Allium arampatzisii (*Amaryllidaceae*) – a new species from Northern Continental Greece

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Abstract. *Allium arampatzisii* is described and illustrated as a species new to science. It shares the main diagnostic characters of the species of *Allium* sect. *Pseudoscorodon* Brullo & al. created quite recently and includes mainly Mediterranean taxa, formerly members of A. sect. *Scorodon* Koch. The new species, however, is well differentiated from all other species of this section by a combination of characters relating to the size and morphology of the perianth and morphology of the inflorescence. The new species is narrowly endemic, only known from the province of Kilkis (C. Macedonia, Greece) where it prefers open habitats with humid grassland vegetation. *A. arampatzisii* is a diploid species with 2x=16. Notes on the karyotype and taxonomic relationships with other taxa of the genus *Allium* are discussed.

Key words: *Allium*, *Amalyllidaceae*, *A.* sect. *Pseudoscorodon*, *A.* sect. *Scorodon*, chromosome number, Greek flora, karyotype

Introduction

Allium is one of the most species-rich genera of the Monocotyledons represented worldwide, mostly in the northern hemisphere, by *ca*. 1200 species (Govaerts & al. 2018). According to Stearn (1978, 1980, 1981), Greece is considered a secondary diversity and evolutionary centre for the genus, since nine out of the twelve *Allium* sections reported from Europe and more than 50 % of the corresponding species are represented in that country. The above statement is further supported by the discovery of several species in Greece in the past 40 years. According to Dimopoulos & al. (2013), *Allium* has proved to be one of the most species-rich genera of the Greek flora, including more than 100 species with *ca* 50 % of them being Greek endemics.

Allium sect. *Scorodon* Koch. was among the sections of the genus recognized by Stearn (1978, 1980) and well represented in the Greek area. It was included by Stearn (l.c.) in this section, where the species were characterized by a slender stem, leaves sheathing the lower ¼ to ½ of the stem, spathe-valves shorter than pedicels, perianth tubular to stellate, stamens included and ovary globose, with distinct nectariferous pores. Based on the above characters, seven species of *A*. sect. *Scorodon* were reported by Stearn (l.c.) from the Greek area. However, considering that among these were species with spathe tubular at the base viz. *A. cupani* group and *A. callimischon* Link, which later were considered members of different sections, viz. *A.* sect. *Brevispatha* Valsecchi and/or *A.* sect. *Cupanioscordum* Ceschm. (Kollmann 1984, Brullo & al. 2015), as well as *A. obtusiflorum* which, actually, does not occur in Greece (Brullo & al. 1994), it becomes evident that *A.* sect. *Scorodon* (s. stricto) was represented in the Greek area only by four species, namely: *A. moschatum* L., *A. bornmuelleri* Hayek, *A. meteoricum* Heldr. & Hausskn., and *A. frigidum* Boiss. & Heldr.

The years that followed the publication of *Flora Europaea*, the intense floristic explorations in Greece and description of the *Allium* species as new to science, as well as a series of taxonomic studies and revisions of this genus resulted in an increase of representatives of *A.* sect. *Scorodon* (s. stricto) from four to eleven (Phitos & Tzanoudakis 1981; Tzanoudakis 1983a; Brullo & Tzanoudakis 1989; Brullo & al. 1993 & 1994; Trigas & Tzanoudakis 2000; Bogdanovic & al. 2011). Quite recently, most of the above 11 species have been considered members of a new *Allium* section, *A.* sect. *Pseudoscorodon*, created by Brullo & al. (2019) and well distinct from *A.* sect. *Scorodon.*

The material described here as a species new to science has been collected by the first author within the framework of floristic explorations in the area of Kilkis, (western part of the NE floristic region of Greece). Morphological examination of both wild and cultivated living material revealed that the populations studied consist of plants with the main diagnostic characters of *A.* sect. *Pseudoscorodon* mentioned above, but well distinct from other species of the section concerned, known from Greece and neighboring regions. Therefore, this explains the decision to describe the material concerned as a species new to science.

Material and methods

Within the framework of floristic explorations in the area of Kilkis (Central Macedonia, North Continental Greece) by the first author, material of the new taxon has been collected from four different localities at

Table 1. Comparison of *A. arampatzisii* with four Greek *Allium* species of *A.*sect. *Pseudoscorodon*. characterized by small (less than 5 mm) and pinkish flowers.

Character	*A. erythraeum*	*A. arampatzisii*	*A. runemarkii*	*A. maniaticum*	*A. thessalicum*
Outer tunics (bulb)	coriaceus	membranous to coriaceus	membranous, partially breaking into parallel fibres	hardly membranous	fibrous, breaking into parallel fibres
Leaf indumentum	glabrous	glabrous	glabrous	glabrous to slightly hairy	glabrous
Spathe attachment	2-valved, valves free	2-valved, valves free or partially fused in base	2-valved valves free, opposite	2-valved valves free, opposite	2-valved, valves free
Spathe valve shape & size	wide-ovoid, acuminate, 6–10 mm	broadly ovoid, acute, 8–12(15) mm	broadly ovoid, acuminate, 5–10 mm	oblong ovoid with long appendage, 7–10 mm	wide-ovoid with a short peak, 5–10 mm
Spathe-valves nerves	3–5	3–5(8)	3–5	1–4	3–5
Inflorescence	many-flowered, hemispheric to sub-ovoid, dense	many-flowered, lax, pedicels often flexuous	many-flowered, sub-hemispheric, dense	few-flowered, lax, pedicels unequal, flexuous	many-flowered, sub-hemispherical, dense
Pedicels (length mm)	pedicels sub- equal, 5–20 mm	pedicels unequal, (15)20–30(40) mm	pedicels equal to sub-equal, 2–8 mm	pedicels unequal , 3–20 mm	pedicels, sub-equal to unequal, 5–25 mm
Perigon shape	cylindrical	cup-shaped to cylindrical	cylindrical	cylindrical to urceolate	cylindrical
Tepals shape and length	all similar, ovate to narrowly elliptical, 4–4.5 mm,	the 3 inner oblong elliptical, the 3 outer oblong- obovate, ca 3.5 mm ,	the 3 inner oblong elliptical, the 3 outer elliptical 3.5–4.5 mm.	all similar, oblong elliptical, 4–5 mm.	all similar elliptical to oblong elliptical, 4.5–5 mm.
Tepals colour	purplish- pink with a dark-purple midvein	pink to pinkish- white with a greenish- purple midvein	whitish-pink with purplish to purplish-green midvein	pinkish-white with a purplish- green midvein	whitish-pink with greenish- purple midvein
Ovary	subglobose, ca 1.2×1.3 mm, white but gradually greenish to the apex	wide-ovoid to subspherical, ca 1.5 mm in diameter; greenish at the base and dark-pink to purplish in the upper part	ovoid, 1.3-2×1.2–1.5 mm. whitish with large purplish spots at apex	ovoid, ca 2×1.5 mm	subglobose-ovoid, ca 1.5–2×1.5–2 mm., whitish-green in the lower part and dark-green at the apex
Stamens (filaments shape and length)	all simple, gradually broadened towards the base, the inner 1.8–2 mm., the outer shorter	all simple, gradually broadened towards the base, the inner ca 2.5 mm. the outer shorter	all simple, up to 3–3.3 mm., the outer 3 gradually broadened towards the base, the inner ones tadpole-shaped	all simple, gradually broadened towards the base, the inner ca 2.5 mm the outer shorter	outer 3 filaments simple, 1.2–1.7 mm, the inner ones often broadened and provided with 2 teeth at the base up to 2.5 mm.
Anthers	pale-yellow	purplish	purple-violet	yellow	yellowish

a distance of a few kilometers from each other. The morphological investigation was carried out on wild material and on plants cultivated in the experimental Botanical Garden of the Botanical Institute of the University of Patras (Greece). For morphological comparisons (Table 1), the authors consulted dry herbarium material kept in UPA, as well as qualitative and quantitative characters mentioned in the original descriptions of the concerned species. The given cytological information is based on bulbs collected in the field and cultivated in the experimental Botanical Garden of the Botanical Institute of the University of Patras. Root tips were pre-treated in saturated solution of a-bromonaphthalene for *ca* 6 hours and fixed in Carnoy's solution (ethanol/acetic acid solution 3:1) overnight. Staining, chromosome morphology and karyotypes are according to Tzanoudakis (1983b). All field photographs are by V. Ioannidis.

Results

Allium arampatzisii Ioannidis & Tzanoud., **sp. nov.** (Figs. 1, 2 & 3)

Type locality: — Greece, Nomos (Prefecture) of Kilkis (NE Greece), near the village Chorigi, 41°1'18.38" N 22°43'19.51" E, alt. *ca* 180 m. a.s.l., 5 June 2019 Ioannidis 14711 (Holotype UPA).

Diagnosis. *Allium arampatzisii*, a spring-flowering species of the Greek flora, is characterized by spathe and spathe-valves shorter than umbel, stamens included in the perianth and ovary with distinct nectariferous pores, and belongs to the group of species of *Allium*. subgen. *Allium*, which were gathered in *A*. sect. *Pseudoscorodon* Brullo & al. (2019). With its lax and multi-flowered inflorescence, unequal and flexuous pedicels and small flowers (*ca*. 3.5 mm) it

Fig. 1. *Allium arampatzisii*: **A** – inflorescence; **B** – shape and color of flowers; **C** – size and inside view of the perianth; **D** – habitat.

Fig. 2. Holotype of *Allium arampatzisii* Ioannidis & Tzanoud., Ioannidis 14711 (UPA).

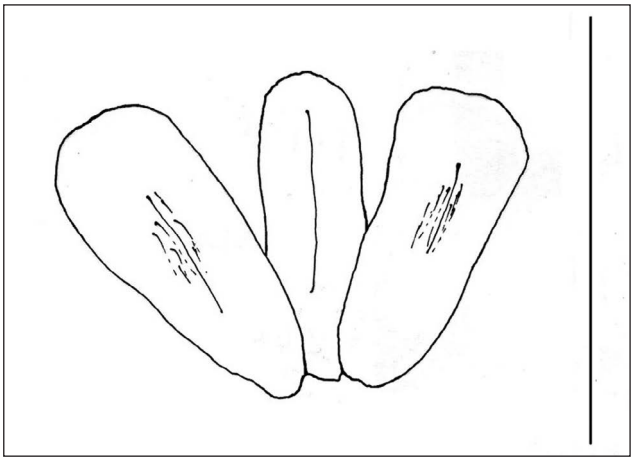

Fig. 3. *Allium arampatzisii*: outer and inner perianth segments. Scale bar =5 mm.

differs from most Greek species of the *Allium* section mentioned above, which are characterized by more compact inflorescences and larger flowers. It also differs from *A. maniaticum*, also characterized by a lax inflorescence and flexuous pedicels, by its multi-flowered inflorescence and cup-shaped to cylindrical and not urceolate to funnel-shaped flowers.

Bulbus subspherical to spherical, 1.2–1.5 in diameter, outer tunics membranous to coriaceus, brown to blackish-brown, inner ones membranous, white. **Bulblets** absent. **Leaves** 3–4(7–10 in cultivation), sheathing the lower ¼ to ½ of the stem, glabrous, fistulose, semi-cylindical, slightly canaliculate, 20–30 cm long and *ca*. 1 mm wide, with a strong garlic/onion smell. **Scape** solitary, erect, 15–25(30) cm tall, terete, 1–1.5 mm in diameter, glabrous. **Spathe** shorter than pedicels, white, transparent, completely or usually partially divided into two 3–6-nerved wide-ovate valves, (8)10–12(15) mm. **Inflorescence** lax, (20)30–50(60)-flowered, fastigiate, pedicels white, unequal (15)20–30(40) mm, the outer ones often flexuous. **Perigon** cup-shaped to cylindrical; **tepals** – the inner oblong elliptical, 3.4 × 1.2 mm, the outer oblong-obovate, 3.5 × 1.4–1.5 mm, pink to pinkish-white, with a greenish mid-vein. **Stamens** included, filaments white, anthers purplish. **Ovary** wide-ovoid to subspherical *ca*. 1.4×1.6 mm, white with greenish nectariferous pores at the base and dark-pink to purplish upper part. **Style** white, **stigma** capitate white. **Capsule** subglobose-obovate *ca*. 3.5 mm. **Seeds** black, *ca*. 3 mm long. **Flowering period:** mid-May to early June. **Chromosome number** 2n = 2x = 16.

Etymology: The name of the new species refers to the late Theodoros Arampatzis (1948–2001), a distinguished naturalist, photographer and botanist, born in the small city of Axioupolis, near the type locality of the new species. He was professor in the Department of Forestry of the Technological Education Institute of Kavala (North Greece) and the author of the notable two-volume monograph *Shrubs and Trees in Greece* published by the Ecological Movement of Dramas & the Technological Education Institute of Kavala (1998–2000).

Distribution, habitat and ecology: *Allium arampatzisii* is currently known from the type locality and a few other nearby localities of the Prefecture of Kilkis, (North Greece, NE floristic region). Mention deserves the fact that, in contrast to most Greek species of *A.* sect. *Pseudoscorodon* which occur mainly in dry rocky places, the new species grows mainly in humid grasslands. It was found in grassland and rocky places near small seasonal springs and streambanks, as well as on sandy soil in fields (mostly abandoned) in the littoral zone of lake Pikrolimni. In the type locality, the new species is accompanied by such plant species like: *Trifolium tomentosum* L., *Plantago lagopus* L., *Aegilops triuncialis* L., *Hordeum bulbosum* L., *Chrysopogon gryllus* (L.) Trin., *Thymus sibthorpii* Benth., *Centaurea benedicta* (L.) L *Ranunculus psilostachys* Griseb., *Ornithogalum armeniacum* Baker, *Dianthus cruentus* Griseb., *Allium sphaerocephalon* L., *A. pallens* L. and *A. guttatum* Steven. In the area of Pikrolimni the floristic composition is a little more different and is characterized by species like: *Cardopatium corymbosum* (L.) Pers., *Suaeda maritima* (L.) Dumort *Verbascum blattaria* L., *Ficaria verna* Huds., *Limonium compactum* Erben & Brullo, *Colchicum soboliferum* (Fisch. & C.A. Mey.) Stef., *Elytrigia elongata* (Host) Nevski, *Ornithogalum wiedemannii* Boiss., *Cerastium brachypetalum* Pers., *Plantago coronopus* L. and *Allium cyrilli* Ten.,

Additional material examined

Greece, Nomos (Prefecture) of Kilkis (NE Greece), near Eleftherochori village 41°4'16.81" N, 22°45'46.33" E, alt. *ca* 90m. 13.06.2017 Ioannidis (UPA); ibid. near Pikrolimni 40°50'44.66" N, 22°48'27.86" E, alt. Ca 50 m., 10.06.2016 Ioannidis (UPA); ibid, near Kastanies village, 41°0'51.38" N 21°44'14" E, alt. *ca* 100m. 9.06.2019 Ioannidis (UPA)

Karyology

Material from two populations (Eleftherochori and Chorigi) has been investigated cytologically and

in both was found the diploid chromosome number 2n=2x= 16. This is not surprising, since the Greek species of *A.* sect. *Pseudoscorodon* show a remarkable stability regarding the basic chromosome number x=8 and their diploid chromosome number 2x=16 (Tzanoudakis 1983b). Similar seems to be the case of the chromosome morphology and karyotype formula of the new species (Fig. 4). A preliminary karyotype analysis showed that the haploid chromosome complement of *A. arampatzisii* consists of six more or less isobrachial chromosomes (metacentrics, m) and two anisobrachial (r-indexes 1.7–3.5) ones. In all examined metaphase plates, the anisobrachial chromosomes with a higher r-index values (c.3.5) showed a nucleolar organizer proximal to the telomere of the short arm and thus it should be considered as subtelocentric SAT- chromosome (st^C), while the others with lower r-index values (1.7–2.0) and without any nucleolar organizer should be considered as submetacentric (sm). Considering that version of the metacentric chromosome pairs, most probably the smaller one, which consists also of SAT-chromosomes (m^A), the karyotype formula of *A. arampatzisii* is as follows: 2n=2x= 10m+ $2m^A$ +2sm+$2st^C$ = 16.

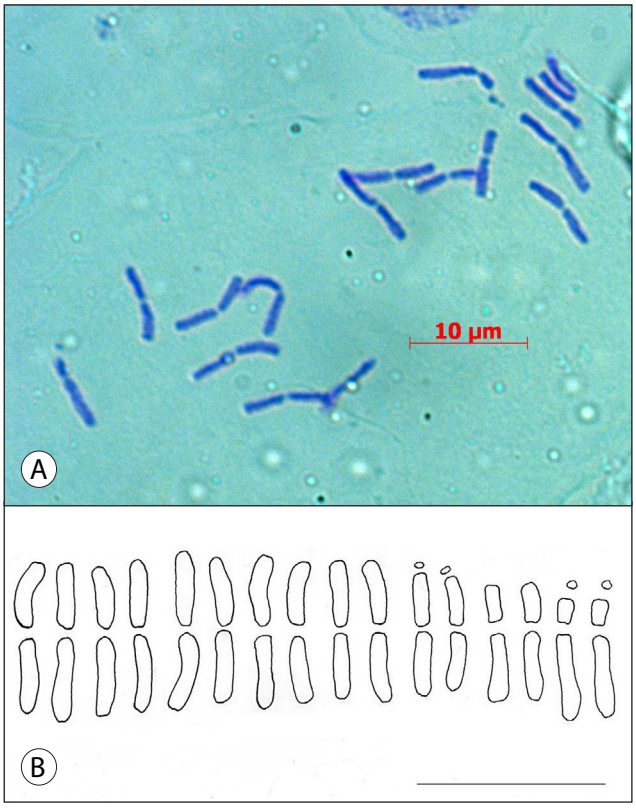

Fig. 4. *Allium arampatzisii* (2n=2x=16): **A** – photograph of a metaphase plate; **B** – karyogram. Scale bars **A** & **B** = 10 µm.

Taxonomic relationships

According to *Flora Europea* (Stearn 1978, 1980) and on the basis of the morphology of its main diagnostic characters (spathe valves, stamens and ovary), *A. arampatzisii* should be classified in *Allium* sect. *Scorodon* Koch (s. str.). However, mention deserves the fact that this *Allium* section is considered as a non-natural group, since it includes several taxa morphologically rather heterogeneous (Kollmann 1984, Bogdanovic & al. 2011, Brullo & al. 2019). This situation is well represented in the rich and diverse Greek flora, which comprises eleven species in this section (Stearn 1978; Dimopoulos & al. 2013). Ten of them are Greek endemics and/ or range- restricted, and only one, viz. *A. moschatum L.,* is widespread. The latter is considered presently as the type species of *A.* sect. *Scorodon*, a member of the *Allium* subgenus *Polyprasson* Radic characterized mainly by rhizomatous species (Friesen & al. 2006). As none of the above-mentioned eleven Greek species is rhizomatous, Brullo & al. (2019) suggested that they should be included into *Allium* subgenus *Allium* and thus created the new *Allium* section *Pseudoscorodon* Brullo, C. Brullo, Cambria, Ciusso and Salmeri to include them. This new section comprised 18 Mediterranean species, six of which are endemic to Greece and former members of *A.* sect. *Scorodon,* namely: *A. erythraeum* Griseb., *A. lagarophyllum* Brullo, Pavone & Tzanoud., *A. maniaticum* Brullo & Tzanoud., *A. meteoricum* Halácsy, *A. runemarkii* Trigas & Tzanoud. and *A. thessalicum* Brullo, Pavone, Salmeri & Tzanoud. There is no doubt that *A. arabatzisii*, on the basis of its main diagnostic characters (spathe, spathe valves, ovary) must to be added to the above species as a member of *A.* sect. *Pseudoscorodon,* too. Compared to the above Greek endemics, *A. arampatzisii*, seems to be closer to *A. erythraeum* from which, however, it is well distinguishable by its smaller perianth, laxer inflorescence with unequal, much longer and often flexuous, pedicels. *Allium maniaticum,* which is also characterized by a small perianth and long and flexuous pedicels, is well distinct from the new species by its lax inflorescence with fewer flowers and its urceolate to funnel-shaped perianth. A comparison of *A. arampatzisii* with the remaining Greek species of *A.* sect. *Pseudoscorodon* shows some affinity with *A. thessalicum* and *A. runemarkii* (Table1), but it seems taxonomically isolated from the Aegean endemics *A. chalkii* Tzanoud. & Kollmann and *A. rhodiacum* Brullo, Pavone & Salmeri, which are characterized by 1-valved

spathe, unilateral inflorescence and urceolate flowers, all characters occurring in the species of *A. cupani* Raf. group considered a member of *A.* sect. *Cupanioscordum* (Brullo & al. 2015, Trigas & al. 2017). Mention also deserves the fact that on the basis of its inflorescence and size and color of flowers, *A. arampatzisii* shows some similarities with *A. candargyi* Karavokyrou & Tzanoud., a Greek endemic from the Eastern Aegean Islands and member of *A. sect. Codonoprasum* Reichenb. (Karavokyrou & Tzanoudakis 1994). On the basis of the above-mentioned characters and not only, the new species also shows similarities with *A. bornmuelleri* Hayek and *A. goulimyi* Tzanoud., two species occurring in North Greece and formerly considered members of *A.* sect. *Scorodon* Koch. (Tzanoudakis 1983a). These two taxa, evidently without rhizomes, cannot be considered as members of the *A.* sect. *Scorodon* of the subgenus *Polyprason* Radic but are not included among the species of *A.* sect. *Pseudoscorodon* by Brullo & al. (2019).

The above observations underline the need of a more comprehensive intrageneric classification of *Allium* and, along these lines, the entire known diversity of the genus should to be analysed molecularly, including the dozens of new species, especially of *A.* subgenus *Allium,* which has been described in the last forty years from the area of Eastern Mediterranean and Asia Minor.

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