



## *Allium therinanthum* (Amaryllidaceae), a new species from Israel

CRISTIAN BRULLO<sup>1</sup>, SALVATORE BRULLO<sup>1\*</sup>, ORI FRAGMAN-SAPIR<sup>2</sup>, GIANPIETRO GIUSSO DEL GALDO<sup>1</sup> & CRISTINA SALMERI<sup>3</sup>

<sup>1</sup>Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Catania, Via A. Longo 19, I - 95125 Catania, Italy, e-mail: salvo.brullo@gmail.com

<sup>2</sup>Jerusalem Botanical Gardens, Hebrew University, 9190401, Jerusalem, Israel

<sup>3</sup>Dipartimento di Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche, Università degli Studi di Palermo, Via Archirafi 38, I - 90123 Palermo, Italy

\*Author for correspondence

### Abstract

*Allium therinanthum*, a new species of *A.* sect. *Codonoprasum*, is described and illustrated from southern Mt. Hermon (Israel). It is a late-flowering diploid species ( $2n = 16$ ), growing on calcareous substrates of the mountain belt. It is a narrowly distributed geophyte, showing morphological relationships mainly with *A. tardiflorum*, a typical autumnal species also occurring in Israel within the pinewoods of Mt. Carmel. The morphology, karyology, leaf anatomy, ecology, conservation status and taxonomical relations are examined for both species. A taxonomic comparison with the most allied late flowering species of the sect. *Codonoprasum* is provided.

**Key words:** Alliaceae, *Allium* sect. *Codonoprasum*, karyology, late flowering, leaf anatomy, phenetic tree, taxonomy

### Introduction

According to literature (Kollmann 1971, 1973, 1985, 1986, Kollmann & Stearn 1975, Kollmann & Shmida 1977, Shmida & Kollmann 1977, Kollmann *et al.* 1990, Brullo *et al.* 1991, 1996, 2008b, Feinbrun-Dothan & Danin 1998, Fragan-Sapir & Fritsch 2012), the genus *Allium* Linnaeus (1753: 294) is represented in Israel by several species (ca. 45), many of which endemic to this territory. Within this genus, particularly interesting are those taxa belonging to the sect. *Codonoprasum* Rchb. in Mössler (1827: 538), having in the Middle East one of the main centres of differentiation. The most significant species of this section occurring in Israel that are worthy to be mentioned are: *Allium tardiflorum* Kollmann & Shmida in Kollmann *et al.* (1990: 24), *A. galileum* Brullo *et al.* (2008: 250), *A. daninianum* Brullo *et al.* (1996: 239), *A. pseudostamineum* Kollmann & Shmida (1977: 138), *A. albotunicatum* Schwarz (1934: 73), *A. hermoneum* (Kollmann & Shmida 1977: 141) Brullo *et al.* (2007: 330), *A. feinbergii* Oppenh. in Oppenheimer & Evenari (1940: 185), *A. sindjarensis* Boiss. & Hausskn. ex Regel (1875: 121), and *A. rupicola* Boiss. ex Mouterde (1966: 273), which are all restricted to Israel or even to some neighboring country (e.g. Lebanon, Syria and Jordan). Other species of this section are widespread in the Mediterranean area or in the Saharo-Arabian region, such as *A. pallens* Linnaeus (1762: 427), *A. dentiferum* Webb & Berthelot (1848: 345), *A. desertorum* Forsskål (1775: 72), and *A. decaisnei* Presl (1845: 544).

In the framework of taxonomical investigations on the genus *Allium* carried out in Israel, an unusual population flowering in summer (July to August) has been found in the western slope of Mt. Hermon (northern Israel). For the habit, bivalve persistent spathe, fastigiata inflorescence, campanulate flowers, and inconspicuous nectaries, these plants clearly fall within the sect. *Codonoprasum* of the subgen. *Allium*. Many taxonomical studies have been focused on this section over the last decades, whose main outcomes were the assessment of some critical taxon or even the description of several new species (Bogdanović *et al.* 2008, 2009, 2011, Brullo *et al.* 2001, 2003a, 2003b, 2004, 2007, 2008b, 2009, 2010, Tzanoudakis 2000, Tzanoudakis & Tan 2000, Biel *et al.* 2006, Peruzzi 2007, Tzanoudakis *et al.* 2008, Özhatay *et al.* 2010, Trigas *et al.* 2010, Koçyiğit & Özhatay 2012). Among

From the morphological point of view, *Allium therinanthum* is well differentiated from the above-mentioned species especially for a series of character-state combinations that allow a clear separation of all of them. In particular, *A. therinanthum*, for some features regarding the habit, inflorescence and flowers, shows closer relationships with *A. tardiflorum*, a punctiform endemism occurring in Israel, too (Figs. 2D, 5). However, *A. tardiflorum* is characterized by larger bulbs, with outer coats membranaceous and purplish-violet, leaves more numerous and longer, sub-cylindrical, without ribs, shorter than stem, spathe valves unilateral, almost completely fused, the shorter one 3-nerved, tepals yellow-green tinged with purple, longer and markedly unequal, anthers longer, white-yellow, ovate and apiculate, occurrence of interstaminal appendices, ovary shorter, ellipsoid, minutely papillose above and capsule subglobose. Besides, *A. tardiflorum* behaves as a typical autumnal flowering species (late September-early November), and it grows at a lower elevation (ca. 400–500 m a.s.l.) in pine-woods dominated by *Pinus halepensis* Miller (1768: without pagination). From the karyological analysis, this species revealed a somatic chromosome number of  $2n = 2x = 16$  in all examined samples from the type locality (Fig. 6A). This is the first karyological report for *A. tardiflorum*. Although both taxa share the same chromosome set, the karyotype of *A. tardiflorum* is very different from that one of *A. therinanthum* given that it is characterized by two subterminal chromosome pairs provided with long linear satellites on the short arms, while the remaining chromosomes are more or less metacentric, with an arm ratio ranging from 1.04 to 1.2 (Fig. 6B). The chromosome formula of *A. tardiflorum* can be summarised as  $2n = 2x = 16: 12m + 4st^{sat}$ . In addition, chromosome size in *A. tardiflorum* is smaller than in *A. therinanthum*: chromosomes range from  $12.22 \pm 1.9 \mu\text{m}$  to  $7.20 \pm 1.7 \mu\text{m}$ . The leaf anatomy also shows relevant differences, because the leaf cross section of *A. tardiflorum* (Fig. 3B) has a subcircular to elliptical and smooth outline, an epidermis covered by a thicker cuticle, with regular cells and more stomata, less (max. 20) and often larger vascular bundles. Besides, *A. therinanthum* can be confused with *A. galileum* especially for its habit; the latter is a species rather common in Israel, usually occurring at lower elevation (200–1000 m a.s.l.). According to Brullo *et al.* (2008b), *A. galileum* (Fig. 2C) differs morphologically from *A. therinanthum* in having bulbs usually smaller (max.  $22 \times 18$  mm), 5–6 leaves, spathe valves completely reflexed, effused-subglobose, pedicels 30–70 mm long, tepals apiculate, greenish-yellow, tinged with brown, stamen filaments purplish, shorter (the inners max. 2.5 mm long), occurrence of interstaminal teeth, and ovary papillose above, 3.2–3.8 mm long. Other differences chiefly regard the karyotype structure, since *A. galileum* has 8 metacentric chromosomes and one microsatellited pair. Finally, *A. galileum* flowers earlier (late April to June), and usually grows in open sunny stands.

## References

- Biel, B., Tan, K. & Tzanoudakis, D. (2006) A new autumn-flowering species of *Allium* (Liliaceae) from the island of Sifnos (Cyclades, Greece). *Willdenowia* 36: 367–372.  
<http://dx.doi.org/10.3372/wi.36.36132>
- Bogdanović, S., Brullo, C., Brullo, S., Giusso del Galdo, G., Musarella, C. M. & Salmeri, C. (2011) *Allium achainum* Boiss. (Alliaceae), a critical species of Greek flora. *Candollea* 66: 57–64.
- Bogdanović, S., Brullo, S., Giusso del Galdo, G. & Salmeri, C. (2009) A new autumn-flowering species of *Allium* (Alliaceae) from Croatia. *Folia Geobotanica* 44: 83–93.  
<http://dx.doi.org/10.1007/s12224-009-9032-2>
- Bogdanović, S., Brullo, S., Mitić, B. & Salmeri, C. (2008) A new species of *Allium* (Alliaceae) from Dalmatia, Croatia. *Botanical Journal of the Linnean Society* 158: 106–114.  
<http://dx.doi.org/10.1111/j.1095-8339.2008.00790.x>
- Boissier, E. (1853) *Diagnoses plantarum orientaliarum novarum*, ser. 1, 12. Typis Henrici Wolfrath, Neacomis, 112 pp.
- Brullo C., Brullo S., Giusso del Galdo G. & Salmeri C. (2010) *Allium makrianum* (Alliaceae), a new autumnal species from Greece. *Phyton (Horn)* 49: 267–278.
- Brullo, F. (2002) *CromoLab*©. Version 1.1. Dipartimento di Botanica, Università degli Studi di Catania.
- Brullo, S., Giusso del Galdo, G. & Terrasi, M. C. (2008a) *Allium aeginiense* Brullo, Giusso & Terrasi (Alliaceae), a new species from Greece. *Candollea* 63: 197–203.
- Brullo, S., Guglielmo, A., Pavone, P. & Salmeri, C. (2001) Cytotaxonomical notes on some rare endemic species of *Allium* (Alliaceae) from Greece. *Caryologia* 54 (1):37–57.  
<http://dx.doi.org/10.1080/00087114.2001.10589212>
- Brullo, S., Guglielmo, A., Pavone, P. & Salmeri, C. (2003a) Considerazioni citotassonomiche e filogenetiche su alcune specie a fioritura autunnale di *Allium* sez. *Codonoprasum* dell'area mediterranea. *Atti 98° Congresso della Società Botanica Italiana*: 15–16. Catania.

- Brullo, S., Guglielmo, A., Pavone, P. & Salmeri, C. (2007) Cytotaxonomic considerations on *Allium stamineum* Boiss. group (Alliaceae). *Bocconea* 21: 325–343.
- Brullo, S., Guglielmo, A., Pavone, P. & Salmeri, C. (2008b) Taxonomic study on *Allium dentiferum* Webb & Berthel. (Alliaceae) and its taxonomic relations with allied species from the Mediterranean. *Taxon* 57: 243–253.
- Brullo, S., Guglielmo, A., Pavone, P., Salmeri, C. & Terrasi, M.C. (2003b) Three new species of *Allium* Sect. *Codonoprasum* from Greece. *Plant Biosystems* 137: 131–140.  
<http://dx.doi.org/10.1080/11263500312331351391>
- Brullo, S., Pavone, P. & Salmeri, C. (1991) *Allium kollmannianum*, a new species from Israel. *Flora Mediterranea* 1: 15–20.
- Brullo, S., Pavone, P. & Salmeri, C. (1996) *Allium daninianum* (Alliaceae), a new species from Middle East. *Willdenowia* 26: 237–244.
- Brullo, S., Pavone, P. & Salmeri, C. (1997a) *Allium oporinanthum* (Alliaceae), a new species from NW Mediterranean area. *Anales del Jardín Botánico de Madrid* 55: 297–302.  
<http://dx.doi.org/10.3989/ajbm.1997.v55.i2.276>
- Brullo, S., Pavone, P. & Salmeri, C. (1997b) *Allium anzalonei*, eine neue Art für die italienische Flora. *Sendtnera* 4: 33–39.
- Brullo, S., Pavone, P. & Salmeri, C. (1999) *Allium archeotrichon* (Alliaceae), a new species from Rhodos (Dodekannisos, Greece). *Nordic Journal of Botany* 19: 41–46.  
<http://dx.doi.org/10.1111/j.1756-1051.1999.tb01901.x>
- Brullo, S., Pavone, P., Salmeri, C. & Scrugli, A. (1994) Cytotaxonomical notes on *Allium savii* Parl. (Alliaceae), a misappreciated Tyrrhenian element. *Candollea* 49: 271–279.
- Brullo, S., Pavone, P., Salmeri, C. & Terrasi, M.C. (2009) *Allium garganicum* (Alliaceae), a new species from Apulia (SE Italy). *Plant Biosystems* 143: 78–84.  
<http://dx.doi.org/10.1080/11263500903487765>
- Brullo, S., Pavone P., Salmeri C. & Venora G. (2004) Cytotaxonomical investigation on *Allium paniculatum* ssp. *exaltatum* (Alliaceae) from Cyprus. *Caryologia* 57: 274–278.  
<http://dx.doi.org/10.1080/00087114.2004.10589404>
- Davis, P.H. (1949) On the flora of the nearer East: XIII. Miscellaneous new species and records. *Kew Bulletin* 4: 97–114.  
<http://dx.doi.org/10.2307/4119046>
- Feinbrun-Dothan, N. & Danin, A. (1998) *Analytical flora of Eretz-Israel*, ed. 2. Publishing House Ltd., Cana, 1008 pp.
- Feulgen, R. & Rossenbach, H. (1924) Mikroskopisch chemischer Nachweis einer nucleinsäure vom typus der Thymonucleinsäure. *Hoppe-Seyler's Zeitschrift für Physiologische Chemie* 135: 203–248.  
<http://dx.doi.org/10.1515/bchm2.1924.135.5-6.203>
- Forsskål, P. (1775) *Flora Aegyptiaco-Arabica*. Heineck et Faber, Hauniae, 200 pp.
- Fragman-Sapir, O. & Fritsch, R.M. (2012) New species of *Allium* sect. *Melanocrommyum* from Eastern Mediterranean. *Herbertia* 65: 31–49.
- Koçyiğit, M. & Özhatay, N. (2012) *Allium maraschicum* sp. nov. (Alliaceae) from Turkey. *Nordic Journal of Botany* 30: 553–559.  
<http://dx.doi.org/10.1111/j.1756-1051.2012.01268.x>
- Kollmann, F. (1971) *Allium ampeloprasum* L. in Israel (Taxonomy). *Israel Journal of Botany* 20: 263–272.
- Kollmann, F. (1973) Karyology of some species of *Allium* section *Molium* in Israel. *Israel Journal of Botany* 22: 92–112.
- Kollmann, F. (1985) The genus *Allium* in Israel. *Rotem* 15: 1–136.
- Kollmann, F. (1986) *Allium*. In: Feinbrun-Dothan, D. (ed.) *Flora Palaestina* 4. The Israel Academy of Sciences and Humanities, Jerusalem, pp. 74–99.
- Kollmann, F. & Shmida, A. (1977) *Allium* species of Mt. Hermon. I. Taxonomy. *Israel Journal of Botany* 26: 128–148.
- Kollmann, F., Shmida, A. & Cohen, O. (1990) *Allium tardiflorum*, a new autumn-flowering species. *Herbertia* 46 (1): 23–32.
- Kollmann, F. & Stearn, W.T. (1975) *Allium trifoliatum* subsp. *hirsutum*. *Israel Journal of Botany* 24: 201–204.
- IUCN (2010) *The IUCN red list of threatened species, version 2010.4*. IUCN Red List Unit, Cambridge, U.K. Available from: <http://www.iucnredlist.org/>. (accessed 10 November 2013).
- Levan, A., Freda, K. & Sandberg, A.A. (1964) Nomenclature for centromeric position on chromosomes. *Hereditas* 52: 201–220.  
<http://dx.doi.org/10.1111/j.1601-5223.1964.tb01953.x>
- Linnaeus, C. (1753) *Species plantarum*, I. Laurentii Salvii, Stockholm, Sweden, 560 pp.
- Linnaeus, C. (1762) *Species Plantarum*, ed. 2, vol.1 Laurentii Salvii, Holmie, 784 pp.
- Miller, P. (1768) *Gardeners Dictionary*, ed. 8. Printed from the Author, London
- Mösslner, J.C. (1827) *Gemeinnütziges Handbuch der Gewächskunde*, ed. 2, I. J.F. Hammerich, Altona, 784 pp.
- Mouterde, P. (1966) *Nouvelle Flore du Liban et de la Syrie* 1., Imprimerie Catholique, Beyrouth, 563 pp.
- Oppenheimer, H.R. & Evenari, M. (1940) II. Florula Cisiordanica. *Bulletin de la Société Botanique de Genève* 31: 143–423.
- Özhatay, N., Koçyiğit, M. & Akalın, E. (2010) *Allium rumelicum*, sect. *Codonoprasum*, a new species from European Turkey. *Phytologia Balcanica* 16: 355–359.
- Parlatore, F. (1857) *Flora italiana* 2(2). Le Monnier, Firenze, pp. 221638.
- Paszko, B. (2006) A critical review and a new proposal of karyotype asymmetry indices. *Plant Systematic and Evolution* 258: 39–48.

- <http://dx.doi.org/10.1007/s00606-005-0389-2>
- Peruzzi, L. (2007) *Allium garbarii* Peruzzi (Alliaceae), a new species endemic to Calabria (S Italy). *Candollea* 62: 17–25.
- Peruzzi, L. & Eroğlu, H.E. (2013) Karyotype asymmetry: again, how to measure and what to measure? *Comparative Cytogenetics* 7: 1–9.
- <http://dx.doi.org/10.3897/compcytogen.v7i1.4431>
- Presl, K. (1845) Botanische Bemerkungen. *Abhandlungen der Königlichen Böhmischen Gesellschaft der Wissenschaften, Prague*, ser. 5, 3: 431–584.
- Rechinger, K.H (1961) Die Flora von Euboea. *Botanische Jahrbücher für Systematik*. 80: 382–465.
- Regel, E. (1875) Alliorum adhuc cognitorum monographia. *Trudy Imperatorskago S.-Peterburgskago Botanicheskago Sada* 3(2): 1–266.
- Schwarz, O. (1934) Additamentum ad florulam Lydiae, I. *Feddes Repertorium Specierum Novarum Regni Vegetabilis* 36: 6596.
- Shmida, A. & Kollmann, F. (1977) *Allium* species of Mt. Hermon. II. Distribution, variation and polyploidy correlated with vertical zonation. *Israel Journal of Botany* 26: 149–159.
- Trigas, P., Iatrou, G. & Tzanoudakis D. (2010) *Allium apergii* sp. nov. (Alliaceae, *A.* sect. *Codonoprasum*) from Evia island, Greece. *Journal of Biological Research-Thessaloniki* 14: 225–229.
- Tzanoudakis, D. (1983) Karyotypes of ten taxa of *Allium* section *Scorodon* from Greece. *Caryologia* 36: 259–284.
- <http://dx.doi.org/10.1080/00087114.1983.10797667>
- Tzanoudakis, D. (2000) *Allium aegilicum* (Alliaceae), a new autumn flowering species from the island of Antikithira (Greece). *Botanika Chronica* 13: 81–86.
- Tzanoudakis, D. & Kypriotakis, Z. (1993) *Allium platakisii*, a new species of the Greek insular flora. *Flora Mediterranea* 3: 309–314.
- Tzanoudakis, D. & Kypriotakis, Z. (2008) *Allium brussalisii* (Alliaceae), a new species from Greece. *Botanical Journal of Linnean Society* 158: 140–146.
- <http://dx.doi.org/10.1111/j.1095-8339.2008.00853.x>
- Tzanoudakis, D. & Tan, K. 2000. *Allium samothracicum*, Tzanoud., Strid & Kit Tan, a new species from the North Aegean Area, Greece. *Portugaliae Acta Biologica* 19: 355–360.
- Webb, P.B. & Berthelot, S. (1848) *Phytografia canariensis*. 3(2), sect. III. Béthune, Paris, pp. 233–479.
- Zahariadi, C. (1975) Le sous-genre *Codonoprasum* (genre *Allium* L., fam. Alliaceae Agardh, 1858) en Grèce et en Roumanie, IIe partie. *Biologia Gallo-Hellenica* 6: 27–64.