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## Cytotaxonomic considerations on *Allium stamineum* Boiss. group (*Alliaceae*)

### Abstract

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The species of the *Allium stamineum* group are examined in their morphological, karyological and taxonomic aspects, on the base of literature data as well as herbarium and field surveys. This group is widely distributed in the eastern Mediterranean area, where it is represented by many species well differentiated as regards their morphology, ecology and distribution. Most of the species are diploid with  $2n=16$  and occur in natural habitats, while some triploid ( $2n=24$ ) and tetraploid ( $2n=32$ ) are linked to synanthropic places. Nomenclature, morphology, karyology, ecology and distribution are provided for each species, as well as the iconography of their main distinctive features. The identification keys of these species are provided too.

### Introduction

The *Allium stamineum* group comprises many critical taxa belonging to *Allium* sect. *Codonoprasum* Reichenb. A marked heterogeneity and morphological diversity, in fact, characterize a lot of populations whose taxonomic treatment is rather difficult. It is differentiated by a pool of characters partly shared with the other taxa of the section and other ones distinctive of this group. They are divaricate spathe valves ending with a very long appendix, lax and diffuse umbel, conical-campanulate perigon, with mean size 4-7 mm (rarely smaller) and colour varying from pinkish white to greenish yellow or to green-blue or purplish, stamens long exerted from perigon and ovary with inconspicuous nectaries.

The group is widely distributed in the Eastern Mediterranean area, mainly in the Balkan and Aegean regions, Anatolian peninsula, extending into the Middle East, in Iranian and Palestinian territories. Its western boundary in the Mediterranean area corresponds to Mt. Gargano in S Italy.

Many distinct species are recognizable into this group, taxonomically well defined and validly described, as confirmed by literature data (Rechinger 1943; Wendelbo 1971; Kollmann 1984, 1986; Stearn 1984; Meikle 1985; Brullo & al. 1993, 1996a; Karavokyrou & Tzanoudakis 1994) and by our detailed herbarium and field surveys. Some of these species are known for a long time, such as *A. stamineum* Boiss., *A. decaisnei* C. Presl, *A. hymettium* Boiss. & Heldr., *A. guicciardii* Heldr. and *A. phrygium* Boiss.; others have been more recently described, as *A. deciduum* Ozhatay & Kollmann, *A. cyprium* Brullo, Pavone

& Salmeri, *A. dodecanesi* Karavokyrou & Tzanoudakis, *A. daninianum* Brullo, Pavone & Salmeri, etc. Further studies are in progress about many other critical populations collected in various localities of E-Mediterranean area, resulting significantly distinct from all up to known species.

In this contribution the taxa presently known are examined to better emphasize the inter- and intraspecific diversity and the taxonomic relationships within the group inquiring into their morphology, karyology and nomenclature.

## Material and methods

This work is based on literature data and herbarium investigations as well as on field collections in type localities and other sites of E-Mediterranean area to verify the variability among natural populations. Specimens from the following Herbarium collections were examined: B, BM, C, CAT, FI, G, HUJ, ISTE, M, OXF, P, PAL and UPA. The karyological analyses were made on mitotic plates from root tip cells of cultivated bulbs, pre-treated with 0.3% colchicine water solution, fixed in ethanol-acetic (3:1) and stained according to the Feulgen technique. Metaphases handling and chromosome measures were made by two image analysis systems, IKAROS 4.6 (Metasystem) and KS300 (Zeiss). Karyotyping was worked out by a specific software (Cromolab<sup>®</sup> 1.1) for the recognition of homologues, couple ordering, chromosome classification and karyotype formula based on the centromere position (Levan & al. 1964; Tzanoudakis 1983). The karyotype symmetry degree was tested on account of different parameters, such as the categories of Stebbins (1971), the TF% index (Huziwara 1962) and the REC and SYi indices (D'Ovidio & Marchi 1990).

## Results

This investigation allowed to individuate in the *A. stamineum* group a lot of species taxonomically well distinct. Their nomenclature, morphology, karyology, ecology and distribution are here provided, together with the iconography of their main distinctive features.

*Allium stamineum* Boiss., Diagn. ser. 2(4): 119 (1859).

Typus: *Lectotypus*: Caria, 1843, Pinard (G-BOISS!). *Isotypi*: BM!, FI!, P!

Iconography: Fig. 1.1 - 2.1 a, b, c.

Description: Bulb ovoid, 12-17 × 6-8 mm, with outer tunics coriaceous, dark brown, the inner ones membranous, whitish yellow. Scape glabrous, erect, 10-50 cm high, covered by leaf sheaths for 1/2-2/3 of its length. Leaves 3-4, green, semicylindrical, costate, up to 25 cm long. Spathe persistent, with 2 unequal valves, longer than umbel, the larger 7-nerved, 2.5-10(-12) cm long, the smaller 5-nerved, 2.5-7 cm long. Inflorescence lax, diffuse, 10-25-flowered; pedicels unequal, flexuous, 7-25 mm long. Perigon conical-campanulate, with tepals equal, greenish yellow tinged with purple, oblong-elliptical, rounded at apex, 4.5-5.5 mm long, the outers 2.4-2.5 mm wide, the inners 2-2.2 mm wide. Stamens simple, exerted, with filaments subulate, 4-6.5 mm long, white below and purplish above, connate at base into an annulus 0.6-1 mm high; anthers ellipsoid, yellow, rounded at apex, 1.5 × 0.8-1 mm. Ovary subglobose, yellow-greenish, rugose-

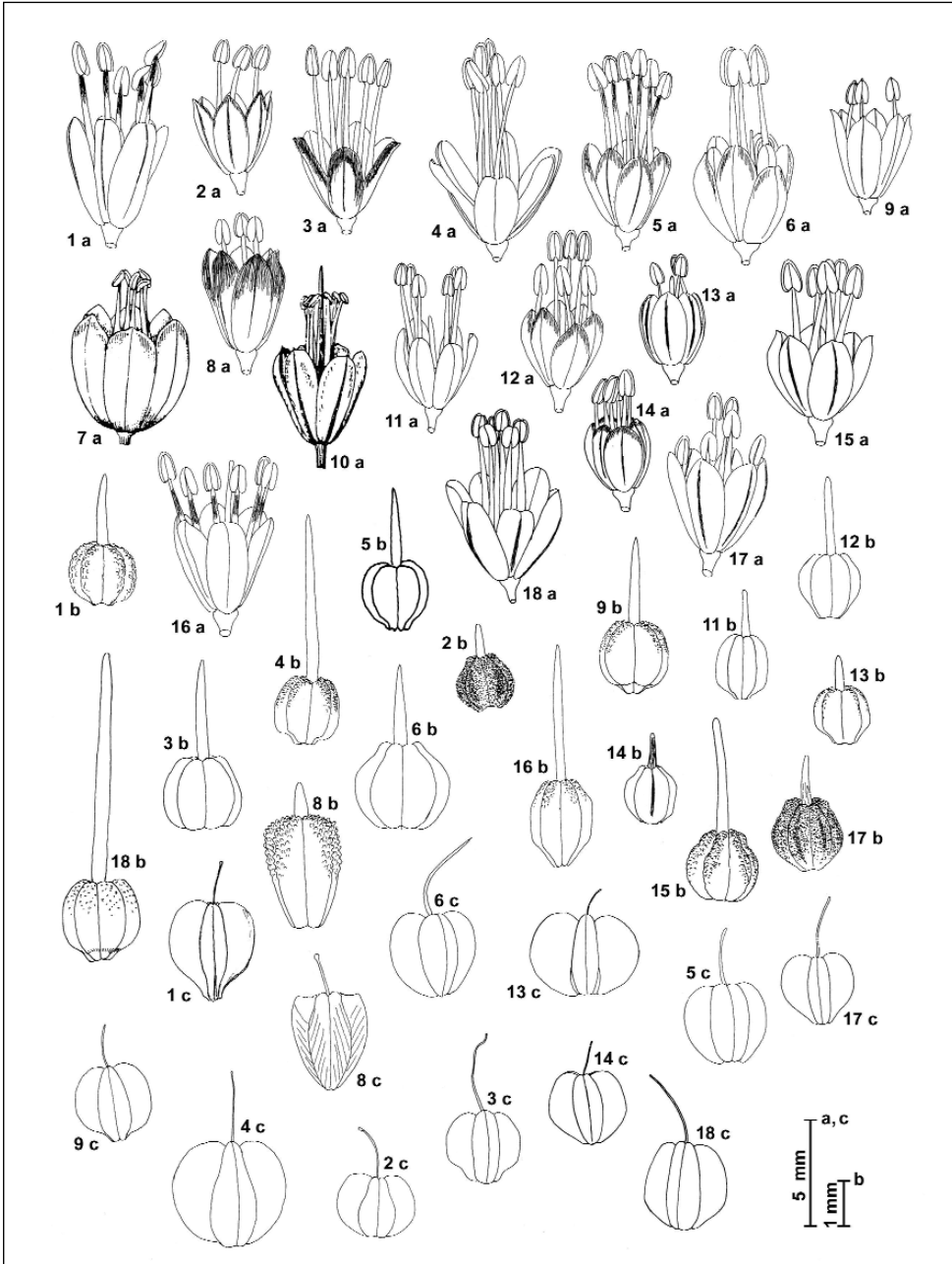


Fig. 1. Flower (a), ovary (b) and capsule (c) of the investigated species of *Allium stamineum* group: 1 - *A. stamineum*, 2 - *A. decaisnei*, 3 - *A. hymettium*, 4 - *A. guicciardii*, 5 - *A. phrygium*, 6 - *A. albotunicatum*, 7 - *A. hermoneum*, 8 - *A. pictistamineum*, 9 - *A. pseudoflavum*, 10 - *A. pseudostamineum*, 11 - *A. deciduum*, 12 - *A. retrorsum*, 13 - *A. cypricum*, 14 - *A. lefkarensense*, 15 - *A. marathasicum*, 16 - *A. dodecanesi*, 17 - *A. daninianum*, 18 - *A. garganicum*.

papillose above, 1.6-1.7 × 1.8-1.9 mm. Style white, 1.5-2.5 mm long. Capsule widely obovoid, stipitate at base, green, 4.5 × 4 mm.

Karyology: Populations from two localities of *locus classicus*, the Caria region in SW Turkey, show a diploid chromosome complement  $2n=16$ . The karyotype arrangement (Fig. 3.1) can be resumed by the following formula:  $2n=2x=16: 8 m + 2 m^{sat} + 4 msm + 2 sm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 74.83, SYi 79.57, TF% 44.31.

Diploid specimens from Cape Sounion (Greece) uncertainly identified by Miceli & Garbari (1979) as *A. stamineum* should be referred to other specific unit.

*Specimen karyologically examined*: Turkey, Alikurt (Denizli), 27.VI.1987, Brullo, Pavone & Signorello (CAT); Ortaklar (Aydin), 24.VI.1988, Brullo, Pavone & Signorello (CAT).

Ecology: Meadows and shrub communities.

Distribution: Southern and Western Anatolia.

***Allium decaisnei*** C. Presl, Bot. Bemerck. 114 (1844).

Typus: *Lectotypus*: Sinai, Arabice, Betel Nagiel in fissuris rupium montis St. Caterinae, 20.VII.1835, Schimper 250 (PRG!). *Isotypi*: BM!, OXF!

Iconography: Fig. 1.2 - 2.2 a, b, c.

Description: It differs from *A. stamineum* in having bulb 12-20 × 10-15 mm, with outer tunics pale brown, the inner ones whitish. Scape 15-25 cm high. Leaves up to 12 cm long. Spathe with larger valve 2.5-5 cm long, the smaller one 1.5-2.5 cm long. Inflorescence with pedicels unequal, 10-20 mm long. Tepals subequal, tinged with brown, sublanceolate, acute at apex, 3-4 mm long, 1.7-2 mm wide. Stamens with filaments 1.5-4 mm long, white, connate at base into an annulus 0.7 mm high; anthers straw-yellow, 1.1-1.2 × 0.7-0.8 mm. Ovary ovoid-pyriform, greenish, entirely papillose, 1.4-1.5 × 1.5 mm. Style 1 mm long. Capsule subglobose, flattened above, 3 × 3.8 mm.

Karyology: Specimens from Negev desert show a diploid chromosome complement  $2n=16$ . This count was already quoted by Kollmann (1985), sometimes with 1 B chromosome. The karyotype arrangement (Fig. 3.2) can be resumed by the following formula:  $2n=2x=16: 10 m + 4 msm + 2 sm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 84.06, SYi 79.31, TF% 44.23.

*Specimen karyologically examined*: Israel, Northern Negev, 15 Km a Nord di Beer Sheva, 24.V.1989, Brullo 15 (CAT); Judean desert, 5 Km SO di Gerico presso il Monastero di S. John, 24.V.1989, Brullo 11 (CAT).

Ecology: Rocky places of arid territories within subdesertic shrub vegetation.

Distribution: Palestine, Sinai.

***Allium hymettium*** Boiss. & Heldr., in Boiss. Diagn. Pl. Or. Nov. 3(4): 120 (1859).

Typus: *Lectotypus*: Hymettos, 1841, Spruner (G-BOISS!).

Iconography: Fig. 1.3 - 2.3 a, b, c.

Description: It differs from *A. stamineum* in having bulb 8-14 × 5-8 mm, with outer tunics pale brown, the inner ones whitish. Scape 8-15 cm high. Leaves 4, up to 10 cm long. Spathe with larger valve 2-4 cm long, the smaller one 1-2 cm long. Inflorescence contracted; pedicels 5-10 mm long. Tepals unequal, 4-4.5 mm long, pinkish yellow with stri-

ae dark brown purplish, the outers elliptic, 2 mm wide, the inners oblanceolate, 1.6-1.8 mm wide. Stamens 3.5-6 mm long, white, connate at base into an annulus 0.8-0.9 mm high provided with interstaminal teeth, anthers ellipsoid, straw-yellow, slightly apiculate, 1.2-1.3 × 0.8 mm. Ovary subglobose-ovoid, greenish, smooth, 1.8 × 1.8 mm. Style 2 mm long. Capsule subglobose, 3.5 × 3.5 mm.

**Karyology:** The plants from the type locality show a diploid chromosome complement  $2n=16$ , as already reported for this species by Johnson (1982). The karyotype arrangement (Fig. 3.3) can be resumed by the following formula:  $2n=2x=16: 8m + 6msm + 2sm$ ; some plates showed microsatellites on the short arms of some chromosomes. The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 70.87, SYi 77.36, TF% 42.80.

*Specimen karyologically examined:* Greece, Monte Hymettos, colline scistose, 4.VI.1992, *Brullo & Pavone* (CAT).

**Ecology:** Ephemeral communities occurring in rocky places.

**Distribution:** Central Greece (Attica, Evvia).

*Allium guicciardii* Heldr., Sched. Herb. Graec. Norm. (1876).

**Typus:** *Lectotypus:* in m. Parnassi reg. alpina, VIII.1855, *Guicciardi 2985* (G-BOISS!).

**Iconography:** Fig. 1.4 - 2.4 a, b, c.

**Description:** It differs from *A. stamineum* in having bulb 10-18 × 8-12 mm. Scape covered by leaf sheaths up to 1/2 of its length. Leaves 4-6. Spathe with larger valve 6-15 cm long, the smaller one 4-9 cm long. Inflorescence 50-70-flowered; pedicels 10-50 mm long. Perigon with tepals unequal, yellowish green, pruinose, elliptical, 4.5-5 mm long, the outers 2.2-2.3 mm wide, the inners 2-2.1 mm wide. Stamens with filaments 6.5-7 mm long, connate at base into an annulus 0.4-0.6 mm high. Ovary subglobose to obovoid, greenish, rugose above, 1.5-2 × 1.8-2 mm. Style 4-5 mm long. Capsule subglobose, 3.5-5 × 3.5-5 mm.

**Karyology:** All specimens collected in Greece and Romania resulted tetraploid with a somatic chromosome number  $2n=32$ . However, Alden (1976) found in some Pindhos mountains (N Greece) populations with  $2n=16$ , besides other ones with  $2n=32$ . The karyotype shows a diploid arrangement (Fig. 3.15) of chromosomes since it was not possible to put them in four. Its structure can be represented by the following formula  $2n=4x=32: 22m + 6msm + 4sm$ . Some difference among populations regards the presence of microsatellites on short chromosome arms. The index values expressing the karyotype symmetry degree are: Stebbins' categories 2A, REC 71.22, SYi 79.33, TF% 44.24.

*Specimen karyologically examined:* Greece, Melissi, 20.VI.1987, *Brullo, Pavone & Signorello* (CAT); Larisa, 21.VI.1987, *Brullo, Pavone & Signorello* (CAT); Metsoia, 20.VI.1987, *Brullo, Pavone & Signorello* (CAT); Romania, Macin, VIII 1993, *Brullo & Scelsi* (CAT).

**Ecology:** Rocky crevices and phrygane mainly disturbed by human activities.

**Distribution:** Central and Northern Greece, Romania.

*Allium phrygium* Boiss., Fl. Or. 5:256 (1882).

**Typus:** *Lectotypus:* Ouchak Phrygiae, 910 m, fin August 1857, *Balansa 89* (G!).

**Iconography:** Fig. 1.5 - 2.5 a, b, c.

Description: It differs from *A. stamineum* in having bulb 8-16 × 6-10 mm, with outer tunics striate, pale brown, the inner ones pale brown. Scape 12-30 cm high, covered by leaf sheaths up to 1/2 of its length. Leaves up to 16 cm long. Spathe with smaller valve 2-5 cm long. Inflorescence 10-15-flowered; pedicels 10-30 mm long. Tepals unequal, yellow-greenish with brown striae, generally rounded at apex, 4-4.5 mm long, the outers 2-2.2 mm wide, the inners 1.5-1.8 mm wide. Stamen filaments 3.5-6 mm long, connate at base into an annulus 0.3-0.5 mm high; anthers 1 × 0.6 mm. Ovary subglobose to ovoid, greenish, smooth, 1.5-2 × 1.5 mm. Style 1-1.5 mm long. Capsule globose, 3.5 × 3.5 mm.

Karyology: Specimens from Usak show a diploid chromosome complement  $2n=16$ , the same count reported by Özhatay (1985, 1993). The karyotype arrangement (Fig. 3.4) can be resumed by the following formula:  $2n=2x=16: 10 m + 6 msm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 74.17, SYi 80.79, TF% 44.49.

*Specimen karyologically examined*: Turkey, Civril, Kizilkadag (Usak), 22.VI.1998, Brullo & Pavone (CAT).

Ecology: Phrygane and steppe meadows.

Distribution: Central and Western Anatolia.

***Allium albotunicatum*** O. Schwarz, Feddes Repert. 36: 73 (1934).

Typus: *Lectotypus*: Turkey, in fruticetis sempervirentibus prope Burnova, solo calcareo, O. Schwarz 890 (B!); *Syntypus*: Turkey, Smyrna, in vallibus montis Coracis prope Lidia, c. 200 m, O. Schwarz 278 (B!).

Iconography: Fig. 1.6 - 2.6 a, b, c.

Description: It differs from *A. stamineum* in having bulb ovoid subglobose, 9-15 × 7-10 mm, with outer tunics white to greyish, split from base. Scape 15-60(-85) cm high. Leaves 4-5, up to 20 cm long. Spathe with longer valve 3-6 cm long, the smaller 2.5-4.5 cm long. Inflorescence 15-50-flowered; pedicels 10-40 mm long. Perigon obovoid with tepals unequal, pale green to yellow green tinged with purple, the outers 4 × 2.3-2.5 mm, the inners 4.5 × 2 mm. Stamens simple, unequal, with outer filaments 1.2-1.5 mm long, inner ones 5-6 mm long, connate at base into an annulus 0.6-0.8 mm high; anthers 1.7-1.9 × 0.9-1 mm. Ovary ovoid-pyriform, smooth, 2 × 2.2 mm. Style 2 mm long. Capsule obovoid, not stipitate at base, 4-5.5 × 4-5.5 mm.

Karyology: Shmida & Kollmann (1977) and Kollmann (1985) reported a triploid chromosome count  $2n=24$  for Israel populations.

Ecology: Xeric maquis at low altitude.

Distribution: W Anatolia, Lebanon, Palestine.

***Allium hermoneum*** (Kollmann & Shmida) Brullo, Guglielmo, Pavone & Salmeri *stat. nov.*

Bas.: *Allium albo-tunicatum* O. Schwarz subsp. *hermoneum* Kollmann & Shmida, Israel J. Bot. 26: 141 (1977).

Typus: *Holotypus*: Mt. Hermon, 2360 m, 14.VI.1974 Shmida (HUJ!).

Iconography: Fig. 1.7 - 2.7 a.

Description: It differs from *A. albo-tunicatum* in having bulbils along the lower part of stem. Scape 15-30 cm high. Leaves 3-4, up to 15 cm long. Spathe with longer valve up to 3

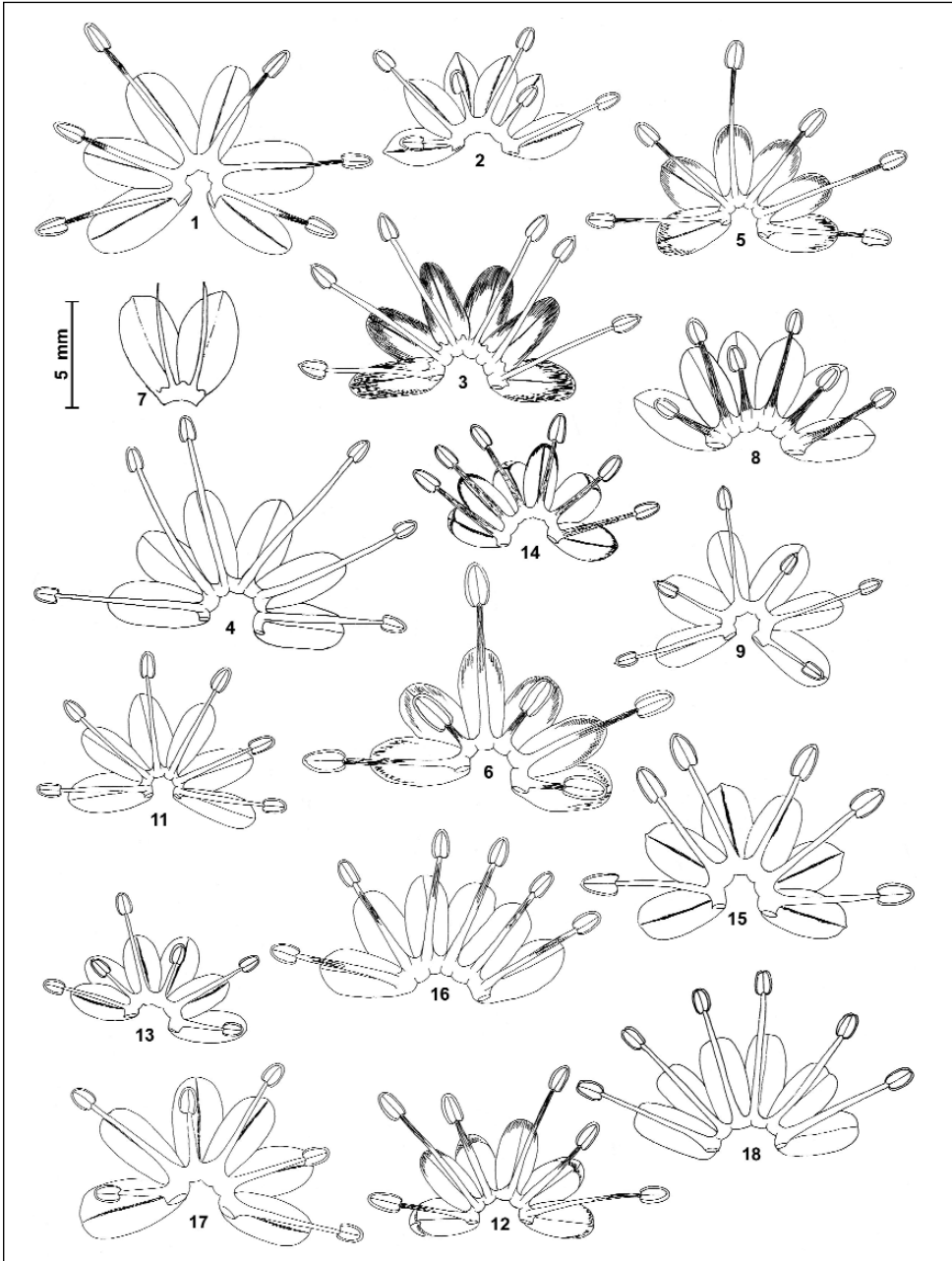


Fig. 2. Perigon and stamens of the investigated species of *Allium stamineum* group: 1 - *A. stamineum*, 2 - *A. decaisnei*, 3 - *A. hymettium*, 4 - *A. guicciardii*, 5 - *A. phrygium*, 6 - *A. albotunicatum*, 7 - *A. hermonium*, 8 - *A. pictistamineum*, 9 - *A. pseudoflavum*, 10 - *A. pseudostamineum*, 11 - *A. deciduum*, 12 - *A. retrorsum*, 13 - *A. cyprium*, 14 - *A. lefkarensis*, 15 - *A. marathasicum*, 16 - *A. dodecanesi*, 17 - *A. daninianum*, 18 - *A. garganicum*.

cm long, the smaller up to 2 cm long. Inflorescence up to 15-flowered; pedicels 10-20 mm long. Perigon with tepals subequal, widely obtuse, 5-5.2 × 2.7-2.8 mm. Stamens simple, equal, 5 mm long, connate at base into an annulus 0.6 mm high with interstaminal lobes.

Karyology: Shmida & Kollmann (1977) and Kollmann (1985) reported both diploid and tetraploid chromosome counts,  $2n=16$  and  $2n=32$  respectively, for specimens of *locus classicus*.

Ecology: Alpine belt at an altitude of 2000-2750 m.

Distribution: Syria and Lebanon (Mt. Hermon).

***Allium pictistamineum*** O. Schwarz, Feddes Repert. 36: 72 (1934).

Typus: *Lectotypus*: Magnesia Sipyli, in rupibus calcareis supra Akpunar, Sipyli pedis, c. 200 m, VI.1933, Schwarz 696 (B!).

Iconography: Fig. 1.8 - 2.8 a, b, c.

Description: It differs from *A. stamineum* in having bulb 12-16 × 5-12 mm, with inner tunics purple. Scape flexuous, 8-45 cm high, covered by leaf sheaths for 1/2 of its length. Leaves up to 30 cm long. Spathe with larger valve 2-4 cm long, the smaller one 2-3 cm long. Inflorescence with pedicels 10-20 mm long. Perigon subcylindrical-campanulate, with tepals equal, greenish yellow below and green pruinose tinged with lilac above, slightly obtuse at apex, 4-4.5 mm long and 2 mm wide. Stamen filaments 2.5-4 mm long, violet, connate at base into an annulus 1 mm high; anthers straw-yellow, 1 × 0.6 mm. Ovary obovoid, greenish, tuberculate above, 2.5 × 2 mm. Style 0.5-1 mm long. Capsule obovoid, 4.5 × 3.5 mm.

Karyology: The plants studied have a diploid chromosome complement  $2n=16$ . The karyotype arrangement (Fig. 3.5) can be resumed by the following formula:  $2n=2x=16: 8m + 6msm + 2sm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 81,48, SYi 72,19, TF% 41,92.

*Specimen karyologically examined*: Turkey, tra Emiralem e Menemen, Izmir, 19.VI.1998, Brullo & Pavone (CAT).

Ecology: Rocky crevices at low altitude.

Distribution: Western Anatolia.

***Allium pseudoflavum*** Vved., Byull. Sredneaz. Gosud. Univ. 19:123 (1934).

Typus: *Lectotypus*: Transcaucasia, Armenia, distr. Nor-Bajazat, in montibus propen pag. Subbotan, 7.VIII.1928, Zedelmeier & Gejdeman (LE).

Iconography: Fig. 1.9 - 2.9 a, b, c.

Description: It differs from *A. stamineum* in having bulb 10-13 × 8-10 mm, with outer tunics pale brown striate, the inner ones pale brown. Scape 10-25 cm high. Leaves 4-5, up to 15 cm long. Spathe with larger valve 3-5(-8) cm long, the smaller one 1.5-3.5 cm long. Inflorescence with pedicels 8-15 mm long. Tepals unequal, greenish yellow tinged with brown, oblong, 4-4.5 mm long, the outers 2 mm wide, the inners 1.7 mm wide. Stamens unequal with filaments white, the outers generally included, 1.8-2 mm long, the inners exerted, 4-4.5 mm long, connate at base into an annulus 0.5-0.7 mm high; anthers apiculate at apex, 1.2 × 0.5 mm. Ovary greenish, slightly rugose above, 1.5 × 1.4-1.5 mm. Style 2 mm long. Capsule subglobose, 3.5 × 3.5 mm.

Karyology: Populations from three different localities of C Anatolia show a diploid chromosome complement  $2n=16$ ; this count agrees with that one quoted by Özhatay



(1993). The karyotype arrangement (Fig. 3.6) can be resumed by the following formula:  $2n=2x=16: 10 m + 6 msm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 77.71, SYi 84.31, TF% 45.17.

*Specimen karyologically examined*: Turkey, pantani di Develi (Kayseri), 8.VII.1989, *Brullo & Signorello* (CAT); monti calcari a Nord di Hınıs, 6.VII.1989, *Brullo & Signorello* (CAT); Zara, 3.VII.1989, *Brullo & Signorello* (CAT).

Ecology: Steppe meadows and salty marshes.

Distribution: C, N and E Anatolia and N Iran.

*Allium pseudostamineum* Kollmann & Shmida, Israel J. Bot. 26(3): 138 (1977).

Typus: *Holotypus*: S Hermon, above Majdal Shams, 2100 m, 30.VII.1969, *Shmida* (HUJ!).

Iconography: Fig 2.10 a.

Description: It differs from *A. stamineum* in having bulb oblong-ovoid, 15-20 × 8-15 mm, with outer tunics grey brown, the inner ones membranous, purplish. Scape 10-15(-20) cm high. Leaves up to 8 cm long. Spathe slightly longer than umbel, the larger 3-4 cm long, the smaller 1.5-2 cm long. Inflorescence compact, spherical to hemispherical, up to 50-flowered; pedicels subequal, 15-20 mm long. Perigon with tepals greenish brown, rounded and apiculate or retuse at apex, 5 mm long. Stamens with filaments 5-7.5 mm long. Capsule globose, 4 × 4 mm.

Karyology: A diploid chromosome number  $2n=16$  is reported by Shmida & Kollmann (1977) on specimens from the *locus classicus*.

Ecology: Rocky places of mountain and alpine belts, mainly among gravels in windy habitats.

Distribution: Syria and Lebanon (Mt. Hermon).

*Allium deciduum* Özhatay & Kollmann, Notes R.B.G Edinb. 41:246 (1983).

Typus: *Holotypus*: Mugla, d. Koycegiz, Sandras dagi, nr Boceli, 1670 m, 24.VII.1977, *E. Özhatay 1219* (ISTE 43971!).

Iconography: Fig. 1.11 - 2.11 a, b.

Description: It differs from *A. stamineum* in having bulb 10-16 × 8-10 mm, with outer tunics fibrous-membranous, greyish brown. Scape 15-30 cm high, covered by leaf sheaths for 1/2 of its length. Leaves 3, up to 18 cm long. Spathe with 2 valves deciduous, unilateral, the larger 7-8-nerved, 2.5-6 cm long, the smaller 4-5-nerved, 2.5-3.5 cm long. Inflorescence with pedicels 10-25 mm long. Perigon greenish yellow tinged with lilac, with tepals unequal, 4 mm long, the outers 1.8-2 mm wide, the inners 1.4-1.5 mm wide. Stamen filaments 4-4.5 mm long, white, connate at base into an annulus 0.5 mm high; anthers 1.1 × 0.6 mm. Ovary obovoid, smooth, 1.7-2 × 1.5-1.7 mm. Style 1-2 mm long. Capsule obovoid, 3-4 × 3-4 mm.

Karyology: The investigated plants from *locus classicus* have a diploid chromosome complement  $2n=16$ , the same count quoted by Kollmann (1984) and Özhatay (1993). The karyotype arrangement (Fig. 3.7) can be resumed by the following formula:  $2n=2x=16: 12 m + 4 msm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 68.56, SYi 86.78, TF% 46.46.

*Specimen karyologically examined*: Turkey, Sandras Dag, 26.VI.1988, *Brullo, Pavone & Signorello* (CAT).

Ecology: Shady rocky places in the under wood of Coniferous forests, at 500-2000 m of altitude.

Distribution: SW Anatolia.

***Allium retrorsum*** (Özhatay & Kollmann) Brullo, Guglielmo, Pavone & Salmeri *st. nov.*

Bas.: *Allium deciduum* Özhatay & Kollmann subsp. *retrorsum* Özhatay & Kollmann, Notes R.B.G Edinb. 41:247 (1983).

Typus: *Holotypus*: Icel, Bolkar Daglari, Arslankoy, Bogazagzi etekleri, 1970 m, 6.VIII.1976, K. Alpınar ISTE 35799 (ISTE!).

Iconography: Fig. 1.12 - 2.12 a, b.

Description: It differs from *A. stamineum* in having bulb 15-20 × 10-14 mm, with outer tunics greyish brown. Scape solitary or paired, 15-25 cm high, covered by leaf sheaths for 1/2 of its length. Leaves up to 20 cm long. Spathe with 2 valves deciduous, unilateral, the larger 5-7-nerved, 4.5-13 cm long, the smaller 3-4-nerved, 2-6 cm long. Inflorescence with pedicels unequal, 10-25 mm long. Tepals greenish yellow tinged with pink and purple striate at margins, rounded at apex, 4.5 mm long, the outers 2 mm wide, the inners 1.5-1.8 mm wide. Stamen filaments 2-5.5 mm long, connate at base into an annulus 0.4-0.5 mm high; anthers 1.8 × 0.8 mm. Ovary ellipsoid, greenish, 1.5-2 × 1.2-1.8 mm. Style 1-2 mm long. Capsule subglobose, 3.5 × 3.5 mm.

Karyology: Specimens from *locus classicus* are diploid with a chromosome complement  $2n=16$ . The karyotype arrangement (Fig. 3.8) is very different from that one of *A. deciduum* and it can be represented by the formula:  $2n=2x=16: 8m + 4msm + 2sm + 2st$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 2A, REC 79.22, SYi 63.12, TF% 38.30.

*Specimen karyologically examined*: Turkey, Arslankoy (Mersin), 2.VII.1988, Brullo, Pavone & Signorello (CAT).

Ecology: Shrub communities of the mountain belt.

Distribution: SE Anatolia.

***Allium cypricum*** Brullo, Pavone & Salmeri, Candollea 48: 280 (1993).

Typus: *Holotypus*: cultivated plant originating from Cyprus, versante occidentale di monte Olympus, ca. 1600 m, 20.VI.1989, Brullo & Pavone s.n. (CAT!).

Iconography: Fig. 1.13 - 2.13 a, b, c.

Description: It differs from *A. stamineum* in having bulb 15 × 8 mm, with outer tunics decaying, the inner ones hyaline. Scape green violet, solitary or paired, 10-13 cm high, covered by leaf sheaths for 1/2 of its length. Leaves 8-20 cm long. Spathe sometimes shorter than umbel, with larger valve 6-nerved, 2.5-3.5 cm long, the smaller one 3-nerved, 1-2 cm long. Inflorescence few-flowered with pedicels 5-15 mm long. Perigon ovoid-subglobose, with tepals equal, dark violet, 3-3.5 mm long and 1.5-1.7 mm wide. Stamens with filaments black violet, the outers included, 2 mm long, the inners exerted, 4.5 mm long, connate at base into an annulus 0.5 mm high; anthers ovoid-ellipsoid, straw-yellow, 1 mm long. Ovary subglobose narrowed at base, rugose above, 1.5 × 1.5 mm. Style 1 mm long. Capsule subglobose, flattened above, 3.5 × 5 mm.

Karyology: The plants from *locus classicus* have a diploid chromosome complement  $2n=16$ . The karyotype arrangement (Fig. 3. 9) can be resumed by the following formula:

$2n=2x=16$ : 12 m + 4 msm; sometimes one metacentric pair shows microsatellites on the short chromosome arms. The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 82.78, SYi 86.73, TF% 46.28.

*Specimen karyologically examined*: see type specimen.

Ecology: In *Pinus brutia* woods and dwarf shrub communities, 1400-1700 m asl.

Distribution: Cyprus (Mt. Troodos).

***Allium lefkarens*** Brullo, Pavone & Salmeri, Candollea 48: 280 (1993).

Typus: *Holotypus*: Cipro: colline presso Lefkara, in ambienti rocciosi, esemplare coltivato, 2.VI.1989, Brullo & Pavone s.n. (CAT!).

Iconography: Fig. 1.14 - 2.14 a, b, c.

Description: It differs from *A. stamineum* in having bulb 7-12 × 12-20 mm, with outer tunics dark brown, decaying, the inner ones membranous orange or brown. Scape 20-40 cm high, covered by leaf sheaths for 1/3-1/2 of its length. Leaves 8-27 cm long. Spathe shorter than umbel or subequal, with larger valve 5-nerved, 2-4 cm long, the smaller one 3-nerved, 1-2 cm long. Inflorescence with pedicels 10-30 mm long. Perigon obovoid-subglobose to slightly campanulate, with tepals unequal, greenish with purple striae at apex and purplish green midvein, 3-3.5 mm long, the outers elliptical, slightly hooded at apex, 2 mm wide, the inners oblong, 1.5 mm wide. Stamen filaments dark purple, up to 4 mm long, sometimes the outers included and 1.5-2 mm long, connate at base into an annulus 0.5 mm high; anthers 1.3 mm long. Ovary ovoid-pyriform, smooth, 1.7-1.8 × 1.5-1.7 mm. Style purple, 1 mm long. Capsule globose, 3.5 × 3.5 mm.

Karyology: The plants from *locus classicus* are diploid with a chromosome complement  $2n=16$ . The karyotype arrangement (Fig. 3.10) is represented by the formula:  $2n=2x=16$ : 14 m + 2 msm. The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 80,58, SYi 89,26, TF% 47,03.

*Specimen karyologically examined*: see type specimen.

Ecology: Xeric garigues, 100-200 m asl.

Distribution: Cyprus.

***Allium marathasicum*** Brullo, Pavone & Salmeri, Candollea 48: 283 (1993).

Typus: *Holotypus*: cultivated plant originating from Cyprus, Marathasa presso Prodhromos, negli incolti, 7.VI.1989, Brullo & Pavone s. n. (CAT!).

Iconography: Fig. 1.15 - 2.15 a, b.

Description: It differs from *A. stamineum* in having bulbiferous bulb, 8-10 × 12-13 mm, with outer tunics decaying, the inner ones hyaline. Scape 28-45 cm high, covered by leaf sheaths for 1/2 of its length. Leaves 15-25 cm long. Spathe with larger valve 5-nerved, 7-10 cm long, the smaller one 3-nerved, 3-4.5 cm long. Inflorescence with pedicels up to 20 mm long, erect at fruiting. Perigon campanulate-urceolate, with tepals unequal, elliptical, apiculate at apex, greenish brown with brown midvein, 4-4.5 mm long, the outers 2.2-2.3 mm wide, the inners 2 mm wide. Stamen filaments white, 5 mm long, connate at base into an annulus 0.8 mm high; anthers 1.7 mm long. Ovary subglobose-pyriform, tuberculate above, 2.2 × 2 mm. Style 3.5 mm long. Capsule subglobose, 4 × 3.5 mm.

Karyology: This is the only taxon found to be triploid with a somatic chromosome number  $2n=24$ . Its karyotype structure (Fig. 3.11) is well represented by the chromosome for-

mula:  $2n=3x=24$ : 15 m + 6 msm + 3 sm; sometimes one metacentric triplet showed microsatellites on the short chromosome arms. The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 86.47, SYi 77.83, TF% 43.62.

*Specimen karyologically examined*: see type specimen.

Ecology: Synanthropic habitats along the road.

Distribution: Cyprus.

***Allium dodecanesi*** Karavokyrou & Tzanoudakis, Ann. Musei Goulandris 9: 141 (1994).

Typus: *Holotypus*: cultivated plant, originated from Greece, prov. Dodecanissos, Island Lipsos, 1 April 1991, Panitsa 2466 (UPA).

Iconography: Fig. 1.16 - 2.16 a, b.

Description: It differs from *A. stamineum* in having bulb globose-ovoid, 10-15 × 8-12 mm, with outer tunics blackish, the inner ones whitish. Scape 20-40 cm high, covered by leaf sheaths for 1/2 of its length. Leaves 3-5, up to 16 cm long. Spathe with larger valve 3.5-8 cm long, the smaller one 1.5-2 cm long. Inflorescence 20-40-flowered, with pedicels 10-25 mm long. Perigon with tepals equal, elliptical, greenish white tinged with pink-purple, rounded at apex, 4-5 mm long and 1.8-2 mm wide. Stamen filaments 4.5-5 mm long, connate at base into an annulus 0.8-1 mm high; anthers 1.3 × 0.7 mm. Ovary obovoid or obovoid-ellipsoid, slightly rugose above, 2-2.5 × 1.8 mm. Style up to 5 mm long. Capsule globose, 4 × 4 mm.

Karyology: As already recorded by Karavokyrou & Tzanoudakis (1994), specimens from Kalimnos are diploid with a somatic chromosome number  $2n=16$ . The karyotype arrangement (Fig. 3.12) can be represented by the formula:  $2n=2x=16$ : 10 m + 2 msm + 4 sm, rather similar to that one reported in the protologue. The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 84.33, SYi 77.63, TF% 43.70.

*Specimen karyologically examined*: Greece, Kalimnos, La Passi (calcari), 31.VIII.1994, Brullo C18 (CAT).

Ecology: Phrygane near the coast and *Pinus* woods.

Distribution: Dodecanese archipelago (Lipsos and Kalimnos).

***Allium daninianum*** Brullo, Pavone & Salmeri, Willdenowia 26: 239 (1996).

Typus: *Holotypus*: Israel, Esdraelon Valley, near Yoqneam, 15.V.1990, Brullo A56, cult. in the Botanical Garden of Catania (CAT!).

Iconography: Fig. 1.17 - 2.17 a, b, c.

Description: It differs from *A. stamineum* in having bulb 7-12 × 6-10 mm, with outer tunics black or dark violet, decaying, the inner ones hyaline. Scape 5-25 cm high. Leaves 4-5 with sheaths tinged with violet. Spathe with larger valve 8-20 cm long, the smaller one 3.5-10 cm long. Inflorescence up to 80-flowered; pedicels 15-40 mm long. Perigon conical-campanulate, with tepals subequal, purplish pink to purple with dark purple midvein, 4-5 mm long and 2-2.3 mm wide. Stamen filaments unequal, purple above, the outers 2-4 mm long, the inners 4-5 mm long, connate at base into an annulus 1 mm high; anthers 1.2 mm long. Ovary subglobose-ovoid, entirely papillose, 2 × 2.2 mm. Style purplish below, 1.5 mm long. Capsule globose, 3-3.5 × 3.2-3.5 mm.

Karyology: As already quoted by Brullo & al. (1996), this species is diploid with a somatic chromosome number  $2n=16$ , the same count reported by Kollmann (1985) for Israel pop-

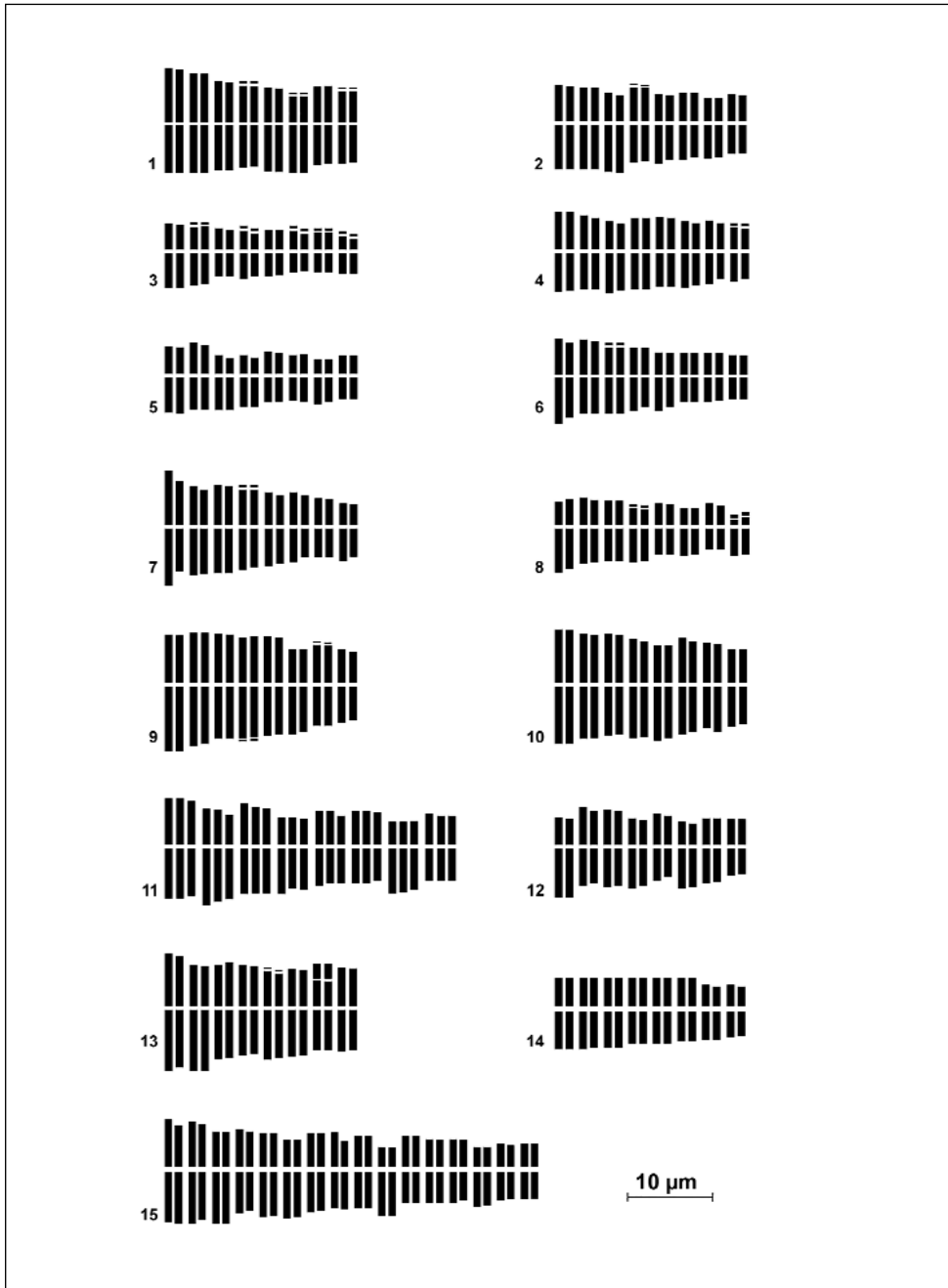


Fig. 3. Karyotypes of the examined species of the *Aliium stamineum* group. 1 - *A. stamineum*, 2 - *A. decaisnei*, 3 - *A. hymettium*, 4 - *A. phrygium*, 5 - *A. pictistamineum*, 6 - *A. pseudoflavum*, 7 - *A. deciduum*, 8 - *A. retrorsum*, 9 - *A. cyprium*, 10 - *A. lefkareense*, 11 - *A. marathasicum*, 12 - *A. dodecanesi*, 13 - *A. daninianum*, 14 - *A. garganicum*, 15 - *A. guicciardii*.

ulations of *A. stamineum*. The karyotype arrangement (Fig. 3.13) can be represented by the formula:  $2n=2x=16: 10 m + 4 msm + 2 sm^{sat}$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 87.83, SYi 81.53, TF% 44.13.

*Specimen karyologically examined*: Israel, Esdraelon Valley, near Yoqneam, 15.V.1990, cult., *Brullo A56* (CAT); Judean Foothills, near Netiv Halamed-hei, 10.V.1989, cult., *Brullo A1* (CAT); Judean, Mt. Kiryat Anavim, 5.V.1989, cult. *Brullo A14* (CAT).

Ecology: Maquis, dwarf shrub communities and rocky places, 0-900 m asl.

Distribution: Middle East (Israel, Lebanon, Jordan, Transjordan, Syria).

### *Allium garganicum* nom. provv.

Iconography: Fig. 1.18 - 2.18 a, b, c.

Description: It differs from *A. stamineum* in having scape up to 40 cm high, covered by leaf sheaths up to 1/2 of its length. Leaves 4-5, green, semicylindrical, costate, up to 20 cm long. Spathe with larger valve 5-6-nerved, 7-11 cm long, the smaller 4-5-nerved, 4-6 cm long. Inflorescence 12-35-flowered; pedicels unequal, flexuous, 20-25 mm long. Perigon conical-campanulate, with tepals yellowish to greenish yellow, slightly pruinose, 4-4.5 mm long, 1.8-2 mm wide. Stamens with filaments 5-6 mm long, white, connate at base into an annulus 0.4-0.5 mm high; anthers 1-1.1 × 0.5-0.6 mm. Ovary slightly papillose above, 2 × 1.9-2 mm. Style 3.5-5 mm long. Capsule ellipsoid, 3.2-3.5 × 2.8-3 mm.

Karyology: Plants from the *locus classicus*, the only station presently known, show a diploid chromosome complement  $2n=16$ . The karyotype (Fig. 3.14), quite regular with rather small chromosomes, can be resumed by the formula:  $2n=2x=16: 14 m + 2 msm$ . The index values expressing the karyotype symmetry degree are: Stebbins' categories 1A, REC 79.79, SYi 88.80, TF% 47.03.

Ecology: Rocky meadows near the coast.

Distribution: SE Italy (Gargano peninsula).

*Specimen karyologically examined*: Puglia, Gargano, stazioni calcaree semiruprestri presso Peschici, 6.7.2002, *Brullo & Giusso* (CAT).

## Discussion

The marked morphological and karyological diversity among the populations of the *A. stamineum* group should be the result of many chorological, environmental and biological factors, as paleogeographic events, ecological and edaphic requirements, reproductive strategies. They surely played an important role in the evolutionary processes within this group, the same as we already observed in other sister groups of *A. sect. Codonoprasum*, such as *A. paniculatum* L., *A. staticiforme* Sm. and *A. hirtovaginum* Cand. (Brullo & al. 1991, 1994, 1995, 1996, 1997, 1997a, 1997b, 2001, 2003, 2004).

The group has its speciation centre in the Anatolian peninsula, where it counts the most number of different taxa and widespread populations. Then, its geographic distribution extended both towards West in the Balkan peninsula and to East in the Iranian territories (Fig. 4), where a lot of taxa with a punctiform distribution are known (Shmida & Kollman 1977a; Brullo & al. 1992, 1993, 1996; Karavokyrou & Tzanoudakis 1994). Based on pub-

lishing data, a new species from Puglia (S Italy), here provisionally designed as *A. garganicum*, represents a very significant record that further widens the geographic distribution of *A. stamineum* group towards West Mediterranean area and improves the Italian floristic set in eastern elements.

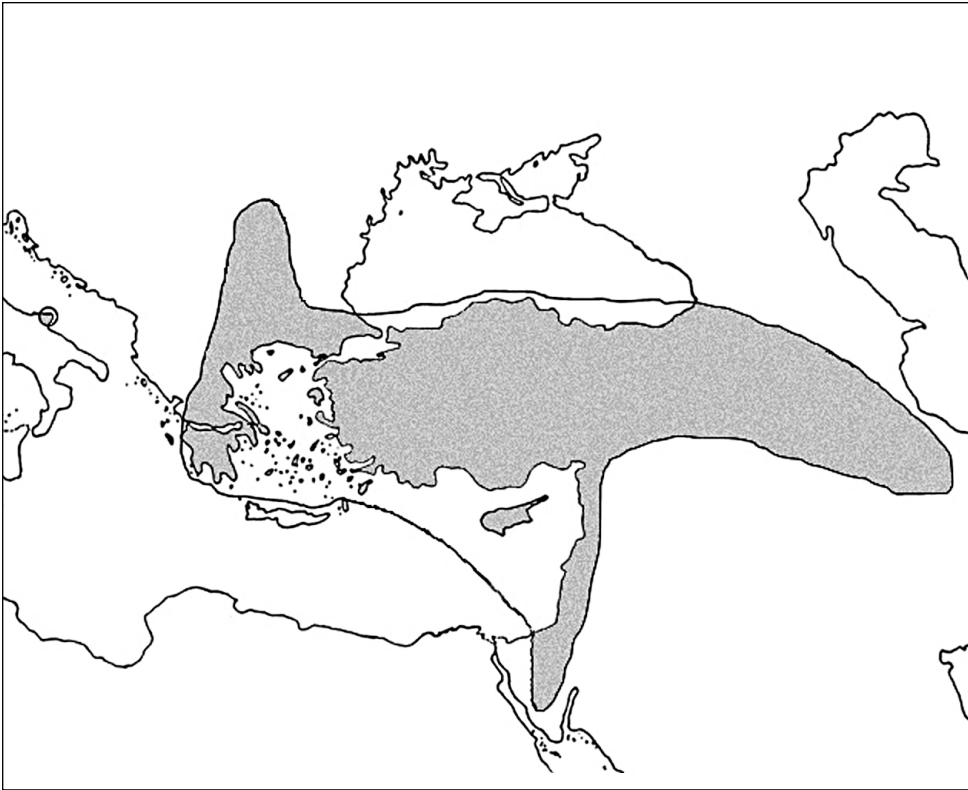


Fig. 4. Geographic distribution of the *Allium stamineum* group in the Mediterranean area.

Most species are linked to conservative habitats, as rupestrian and rocky places, typically cliffs, garigues and meadows, or sometimes open pinewoods and salt marshes. Populations growing in these habitats are prevalently diploid with a somatic chromosome number  $2n=16$  and probably the marked speciation processes in this group were favored by geographic isolation or adjustment to different ecological conditions. Colonization of secondary habitats as synanthropic ones, instead, seems to be favoured by a polyploid arrangement of chromosome complement, as we can observe in *A. marathasicum* from Cyprus, a triploid species ( $2n=24$ ) localized in ruderal places, and *A. guicciardii* from Balkan Peninsula, tetraploid ( $2n=32$ ) and often growing in seminatural habitats disturbed by human activities.

The following analytical keys were realized for comparing and better distinguishing the different taxa within the *A. stamineum* group.

1	Perigon 3-4 mm long.....	2
1	Perigon 4-5.5 mm long.....	4
2	Stem 10-13 cm tall; tepals dark violet; capsule 5 mm wide.....	<i>A. cyprium</i>
2	Stem 15-40 cm tall; tepals greenish or greenish yellow; capsule 3.5-3.8 mm wide.....	3
3	Perigon campanulate; tepals sublanceolate, acute at apex; stamen filaments and style white; ovary entirely papillose.....	<i>A. decaisnei</i>
3	Perigon obovoid-subglobose; tepals oblanceolate-elliptical, rounded at apex; stamen filaments and style purple; ovary smooth.....	<i>A. lefkarensis</i>
4	Leaves flat; tepals purplish pink; ovary entirely papillose; style purplish below.....	<i>A. daninianum</i>
4	Leaves semicylindrical; tepals greenish to yellow; ovary smooth to slightly papillose above; style white.....	5
5	Outer bulb tunics white-grey; perigon obovoid.....	6
5	Outer bulb tunics pale brown to black; perigon campanulate to campanulate-urceolate.....	7
6	Larger spathe valve 3-6 cm long; smaller one 2.5-4.5 cm; umbel 15-50-flowered; perigon 4-4.5 mm long; interstaminal teeth absent.....	<i>A. albotunicatum</i>
6	Larger spathe valve 3 cm long; smaller one 2 cm; umbel max. 15-flowered; perigon 5-5.2 mm long; interstaminal teeth present.....	<i>A. hermoneum</i>
7	Spathe valves deciduous, unilateral.....	8
7	Spathe valves persistent, opposed.....	9
8	Outer bulb tunics fibrous-membranaceous; larger spathe valve 7-8-nerved, 2.5-6 cm long; umbel 7-20-flowered; perigon 4 mm long; stamen filaments entirely white; anther 1.1 mm long; ovary obovoid; capsule obovoid.....	<i>A. deciduum</i>
8	Outer bulb tunics coriaceous; larger spathe valve 5-7-nerved, 4.5-13 cm long; umbel 20-30-flowered; perigon 4.5 mm long; stamen filaments purple above; anther 1.8 mm long; ovary ellipsoid; capsule subglobose.....	<i>A. retrorsum</i>
9	Larger spathe valve 5-6-nerved.....	10
9	Larger spathe valve 7-nerved.....	11
10	Smaller spathe valve 3-nerved; perigon campanulate-urceolate; tepals greenish brown, 2-2.3 mm wide, apiculate at apex; anther 1.7 mm long; capsule subglobose, 4 mm long.....	<i>A. marathasicum</i>
10	Smaller spathe valve 4-5-nerved; perigon conical-campanulate; tepals greenish yellow, 1.8-2 mm wide, rounded at apex; anther 1-1.1 mm long; capsule ellipsoid, 3.2-3.5 mm long.....	<i>A. garganicum</i>
11	Outer bulb tunics black; tepals greenish white.....	<i>A. dodecanesi</i>
11	Outer bulb tunics brown; tepals greenish yellow to greenish brown.....	12
12	Perigon 4-4.5 mm long.....	13
12	Perigon 4.5-5.5 mm long.....	16
13	Outer bulb tunics dark brown; stem up to 45 cm tall; leaves up to 30 cm long; tepals obtuse at apex; stamen filaments entirely violet; ovary obovoid, above tuberculate, 2.5 mm long; capsule obovoid, 4.5 mm long.....	<i>A. pictistamineum</i>



- 13 Outer bulb tunics pale brown; stem max. 30 cm tall; leaves up to 16 cm long; tepals rounded at apex; stamen filaments entirely white or purple above; ovary subglobose or subglobose-ovoid, smooth or rugose above, 1.5-2 mm long; capsule globose-subglobose, 3.5 mm long.. **14**
- 14 Outer bulb tunics coriaceous; leaves up to 10 cm long; tepals pinkish yellow; interstaminal teeth present..... *A. hymettium*
- 14 Outer bulb tunics striate-coriaceous; leaves up to 16 cm long; tepals greenish yellow; interstaminal teeth absent..... **15**
- 15 Stamen filaments white and purple above, subequal, 3.5-6 mm long, annulus 0.3-0.5 mm high; anthers rounded at apex; ovary smooth..... *A. phrygium*
- 15 Stamen filaments white, unequal, the outers 1.8-2 mm long, the inners 4-4.5 mm long; annulus 0.5-0.7 mm high; anthers apiculate at apex; ovary rugose..... *A. pseudoflavum*
- 16 Inner bulb tunics purplish; stem 10-15 (-20) cm tall; leaves to 8 cm long; larger spathe valve 3-4 cm long; smaller spathe valve 1.5-2 cm long; umbel compact spherical to hemispherical; tepals greenish brown, apiculate or retuse at apex..... *A. pseudostamineum*
- 16 Inner bulb tunics whitish; stem (10)-15 -50 cm tall; leaves to 25 cm long; larger spathe valve to 15 cm long; smaller spathe valve 2.5-9 cm long; umbel lax, diffuse; tepals greenish yellow, rounded at apex..... **17**
- 17 Leaves 3-4; perigon conic campanulate; tepals tinged with purple; stamen filaments 4-6.5 mm long; annulus 0.6-1 mm high; ovary subglobose; style 1.5-2.5 mm long; capsule obovoid stipitate..... *A. stamineum*
- 17 Leaves 4-6; perigon campanulate; tepals pruinose; stamen filaments 6.5-7 mm long; annulus 0.4-0.6 mm high; ovary subglobose-ovoid; style 4-5 mm long; capsule subglobose..... *A. guicciardii*

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