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Authors: Galanos, Christos J., and Tzanoudakis, Dimitris

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CHRISTOS J. GALANOS[1*] & DIMITRIS TZANOUDAKIS[2]

Allium symiacum (*Amaryllidaceae*), a new species from Symi Island (SE Aegean, Greece)

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Abstract: *Allium symiacum* Galanos & Tzanoud., from the island of Symi (SE Aegean, Greece), is described as a species new to science. It is an autumn-flowering, single-island endemic species of *A.* sect. *Codonoprasum* (*Amaryllidaceae*) and is classified as Critically Endangered according to IUCN Red List categories and criteria. Considering the morphological and karyological characters of the new species, its possible relationships to other autumnal species of *A.* sect. *Codonoprasum* distributed in the E Mediterranean area are discussed.

Key words: Aegean, *Allium*, *Amaryllidaceae*, *Allium* sect. *Codonoprasum*, chromosome number, Dodecanese, Greece, karyology, new species, Symi, taxonomy

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Introduction

Allium L. (*Amaryllidaceae*) is considered as one of the most species-rich genera of flowering plants, as it comprises more than 960 species (Govaerts & al. 2005–2014). In *Flora europaea* (Stearn 1980; see also Stearn 1978), 47 *Allium* species were recorded as occurring in Greece, and the Greek area was regarded as an evolutionary centre for the genus (Stearn 1981; Tzanoudakis & Vosa 1988). This view is further supported by newer floristic data, according to which, the genus *Allium* is represented in Greece by more than 100 species (Dimopoulos & al. 2013; Brullo & al. 2015; Tzanoudakis & Trigas 2015; Trigas & al. 2017). The doubling of species number within the last four decades, mainly because of the description of numerous new species, indicates the amplitude of diversity of the genus in Greece.

It is worth noting that among these new *Allium* taxa, two, often overlapping, groups are well represented. The first one consists of species of *A.* sect. *Codonoprasum* Rchb., the members of which show a remarkable diversity regarding their morphology, ploidy level, habitat traits and flowering period. The second group consists of species particularly characterized by an autumn-flowering period and a life cycle in which the dormancy phase is almost absent (Tzanoudakis & Kypriotakis 1993).

The *Allium* species described here from the island of Symi is a member of *A.* sect. *Codonoprasum*, is autumn-flowering and was collected in the framework of the floristic explorations and studies of the authors in the Aegean islands.

The island of Symi was visited by the first author in November 2015. During the fieldwork, a small *Allium* population, with some individuals still in flower, was found growing on a calcareous coastal slope. The autumnal flowering period and the obvious morphological differences of the individuals from all known autumn-flowering *Allium* species of Greece indicated an interesting

1 Parodos Filerimou, 85101 Ialisos, Rodos, Greece; *e-mail: galanosx@gmail.com (author for correspondence).
2 Division of Plant Biology, Department of Biology, University of Patras, 26500, Patras, Greece; e-mail: tzanoyd@upatras.gr

Fig. 1. The floristic regions of Greece (from Dimopoulos & al. 2013) showing the position of Symi in the SE Aegean.

new finding. Living bulbs and herbarium specimens were collected for cultivation and further studies. Careful and thorough examination of the collected material lead us to the conclusion that it is distinct from all other members of *A.* sect. *Codonoprasum* and it is described here as a species new to science.

Symi is one of the small but inhabited islands of the Dodekanisa island complex (Dodecanese, SE Aegean region) and it is located 22 km N of Rodos (Rhodes) and 6.75 km W of the nearest Turkish coast (36°36'N, 27°50'E, Fig. 1). It covers an area of 58 km², has a coastline of 84 km and includes five main settlements with a total population of c. 2500 permanent inhabitants. It is mostly mountainous and rocky, and its highest elevation (Vigla peak) is 616 m. According to the climatic diagrams of the Hellenic National Meteorological Service (http://www.hnms.gr), the climate of the island is similar to that of Rodos, i.e. semi-arid Mediterranean, with short, mild and wet winters, followed by long, hot and dry summers.

The vegetation of the island mainly consists of phrygana communities and remnants of pre-existing conifer (*Cupressus* L. and *Pinus* L.) woodlands, as well as sclerophyllous and deciduous forests. The latter, however, are nowadays limited by human impact to the foot of the hills and the valleys (Kagiampaki 2011). According to the literature (Carlström 1987; Chilton 1999; Galanos 2016; Strid 2016), the vascular flora of Symi known until the present study amounts to more than 600 species.

Fig. 2. *Allium symiacum*, holotype specimen: *Galanos 15.114* (UPA). – Photograph by Ch. Galanos.

Material and methods

The floristic exploration in the island of Symi, as well as the collection of herbarium specimens and living bulbs, took place in November 2015 and October 2016, after obtaining official permission (see Acknowledgements). The bulbs were cultivated at the experimental botanical garden of the University of Patras for karyological and morphological studies. For the karyological analyses, root tips from potted bulbs were pre-treated in a-bromonaphthalene for c. 8 hours at 4°C. Fixation, staining and chromosome measurements and construction of the karyogram follow Tzanoudakis (1983).

Results

Allium symiacum Galanos & Tzanoud., **sp. nov.** – Fig. 2 & 3.
Holotype: Greece, Nomos (Prefecture) of Dodekanisa (SE Aegean region), Island of Symi, near Symi harbour, c. 36°37'N, 27°50'E, 30 m, rocky calcareous coastal slopes with shrubs, phrygana, geophytes and annuals, 14 Nov 2015, *Galanos 15.114* (UPA; isotypes: herb. Galanos).

Diagnosis — *Allium symiacum* is an autumn-flowering species of *A.* sect. *Codonoprasum*. It differs from other autumn-flowering species of the *A. paniculatum* subgroup known from Greece mainly by its smaller perianth with exserted stamens and from the species of the *A. flavum* L. and *A. stamineum* Boiss. subgroups (which are also characterized by exserted stamens) by its greenish white flowers appearing in autumn.

Description — Geophyte, perennial. *Bulb* ovoid 1.2–1.5 × 2–2.5 mm; *tunics* brown to blackish brown, coriaceous. *Stem* ascending to erect, 30–60 cm tall, glabrous. *Leaves* 4 or 5, sheathing ¾–⁴/₅ of stem, usually longer than scape, fistulose, slightly canaliculate, c. 2 mm wide, glabrous. *Spathe* persistent, with 2 opposite and unequal valves, longer one 10.5–12.5 cm, 6- or 7-nerved, much longer than umbel, shorter one 2.5–3 cm, 4- or 5-nerved, equalling or longer than umbel. *Inflorescence* lax, fastigiate, (17–)20–35(–42)-flowered; bostryces numerous; *pedicels* erect, green, unequal, 10–30 mm. *Perigon* cup-shaped to campanulate; *tepals* greenish white with darker green midvein, obovate-elliptic, equal, 4.2–4.5 × 2.2–2.4 mm, apex rounded. *Stamens* exserted from perigon; *filaments* white, connate at base into an annulus c. 1 mm long; *anthers* yellowish white. *Ovary* light green proximally, papillose and dark green distally, obovoid, apex truncate; *style* white, c. 2 mm long; *stigma* white, globose. *Capsule* green, subglobose, narrower at base, 3.5–4 × 4–5 mm, 3-valved. *Seeds* black, c. 3 mm. *Chromosome number* $2n = 16$.

Phenology — Flowering from late September to the middle November; the first mature seeds appear almost one month later, from October to late November.

Fig. 3. *Allium symiacum* – A: inflorescence; B: flower; C: natural habitat; D: bulb and outer bulb tunics; E: habit; note last year's leaves sheathing much more than ¾ of stem and new leaves already well developed. – All photographs by Ch. Galanos: A, B, C & E at the type locality on 14 Nov 2015; D from the holotype specimen.

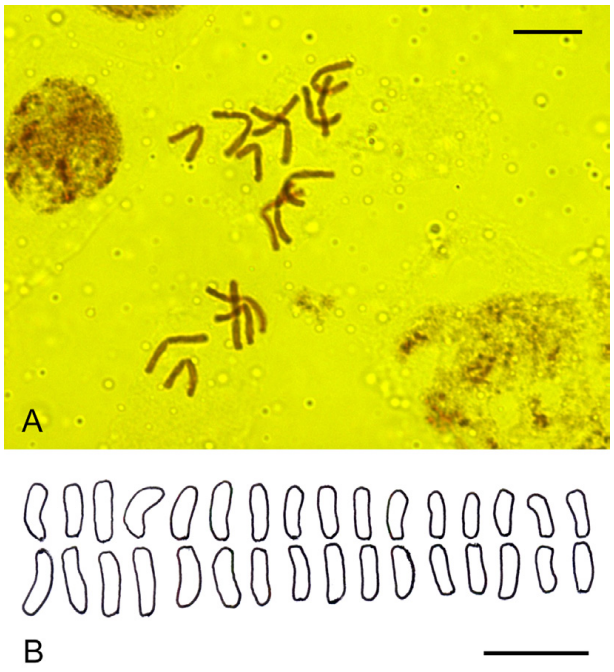

Fig. 4. *Allium symiacum* ($2n = 2x = 16$). – A: photograph of metaphase plate; B: karyogram. – Scale bars: A & B = 10 µm.

Etymology — The specific epithet is derived from the Greek adjective *symiakós* (συμιακός), which means originating from the island of Symi, where the species was discovered.

Distribution, habitat and ecology — *Allium symiacum* is currently known only from the type locality on Symi and should be considered as a single-island endemic. It grows on calcareous stony coastal slopes (Fig. 3C, E). The accompanying taxa of *A. symiacum* are typical of this habitat in the Aegean, e.g.: *Achillea cretica* L., *Arisarum vulgare* O. Targ. Tozz., *Asphodelus ramosus* L., *Ballota acetabulosa* (L.) Benth., *Briza maxima* L., *Convolvulus althaeoides* L., *Cyclamen persicum* Mill., *Drimia aphylla* (Forssk.) J. C. Manning & Goldblatt, *Knautia integrifolia* subsp. *urvillei* (Coult.) Greuter, *Origanum onites* L., *Prospero autumnale* (L.) Speta and *Sarcopoterium spinosum* (L.) Spach.

Karyology — In all the material examined the diploid chromosome number $2n = 2x = 16$ was found. Regarding the chromosome size and morphology, the data available suggest that the new species is characterized by a symmetrical karyotype, since anisobrachial (sm or st) chromosomes have not been observed in the metaphase plates, while the eight metacentric chromosomes of the haploid complement do not show significant size differences (Fig. 4). It is also worth noting that chromosomes with nucleolar organizers (SAT-chromosomes) have not been observed in the material examined. While the basic chromosome number $x = 8$ characterizes *Allium* sect. *Codonoprasum*, anisobrachial chromosomes, mainly sm or st, as well as SAT-chromosomes of the "*Codonoprasum* type" (m^A or sm^A), have been observed in the majority of the studied species of this section (Tzanoudakis 1983, 1992).

Conservation status — Based on data currently available and considering the IUCN Red List Categories and Criteria (IUCN 2012), *Allium symiacum* could possibly be assigned to the category Critically Endangered: CR D. Specifically, the area of occupancy is estimated to be less than 10 km^2, the species is so far known only from a single location and the number of mature individuals is estimated at fewer than 50. Nevertheless, further field research during the flowering season could provide more information, such as the size and dynamics of the population, as well as the existence of new localities, which could change the category and the conservation status of the species.

Discussion

The presence of two opposite and unequal spathe valves, with at least one of them longer than the pedicels, the fastigiate inflorescence, the simple filaments and the absence of conspicuous nectaries at the base of the ovary undoubtedly classify *Allium symiacum* within *A.* sect. *Codonoprasum*. Unlike the majority of Greek autumn-flowering species of this section (viz. *A. aegilicum* Tzanoud., *A. apolloniensis* Biel & al., *A. archeotrichon* Brullo & al., *A. dirphianum* Brullo & al., *A. orestis* Kalpoutz. & al., *A. phitosianum* Brullo & al., *A. platakisii* Tzanoud. & Kypr., *A. rausii* Brullo & al. and *A. tardans* Greuter & Zahar.), *A. symiacum* has a cup-shaped, rather than campanulate, perigon and its stamens (both filaments and anthers) are exserted from the perigon (Fig. 3A, B).

Allium symiacum is also well distinguished from *A. dirphianum*, *A. orestis*, *A. phitosianum*, *A. rausii* and *A. tardans* by the size and colour of the flowers: in *A. symiacum* the tepals are shorter than 5 mm and greenish white with a dark green midvein (Fig. 3B), whereas in the former species the tepals are longer than 5 mm and mostly in shades of pink, purple or brown.

Considering the white colour in its flowers, *Allium symiacum* could also be compared with the autumn-flowering Aegean species *A. aegilicum*, *A. apolloniensis*, *A. archeotrichon* and *A. platakisii*, which, however, are well differentiated from the new species on the basis of their campanulate to semi-cylindric and longer perigon.

Although *Allium symiacum* is characterized by exserted stamens, it is well differentiated from the Greek species of *A.* sect. *Codonoprasum* that have similar flowers and inflorescence, i.e. the species of the *A. flavum* and *A. stamineum* groups. Those species have leaves sheathing less than ½ of the stem, perigon yellowish, pinkish or brownish, ovary more or less globose and often stipitate, and they flower in spring or early summer.

Allium symiacum shows also some similarity to *A. tardiflorum* Kollmann & Shmida, another autumn-flowering species described from Israel, mainly in the shape of the inflorescences. The later species, however, is distinct in its much longer flowers and the almost unilateral spathe valves (Kollmann & al. 1990).

On the basis of the above comparisons, *Allium symiacum* should be considered as a species with a well distinguished taxonomic position among the Greek species of *A.* sect. *Codonoprasum*: it is the only species with exserted stamens in the autumn-flowering subgroup of this section and at the same time it is the only autumn-flowering species among those species of this section that have exserted stamens. Moreover, *A. symiacum* is characterized by leaves sheathing more than ¾ of the stem and greenish white perianth segments less than 5 mm long. Leaves sheathing more than ¾ of the stem and a life cycle in which dormancy is almost absent are characters that coexist in a few other Greek *Allium* species belonging to three different sections, viz. *A. archeotrichon* and *A. makrianum* C. Brullo & al. (*A.* sect. *Codonoprasum*), *A. callimischon* Link and *A. ritsi* Iatroú & Tzanoud. (*A.* sect. *Brevispatha* Vals.) and *A. chamaespathum* Boiss. (*A.* sect. *Allium*). Characters like these have been considered as biological traits and adaptations in the arid climatic conditions prevailing in the Mediterranean area during the late Tertiary, i.e. more than 5 million years ago, and the species concerned have been considered as relict floristic elements (Greuter 1979; Kollmann & al. 1990; Tzanoudakis & Kypriotakis 1993, 2008; Brullo & al. 1997; Tzanoudakis 2000).

Taking into consideration the morphology (leaf sheaths) and the life cycle (autumn-flowering/no dormancy) of *Allium symiacum*, it could be also considered as a relict element. This aspect is further supported by the symmetrical diploid karyotype and the restricted distribution range. Plant taxa characterized by small size, an unusual flowering period and small population size, however, are rather under-collected and as a consequence their distribution range is often underestimated. This is the case of some *Allium* species previously considered endemic to Greece, viz. *A. aeginiense* Brullo & al., *A. brussalisii* Tzanoud. & Kypr., *A. guicciardii* Heldr. and *A. pilosum* Sm., which have been recently reported from Asia Minor (Koçyiğit & al. 2014).

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