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Allium panormitisi (Amaryllidaceae), a new autumn-flowering species from Symi Island, SE Aegean, Greece

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ABSTRACT: *Allium panormitisi*, from the island of Symi (SE Aegean, Greece), is described as a species new to science. It is an autumn-flowering species of *Allium* section *Codonoprasum* (*Amaryllidaceae*) and is classified as endangered (EN) according to IUCN criteria. Its morphology, karyology and conservation status are presented and discussed, in addition to its taxonomic relationships to other autumnal species of *A.* sect. *Codonoprasum* distributed in the E Mediterranean area.

Keywords: *Codonoprasum*, chromosome number, Dodecanisos, karyology, taxonomy, conservation

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INTRODUCTION

Allium Linnaeus (Linnaeus 1753) is considered to be one of the most species-rich genera of monocotyledonous flowering plants, as it currently comprises 973 species (Govaerts *et al.* 2018). Greece is regarded as an evolutionary centre of the genus (Stearn 1981; Tzanoudakis & Vosa 1988), since it is represented in the country by more than 100 species, of which more than 50% are endemics (Dimopoulos *et al.* 2013; Brullo *et al.* 2015; Tzanoudakis & Trigas 2015; Galanos & Tzanoudakis 2017; Trigas *et al.* 2017), emphasising the amplitude of diversity and endemism of this genus in the area.

Symi is one of the smallest inhabited islands of the Dodecanese island complex (SE Aegean region). It is located 22 km N of Rodos (Rhodes) and 6.75 km W of the nearest Turkish coast. Information concerning the geography, vegetation and vascular flora of Symi are given by Carlström (1987), Strid (2016) and Galanos & Tzanoudakis (2017). Several recent floristic explorations on the island yielded a number of new floristic records (Galanos 2016; Burton & Tan 2017, 2018; Cattaneo & Grano 2017, 2018; Galanos & Tzanoudakis 2017). The *Allium* species described here from the island of Symi is a member of the *A.* sect. *Codonoprasum*, is autumn-flowering and was collected in the framework of floristic surveys and studies conducted by the authors in the Dodecanese islands. After *A. archeotrichon* Brullo, Pavone & Salmeri (Brullo et al. 1999) and *A. symiacum* Galanos & Tzanoudakis (Galanos & Tzanoudakis 2017), the discovery of a third autumn-flowering *Allium* species, and of a second local endemic one, on such a small island emphasises once more the richness and diversity of this genus in Greece and particularly of the flora of small Greek islands such as Symi (Galanos 2016; Galanos & Tzanoudakis 2017). Material of the new species described here was initially collected during fieldwork carried out by the first author in October of 2016 on the island of Symi in the context of monitoring the population of *A. symiacum*. A careful and thorough examination of the material concerned leads us to the conclusion that it is a taxon clearly distinct from all other autumn-flowering species of *A.* sect. *Codonoprasum* known from Greece and the East Mediterranean area.

MATERIALS AND METHODS

Floristic investigations on the island of Symi took place in October of 2016, 2017 and 2018. A total of 18 living plants were measured in situ using a digital calliper (Total TMT321501), and living bulbs were collected with permission of the Ministry of Environment and Energy

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Table 1. Morphological features differentiating *Allium panormitisi* from other autumn-flowering species reported from Greece or other Mediterranean territories. Comparison is based on fresh material, herbarium specimens and literature data

FEATURES	*A.aegilicum*	*A.archeotrichon*	*A.autumnale*	*A. makrianum*	*A.panormitisi*	*A.savii*	*A.symiacum*	*A.tardiflorum*	*A.telmatum*
Scape length (cm)	20-30	8 - 60	30 - 50	10 - 40	30 - 60	45 - 55	30 - 60	40 - 60	30 - 40
Leaf indumentum	glabrous	hairy	glabrous	hairy	glabrous	glabrous	glabrous	glabrous	glabrous
Leaf seathing stem	5/6	2/3 – 4/5	2/3 – 3/4	4/5	3/4 - 4/4	1/2	3/4 - 4/5	3/4 - 4/5	1/2 - 2/3
Spathe attachment	opposite	opposite	unilateral	unilateral	opposite	unilateral	opposite	unilateral	unilateral
Perigon shape	subcylindric	campanulate	campanulate	campanulate	campanulate	campanulate	cup-shaped to campanulate	campanulate	campanulate
Tepal colour	pink	brownish-white	greenish- purple	greenish-white	purplish-brown	pinkish-white	greenish-white	greenish-wine	pinkish-white
Tepal length (mm)	5 - 6	6 - 7	5 - 6	5 - 6	5 - 6	6 - 7	4.2 – 4.5	6 - 7	5.5 - 6
stamens	included into perigon	inner ones often slightly exerted from perigon	included into perigon	included into perigon	exerted from perigon	included into perigon	exerted from perigon	included into perigon	inner ones exerted from perigon

(permit reference number: 178903/588). Morphological investigations were carried out both on living material from the type locality and on specimens cultivated in Rodos and in the experimental botanical garden of the University of Patras. Comparison of *Allium panormitisi* Galanos & Tzanoudakis with similar autumn-flowering *Allium* species reported from Greece or other Mediterranean territories is provided based on diagnostic characters important for the genus *Allium* (Table 1).

For the cytological studies, root tips from potted bulbs were pre-treated in α-bromonaphthalene for c. 8 hours at 4°C. Fixation, staining and construction of the karyogram follow Tzanoudakis (1983). Due to the rarity of this species in the field, only two bulbs were investigated cytologically, so the presented results should be considered as preliminary. All field photographs are by Ch. Galanos.

RESULTS AND DISCUSSION

Description of the new species. *Allium panormitisi* Galanos & Tzanoudakis, *sp. nov.* – (Figs. 2 & 3).
Allium panormitisi is an autumn-flowering species of *A.* sect. *Codonoprasum*, which differs from other autumn-flowering species of the *A. paniculatum* group mainly in its exserted stamens and purplish perianth segments. From *A. symiacum*, which is also characterised by exserted stamens, the new species differs in its more robust stem, its larger flowers and perianth segments, and its pinkish to purple anthers.

Type locality: — GREECE, Nomos (Prefecture) of Dodekanisos (SE Aegean region), Island of Symi, near Symi harbour, c. 36°37' N, 27°50' E, c. 30 m a.s.l., rocky calcareous slopes with shrubs, phrygana and geophytes, 16 Oct 2016, Galanos *16.102* (Holo- UPA, Iso- UPA & herb. Galanos).

Description: Geophyte, perennial. *Bulbils* absent. *Bulb* ovoid 15-20 × 10-15 mm (up to 27 × 22 mm in cultivation); outer bulb tunics brownish white, often with blackish dots, membranous to papyraceus, extended and covering the lower part of stem, the inner ones membranous, white. *Stem* 30-60 cm tall, 2-3 mm wide, glabrous. *Leaves* (5)7-9, sheathing 3/4 - 4/4 of stem, glabrous, fistulose, slightly canaliculated, longer than scape, up to 2 mm wide. *Spathe* persistent with two opposite and unequal valves, the longer 5-6-nerved, 9-20 cm long, the shorter 4-5-nerved, 5-8 cm long. *Inflorescence* lax, fastigiate, 23-30(-58)-flowered, pedicels unequal, purplish brown, 5-20(-30) mm long. *Perigon* campanulate; *tepals* elliptical to obovate elliptical, apiculate, 5-6 × 2-2.5 mm, purple to greenish purple with darker purple-brownish midvein. *Stamens* exserted from perigon at flowering peak, *filaments* white, connate at the base into an annulus c. 1 mm, *anthers* ovate-elliptical, pinkish to purple.

Fig. 1. *Allium panormitisi* – A: natural habitat; B: habit – Symi, at the type locality on 16 October 2016.

Fig. 2. *Allium panormitisi* – Inflorescence; leaves sheathing stem almost up to the base of the inflorescence. Symi, at the type locality on 16 October 2016.

Ovary cylindrical, obovate, 3.5 × 2 mm, smooth and yellowish white but greenish and slightly papillose in the upper part. *Style* 2-2.5 mm long, exserted from perigon at flowering peak. *Capsule* subglobose, tri-valved. *Seeds* black, 3 mm long. *Chromosome number* $2n = 2x = 16$.

Phenology. Flowering occurs from the end of September to the end of October; the first mature seeds appearing from the middle of October. It must be noted, however, that according to our field observations, only in a small portion of the flowers in each inflorescence is the ovary developed into a mature capsule.

Etymology. The name of the new species refers to the *Panormitis* Monastery (*Παναρμίτης* in Greek) devoted to the Archangel Michael, which is located on the south coast of Symi and is the most famous place and destination on the island.

Distribution, habitat and ecology. *Allium panormitisi* is currently known only from the type locality in the northern part of Symi island (SE Aegean, Greece). It grows on calcareous stony slopes (Fig. 1) and is accompanied by taxa typical of corresponding habitats in the Aegean, e.g.: *Achillea cretica* L., *Asphodelus ramosus* L., *Ballota acetabulosa* (L.) Benth., *Convolvulus althaeoides* L., *Cyclamen persicum* Mill., *Drimia aphylla* (Forssk.) J. C. Manning & Goldblatt, *Knautia integrifolia* subsp. *urvillei* (Coult.) Greuter, *Origanum onites* L., *Prospero autumnale*

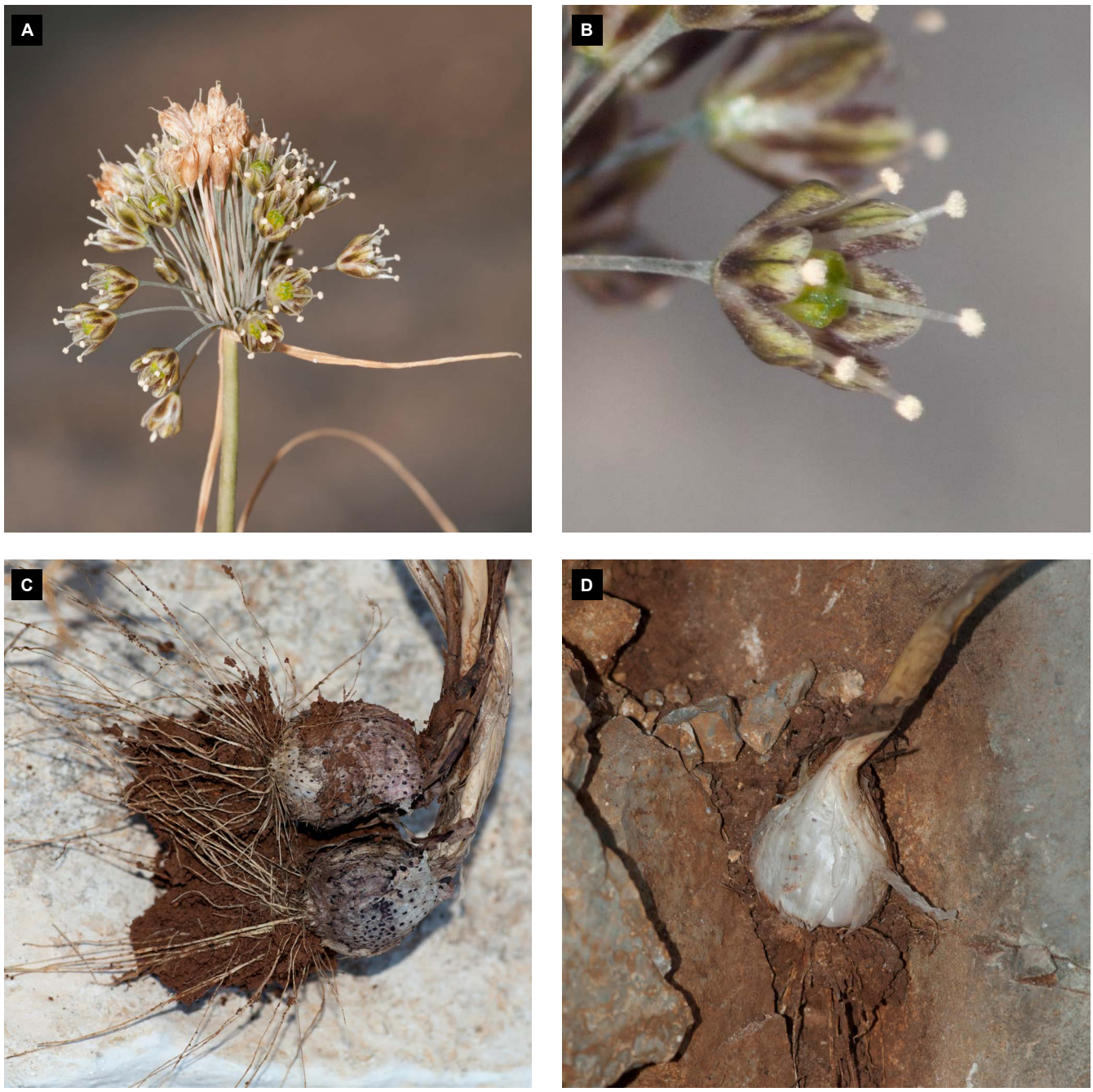

Fig. 3. *Allium panormitisi* – A: inflorescence in late flowering; B: flower; C & D: bulbs and outer bulb tunics. All photographs at the type locality on 16 October 2016.

(L.) Speta and *Sarcopoterium spinosum* (L.). Among them, three *Allium* species were recorded, viz., *A. archeotrichon* [endemic to Rodos, Tilos and Symi (Galanos 2016)], *A. symiacum* [endemic to Symi (Galanos & Tzanoudakis 2017)] and the Anatolian *A. sandrasicum* Kollman, Özhatay & Bothmer [in Greece known only from the island of Symi (Karavokyrou & Tzanoudakis 1991)].

Karyology. In the cytologically investigated material of *A. panormitisi*, a diploid chromosome number of $2n = 2x = 16$ was found. The results are in agreement with earlier studies in regard to the basic chromosome number ($x = 8$), which is characteristic of the species of *A.* sect. *Codonoprasum* (Tzanoudakis 1992), and the diploid number, which seems to dominate among autumn-flowering species of the section occurring in the East Mediterranean area (Özhatay *et al.* 2018). The same seems to be the case regarding the size and morphology of chromosomes of the new species. The obtained preliminary results suggest that the karyotype of *A. panormitisi* con-

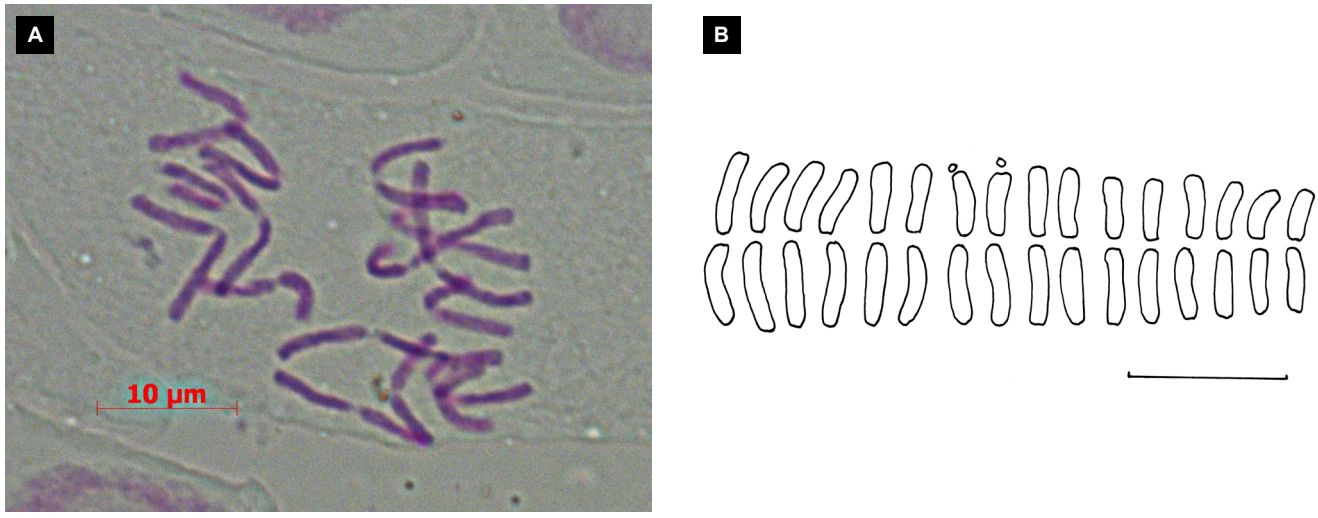

Fig. 4. *Allium panormitisi* ($2n = 2x = 16$). – A: photograph of metaphase plate of specimen from the type locality; B: karyogram. – Scale bars: A & B = 10 µm.

sists exclusively of metacentric chromosomes, which, moreover, show no significant size differences (Fig. 4B). In the metaphase plates, up to two chromosomes with nucleolar organisers were observed, suggesting that, in the diploid chromosome complement of the species at least, one pair of SAT-chromosomes is present (Fig. 4). The SAT-chromosomes belong to the *Codonoprasum* type (m^A, sensu Tzanoudakis 1983).

Conservation status. On the basis of IUCN Red List categories and criteria (IUCN 2017) as well currently available data, we can assert that *A. panormitisi* should be classified as Endangered (EN) using the D criterion because of the very small size of its population, seeing as how the number of flowered individuals is estimated to be fewer than 250. At present, the known population of *A. panormitisi* does not seem to be particularly threatened by human activities. On the other hand, overgrazing constitutes a serious potential threat for this species, since more than 17,000 ovines graze on Symi (as assessed in 2004), a number which exceeds by 10:1 the island´s grazing capacity (Voulgaris & Theodoridis 2006). In addition, the area of its natural habitat is vulnerable to the adverse impacts of landslides caused by heavy winter rainfalls and exposure to strong north winds leading to soil erosion (Fig. 1B). Furthermore, due to the fact that the percentage of flowers producing capsules, both in plants examined in the field and in cultivated specimens, at the end of October (2017 and 2018) was approximately 5%, it would be interesting to conduct more studies on the reproduction mechanism of the species. Additionally, further and more detailed field research on the island of Symi, as well as in neighbouring insular and continental areas, could provide more information regarding the range and conservation status of the species and possibly even change its category.

Taxonomic relationships. In Flora Europaea (Stearn 1978, 1980, 1981), 47 *Allium* species were recorded as occurring in Greece, but only three of them [*A. chamaespathum* Boiss. (sect. *Allium*), *A. callimischon* Link (sect. *Brevispatha*) and *A. tardans* Greuter & Zahar. (sect. *Codonoprasum*)] were characterised by an autumn-flowering period. Up to the present and including the new species described here, the corresponding numbers are increased to 104 and 17, respectively (Kalpoutzakis *et al.* 2012; Dimopoulos *et al.* 2013; Brullo *et al.* 2015; Tzanoudakis & Trigas 2015; Galanos & Tzanoudakis 2017; Trigas *et al.* 2017). The majority of autumn or late-flowering species mentioned above belong to *A.* sect. *Codonoprasum* and have been described as species new to science in the last three decades. Characterised by the presence of two opposite and unequal spathe valves longer than pedicels, a fastigiated inflorescence, a campanulate perigon, stamens with simple filaments and an ovary without conspicuous nectaries, the new species described here also belongs to *A.* sect. *Codonoprasum*. Apart from Greece, *Allium* species with a late flowering period (August-October) also occur in other Mediterranean countries, and a total of 18 species of *A.* sect. *Codonoprasum* are listed and compared to each other by Özhatay *et al.* (2018). It is worth noting, however, that these 18 species of *A.* sect. *Codonoprasum* differ with respect to a number of key morphological, karyological and ecological characters, viz., the shape and colour of flowers (cylindrical or campanulate, pinkish white or greenish yellow), the shape and size of the spathe and spathe-valves (opposite or unilateral), the proportion of the stem covered by leaf-sheaths (1/2-4/5) and the presence or absence of dormancy in the life cycle. The new species, *A. panormitisi*, is one characterised by leaves sheathing the stem almost up to the base of the inflorescence (Fig. 2), a very late flowering period

(late September / October) and the apparent absence of dormancy from its life cycle. As such, it clearly belongs to the group of "true" autumn-flowering species and to the category of species considered to be relict floristic elements (Galanos & Tzanoudakis 2017). It should be noted that the above-mentioned morphological and biological characters also occur in autumn-flowering species of *A.* sect. *Allium* and *A.* sect. *Brevispatha* (Galanos & Tzanoudakis 2017). On the basis of the above three characters and in its opposite and very long spathe valves, *A. panormitisi* shows similarities to the species *A. aegilicum* Tzanoudakis (Tzanoudakis 2000), *A. archeotrichon*, *A. makrianum* Brullo C, Brullo S, Giusso del Galdo & Salmeri (Brullo *et al.* 2010) and *A. symiacum*, from which it differs in its purplish campanulate perigon, exserted stamens and glabrous sheaths and leaves (Table 1). *Allium aegilicum* is characterised by a more or less cylindrical and pinkish white perigon, *A. archeotrichon* and *A. makrianum* are characterised by hairy sheaths and leaves, while *A. symiacum* is clearly differentiated due to its small (less than 5 mm long) greenish white perigon segments. From some other autumn-flowering *Allium* species described recently, viz., *A. istanbulense* Özhatay, Koçyiğit, Brullo & Salmeri (Özhatay *et al.* 2018), or reported from other Mediterranean territories, viz., *A. autumnale* Davis (Davis 1949: 113), *A. oporinanthum* Brullo, Pavone & Salmeri (Brullo *et al.* 1997: 297), *A. savii* Parlatore (Parlatore 1857: 554), *A. tardiflorum* Kollmann & Shmida, in Kollmann *et al.* (1990: 24) and *A. telmatum* Bogdanović, Brullo, Giusso del Galdo & Salmeri (Bogdanović *et al.* 2009: 85), the new species is clearly differentiated on the basis of at least one of the following characters: exserted stamens, purplish perigon segments and opposite and no unilateral spathe valves (Table 1).

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REZIME

Allium panormitisi (Amaryllidaceae), nova jesenja vrsta sa ostrva Symi (JI Egej, Grčka) SE Aegean, Greece

Christos J Galanos i Dimitrios Tzanoudakis

Vrsta *Allium panormitisi* sa ostrva Symi (JI Egej, Grčka) je opisana kao nova za nauku. To je u jesen cvetajuća vrsta iz sekcije *Codonoprasum* (*Amaryllidaceae*), koja se prema IUCN kriterijumima klasifikuje kao ugrožena. U radu su predstavljane njene morfološke i kariološke karakteristike, konzervacioni status, kao i taksonomska povezanost sa ostalim jesenjim vrstama sekcije *Codonoprasum* koje su rasprostranjene u istočnom Mediteranu.

Ključne reči: *Codonoprasum*, broj hromozoma, Dodecanisos, kariologija, taksonomija, konzervacija.