The genus *Allium* (Amaryllidaceae) in Iran: on the status of *Allium ampeloprasum* L. and its relatives

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**Abstract.** *Allium ampeloprasum* (Amaryllidaceae) is recorded as a new taxon for the flora of Iran. It is morphologically most similar to *Allium atroviolaceum* and *Allium iranicum*. This species is compared with its two aforementioned relative species and some notes are given on its affinities. A full description, images and a distribution map are also provided. In addition, a lectotype is selected for *A. atroviolaceum*.

**Keywords.** Asia, distribution pattern, flora, lectotype, taxonomy

**INTRODUCTION**

The genus *Allium* L. (Amaryllidaceae) comprises more than 900 species, making it one of the largest monocotyledonous genera (Govaerts  et al., 2013). *Allium* species have adapted to diverse habitats and display a remarkable polymorphism, which is the main reason for the widely recognized difficulties in their taxonomy and classification (Fritsch & Friesen, 2002). Members of *Allium* are distributed mainly in the Mediterranean regions, southwestern and parts of Central Asia (Mathew, 1996; Fritsch  et al., 2010). Southwestern Asia, especially Iran, is known as an important center of diversity of this genus (Akhaban  et al., 2014). The most recent classification of the genus proposes 15 subgenera and 56 sections in the genus (Friesen  et al., 2006). This genus has been reported with 139 species in the area of Flora Iranica, among which 75 species are present in Iran (Wendelbo, 1971).
The recent investigations have shown that this number should be increased considerably (Khassanov et al., 2006; Razyfard et al., 2011; Memariani et al., 2012). Currently, about 121 species are known to grow in Iran (Fritsch & Maroofi, 2010) classified into 7 subgenera and 29-30 sections (Friesen et al., 2006; Fritsch et al., 2006). Allium subg. Allium is the largest subgenus, comprising almost 40% of the total species (ca. 280 species) classified in 10 sections (Hanelt, 1996; Friesen et al., 2006).

Allium sect. Allium is one of the most economically important sections of the genus, comprising several medicinal and edible species such as A. porrum L. (leek), A. sativum L. (garlic), and A. ampeloprasum L. (wild leek). The species of the section bear well-developed bulbs, solid (V-shaped or flat) or fistulose leaves and stamens arranged in two whorls, the outer three usually simple and the inner three markedly tricuspidate (Mathew, 1996). It has been suggested that those members distinctly dimorphic in stamens, i.e. the members of A. sect. Allium, stand apart from the other sections of A. subg. Allium (Hanelt, 1996).

Allium sect. Allium comprises about 112–115 species worldwide, of which at least 30, including 6 endemics, grow in Alborz and Zagros mountain ranges in the North and the West of Iran (Wendelbo, 1971; Mathew, 1996; Hosseinzadeh et al., 2009; Miryeganeh & Movafeghi, 2009). Wendelbo (1971) listed two subspecies under A. ampeloprasum: subsp. iranicum Wendelbo and subsp. ampeloprasum in Iran. However, he considered A. ampeloprasum subsp. iranicum to be distributed only in Iran, and separated it from A. atroviolaceum Boiss. by having acute tepals and stamen filaments non-verrucate on surface. Later on, this subspecies was raised to specific rank as A. iranicum (Wendelbo) Wendelbo, still considered to be closely related to A. ampeloprasum which should be absent in Iran wildly (Wendelbo, 1985).

The reports showed that A. ampeloprasum comprises a species complex with various ploidy levels of 2n = 16-64 (Hirschegger et al., 2010; Guenaoui, et al., 2013) over the Mediterranean countries (Mathew, 1996; Fritsch & Friesen, 2002). The members of the complex were divided into four horticultural groups: leek, kurrat, great headed garlic (GHG) and pearl onion (Jones & Mann, 1963). Other domesticated species were later recorded as Tare Irani, Prei-anak, pearl-onion, and mushu-ninniku (Tahbaz, 1971; Van der Meer & Hanelt, 1990; Ariga et al., 2002). Based on the recent molecular data, the tetraploid accessions of A. ampeloprasum form a single subgroup closely related to A. atroviolaceum and A. iranicum, but interspecific relationships still remain unresolved (Hirschegger et al., 2010).

The aims of the present study were: 1) to clarify possible occurrence of A. ampeloprasum in Iran, 2) to provide a complete description for this taxon, and 3) to compare it with its close relatives, i.e. A. atroviolaceum and A. iranicum.

Table 1. Collection data for three species of Allium sect. Allium examined in Iran.

| Species                | Collection data                                                                 |
|------------------------|---------------------------------------------------------------------------------|
| A. ampeloprasum L.     | Mazandaran: SE Behshahr, Hezarjarib village, 1900 m, M. Khorasani 45224 (TUH); SW Sari, Dodangeh dam, 1350 m, M. Khorasani 5983 (GUH); S Babol, Khajeh Kola village, 1300 m, M. Khorasani & M. R. Rahimi 5984 (GUH). |
| A. atroviolaceum Boiss.| Mazandaran: Babol, 3 km to Mosakheyl village, toward Mehdikheyl village, 600 m, M. Khorasani 5985 (GUH) |
|                        | Kurdestan: Dehgolan, Sis village, 1904 m, M. Khorasani 5986 (GUH).               |
|                        | Hamedan: 2 km to Asad Abad, 1672 m, M. Khorasani 5987 (GUH).                     |
| A. iranicum (Wendelbo) | Mazandaran: Haraz road, Vana region, 1439 m, M. Khorasani 5988 (GUH).             |
|                        | Kordestan: Road of Kooleh to Divandarreh, 15 km to Divandarreh, Tazeh Abad village, 2120 m, M. Khorasani 5989 (GUH). |
|                        | Hamedan: Asad Abad, after Khandagh village, Ghaseem abad village, Karkas mountain (Karkasin) 2896 m, M. Khorasani 5990 (GUH). |
MATERIALS AND METHODS

In order to address the status of *A. ampeloprasum* in Iran, extensive field collections were conducted during 2014-2016 in Iran. Many parts of Alborz and Zagros mountain ranges were visited by the first author. The sampling was focused on the following taxa: *A. ampeloprasum, A. atroviolaceum* and *A. iranicum*. The specimens were studied and photographed in field from several localities and scored for certain morphological features. A list of voucher specimens for this study, held in the herbaria GUH (Guilan University Herbarium) and TUH (University of Tehran Herbarium), is provided in Table 1. In addition, we examined the photographs of the type materials provided by various virtual herbaria and ‘Global Plants on JSTOR’ (https://plants.jstor.org/) of the mentioned taxa.

RESULTS AND DISCUSSION

Taxonomic treatment

*A. ampeloprasum* L., Sp. Pl. 294 (1753) (Fig. 1).

Syn.: *Porrum sativum* (L.) Mill., Gard. Dict. (ed. 8) 1, 1768; *P. ampeloprasum* (L.) Mill., Gard. Dict. (ed. 8) 2, 1768; *Allium lactetum* Salisb., Prodr. Stirp. Chap. Allerton 235, 1796; *A. porrum* var. *ampeloprasum* (L.) Mirb., Dict. Sci. Nat. (ed. 2) 1: 384, 1816; *A. porraceum* Gray, Nat. Arr. Brit. Pl. 2: 181, 1821; *A. halleri* G. Don, Monogr. All. 15, 1827; *P. commune* Rchb., Fl. Germ. Excurs. 411, 1830; *P. amethystinum* Rchb., Fl. Germ. Excurs. 140(16), 1831; *A. ascendsens* Ten., Syll. Pl. Fl. Neapol. 164, 1831; *A. holmense* Mill. ex Kunth, Enum. Pl. 4: 384, 1843; *A. ampeloprasum var. porrum* (L.) J.Gay, Ann. Sci. Nat., Bot. III, 8: 218, 1847; *A. ascendsens* Kunth, Enum. Pl. 4: 385, 1843; *A. pyileum* De Not., Index Sem. (Genoa) 30, 1843; *A. lineare* Mill. [illeg. non L.], Enum. Pl. [Kunth] 4: 419, 1843; *A. bertoloni* De Not., Repert. Fl. Ligust. 414, 1844; *A. spectabile* De Not., Repert. Fl. Ligust. 414, 1844; *A. babingtonii* Boiss., Bull. Misc. Info. Bot. Gard. 2906, 1849; *A. durieuanum* Walp., Ann. Bot. Syst. 1: 860, 1849; *A. byzantinum* K.Koch, Linnaea 22: 240, 1849; *A. albescens* Guss., Enum. Pl. Inarim. 338, 1855; *A. gasparrinii* Guss., Enum. Pl. Inarim. 337, 1855; *A. ampeloprasum var. babingtonii* (Borrer) Syme, Engl. Bot. ed. 3, 9: 204, 1869; *A. ampeloprasum var. bulbiferum* Syme, Engl. Bot. ed. 3, 9: 204, 1869; *A. durieeanum* Regel [illeg.], Trudy Imp. S.-Peterburgsk. Bot. Sada 3(2): 54, 1875; *A. ampeloprasum var. wiedemannii* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 3(2): 55, 1875; *A. ampeloprasum var. bertoloni* (De Not.) Nyman, Conspl. Fl. Eur. 735, 1882; *A. ampeloprasum var. gasparrinii* (Guss.) Nyman, Conspl. Fl. Eur. 735, 1882; *A. ampeloprasum subsp. halleri* Nyman, Conspl. Fl. Eur. 735, 1882; *A. ampeloprasum subsp. thessalum* (Boiss.) Nyman, Conspl. Fl. Eur. 735, 1882; *A. scorodoprasum subsp. babingtonii* (Borrer) Nyman, Conspl. Fl. Eur. 736, 1882; *A. syriacum* Boiss., Fl. Orient 5: 232, 1882; *A. thessalum* Boiss., Fl. Orient. 5: 232, 1882; *A. ampeloprasum var. bulgaricum* Podp., Verh. K. K. Zool.-Bot. Ges. Wien 52: 676, 1902; *A. ampeloprasum var. pyileum* (De Not.) Asch. & Graebn., Syn. Mitteleur. Fl. 3: 107, 1905; *A. ampeloprasum var. ampeloprasum f. holmense* (Asch. & Graebn.) Holmboe, Veg. Cyp. 45 1914; *A. ampeloprasum var. holmense* Asch. & Graebn., Syn. Mitteleur. Fl. 3: 105, 1905; *A. scopulicola* Font Quer, Butl. Inst. Catalana Hist. Nat. 24: 144, 1924; *A. kurrat* Schweinf. ex K.Krause, Notizbl. Bot. Gart. Berlin-Dahlem 9: 524, 1926; *A. ampeloprasum var. gracile* Cava, Bull. Orto Bot. Regia Univ. Napoli 9(1): 46, 1927; *A. ampeloprasum subsp. porrum* (L.) Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30(3): 39 1932; *A. ampeloprasum var. caudatum* Pamp., Arch. Bot. (Forli) 12: 21, 1936; *A. porrum var. kurrat* (Schweinf. ex K.Krause) Seregin, Novosti Sist. Vyssh. Rast. 36: 102, 2004.

Phenology: Flowering in May-June and fruiting in July-August.

Ecology: *Allium ampeloprasum* grows in wet soils in association with other species such as *Urtica dioica* L. and *Salix alba* L. in Iran. It prefers clay soils in the shadow of trees. It is known in several localities in Mazandaran Province as wild and probably has a wider distribution range in humid areas of north Iran. Specimens seen in Iran (Fig. 4): Northeast, Prov. Mazandaran: SE Behshahr, Hezarjarib village, 1900 m, N 36° 39' 43.14", E 53° 38' 23.43", 13 June 2014, M. Khorasani 45224 (TUH); SW Sari, Dodange dam, 1350 m, N 36° 28' 12.94", E 53° 4' 23.86", 29 May 2015, M. Khorasani 5983 (GUH); S Babol, Khajehkola village, 1300 m, N 36° 21' 23.08", E 52° 47' 42.73", 20 May 2015, M. Khorasani & M. R. Rahimi 5984 (GUH).

Description: Herbaceous, bulbous plants. Bulbs ovoid to subglobose, aggregate, 3.5-4.5 cm; outer tunics papery, ± longitudinally splitting, white; the innermost tunics coriaceous, yellowish; bulblets 3-4, placing at base and tip of bulbs, 0.5-0.6 mm diam., yellowish-brown. Leaves 6-8, narrowly lanceolate to linear, alternate, thick, ascending arcurately, canaliculate, glabrous, deep green, 35-45×1.5-3.5 cm; sheath 5-11 cm long, glabrous, initially green, after anthesis white-greyish, soon decaying. Scape cylindrical, erect, smooth, strong, green, 50-130 cm.
(180) cm long, near base 1.5-2 cm diam. Spathe funnel shaped, caudate, thick, initially deep green, covering the inflorescence, after anthesis white with green veins, divided into 1-3(4) ovate to semi-globose parts. Inflorescence globose, dense, many-flowered (up to 200), ca. 7-8 cm in diam, in the fruiting stage even larger. Pedicel thick, wire like, straight, stiff, unequal, 3-4 (5) cm long, same color as tepals, upper side pale pink-whitish. Tepals oblong, navicular, obtuse, throughout verrucose, 4-5 mm long, 2-3 mm wide, only basally united, erect after anthesis, pale pink, purple-whitish, lilac or green, sometimes with a green or purple midvein. Filaments longer than tepals, basally 0.5-0.7 mm connate and 1-1.5 mm adnate to the tepals, white or purplish, dimorphic, with three simple and triangular filaments (5-6 mm long) with minute lateral cusps and three tricuspidate filaments filiform at apex with expanding lateral cusps (8-12 mm long), white, verrucose. Anther oblong, 0.8-1.2 mm long, pinkish. Ovary subglobose, pear-shaped with ± sharp bulges, surface finely coarse, sessile, 5 × 3 mm, green. Style narrowly conical, thread like, 3-4 mm long, white. Stigma undivided, subcapitate, white. Capsule triangular-subglobose, 5-6 × 4-5 mm, opening with 3 narrow slits, valves subovate, light brown. Seeds 1(-2) per capsule, ovate, drop-shaped, acuminate, 3 × 2 mm, blackish in color.

Fig. 1. *Allium ampeloprasum*. A: Habitat; B: Habit; C, D: Inflorescence with the verrucose tepals and the filiform filaments; E: Aggregate bulb; F: Bulblets in base and apex of bulb, (Photo by M. Khorasani).
Fig. 2. *Allium iranicum*. A: Habit; B: Inflorescence; C: Aggregate bulb and bulblets at the base and on the scape, (Photo by M. Khorasani).

Note: According to the description given in Flora of the U.S.S.R. (Vvedensky, 1935), the main features of *A. ampeloprasum* are as follows: a scape arising laterally from the bulb leading to its easy recognition from its closely related species, i.e. *A. iranicum*, previously identified as a subspecies of *A. ampeloprasum* in Flora Iranica (Wendelbo, 1971) and Flora of Turkey (Kolmann, 1984). *Allium ampeloprasum* is known from Europe to Asia, especially in regions such as England, west Mediterranean, Turkey, Iraq, Syria, Cyprus, Lebanon, Palestine, Jordan, Egypt, Arabia, Russia, Turkmenistan, Kazakhstan, east Caspian Sea, and Caucasus mountains (Vvedensky, 1935; Wendelbo, 1971; Kolmann, 1984; Wendelbo, 1985; Mathew, 1996; Fritsch & Friesen, 2002). Therefore, the occurrence of this species in Iran is not unexpected.

The species is closely related to *A. iranicum* and *A. atroviolaceum* (A. sect. *Allium*) due to verrucate tepals and ovaries, dimorphic filaments and alternate leaves, but differs from them by several characters (Table 2). The absence of bulblets on the scape and the obtuse tepals in *A. ampeloprasum* are the most important characteristic features separating *A. ampeloprasum* from *A. iranicum*. It differs from *A. atroviolaceum* by having pale pink and purple-whitish flowers, subglobose bulblets and papery or coriaceous tunics (Figs. 1-3). A previous study indicated six independent groups in *A. sect. Allium* based on tunic type, presence of bulbils in inflorescence, shape of leaf and mode of anther anthesis (Mathew, 1996). In the same work, in *A. ampeloprasum* group, three close species, i.e. *A. iranicum*, *A. atroviolaceum* and *A. ampeloprasum* were separated from each other, based on tunic type, shape and position of bulblets, leaf shape and color, and shape of tepals, which are consistent with our findings.
Fig. 3. *Allium atroviolaceum*. A: Habit; B: Inflorescence; C: Solitary bulb and bulblets at the base of bulb, (Photo by M. Khorasani).

Fig. 4. Distribution map of *A. ampeloprasum* (white star) and its allies: *A. atroviolaceum* (white square) and *A. iranicum* (black triangle), according to the collection data and herbaria specimens by the authors.
Table 2. Morphological comparison between A. ampeloprasum and its two relatives.

| Characters                  | A. ampeloprasum | A. iranicum | A. atroviolaceum |
|-----------------------------|-----------------|-------------|------------------|
| Bulb                        | aggregate–solitary | aggregate | solitary          |
| Bulblet position            | base and tip of bulb | base and on the scape | base of bulb |
| Outer tunic                 | papery, entire, prolonged into a long collar–whitish | papery–white | reticulate fibrous–brown |
| Inner tunic                 | coriaceous      | Papyry      | papery           |
| Scape length                | 50–130 (180)× 1.5–2 cm | 40–60×0.3–0.8 cm | 50–100×0.4–0.9 cm |
| Scape type                  | lateral and central | Central    | central          |
| Leaf size                   | 35–45 ×1.5–3 (5) cm | 20–45×0.6–0.9 cm | 19–28×0.4–1 cm |
| Pedicel color               | purple, reddish, lilac or green | Purple | purple           |
| Tepal color                 | pale pink, purple–whitish, lilac or green, sometimes with a green or purple midvein | bright pink, with purple midvein or purple in upper part, shining | purple or green |
| Tepal apex                  | obtuse           | ± acute     | obtuse           |
| Ovary color                 | green            | Purple      | purple           |
| Verrucae in the base of the filaments | present | ± present | ± present |
| Bulblet shape               | subglobose and helmet-shaped | elliptic and helmet-shaped | elliptic and helmet-shaped |

Based on our field observations, A. ampeloprasum is growing wild in Iran and not, as previously reported (Wendelbo, 1981), only as a cultivated plant (Fig. 3). According to available data and obtained findings, we recognize A. ampeloprasum to be separated from A. iranicum and follow the treatment in Flora of U.S.S.R. (Vvedensky, 1935), Flora of Iraq (Wendelbo, 1985) and the review of Mathew (1996) on A. sect. Allium on this species group.

Typification of Allium atroviolaceum

Allium atroviolaceum Boiss., Diagn. Pl. Orient. ser. 1, 7: 112, 1846.
Type: Iran. In monte Sabs-Buschom prope u. Schiras, 31.5.1842, K.G.T. Kotschy 450 (lectotype designated here: G, barcode G00164986!; isolectotypes, BM, barcode BM000958288!, Fl, barcode Fl012000!, G!, barcodes, G00164987!, G00164988!, GOET, barcode GOET000718!, K, barcode K000464376!, L, barcode L0041350!, LE, barcodes LE00010808!, LE00010809!, MO, barcode MO-149473!, P, barcodes P00747749!, P00601092!, P00601093!).
There are many duplicates of the type specimens in different herbaria. In G we found three specimens, thus, no single specimen could serve as holotype. Therefore, here we select the aforementioned specimen as the lectotype because it was the most complete one and agreed well with the protologue.

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