# Allium Achaium Boiss. (Alliaceae), a Critical Species of Greek Flora

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# Allium achaium Boiss. (Alliaceae), a critical species of Greek flora

**Sandro Bogdanović, Cristian Brullo, Salvatore Brullo, Gianpietro Giusso del Galdo, Carmelo Maria Musarella & Cristina Salmeri**


## Abstract

BOGDANOVIĆ, S., C. BRULLO, S. BRULLO, G. GIUSSO DEL GALDO, C. M. MUSARELLA & C. SALMERI (2011). Allium achaium Boiss. (Alliaceae), a critical species of Greek flora. *Candollea* 66: 57-64. In English, English and French abstracts.

*Allium achaium* Boiss. *(Alliaceae),* a critical and misappreciated species of Greek flora is investigated from a taxonomic point of view and illustrated. It belongs to sect. *Codonoprasum* Rchb. and shows close relationships with the taxa of the *Allium stamineum* Boiss. group. Karyology, ecology and distribution of that species are examined.



## Key-words

*ALLIACEAE* – *Allium* – Greece – Taxonomy – Karyology



## Résumé

BOGDANOVIĆ, S., C. BRULLO, S. BRULLO, G. GIUSSO DEL GALDO, C. M. MUSARELLA & C. SALMERI (2011). Allium achaium Boiss. (Alliaceae), une espèce critique de la flore grecque. *Candollea* 66: 57-64. En anglais, résumés anglais et français.

*Allium achaium* Boiss. *(Alliaceae),* une espèce critique et mal connue de la flore grecque, est étudiée du point de vue taxonomique et illustrée. Elle appartient à la sect. *Codonoprasum* Rchb., et montre une remarquable affinité avec les taxons du groupe de *Allium stamineum* Boiss. La caryologie, l'écologie et la distribution de cette espèce sont aussi examinées.


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## Introduction

The aim of this work is to clarify the taxonomical position of *Allium achaium* Boiss., a critical species of Greek flora. It was described by Boissier (1882) based on specimens collected by Orphanides in Mt Klokos (North Peloponnisos) and treated as closely related to *A. paniculatum* L. Besides, the same author included within *A. achaium* a population from Mt. Parnassos describing it as var. *parnassicum* Boiss. Afterwards, this species was treated by Halácsy (1904), Hayek (1924-1933) and Stearn (1978, 1980, 1981) as synonym of *A. frigidum* Boiss. & Heldr., while Andersson (1991), Tzanoudakis & Tan (2000) and Tan & Iatrou (2001) keep it at a specific rank.

Morphological investigations, carried out both on dried and living material coming from the *locus classicus* and many other Greek localities, highlighted that the true *A. achaium* is a well differentiated species, belonging to the *A. stamineum* Boiss. group. Therefore, the taxonomic treatment of *A. achaium* as synonym of *A. frigidum* must be rejected. According to Brullo & al. (2001), *A. frigidum* is characterized by spathe valves shorter than the pendulous inflorescence, stamens included in the perigon, with interstaminal teeth and white filaments, ovary ellipsoid and capsule subglobose, while *A. achaium* has spathe valves longer than the umbel, which is erect, stamens exserted from the perigon, without interstaminal teeth, and filaments purplish above, ovary subglobose and capsule globose.

Several morphological characters allow *A. achaium* to be well distinguished from *A. parnassicum* (Boiss.) Halácsy, which is indeed closely related to *A. frigidum* (cf. Brullo & al., 2001).

Due to its geographical distribution, *A. achaium* occurs only on some mountains of Peloponnisos, therefore the records of Andersson (1991) and Tan & Iatrou (2001) for Sterea Ellas should be considered a misinterpretation. In fact, based on herbarium and field investigations, this species is a rare orophyte found within the thorny, cushion-like plant communities of North and Central Peloponnisos.

## Materials and methods

Our investigation was based on living material of *A. achaium* collected in various mountains of Peloponnisos (Mt. Klokos, Mt. Parnon, Mt. Panachaiko, Mt. Chelmos, Mt. Erimanthos and Mt. Menalo), and cultivated in the Botanic Garden of Catania. In addition, herbarium specimens of *A. achaium*, deposited in many European herbaria (BM, CAT, G, K, WU), were examined for the morphological study. The karyological analyses were made on mitotic plates from root-tip cells of cultivated bulbs coming from above mentioned localities, pre-treated with 0.3% colchicine water solution, fixed in ethanol-acetic (3:1) and stained according to the Feulgen technique. Metaphases observations and chromosome measurements were made using the image analysis systems IKAROS 4.6 (Metasystem) and AXIOVISION 5.1 (ZEISS). Karyotyping was done with the software Cromolab© 1.1. (Brullo, 2002-2003) specialized in recognizing chromosome pairs, ordering them by size and classifying by morphology, and assembling the karyotype formula based on the centromere position (Levan & al., 1964; Tzanoudakis, 1983). Eleven mitotic plates from six individuals were used for determining the karyotype parameters. To estimate the karyotype asymmetry, different numerical parameters were calculated, such as categories of Stebbins (1971), REC and SYi (Greilhuber & Speta, 1976), TF% (Huziwara, 1962), A1 and A2 (Romero Zarco, 1986), DI (Lavania & Srivastava, 1992), $CV_{CI}$, $CV_{CL}$ and AI index (Paszko, 2006). The leaf anatomy was studied on the living material, sectioned using the freezing microtome.

## Results

***Allium achaium*** Boiss., Fl. Orient. 5: 259. 1882 (Fig. 1, 2).

**Lectotypus** (designated by Andersson, 1991): **Greece. Peloponnisos:** In monte Clocos Achajae prope Bostitzam loco dicto Pente Vryses, 4000 m, 9-21.VII.1855, *Orphanides 427* (G-BOIS!; iso-: G!, K!, WU!).

*Bulb* ovoid, 12-25 × 10-15 mm, with outer tunics fibrous, dark-brown, splitting in thin parallel fibres, the inner ones pale-brown to whitish. *Stem* 10-30 cm tall, cylindrical, 2-5 mm in diameter, glabrous, erect, covered for 1/2-2/3 of its length by leaf sheaths. *Leaves* 4, 7-15 cm long, 1.5-3 mm wide, compact, subequal or shorter than stem, green-glaucous, glabrous. *Spathe* valves unequal, persistent, the larger one longer than the umbel, 3-8 cm long, 7-nerved, the smaller one shorter to longer than the umbel, 2-3.5 cm long, 5-nerved. *Umbel* lax and expanded, 3-5 cm in diameter, 9-45 flowered, with unequal pedicels, 10-20(-25) mm long. *Perigon* campanulate; tepals equal, white-yellowish, tinged with pink, pruinose, elliptical, smooth, rounded at the apex, 4.5-5 mm long and 1.8-2 mm wide, midrib green-purplish. *Stamens* exserted from perigon, with simple filaments, subequal, purplish above and white below, 4-6 mm long, below connate into an anulus 0.5 mm high. *Anthers* yellow, elliptical, 1.5-1.6 mm long, 0.8-0.9 mm wide, rounded at the apex. *Ovary* obovoid, green, lightly tuberculate above, 2-2.2 mm long, 1.8-2 mm wide, slightly contracted below. *Style* white, 2-2.5 mm long. *Capsule* trivalved, globose, lightly flattened, 2.8-3 × 3.3-3.8 mm.

*Distribution, ecology and conservation status. – Allium achaium* occurs in several mountains of Peloponnisos (Mt. Klokos, Mt. Parnon, Mt. Panachaiko, Mt. Chelmos, Mt. Erimanthos and Mt. Menalo), where it grows at an altitude of ca. 1200-2000 m (Fig. 3). It is normally quite rare, chiefly localizing on rocky places colonized by thorny cushion-like

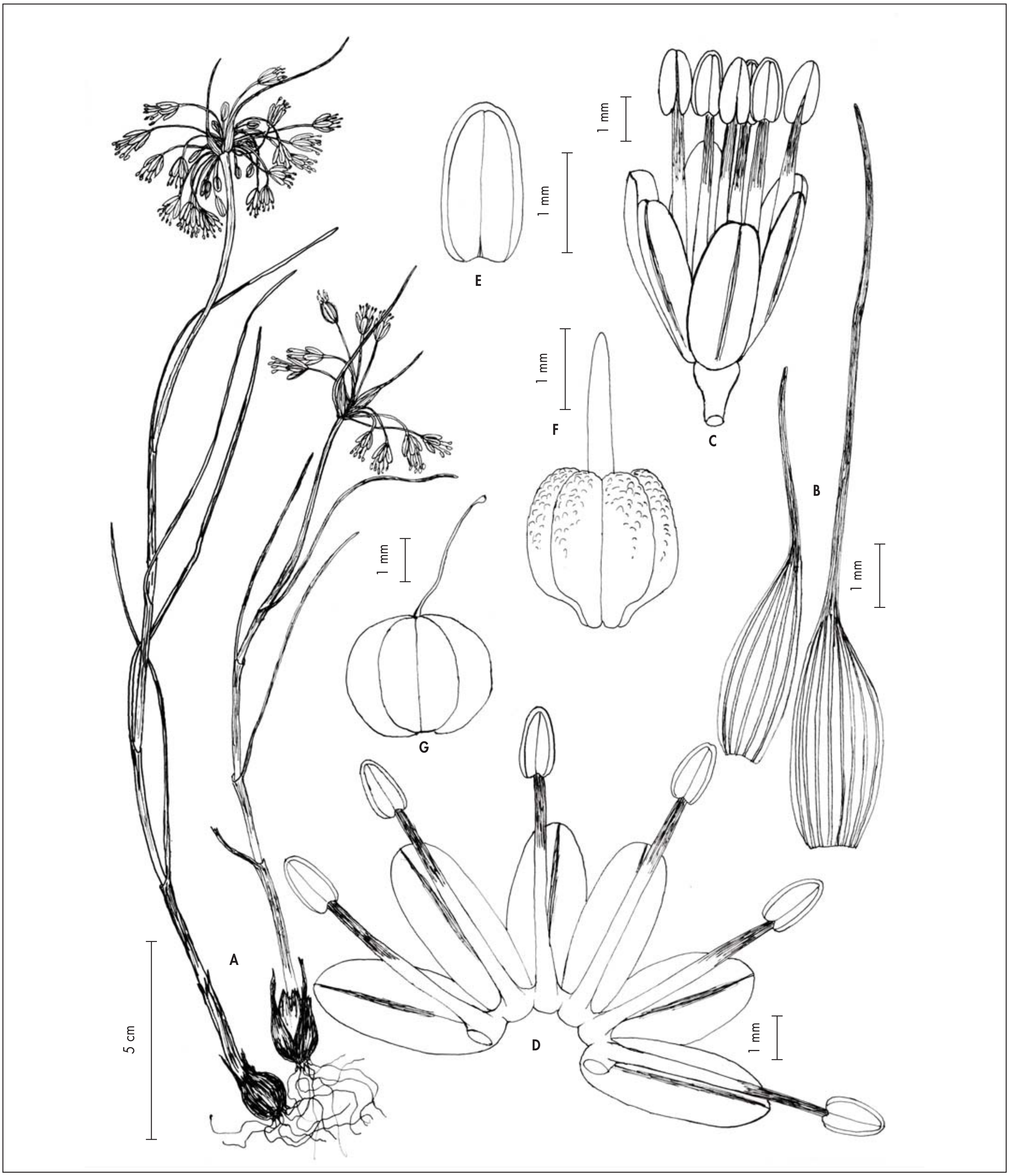


**Fig. 1.** – *Allium achaium* Boiss. **A.** Habit; **B.** Spathe valves; **C.** Flower; **D.** Open perigon; **E.** Anther; **F.** Ovary; **G.** Capsule.
[*Brullo, Giusso & Musarella s.n.*, CAT] [Drawn by Salvatore Brullo]

**Fig. 2. –** Inflorescence of *Allium achaium* Boiss.
[Photo: S. Brullo]

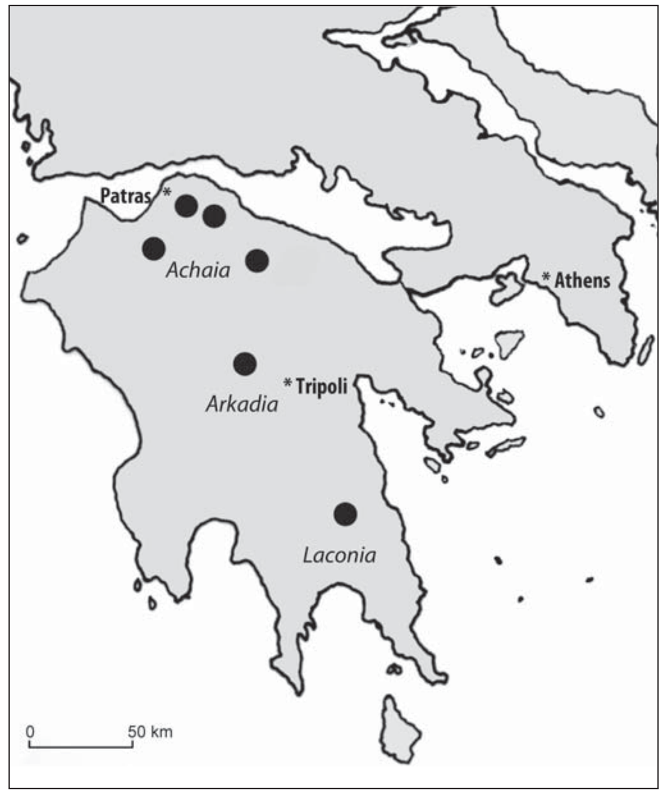


**Fig. 3. –** Geographical distribution of *Allium achaium* Boiss.

plant communities. Floristically, this vegetation is characterized by the dominance of numerous pulvinate orophytes, most of them endemic (*Astragalus rumelicus* subsp. *taygeticus* (Sirj.) Podlech, *Astragalus angustifolius* Lam. subsp. *angustifolius*, *Marrubium cylleneum* Boiss. & Heldr., *Cerastium candidissimum* Correns, *Galium thymifolium* Boiss. & Heldr., *Pterocephalus perennis* Coult. subsp. *perennis*, *Erodium chrysanthum* DC., *Asperula boissieri* Boiss., *Centaurea pichleri* Boiss., etc.). The bioclimate affecting the growing site of *Allium achaium* prevalently coincides with the supramediterranean belt, only marginally with the mesomediterranean one, while the substrate is represented by Mesozoic limestones and dolomites.

At present, *A. achaium* can be considered as a threatened species on the few populations with low number of individuals. Therefore, this species should be added to the 'Red List of Threatened Species' as vulnerable (VU), and following the criteria adopted by IUCN (2001, 2003, 2006), it should be included in the category VU and D1.

*Karyology*. – *Allium achaium* is a tetraploid species with a somatic chromosome number $2n = 32$ (Fig. 4A); both the somatic number and the basic one ($x = 8$) are quite common

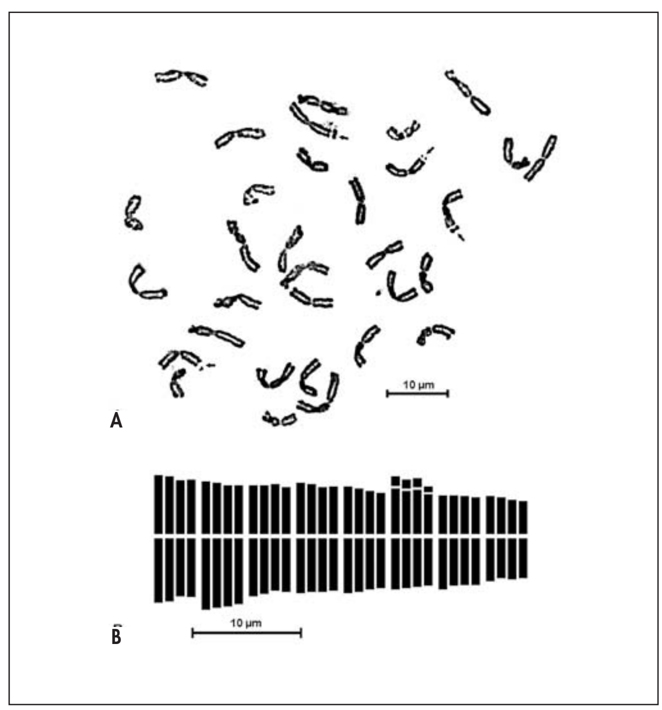


**Fig. 4. –** *Allium achaium* Boiss. **A.** Metaphasic plate ($2n = 32$); **B.** Karyogram.

within the *Allium* sect. *Codonoprasum* Rchb. All investigated specimens show a very regular and homogeneous complement with an autopolyploid arrangement. On the whole, chromosomes assemble in 8 sets of four homologues which are nearly all metacentric. Only one set tends towards the submetacentric type (arm ratio exceeding 1.30) and chromosomes are indicated as «msm» according to TZANOUDAKIS (1983). Short satellites are well evident only in Mt. Klokos populations, occurring on the short arm of one metacentric set (Fig. 4B). The karyotype formula can be resumed as $2n = 4x = 32$: 24m + $4m^{sat}$ + 4msm. The absolute chromosome length varies from 11 ± 1.95 µm for the longest chromosome, to 6.56 ± 0.99 µm for the shortest one, while the relative length ranges from 3.86 ± 0.37% to 2.20 ± 0.13%. Many different indices were also calculated to evaluate the symmetry degree of the chromosome complement; all values remarked a high homogeneity in the karyotype of *A. achaium* (Table 1).

*Leaf anatomy.* – The leaf cross section of *Allium achaium* has a subpentagonal outline, with rounded edges. The epidermis is covered by a well developed cuticle. The several stomata are distributed along the whole leaf perimeter. The palisade tissue is regular, compact, and two-layered, with the cells of the abaxial face bigger than those ones of adaxial face. The spongy tissue is compact with small cells, slightly larger in the middle part. Several secretory canals occur in the outermost part of the spongy tissue. The vascular bundles are 20, of which 12 abaxial (6 are bigger), and 8 adaxial (all small) (Fig. 5).

*Taxonomic discussion.* – According to the literature data (HALÁCSY, 1904; HAYEK, 1924-1933; STEARN, 1980), *A. achaium* is a misappreciated species usually treated as synonym of *A. frigidum*. This is probably due to both its infrequency and very scattered distribution and the lack of in-depth morphological investigations of this species. Moreover, it must be highlighted that in the most important European herbaria, specimens belonging to the typical population of this species are rather rare. For *A. frigidum*, its ecological requirements are similar to those of *A. achaium*, as testified by their usual co-occurrence in the same stands, but remarkable morphological differences as mentioned above and in Table 2 distinguish these species quite well. Also the chromosome number differs, since *A. frigidum* is usually diploid or rarely triploid ($2n$ = 16, 24), as quoted by TZANOUDAKIS (1983) and BRULLO & al. (2001). Taxonomically, *A. achaium* is instead closely related to *A. stamineum* s.l., which is widely distributed in the eastern

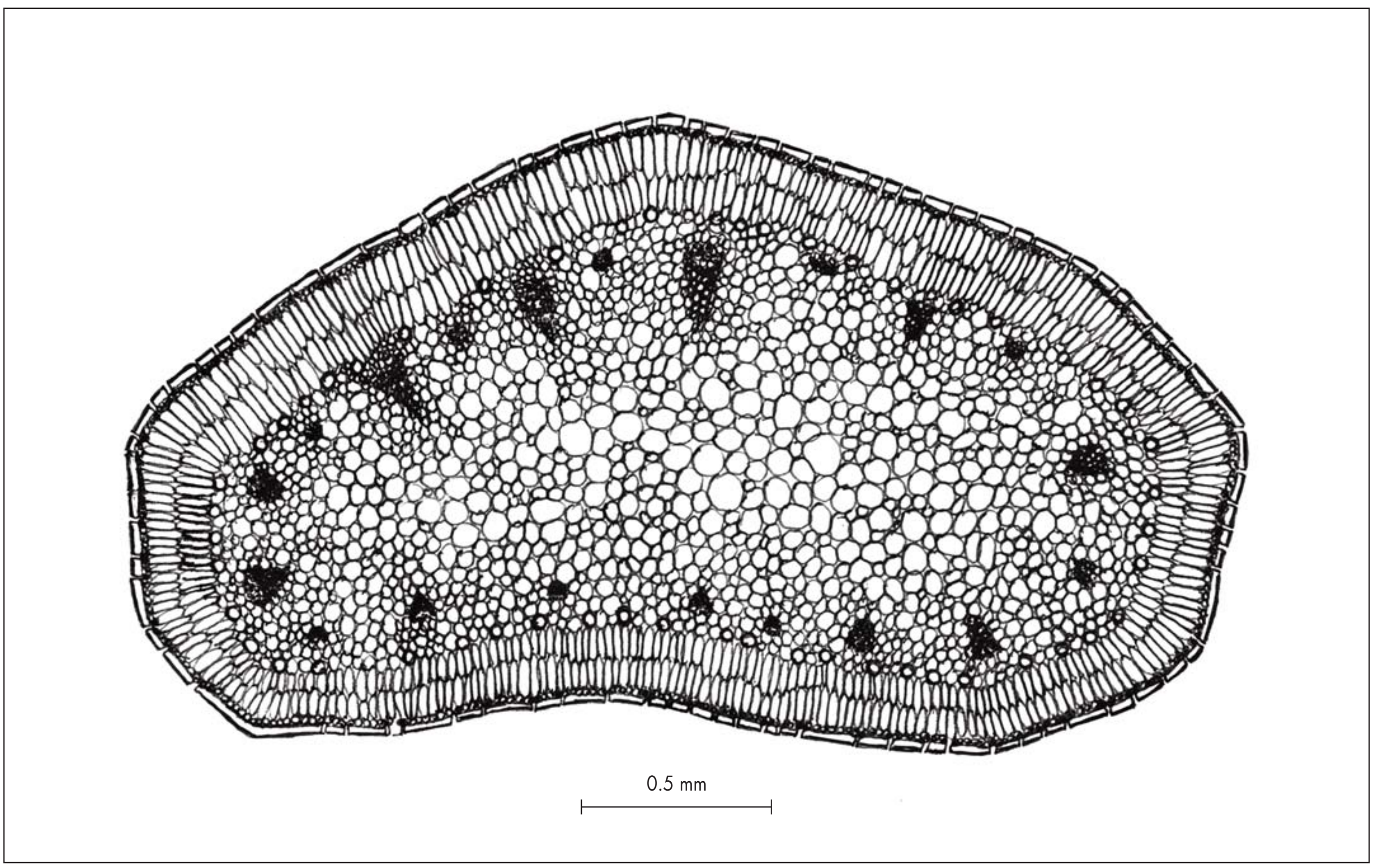


**Fig. 5.** – *Allium achaium* Boiss. Leaf cross section.

**Table 1.** – *Allium achaium* Boiss. Measures and classification of chromosomes.

| Chrom. | Absolute length [μm] | | | Relative length [%] | | | Ratio l/s | CI | Type |
|---|---|---|---|---|---|---|---|---|---|
| | Long arm Mean ± S.D | Short arm Mean ± S.D. | Total length Mean ± S.D. | Long arm Mean ± S.D. | Short arm Mean ± S.D. | Total length Mean ± S.D. | | | |
| 1 | 5.79 ± 0.99 | 5.3 ± 0.99 | 11.09 ± 1.95 | 2.02 ± 0.15 | 1.84 ± 0.08 | 3.86 ± 0.21 | 1.09 | 47.8 | m |
| 2 | 5.68 ± 1.14 | 5.18 ± 0.93 | 10.85 ± 2 | 1.97 ± 0.18 | 1.97 ± 0.18 | 3.77 ± 0.18 | 1.1 | 47.7 | m |
| 3 | 5.35 ± 0.83 | 4.83 ± 0.81 | 10.18 ± 1.6 | 1.87 ± 0.1 | 1.68 ± 0.02 | 3.54 ± 0.09 | 1.11 | 47.42 | m |
| 4 | 5.21 ± 0.85 | 4.85 ± 0.78 | 10.06 ± 1.6 | 1.81 ± 0.08 | 1.69 ± 0.04 | 3.5 ± 0.06 | 1.07 | 48.28 | m |
| 5 | 6.4 ± 0.78 | 4.74 ± 1.31 | 11.14 ± 2 | 2.24 ± 13 | 3.87 ± 0.16 | 3.87 ± 0.16 | 1.35 | 42.54 | msm |
| 6 | 6.16 ± 0.69 | 4.59 ± 1.37 | 10.75 ± 1.94 | 2.16 ± 0.15 | 1.58 ± 0.25 | 3.74 ± 0.19 | 1.34 | 42.67 | msm |
| 7 | 6.09 ± 0.87 | 4.36 ± 1.12 | 10.45 ± 1.98 | 2.13 ± 0.1 | 1.51 ± 0.18 | 3.63 ± 0.24 | 1.4 | 41.75 | msm |
| 8 | 5.9 ± 0.96 | 4.39 ± 1.34 | 10.29 ± 2.1 | 2.06 ± 0.14 | 1.51 ± 0.26 | 3.57 ± 0.31 | 1.34 | 42.65 | msm |
| 9 | 5.25 ± 0.81 | 4.39 ± 0.53 | 9.64 ± 1.24 | 1.83 ± 0.1 | 1.54 ± 0.13 | 3.37 ± 0.12 | 1.2 | 45.53 | m |
| 10 | 4.99 ± 0.8 | 4.38 ± 0.73 | 9.36 ± 1.51 | 1.74 ± 0.04 | 1.52 ± 0.04 | 3.26 ± 0.01 | 1.14 | 46.73 | m |
| 11 | 4.76 ± 0.8 | 4.46 ± 0.64 | 9.23 ± 1.44 | 1.66 ± 0.03 | 1.56 ± 0.05 | 3.21 ± 0.03 | 1.07 | 48.37 | m |
| 12 | 4.73 ± 0.78 | 4.3 ± 0.68 | 9.03 ± 1.42 | 1.64 ± 0.05 | 1.5 ± 0.07 | 3.14 ± 0.03 | 1.1 | 47.65 | m |
| 13 | 4.91 ± 0.94 | 4.61 ± 0.82 | 9.53 ± 1.75 | 1.7 ± 0.07 | 1.6 ± 0.05 | 3.31 ± 0.12 | 1.07 | 48.43 | m |
| 14 | 4.73 ± 0.89 | 4.51 ± 0.83 | 9.24 ± 1.71 | 1.64 ± 0.1 | 1.57 ± 0.07 | 3.21 ± 0.17 | 1.05 | 48.85 | m |
| 15 | 4.85 ± 0.95 | 4.3 ± 0.86 | 9.14 ± 1.77 | 1.68 ± 0.11 | 1.49 ± 0.13 | 3.17 ± 0.2 | 1.13 | 47.06 | m |
| 16 | 4.8 ± 0.92 | 4.25 ± 0.92 | 9.05 ± 1.83 | 1.67 ± 0.1 | 1.47 ± 0.1 | 3.14 ± 0.22 | 1.13 | 46.96 | m |
| 17 | 4.83 ± 0.83 | 4.21 ± 0.55 | 9.04 ± 1.35 | 1.68 ± 0.11 | 1.47 ± 0.08 | 3.15 ± 0.15 | 1.15 | 46.61 | m |
| 18 | 4.85 ± 0.79 | 4.06 ± 0.66 | 8.91 ± 1.39 | 1.69 ± 0.15 | 1.41 ± 0.03 | 3.11 ± 0.15 | 1.19 | 45.58 | m |
| 19 | 4.6 ± 0.49 | 3.91 ± 0.49 | 8.51 ± 0.94 | 1.62 ± 0.15 | 1.37 ± 0.07 | 2.98 ± 0.2 | 1.18 | 45.96 | m |
| 20 | 4.53 ± 0.54 | 3.73 ± 0.35 | 8.25 ± 0.84 | 1.59 ± 0.14 | 1.31 ± 0.09 | 2.89 ± 0.21 | 1.21 | 45.15 | m |
| 21 | 4.65 ± 0.76 | 4.06 ± 0.8 | 9.15 ± 1.6 | 1.62 ± 0.07 | 1.41 ± 0.07 | 3.18 ± 0.19 | 1.14 | 44.4 | $m^{sat}$ |
| 22 | 4.55 ± 0.84 | 3.9 ± 0.87 | 8.88 ± 1.59 | 1.58 ± 0.07 | 1.35 ± 0.1 | 3.09 ± 0.17 | 1.17 | 43.94 | $m^{sat}$ |
| 23 | 4.39 ± 0.64 | 4.03 ± 1.01 | 8.83 ± 1.76 | 1.53 ± 0.04 | 1.39 ± 0.19 | 3.07 ± 0.31 | 1.09 | 45.61 | $m^{sat}$ |
| 24 | 4.33 ± 0.77 | 3.63 ± 0.66 | 8.2 ± 1.3 | 1.5 ± 0.03 | 1.26 ± 0.1 | 2.86 ± 0.04 | 1.19 | 44.21 | $m^{sat}$ |
| 25 | 4.59 ± 0.92 | 3.54 ± 0.68 | 8.13 ± 1.54 | 1.59 ± 0.14 | 1.23 ± 0.05 | 2.82 ± 0.14 | 1.3 | 43.54 | m |
| 26 | 4.35 ± 0.75 | 3.54 ± 0.71 | 7.89 ± 1.45 | 1.51 ± 0.06 | 1.23 ± 0.05 | 2.74 ± 0.08 | 1.23 | 44.85 | m |
| 27 | 4.21 ± 0.74 | 3.44 ± 0.65 | 7.65 ± 1.37 | 1.47 ± 0.08 | 1.19 ± 0.06 | 2.66 ± 0.08 | 1.23 | 44.93 | m |
| 28 | 4.2 ± 0.81 | 3.26 ± 0.63 | 7.46 ± 1.36 | 1.46 ± 0.12 | 1.13 ± 0.08 | 2.59 ± 0.08 | 1.29 | 43.72 | m |
| 29 | 3.86 ± 0.77 | 3.39 ± 0.67 | 7.25 ± 1.43 | 1.34 ± 0.14 | 1.18 ± 0.07 | 2.52 ± 0.21 | 1.14 | 46.72 | m |
| 30 | 3.61 ± 0.48 | 3.26 ± 0.61 | 6.88 ± 1.07 | 1.27 ± 0.13 | 1.13 ± 0.08 | 2.4 ± 0.19 | 1.11 | 47.45 | m |
| 31 | 3.69 ± 0.69 | 3.09 ± 0.38 | 6.78 ± 1.06 | 1.28 ± 0.11 | 1.08 ± 0.06 | 2.36 ± 0.16 | 1.19 | 45.57 | m |
| 32 | 3.56 ± 0.52 | 3 ± 0.51 | 6.56 ± 0.99 | 1.25 ± 0.13 | 1.04 ± 0.02 | 2.29 ± 0.13 | 1.19 | 45.71 | m |

**Complement length *(2n)*:** 287.35 ± 46.88 μm

**Symmetry indices:** Stebbins' Cat.: 1A; AI: 0.81; $CV_{CL}$: 17.01; $CV_{CI}$: 4.77; A1: 0.15; A2: 0.17; REC: 95.70; SYi: 85.16; TF%: 45.75

**Table 2.** – Comparative scheme of the main features between *Allium achaium* Boiss., *A. guicciardii* Heldr. and *A. frigidum* Boiss. & Heldr.

| | *A. achaium* | *A. guicciardii* | *A. frigidum* |
|---|---|---|---|
| **Bulb size (mm)** | 10-25 × 10-15 | 10-18 × 8-12 | 5-14 × 5-12 |
| **Outer tunics** | fibrous | coriaceous | coriaceous |
| **Stem length (cm)** | 10-30 | 10-50 | (6-)8-22 |
| **Leaf number** | 4 | 4-6 | 3 |
| **Leaf max. length (cm)** | 7-15 | 25 | 3-7 |
| **Leaf width (mm)** | 1.5-3 | 1-2 | 0.6-0.8 |
| **Leaf sheating the stem** | $^1/_2$-$^2/_3$ | $^2/_3$ | $^1/_3$-$^1/_2$ |
| **Nerves of larger spathe** | 7 | 7 | 5-8 |
| **Nerves of smaller spathe** | 5 | 5 | 3-5 |
| **Larger spathe valve length [cm]** | 3-8 | 6-15 | 1.2-2.8 |
| **Smaller spathe valve length [cm]** | 2-3.5 | 4-9 | 1-1.8 |
| **Pedicel length (mm)** | 10-20(-25) | 10-50 | 5-15 |
| **Inflorescence feature** | erect | erect | pendulous |
| **Inflorescence flowers** | 9-45 | 50-70 | 5-20(-25) |
| **Perigon colour** | white-yellowish, pruinose | yellowish-green, pruinose | white-pinkish |
| **Tepal shape** | elliptical | elliptical | elliptical to oblong-elliptical |
| **Tepal apex** | rounded | rounded | obtuse-mucronate |
| **Tepal length [mm]** | 4.5-5 | 4.5-5 | 5-6 |
| **Tepals width [mm]** | 1.8-2 | 2-2.3 | 1.5-2.2 |
| **Stamen filament colour** | purplish above | white | white |
| **Stamen filament size** | unequal, exserted | equal, exserted | unequal, included |
| **Stamen filament length [mm]** | 4-6 | 6.5-7 | 1.8-2.6 |
| **Length of filament anulus [mm]** | 0.5 | 0.4-0.6 | 1, with interstaminal teeth |
| **Anther size [mm]** | 1.5-1.6 × 0.8-0.9 | 1.5 × 1 | 1-1.2 × 0.8-0.9 |
| **Anther colour** | yellow | yellow | white-yellowish |
| **Ovary shape** | obovoid | subglobose to obovoid | obovoid-ellipsoid |
| **Ovary size [mm]** | 2-2.2 × 1.8-2 | 1.5-2 × 1.8-2 | 3-3.5 × 1.8-2 |
| **Style length [mm]** | 2-2.5 | 4-5 | 0.5-1 |
| **Capsule shape** | globose | subglobose | subglobose |
| **Capsule size [mm]** | 2.8-3 × 3.3-3.8 | 3.5-5 × 3.5-5 | 4.8-5 × 4-5 |
| **Chromosome number [2*n*]** | 32 | 32 | 16, 24 |

Mediterranean area (Brullo & al., 2007). Among the taxa belonging to this group, *A. achaium*, for its tetraploid chromosome complement and some morphological characters, such as the habit, inflorescence and flower, seems to be more closely related to *A. guicciardii* Heldr. occurring in C-N Greece (Brullo & al., 2007). Nevertheless, *A. guicciardii* is a thermophilous species, chiefly found on rocky habitats, more or less disturbed by human activities, and usually localized in the thermo-mediterranean belt. In addition, *A. guicciardii* morphologically differs from *A. achaium* in having coriaceous bulb tunics, stems covered up to 2/3 of its length by leaf sheaths, inflorescence 50-70-flowered, tepals unequal, yellowish-green, stamens with filaments 6.5-7 mm long, ovary shorter with style 4-5 mm long, capsule larger (Table 2). Another important difference regards the karyotype structure, as *A. guicciardii* is a tetraploid taxon with a diploid arrangement of its chromosomes (Brullo & al., 2007).

*Specimens examined*. – **Greece:** Vostitza, VII.1861, *Heldreich s.n.* (G-BOIS); in monte Klokos Achaia prope Vostitza, rariss. 4000 m, 21.VII.1855, *Orphanides 427* (BM, G); Peloponneso, Mt. Panachaiko presso Prof. Ilias, 1500 m, 24.VI.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Erimanthos, versante nord, ca. 1300 m, 25.VI.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Parnon, a Prof. Ilias presso Agriani, ca. 1400 m, 29.VI.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Menalon, ca. 1600 m, 1.VII.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Chelmos a Pouliou Vrisi, ca. 2000 m, 2.VII.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Klokos presso la cima, ca. 1700 m, 4.VII.2006, *Brullo, Giusso & Musarella s.n.* (CAT); Peloponneso, Mt. Klokos, ca. 1600 m, 30.VI.2007, *Brullo, Giusso & Musarella s.n.* (CAT).

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