the others by the felty indumenta on the lower surface of leaves and by the greyish felty floral axis and called it *C. colchica*. *C. pentagyna* mainly hybridizes with other types of hawthorns and creates dark red coloured pulped fruit (*C.* x *zangezura* = *C. pentagyna* x *C. pseudoheterophylla*).

C. zangezura was added to the flora of Azerbaijan as a new species in 1983 by Kasumova (1983) supported by the materials collected from Chalkhangala villages of Kengerli region and Nusnus village of Ordubad district. Pojarkova (1939) believed that *C. zangezura* was of hybridogen origin (*C. pentagyna* x *C. pseudoheterophylla*) close to *C. pallasia*. Therefore, it would be better to consider *C. zangezur* hawthorn as a synonym for *C. pallasia* in the South Caucasus. Grossheim (1934) argued that *C. zangazur* was an ordinary hybridogenic genus for the Caucasus and derived from *C. pentagyna* and other hawthorns.

However, if we accept the ideas of Pojarkova (1939) we cannot distinguish *C. zangezura* as an independent species. Prilipko (1954) suggested that this species is present in the Minor Caucasus. Poletiko (1954) proposed to include *C. zangezura* to the *pentagynae* branch. However, he noted that it would be more expedient to add *C. zangezura* to the *crataegus* branch, on account of the black berry fruits and the yellowish two-seeded fruit pulps (not 3–5). The same idea was also supported by Fedorov (1958) and Isayev & Kasumova (1976). Christensen (1992) proposed two subspecies and showed that *C. zangezura* is a hybrid-originated species derived from the hybridization of *C. pentagyna* and *C. pseudoheterophylla*: *C. zangezura* nothosubsp. *zangezura* (*C. pentagyna* subsp. *pentagyna* x *C. pseudoheterophylla* subsp. *pseudoheterophylla*) for the territory of Armenia and *C. zangezura* nothosubsp. *pseudoambigua* (Pojarkova) Christensen (*C. pentagyna* subsp. *pseudomelanocarpa* x *C. pseudoheterophylla* subsp. *turkestanica*) for the territory of Turkmenistan.

C. pojarkoviae Kossych. was included in the flora of Azerbaijan on account of the collected samples from Gizil Gishlag village of Shahbuz region by Kasumova (dry stony-gravel slopes, 20.X.1980, Kasumova (1983). Christensen (1992) accepted *C. pojarkoviae* Kossych. as a subspecies *C. orientalis* subsp. *pojarkoviae* (Kossych) Byatt. It should be noted that *C. pojarkoviae* Kossych. differs from *C. orientalis* by its rough-thorny branches and yellow (not orange), round oval or pear shaped (not crushed from the poles or ribbed) fruits (Table 1). We suggested considering it as an independent species.

Table 1

Key morphological features of *C. pojarkoviae*, *C. orientalis* and C. *tournefortii*

Parameter	*C. pojarkoviae*	*C. orientalis*	*C. tournefortii*
Life form	shrub, small tree	shrub, small tree	shrub, small tree
Height, m	3–6	3–5 (7)	2.0–2.5
Flowering time	June	May–June	May–June
Flower number per inflorescence	6–12	4–10	6–15
Leaf size (on short shoot, cm, here and further)	3–15 × 4–20	1.6–5.3 × 1.1–4.5	1.6–4.2 × 1.1–3.3
Leaf indumentum (beneath)	appressed-pubescent	lanate	long villous
Leaf base (on short shoot)	attenuate or cuneate	attenuate or cuneate	petioles villous
Stamens	15–20	18–20	15–20
Pyrenes	5, rarely 4	5, rarely 4	4–5, rarely 3–2
Fruit colour	yellowish orange, when dried becoming orange	yellowish orange to dark red, more or less lanate	dark-cherry
Fruit size, mm	15–18 × 12–16	10–15 × 12–18	10–12 × 10–12
Thorn length, mm	–	10–15	5–10
Thorn shape	without thorns	stout	thin

According to Pojarkova (1939), the distribution range of *C. tournefortii* area is the Crimea and the South Caucasus. Prilipko (1965) named

C. tournefortii by *C. schraderiana* and proved its presence in the Nakhchivan Autonomous Republic. Christensen (1992) adopted *C. tournefortii* as a synonym of *C. orientalis* identifying it to the *C. orientalis* subsp. *orientalis*. However, we discovered that both species differ from each other significantly by the flowers, shapes of leaves, fuzzyness, size, shape, and colour of fruits and by number of seeds (Table 1). It is possible to assume that *C. tournefortii* is a completely different species from *C. orientalis*, and this should be further clarified.

Letukhova & Potapenko (2011) reported that *C. tournefortii* was of hybridogenic origin and resulted from the hybridization of *C. orientalis* and *C. pentagyna*.

C. szovitsii Pojark. was added to the Nakhchivan Autonomous Republic flora as a new species during the analysis of materials collected from Kolani village (dry-stony slopes) of Shahbuz region, Payiz and Buzgov villages of Babek region in 1976 by Isayev and Kasumova (1976). According to the authors, the collected herbariums differed from the typical examples and had 3–5 seeds (not 2–4). *C. szovitsii* has been regarded as *C. orientalis* subsp. *szovitsii* (Pojark.) Christensen by A. Christensen (1992). However, we determined that *C. szovitsii* differs from *C. orientalis* by more fragmented leaves, reddish-yellow fruits and number of seeds 3 (2) to 4 (5). Generally, *C. szovitsii* is considered an independent species, given its obvious distinction from other hawthorn species by many features (Table 2).

Table 2
Key morphological features
of *Crataegus szovitsii*, *C. eriantha* and *C. meyeri*

Characteristic	*C. szovitsii*	*C. eriantha*	*C. meyeri*
Life form	Shrub, small tree	shrub, small tree	shrub, small tree
Height, m	2–3	3–5	2–4 (6)
Flowering time	May	May–June	May–June
Flower number per inflorescence	10–12	5–15	9–20
Leaf size (on short shoot)	3–5 × 2.0–4.5	25–40 × 25–40	20–40 × 20–40
Leaf indumentum (beneath)	coriaceous	almost truncate	long villose
Leaf base (on short shoot)	glaucous	pubescent	cuneate or attenuate
Stamens	20	18–20	18–20
Pyrenes	3–4, rarely 2	2, rarely 1	2, rarely 1
Fruit colour	dark red	dark red	red, more or less villous
Fruit size, mm	12–14 × 10–12	10–12 × 6–8	12–15 × 8–10
Thorn length, mm	7–10	10	5–10 (15)
Thorn shape	more or less stout	thin	stout

C. pontica C. Koch as a new species was included to the flora of Azerbaijan by Kasumova (1981) with the samples collected from the territory of Nakhchivan Autonomous Republic.

C. meyeri Pojark. was broadly distributed in the South Caucasus and was described as *C. pectinata* C. A. Mey. by Grossheim (1952). According to Pojarkova (1939), some authors incorrectly identified *C. meyeri* with 2–3 seeded fruits as *C. caucasica*, and some of them misidentified it as *C. orientalis* confused by the densely fuzzy character of both sides of the leaves.

C. eriantha Pojark. is closer to *C. meyeri*, and differs by fewer fragmented, rarely fuzzy leaves, relatively large, sparse, densely fuzzy flowering groups. We also presented a comprehensive description of these species (Table 2).

Christensen (1992) considered *C. atrosanguinea* as a synonym of *C. ambigua* subsp. *ambigua* Meyer ex Becker. However, we discovered that they are different species and differ from each other by key features. Thus, their leaves are large, greenish, and have smooth edges, but there are slightly larger serrated plaques on the top of the leaves of *C. atrosanguinea*. The leaves are dark green coloured, serrated plaques and the serration continue from the middle of the leaf to the apex of the *C. ambigua*. Two seeds per fruit. The *C. ambigua* are herbarium samples stored in Saint Petersburg has fruits with 1–2 (3) seeds (Christensen, 1992) (Table 3).

C. rhipidophylla Gand. (*C. curvisepala* Lindm., *C. kyrtostyla* Pojark.) in contemporary literature (Donmez, 2004; Tzvelev, 2006; Christensen & Zielinski, 2008) is called *C. rhipidophylla*, which does not take into account *C. curvisepala* (*C. kyrtostylae*). It was not mentioned by Cherepanov (1995) and in the study by Sargsyan (2011) *C. curvisepala* (*C. kyritostyla*) was accepted as *C. rhipidophylla*. As was mentioned in Pojarkova (1939) and Poletico (1954), *C. pseudoheterophylla* sometimes is mistakenly applied to *C. monogyna* or *C. heterophylla*. However, *C. heterophylla* is distributed in Spain as a wild species and was not found in the former Soviet Union. Pojarkova reported that both *C. kyrtostyla* and *C. pseudoheterophylla* were presented as *C. monogyna*. Further *C. pseudoheterophylla* was found in Tuapse and in Krasnodar region (Fedorov, 1958).

Table 3
Key morphological features
of *C. atrosanguinea*, *C. ambigua*, *C. monogyna* and *C. rhipidophylla*

Characteristic	*C. atrosanguinea*	*C. ambigua*	*C. monogyna*	*C. rhipidophylla*
Life form	shrub	shrub, small tree	shrub, small tree	shrub, small tree
Height, m	4–6 (10)	12	3–6 (8)	3–5 (7)
Flowering time	May–June	May–June	June	May–June
Flower number per inflorescence	6–12	5–12	10–18	5–15
Leaf size (on short shoot)	1.8–5.0 × 1.8–5.0	2.3–5.8 × 1.9–6.6	1.1–5.7 × 0.8–5.4	1.8–5.0 × 1.8–5.0
Leaf indumentum (beneath)	glabrous or villous	coriaceous, glabrous or more or less villous	coriaceous, more or less glabrous or villous	subglabrous or rarely more or less villous
Leaf base (on short shoot)	attenuate-cuneate	attenuate-cuneate	attenuate or cuneate or rounded	villous
Stamens	20	18–20	15–20	18–20
Pyrenes	2 (3)	1–2 (3)	1–2 (2)	1–2 (2)
Fruit colour	dark, blood red	dark red to blackish purple	bright or dark red	bright or dark red
Fruit size, mm	14–18 × 15–18	8–14 × 7–13	6–11 × 5–10	8–15 × 6–12
Thorn length, mm	5–15	5–15	10–15	10–12
Thorn shape	missing or small, direct	more or less stout	more or less stout	stout

According to Sargsyan (2011), the hawthorn was hybridized by *C. pseudoheterophylla* x *C. atrosanguinea* = *C.* x *C. razdanica*; *C. pentagyna* x *C. pseudoheterophylla* = *C.* x *C. zangezura*.

C. monogyna Jacq. is polymorph. According to Pojarkova (1939), the Russian and European authors did not differentiate between *C. kyrtostyla* and *C. monogyna* Jacq., but *C. kyrtostyla* is currently considered a hybrid between *C. monogyna* and *C. rhipidophylla*, as evidenced by stipule serration, leaf serration and fruit characters (Christensen, 1992).

However, *C. kyrtostyla* differs significantly from *C. monogyna* by the fragmentation of the smallest, wide, and darker green leaves, and shape of the sepals (Table 3). Poyarkova (1939) reported that *C. monogyna* has a narrow range, adapted to the European part of the former Soviet Union (southern and especially eastern regions), and cannot be distributed in the South Caucasus in comparison to *C. kyrtostyla*. Sargsyan (2011) has shown that *C. monogyna* is not distributed in Nakhchivan Autonomous Republic. However, there are species formed by hybridization of *C. kyrtostyla* x *C. monogyna* in the South Caucasus. Despite the fact that range of *C. monogyna* includes Ganja, Lankaran and Garabagh (Grossheim, 1934)], the herbarium samples collected later were designated as *C. curvisepala* (*C. kyrtostyla*).

C. x *armena* Pojark. was added to the flora of Azerbaijan by Kasumova according to the samples collected from the Bichenek forest (20.X.1980) and Gizil Gishlag village (10.X.1980, stony-gravel slopes) of Shahbuz region. According to Pojarkova (1939), crossbreeding of *C. kyrtostyla* and *C. meyeri* created this species. Grossheim (1952) also did not regard *C. armena* as an independent species and considered it hybrid species. Fedorov (1958) did not agree with Grossheim's ideas, stating that "the *C. armena* has not been fully proven to be hybrid", therefore it was more acceptable to consider this species independent. Christensen (1992) also believed that this species derived from the hybridization of *C. criteris* and *C. monogyna*. Thus, the lower slices of leaves of the flowering twig of *C. armena* have 1–5 teeth, as in *C. monogyna*. The number of teeth of *C. monogyna* varies between 6 and 16. Besides, there are also many similarities of the perianths in the *C. armena*, *C. monogyna* and

C. meyeri. For instance, fruiting perianth of *C. armena* is pyrene, resembles of the *C. meyeri* perianths.

Sargsyan (2011) noted that there were no records of *C. monogyna* in Armenia and that so far no individuals have been introduced to the area. The author was also skeptical about the distribution of *C. monogyna* in the Nakhchivan Autonomous Republic and Iran, so *C. monogyna* could not have hybridised with *C. meyeri*. Considering the number of leaf slice teeth and similarity of features of perianths, and taking into account the hybrid origin of *C. armena*, this suggestion should be definitely accepted. Sargsyan agreed with Pojarkova that *C. meyeri* and *C. rhipidophylla* (*C. kyrtostyla*) are hybrids, whereas Byatt & Murray (1977) and Christensen (1992) suggested that *C. rhipidophylla* is a separate species. Moreover, *C.* x *kyrtostyla* is the hybrid between *C. rhipidophylla* and *C. monogyna*, which was also confirmed by a number of evidences.

Table 4
Key morphological features of *C. armena*, *C. cinovskisii* and *C. pontica*

Characteristic	*C. armena*	*C. cinovskisii*	*C. pontica*
Life form	shrub	shrub, small tree	shrub, small tree
Height, m	2.0–2.5	5–6	4–5 (8)
Flowering time	May–June	May	May–June
Flower number per inflorescence	8–10	8–15	5–15
Leaf size (on short shoot)	3.8–4.2 × 3.4–3.6	4.1–5.1 × 3.2–4.9	3.1–7.1 × 2.1–5.7
Leaf indumentum (beneath)	villous	villous to appressed-pubescent	appressed-pubescent
Leaf base (on short shoot)	cuneate or truncate	cuneate or attenuate	cuneate-attenuate
Stamens	18–20	16–20	20
Pyrenes	1, rarely 2	4–5	2–3
Fruit colour	red, more or less villous	cherry-dark	yellowish or orange
Fruit size, mm	7–12 × 6–9	10–15 × 12–18	14–18 × 15–21
Thorn length, mm	7–15	up to ca. 13 mm long, rare	up to ca. 10 mm long, rare
Thorn shape	stout	more or less stout	small

According to Kasumova (1981, 1983), *C. cinovskisii* Kassumova is close to *C. pontica* and differs from it by dark-coloured fruits (vs. yellowish) and by 4–5 (vs. 2–3) seeds (Table 4). It is a Nakhchivan endemic species and its further research is needed.

Conclusions

Thus, we reported 17 species of the *Crataegus* genus in the Nakhichevan Autonomous Republic found as wild species, namely *C. pentagyna* Waldst. et Kit. ex Willd., 1800, *C. zangezura* Pojark., 1939, *C. orientalis* Pall. ex Bieb., 1808, *C. pojarkoviae* Kossych, 1964, *C. tournefortii* Griseb., 1843, *C. szovitsii* Pojark., 1939, *C. pontica* C. Koch, 1853, *C. meyeri* Pojark., 1939, *C. eriantha* Pojark., 1939, *C. atrosanguinea* Pojark., 1939, *C. caucasica* C. Koch, 1853, *C. pallasii* Griseb., 1843, *C. rhipidophylla* Gand. 1871 (*C. curvisepala* Lindm., *C. kyrtostyla* Pojark.), *C. pseudoheterophylla* Pojark., 1939, *C. monogyna* Jacq., 1775, *C.* x *armena* Pojark., 1939, and *C.* x *cinovskisii* Kassumova. In addition, five species – *C. chlorocarpa*, *C. ferganensis*, *C. sanguinea*, *C. songarica*, and *C. turkestanica* were introduced and used in greenery for parks and gardens. Of these, *C. pojarkoviae* and *C. tournefortii* were included in "Red Data Book of USSR", *C. pontica* was included in "Plants and plant formations recommended for the "Red" and "Green" Books of Azerbaijan". Talibov & Ibragimov (2013) included *C. orientalis* Pall. ex Bieb. (NT) and *C. pontica* C. Koch (NT) into the "Red Book" of the Nakhchivan Autonomous Republic. Later, Mammadov et al. (2016) included *C. caucasica* C. Koch (category CR A2abc; C1), *C. eriantha* A. Pojark. (VU D2), *C. orientalis* Pall. ex Bieb. (NT), *C. pontica* C. Koch (NT), *C. tournefortii* Griseb. (EN A1abc; Bb (i, ii)) into "Rare trees and shrubs of Azerbaijan".

We confirmed that the Nakhchivan Autonomous Republic has high endemic species diversity of the *Crataegus* L. genus, while *C. caucasica* Willd. and *C. armena* Pojark. are Caucasus endemics and *C. cinovskisii* Kasumova is endemic to Azerbaijan.

References

Albarouki, E., & Peterson, A. (2007). Molecular and morphological characterization of *Crataegus* L. species (Rosaceae) in Southern Syria. Botanical Journal of the Linnean Society, 153(3), 255–263.

Asadov, K. S., & Asadov, A. K. (2001). Dikorastushchie plodovye rasteniia Azerbaidzhana [Wild fruit plants of Azerbaijan]. Azerbaijan Milli Encyclopediasi, Baku (in Russian).

Asadov, K. S., Mamedov, F. M., & Sadigova, S. A. (2008). Dendroflora i less severo-vostochnoy chasti Bolshogo Kavkaza [Dendroflora and forests of the northeastern part of the Greater Caucasus]. Elm, Baku (in Azerbaijan).

Asadov, K. S., Mirzoev, O. H., & Mamedov, F. M. (2014). Dendrologiya [Dendrology]. Elm, Baku (in Azerbaijan).

Askerov, A. M. (2006). Vysshye rasteniya Azerbajdzhana [Higher plants of Azerbaijan (Abstract of flora of Azerbaijan)]. Elm, Baku (in Azerbaijan).

Baranec, T. (1983). Karyotaxonomical notes of some taxa of the genus *Crataegus* L. from Slovakia. Biologia (Bratislava), 38, 853–864.

Baranec, T. (1986). Biosistematicke stadium rodu *Crataegus* L. na Slovensku. Dendrologica, Bratislava.

Bridson, D., & Forman, L. (1998). The herbarium handbook. 3rd ed. Royal Botanic Gardens, Kew.

Browicz, K. (1972). *Crataegus* L. (Rosaceae). Flora of Turkey and the East Aegean Islands. Edinburgh University Press, Edinburgh.

Byatt, J. I., & Murray, B. G. (1977). Chromosome numbers of some Eurasian species of *Crataegus*. Watsonia, 11, 374–375.

Cherepanov, S. K. (1995). Vascular plants of Russia and adjacent states (of the former USSR). Nauka, Saint Petersburg (in Russian).

Christensen, K. I. (1992). Revision of *Crataegus* Sect. *Crataegus* and Nothosect. Crataeguineae (Rosaceae-Maloideae) in the old world. Systematic Botany Monographs, 35, 1–199.

Christensen, K. I., & Zielinski, J. (2008). Notes on the genus *Crataegus* (Rosaceae-Pyreae) in Southern Europe, the Crimea and Western Asia. Nordic Journal of Botany, 26, 344–360.

Cinovskis, R. E. (1971). Bokaryshniki Pribalitiki [Crataegi Baltici]. Editio Zinatne, Riga (in Russian).

Dickinson, T. A., & Talent, N. (2007). Polyploidy, reproductive biology and Rosaceae understanding evolution and making classification. Plant Systematics and Evolution, 266, 59–78.

Dönmez, A. A. (2004). The genus *Crataegus* L. (Rosaceae) with special reference to hybridisation and biodiversity in Turkey. Turkish Journal of Botany, 28, 29–37.

Dönmez, A. A. (2005). A new species of *Crataegus* (Rosaceae) from Turkey. Botanical Journal of the Linnean Society, 148, 245–249.

Dönmez, A. A. (2007). Taxonomic notes on the genus *Crataegus* (Rosaceae) in Turkey. The Linnean Society of London, Botanical Journal of the Linnean Society, 155, 231–240.

Dönmez, A. A. (2014). Nomenclatural, taxonomic and biogeographic novelties in the Turkish *Crataegus* L. (Rosaceae-Maleae) taxa. Adansonia, 36(2), 245–253.

Dönmez, A. A., & Özderin, S. (2019). Additional contributions to taxonomy, nomenclature and biogeography of the Turkish *Crataegus* (Rosaceae) taxa. PhytoKeys, 122, 1–13.

Fedorov, A. A. (1958). Rod Boyaryshnik. Flora Armenii [The genus *Crataegus*. Flora of Armenia]. Yerevan, n.ed. (in Russian).

Fineschi, S., Salvini, D., Turchini, D., Pastorelli, R., & Vendramin, G. G. (2005). *Crataegus monogyna* Jacq. & *C. laevigata* (Poir.) DC (Rosaceae, Maloidese) display low levels of genetic diversity assessed by chloroplast markers. Plant Sytematics and Evolution, 250, 187–196.

Gabrielian, E. T., & Sargsyan, M. V. (2009). Novyy dlya nauki endemichnyy vid *Crataegus susanykleinae* (Rosaceae) iz Armenii [New to science endemic species *Crataegus susanykleinae* (Rosaceae) from Armenia]. Flora, Vegetation and Plant Resources of Armenia, 17, 10–11 (in Russian).

Gladkova, V. N. (1967). Khromosomnye chisla nekotorykh vidov *Cotoneaster* Medik. i *Crataegus* L. [Chromosome numbers of some species of *Cotoneaster* Medik. and *Crataegus* L.]. Botanicheskii Zhurnal, 52, 354–356 (in Russian).

Gladkova, V. N. (1968). Kariologicheskie issledovaniya rodov *Crataegus* L. i *Cotoneaster* Medik. (Maloideae) v svyazi s ikh taksonomiey [Karyological studies on the genera *Crataegus* L. and *Cotoneaster* Medik. (Maloideae) as related to their taxonomy]. Botanicheskii Zhurnal, 53, 1263–1273 (in Russian).

Grossheim, A. A. (1934). Flora Kavkaza [Flora of the Caucasus]. Baku, n.ed. (in Russian).

Grossheim, A. A. (1952). Flora Kavkaza [Flora of the Caucasus]. Academy of Sciences of the USSR, Moscow-Leningrad (in Russian).

Gurbanov, E. M. (1996). Rastitel'nyy mir basseyna reki Nakhichevan'chay [Plant world of Nakhichevanchay River basin]. Baku State University, Baku (in Russian).

Ibragimov, A. S. (2005). Rastitel'nost' Nakhchyvanskoy Avtonomnoy Respubliki i ee natsional'noe ekonomicheskoe znachenie [Vegetation of the Nakhchivan

Autonomous Republic and its national economic importance]. Elm, Baku (in Russian).
Ibrahimov, A. M. (2017). Raznoobrazie roda *Crataegus* L. (Rosaceae) v Nakhchyvanskoy Avtonomnoy Respublike (Respublika Azerbaydzhan) [The diversity of genus *Crataegus* L. (Rosaceae) in Nakhchivan Autonomous Republic (Republic of Azerbaijan)]. Ukrainian Journal of Ecology, 7(3), 32–42 (in Russian).
Ibrahimov, A. M., Talibov, T. H., & Mammadov, T. S. (2018). *Crataegus* L. (Rosaceae) in the Flora of Nakhchivan Autonomous Republic of Azerbaijan. International Journal of Agriculture Innovations and Research, 6(4), 109–114.
Isaev, Y. M., & Kasumova, T. A. (1976). Boyaryshnik Shovitsa (*Crataegus szovitsii* Pojark.) – novyy vid flory Nakhichevanskoy ASSR [Hawthorn Shovitsa (*Crataegus szovitsii* Pojark.) – a new species of the flora of the Nakhichevan ASSR]. Reports of the Academy of Sciences of the Azerbaijan SSR, 32(3), 61–62 (in Russian).
Kasumova, T. A. (1981). Novye vidy boyaryshnika dlya flory Azerbaydzhana [New species of hawthorn for the flora of Azerbaijan]. Reports of the Academy of Sciences of the Azerbaijan SSR, 37(1), 69–71 (in Russian).
Kasumova, T. A. (1983). Novye vidy boyaryshnika dlya flory Azerbaydzhana II [New species of hawthorn for flora of Azerbaijan II]. Reports of the Academy of Sciences of the Azerbaijan SSR, 39(7), 73–75 (in Russian).
Kasumova, T. A. (1985). Novyy vid roda *Crataegus* (Rosaceae) iz Azerbaydzhana [A new species of the genus *Crataegus* (Rosaceae) from Azerbaijan]. Botanical Journal, 70, 266–267 (in Russian).
Kasumova, T. A. (1991). O zabytoy forme roda *Crataegus* (Rosaceae) [On the forgotten form of the genus *Crataegus* (Rosaceae)]. Botanical Journal, 76(7), 985–986 (in Russian).
Kasumova, T. A. (2004). Opredelitel' vidov roda *Crataegus* vo flore Azerbaydzhana [The key for determining the species of the genus *Crataegus* in the flora of Azerbaijan]. Proceedings of the Institute of Botany National Academy of Sciences of Azerbaijan, 25, 101–103 (in Russian).
Kasumova, T. A., & Akhundov, G. F. (2004). Boyaryshniki Nakhchyvanskoy ASSR [Hawthorns of the Nakhchivan ASSR]. Reports of the Academy of Sciences of the Azerbaijan SSR, 41(4), 54–57 (in Russian).
Kasumova, T. A., Amirov, G. A., & Ibragimov, A. S. (1991). Zapasy plodov vidov *Crataegus* L. v Nakhchyvanskoy ASSR [Reserves of fruits of *Crataegus* L. species in the Nakhchivan ASSR]. Rastitelnye Resursy, 27(2), 24–26 (in Russian).
Kryshtofovich, A. N. (1957). Paleobotanika [Paleobotany]. Nauka, Leningrad (in Russian).
Letukhova, V. J., & Potapenko, I. L. (2011). Sovremennoe sostoyanie populyatsii *Crataegus tournefortii* Grieseb v Starom Krymu (Ukraina, Krym) [Modern state of *Crataegus tournefortii* Grieseb population at Stary Krym (Ukraine, Krimea)]. Natural Almanac, Series Biological Sciences, 15, 83–89 (in Russian).
Lo, E. Y. Y., Stefanovic, S., & Dickinson, T. A. (2007). Molecular reappraisal of relationships between *Crataegus* and *Mespilus* (Rosaceae, Pyreae) – two genera or one? Systematic Botany, 32, 596–616.
Lo, E. Y., Stefanović, S., Christensen, K. I., & Dickinson, T. A. (2009). Evidence for genetic association between East Asian and western North American *Crataegus* L. (Rosaceae) and rapid divergence of the eastern North American lineages based on multiple DNA sequences. Molecular Phylogenetics and Evolution, 51(2), 157–168.
Magulaev, A. J. (1976). The chromosome numbers of flowering plants of the Northern Caucasus. Part 2. Flora of the Northern Caucasus, 2, 51–62.
Mammadov, T. S., Iskandar, E. O., & Talibov, T. H. (2016). Redkie vidy derevyev i kustarnikov Azerbajdzhana [Rare trees and shrubs of Azerbaijan]. Nauka, Baku (in Azerbaijan).
Metsger, D. A., & Byers, S. C. (1999). Managing the modern herbarium: An interdisciplinary approach. Society of the Preservation of Natural History Collections with The Royal Ontario Museum Centre for Biodiversity and and Conservation Research, Washington.
Mirzeyev, P. S. (1972). Agroklimaticheskie kharajteristiki Nakhchivanskoy ASSR [Agroclimatic characteristic of Nakhchivan ASSR]. Azerneshr, Baku (in Azerbaijan).
Novruzova, Z. A. (1970). Derevya i kustarniki Azerbajdzhana. *Crataegus* L. [Trees and shrubs of Azerbaijan. Crataegus L.]. Azerneshr, Baku (in Azerbaijan).
Phipps, J. B., O'Kennon, R. J., & Lance, R. W. (2003). Hawthorns and medlars. Royal Horticultural Society, Cambridge.
Phipps, J. B., Robertson, K. R., Rohrer, J. R., & Smith, P. G. (1991). Origins and evaluation of Subfam. Maloideae (Rosaceae). Systematic Botany, 16, 303–332.
Poletiko, O. M. (1954). Derevya i kustarniki SSSR. Genus *Crataegus* L. [Trees and shrubs of the USSR. Genus *Crataegus* L.]. Academy of Sciences of the USSR, Moscow–Leningrad (in Russian).
Poyarkova, A. I. (1939). Flora SSSR. Genus *Crataegus* L. [Flora of the USSR. Genus *Crataegus* L.]. Academy of Sciences of the USSR, Moscow–Leningrad (in Russian).
Prilipko, L. I. (1939). Rasitelnye otnosheniya v Nakhchivanskoy SSR [Vegetation patterns in the Nakhchivan ASSR]. Botanical Institute, Baku (in Russian).
Prilipko, L. I. (1954). Flora Azerbajdzhana. Genus *Crataegus* L. [Flora of Azerbaijan. Genus *Crataegus* L.]. Baku, en.d. (in Russian).
Prilipko, L. I. (1965). Dendroflora Kavkaza (Dikie i kulturnye derevya i kustarniki). Genus *Crataegus* L. [Dendroflora of the Caucasus (Wild and cultivated trees and shrubs). Genus *Crataegus* L.]. Vol. 4. Academy of Sciences of the Georgian SSR, Tbilisi (in Russian).
Ptak, K. (1986). Cyto-embryological investigations on the Polish representatives of the genus *Crataegus* L. I. Chromosome numbers; embryology of diploid and tetraploid species. Acta Biologica Cracovensia, Series Botanica, 28, 107–122.
Rajeb, C., Messaoud, C., Chograni, H., Bejaoui, A., Boulila, A., Rejeb, M. N., & Mohamed Boussaid, M. (2010). Genetic diversity in Tunisian *Crataegus azarolus* L. var. *aronia* L. populations assessed using RAPD markers. Annals of Foreing Science, 67, 512.
Riedl, H. (1969). *Crataegus* (Rosaceae). Flora Iranica. Akademische Druck und Verlagsanstalt, Graz-Austria, 66, 49–65.
Sargsyan, M. V. (2011). Rod *Crataegus* (Rosaceae) v Yuzhnom Transkavkazii [The genus *Crataegus* (Rosaceae) in Southern Transcaucasia]. Takhtajania, 1, 110–117 (in Russian).
Takhtajan, F. K. (1978). Floristicheskie oblasti zemli [The floristic regions of the world]. Nauka, Leningrad (in Russian).
Talent, N., & Dickinson, T. A. (2005). Polyploidy in *Crataegus* and *Mespilus* (Rosaceae, Maloideae): Evolutionary inferences from flow cytometry of nuclear DNA amounts. Canadian Journal of Botany, 83, 1268–1304.
Talibov, T. H., & Ibragimov, A. S. (2008). Taxonomic spectre of the flora of Nakhchivan Autonomous Republic. Ajami, Nakhchivan (in Azerbaijan).
Talibov, T. H., & Ibragimov, A. S. (2010). Red Book of the Nakhchivan Autonomous Republic. Ajami, Nakhchivan (in Azerbaijanian).
Talibov, T. H., & Ibrahimov, A. M. (2013). The dendrofloras of Nakhchivan Autonomous Republic. News of Nakhchivan Section of Azerbaijan National Academy of Sciences, The Series of Natural and Technical Sciences, 9(4), 69–77 (in Azerbaijanian).
Techniques and procedures for collecting, preserving, processing and storing botanical specimens (1996). British Columbia Ministry of Forests, Victoria, Canada. Working Paper 18/1996.
Tzvelev, N. N. (2001). *Crataegus* L. flora Vostochnoy Evropy [*Crataegus* L. flora of East Europe]. SPKHVA Press, Staint Petersburg (in Russian).
Ufimov, R. A. (2011). Novyi vid roda *Crataegus* (Rosaceae) iz Talysha [A new species of the genus *Crataegus* (Rosaceae) from Talysh]. Botanical Journal, 96(9), 1254–1257 (in Russian).
Ufimov, R. A. (2013). Zametki o rode *Crataegus* L. (Rosacea) [Notes on the genus *Crataegus* L. (Rosaceae)]. Novitates Systematicae Plantarum Vascularium, 44, 113–125 (in Russian).