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Cytotaxonomical revision of the *Allium obtusiflorum* group (*Alliaceae*)

Abstract

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Herbarium specimens and living material of some populations belonging to *Allium obtusiflorum* s. l. have been investigated. Three closely related species are recognized: *A. obtusiflorum* DC. from Sicily, *A. erythraeum* Griseb. from Macedonia (N Greece) and *A. thessalicum* sp. nov. from Thessaly (C Greece). Their taxonomy, karyology, leaf anatomy and relationships are discussed.

Introduction

A cytotaxonomical study of *Allium obtusiflorum* DC., a critical Mediterranean species was carried out, based on material from populations previously referred to it.

Allium obtusiflorum, described from Sicilian specimens, was reported as occurring in Greece by Stearn (1978), who may have included in this species the Macedonian populations previously described by Grisebach (1845) as *A. erythraeum* and populations from various localities of Central and Southern Greece. Brullo & Tzanoudakis (1989) subsequently pointed out that the Peloponnesus specimens belong to a new species, *A. maniaticum*, that is taxonomically quite isolated and does not belong to the *A. obtusiflorum* group at all. Recently Brullo & al. (1991) and Tzanoudakis (1992), studying Macedonian live material, recognized that *A. erythraeum* is morphologically and karyologically quite distinct from *A. obtusiflorum*. Further study has shown that the Greek populations in Thessaly, in turn, are well differentiated from the Macedonian ones. Consequently, they are here described as belonging to a species new to science, *A. thessalicum*.

Material and methods

This study is based on specimens collected in various localities of Sicily and Greece and on live plants cultivated in the Botanical Garden of Catania. For the karyological study, root tips of cultivated bulbs were pretreated with 0.3 % colchicine, fixed in Carnoy and stained according to the Feulgen technique. Leaf anatomy was studied on the same cultivated material, which was fixed in Karpetschenko and embedded in parafin; the cross sections were made in the central part of the leaf lamina and were stained with ruthenium red and lightgreen yellowish.

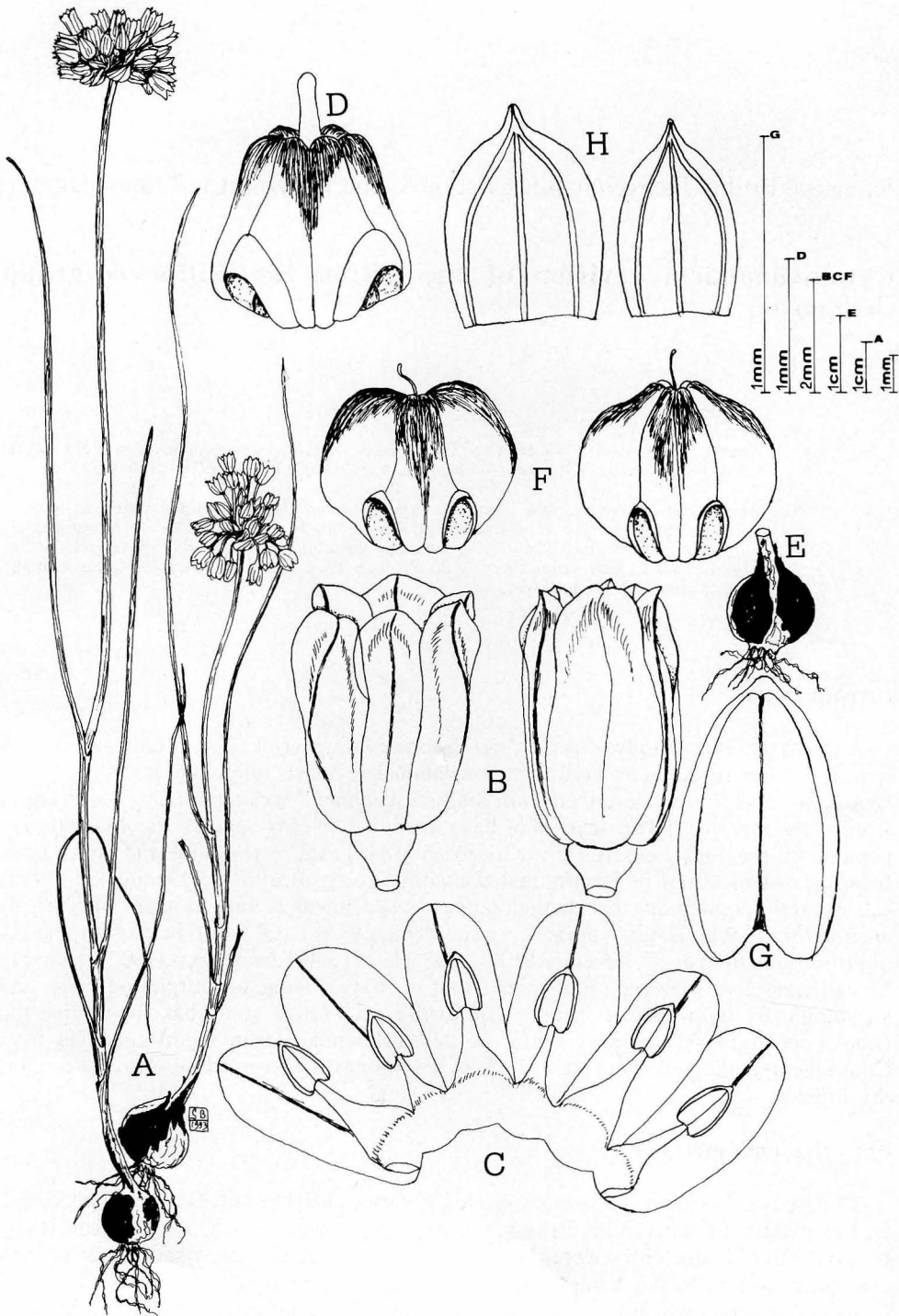


Fig. 1. *Allium obtusiflorum* : A, habit; B, flowers; C, perigon with stamens; D, ovary; E, bulb; F, capsules; G, anther; H, spathe valves.

Results

Taxonomic treatment

The cytotaxonomical features of the examined populations belonging to the cycle of *Allium obtusiflorum* support recognition of three different species.

Allium obtusiflorum DC. in Redouté, Liliacées 2: t. 118. 1805 (Fig. 1). - Type: in Redouté, Liliacées, 2:t. 118. 1805 [iconotype].

Bulbs subglobose, 1 cm in diameter, with outer tunics coriaceous, dark brown, the inner ones membranous, whitish, hyaline. Leaves 4-6, filiform, their blade subcylindrical or semicylindrical, 0.5-0.8 mm wide. Scape solitary or rarely geminate, 7-18 cm high, covered by leaf sheaths for 1/2-1/5 of its length. Inflorescence subglobose or ovoid, dense, many-flowered, with erect or flexuous, 4-18 mm long pedicels. Spathe persistent, with 2 free valves, both 3-nerved, 5-7 mm long, shortly beaked. Bostryces 6. Perigon cylindrical; tepals oblong, gibbous on the back, rounded at the tip, whitish-pink with a dark purplish mid-vein, 3.5-5 mm long, the outer ones 2-2.3 mm wide, the inner ones 1.6-1.8 mm wide. Stamens simple, shorter than tepals; filaments triangular, 1-1.8 mm long, the inner ones longer and markedly broadened at the basis, connate into an annulus 0.8-1 mm long; anthers elliptical, purple-violet, shortly apiculate, 1-1.2 mm long. Ovary ovoid, 1.2-1.5 mm long, whitish-green with a long purplish-brown spot in the upper part of each lobe, with well developed nectaries. Style white, 0.5-1 mm long. Capsule with three valves, subglobose, 3.5 x 3.5 mm, maculated with brown-purple in the upper part of its valves. Seeds black.

Specimens examined. - Sicily, Ficarizzi, in collibus maritimis, s.d., s. l. (FI); *ibid.*, in calcareis pascuis maritimis, 6.1880, *Lojacono* 129 (FI); *ibid.*, in calcareis maritimis aridis, 5.1879, *Lojacono* (BM); Palermo, s. d., *Tenore* (NAP, herb. Tenore; type of *Allium pusillum* Cyr.); *ibid.*, 1843, *Calcara* (FI); *ibid.*, in herbosis maritimis, 5, *Lojacono* 129 (PI); *ibid.*, in maritimis, s. d., *Todaro* (FI); *ibid.*, in aridis maritimis, s. d., *Todaro* (PARMA); *ibid.*, in campis maritimis, 6.1884, *Ross* (FI); *ibid.*, 9.6.1899, *Ross* (BM); *ibid.*, in campis et collibus maritimis, 6.1896, *Ross* (FI); *ibid.*, alla Scalagna, 6.1844, *Inzenga* (NAP, Herb. Guss.); *ibid.*, a Mondello, s. d., *Parlatore* (FI); *ibid.*, a Catalfano, in campis maritimis, 6, *Todaro* 1006 (BM, FI, PAL, PI); Monte Catalfano, 5.1979, *Marcenò* (CAT); nelle colline e nelle spiagge prope Palermo, 1822, *Gussone* (BOLO); in collibus maritimis prope Palermo, 1826, *Gussone* (BOLO); in arenosis maritimis Vergine Maria prope Panormum, 11.6.1856, *Huet de Pavillon* 204 (BM, FI); Villa Maria prope Palermo, s. d., *Gussone* (NAP, Herb. Guss.); Bagheria, in campis maritimis, 6, *Ross* (FI); Sferracavallo, 30.5.1849, s. l. (PAL); *ibid.*, 1827, s. l. (PAL); Dietro Monte Gallo, in campis calcareis maritimis, 6, *Todaro* (PI); Partanna, in campis maritimis, 6.1882, *Lojacono* 129 (FI); Capo Passero, verso il Pantano Morghella, in luoghi rocciosi calcarei erbosi incolti, Pipitona, 6.1909, *Albo* (NAP); Noto, Testa dell'Acqua, 2.6.1973, *Brullo* (CAT); *ibid.*, 9.6.1988, *Brullo* (CAT); Siracusa, penisola Maddalena, 16.6.1977, *Brullo* (CAT); *ibid.*, 1.8.1977, *Brullo* (CAT); Ispica, 26.5.1976, *Brullo* (CAT); *ibid.*, 24.5.1978, *Brullo* (CAT); *ibid.*, 10.6.1978, *Brullo* (CAT); *ibid.*, 2.6.1979, *Brullo* (CAT); Cava d'Ispica (Lecceta), 10.5.1987, *Brullo, Minissale & Scelsi* (CAT); Modica, 1.8.1977, *Brullo* (CAT); *ibid.*, a Monserrato, 3.6.1976, *Brullo* (CAT); Monte Lauro, su substrato calcareo, 26.7.1977, *Brullo* (CAT); *ibid.*, 30.5.1979, *Brullo* (CAT); Canicattini Bagni, 25.5.1979, *Brullo* (CAT); Lentini, San Demetrio, 24.5.1978,

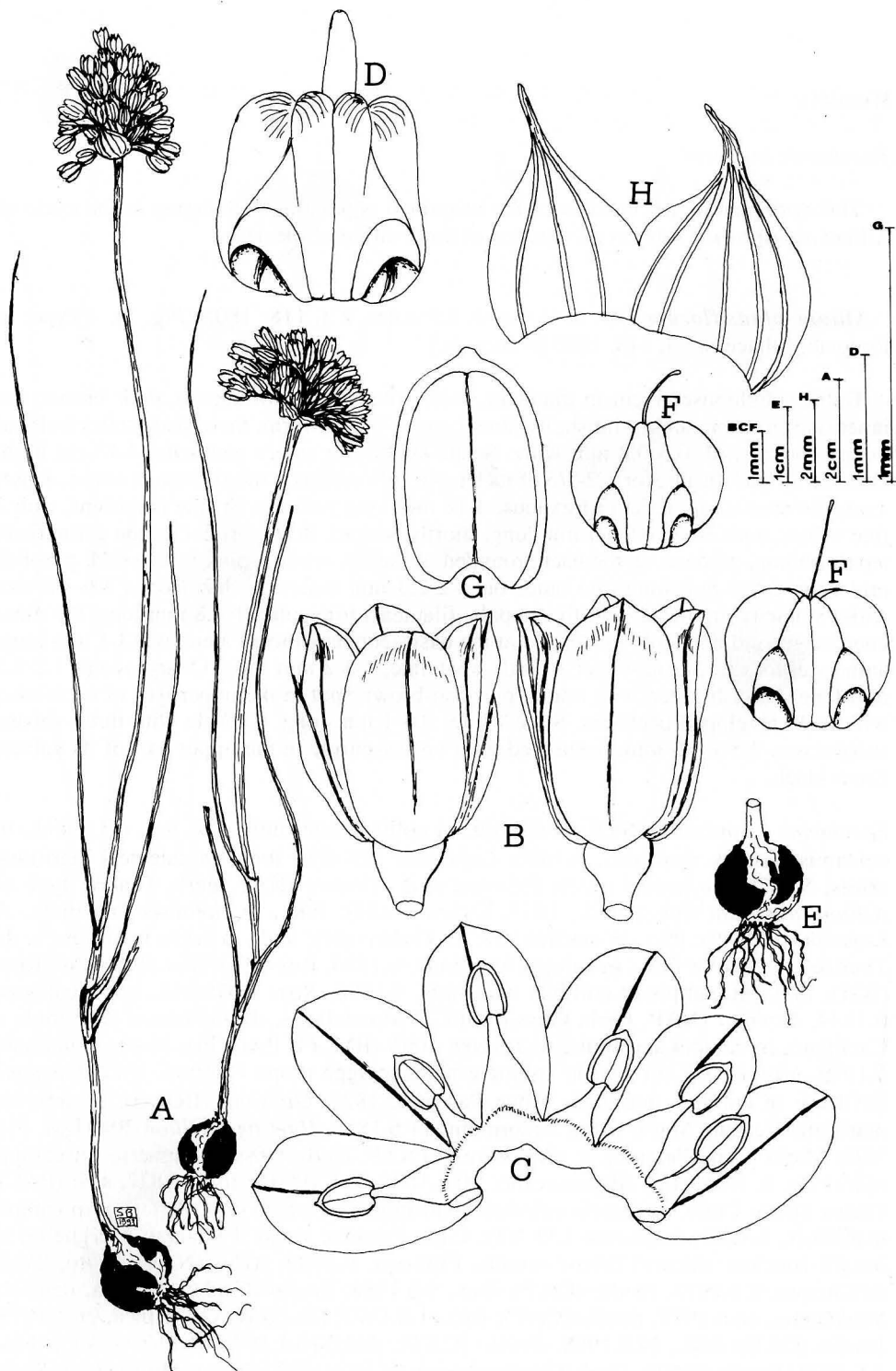


Fig. 2. *Allium erythraeum*: A, habit; B, flowers; C, perigon with stamens; D, ovary; E, bulb; F, capsules; G, anther; H, spathe valves.

Brullo (CAT); *ibid.*, 2.6.1980, *Brullo* (CAT); Siracusa, al Teatro Greco, 23.5.1980, *Brullo* (CAT); Brucoli, presso Augusta, 8.6.1980, *Brullo* (CAT).

Geographical distribution. - Endemic to Sicily, where it occurs along the northern coast near Palermo and in the Iblean area from the coast up to mountain sites (Fig. 4).

Allium erythraeum Griseb., Spic. Fl. Rumel. 2: 396. 1845 (Fig. 2). - Type: Macedonia, *Frivaldszky* sub *A. tenue* Pallas (Isotype: G-BOISS!, BM!; Lectotype: probably in GOET).

Bulbs subglobose-ovoid, 1-1.5 x 1-1.5 cm, with outer tunics coriaceous, dark brown, the inner ones membranous, whitish, hyaline. Leaves 3, glabrous, smooth, their blade semicylindrical to more or less flat, 8-13 cm long and 1-1.5 mm wide, fistulose. Scape solitary, erect, 7-20 cm high, glabrous, cylindrical, covered by leaf sheaths for 1/4-1/3 of its length. Inflorescence hemisphaerical to subovoid, dense, many-flowered, with erect or slightly flexuous, 5-20 mm long pedicels. Spathe persistent, shorter than umbel, with 2 subequal valves, sheathing the inflorescence base, 3 and 5-nerved respectively, 6-10 mm long, with a long beak. Bostryces 6. Perigon cylindrical; tepals equal, elliptical, rounded at the tip purplish-pink with a dark purple mid-vein, 4-4.5 mm long and 2-2.6 mm wide. Stamens shorter than tepals; filaments all simple, broadened at the basis, the outer ones 1-1.5 mm long, the inner ones 1.8-2.2 mm long, connate into an annulus 0.6-0.8 mm long; anthers pale yellow, elliptical, slightly apiculate, 1-1.1 x 0.6-0.7 mm. Ovary subglobose, white suffused with green and striped with green at the apex, 1.2-1.3 x 1.2-1.5 mm, with well developed nectaries. Style white, 0.5 mm long. Capsule with three valves, green, subglobose, 2.5-3 x 2.5-3 mm. Seeds black.

Specimens examined. - Greece, Prov. Chalkidiki, prope Pagum Metamorphosis, 28.6.1988, *Tzanoudakis* 8663 (UPA); *ibid.*; penins. Sithonia prope pagum Vourvouro, cult. specimen, 5.5.1990, *Georgiou* 742 (CAT, UPA); *ibid.*, prope Toroni ex locum Tristicunda dict., 29.6.1988, *Tzanoudakis* 8660 (CAT, UPA); Macedonia, s. d., *Frivaldszky* (BM, G-BOISS); *ibid.*, in herbosis ad Yenikapou prope Thessalonicum, 5.7.1889, *Heldreich* (HUJ, PAL); *ibid.*, *Charrel* 1091 (B, BM, G, K, P); *ibid.*, M. Triveldiki, s. d., *Moricand* (G); Salonica, Micra dans les sables arides, 2.6.1919, *Gabusteau* (P).

Geographical distribution. - Endemic to N Greece, S-E Macedonia and in the Sithonia peninsula (Fig. 4).

Allium thessalicum Brullo, Pavone, Salmeri & Tzanoudakis, sp. nova (Fig. 3). - Type: Greece, Thessalia, Kastrion presso Volos, 22.6.1987, *Brullo, Pavone & Signorello* (CAT).

Bulbus subglobosus vel ovoideus, 1-1,7 x 1-1,5 cm, tunicis externis brunneis, fibrosis in fibras parallelas solutis, internis membranaceis, hyalinis. Folia 3-4, glabra, laevia, lamina plana, 10-15 cm longa et 1,5-3 mm lata, subfistulosa. Scapus solitarius, erectus vel erecto-adscendens, 10-20 cm altus, glaber, teres, vaginis foliorum per 1/3 longitudinis tectus. Inflorescentia densa, multiflora, subhemisphaerica, pedicellis 5-25 mm longis, erectis. Spatha bivalvis, persistens, valvis subaequilongis, umbella brevioribus, 5-10 mm longis, 3-5 nerviis, basi breviter vaginatis, apice breviter apiculatis. Bostryces 6. Perigonium cylindricum, tepalis aequilongis ellipticis vel oblongo-ellipticis, 4,5-5 mm longis et 1,7-2,3 mm latis, apice rotundatis, albo-roseis vel roseo-purpureis vena mediana

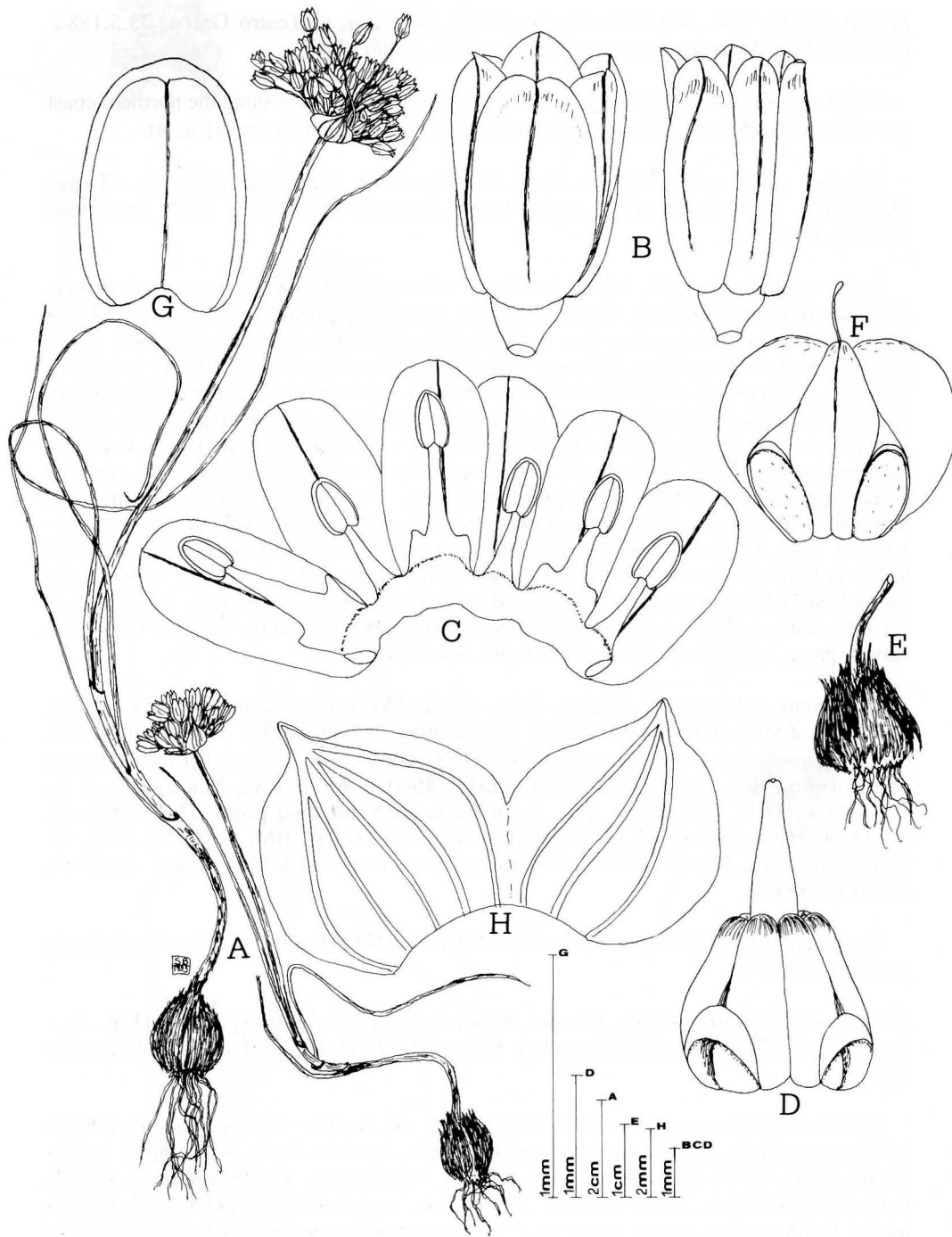


Fig. 3. *Allium thessalicum*: A, habit; B, flowers; C, perigon with stamens; D, ovary; E, bulb; F, capsule; G, anther; H, spathe valves.

purpureo-viridi. Stamina tepalis breviora, filamentis exterioribus brevioribus, simplicibus, 1,2-1,7 mm longis, interioribus 2-2,5 mm longis, basi saepe dilatatis, dentibus lateralibus duobus praeditis, inferne cum tepalis per 0,7-0,8 mm in anulum connatis; antheris luteolis, ellipticis, breviter apiculatis, 1-1,2 x 0,7-0,8 mm. Ovarium subgloboso-ovoideum, albo-viride, apice atro-viridi maculatum, basi foveis nectariferis praeditum, 1,5-2 x 1,5-2 mm. Stylus albus, 1-2 mm longus. Capsula trivalvis, subglobosa, 3,5-4 x 4-5 mm. Semina nigra.

Bulbs subglobose or ovoid, 1-1.7 x 1-1.5 cm, with pale brown outer tunics, fibrous, breaking into parallel fibres, the inner ones membranous, hyaline. Leaves 3-4, glabrous, smooth, their blade flat, 10-15 cm long and 1.5-3 mm wide, slightly fistulose. Scape solitary, erect or erect-ascending, 10-20 cm high, glabrous, cylindrical, covered by leaf sheaths for 1/3 of its length. Inflorescence subhemisphaerical, dense, many-flowered, with erect, 5-25 mm long pedicels. Spathe persistent, with 2 subequal valves shorter than umbell, sheathing the inflorescence base, 3 and 5-nerved respectively, 5-10 mm long, with a short beak. Bostryces 6. Perigon cylindrical; tepals equal, elliptical or oblong-elliptical, rounded at the tip, whitish-pink, with a greenish-purple mid-vein, 4.5-5 mm long and 1.7-2.3 mm wide; stamens shorter than tepals; outer filaments simple, 1.2-1.7 mm long, the inner ones often broadened and provided with 2 teeth at the basis, 2-2.5 mm long, connate into an annulus 0.7-0.8 mm long; anthers yellowish, elliptical, shortly apiculate, 1-1.2 x 0.7-0.8 mm. Ovary subglobose-ovoid, whitish-green, dark green at the apex, 1.5-2 x 1.5-2 mm, with well developed nectaries. Style white, 1-2 mm long. Capsule with three valves, subglobose, 3.5-4 x 4-5 mm. Seeds black.

Specimens examined. - Greece, Thessalia, Kastriion presso Volos, 22.6.1987, *Brullo, Pavone & Signorello* (CAT); *ibid.*, 24.7.1989, *Dimopoulos 901122* (UPA); *ibid.*, Larisa, 22.6.1987, *Brullo, Pavone & Signorello* (CAT); *ibid.*, Larisa presso Chalki, 22.6.1987, *Brullo, Pavone & Signorello* (CAT); Prov. Magnissia, supra Volos, 12.7.1994, *Tzanoudakis 10715* (UPA); Prope Xynovryssi, 3.9.1991, *Tzanoudakis 10716* (UPA).

Geographical distribution. - Endemic to C Greece (Thessaly), where it occurs in various places (Fig. 4).

Karyology

The karyological study showed that all plants are diploid with a somatic number $2n = 16$ (Fig. 5). On the whole, the chromosome complements of the three studied species are morphologically quite different. The karyotype of *A. obtusiflorum* is characterized by 12 metacentric chromosomes with one macrosatellited pair, two macrostatellited submetacentric and two macrosatellited subtelo-centric chromosomes (Fig. 5C, 6C), which confirms results by Garbari & Senatori (1976) and Brullo et al. (1982). The karyotype of *A. erythraeum*, already studied by Brullo & al. (1991) and Tzanoudakis (1992), differs from that of *A. obtusiflorum* mainly in the smaller size and in the lack of submetacentric chromosomes and macrosatellites; its idiogram shows 14 metacentric chromosomes, four of which are microsatellited, and two subtelo-centric microsatellited ones (Fig. 5B, 6B). The karyotype of *A. thessalicum* is again different in that it lacks the subtelo-centric pair. It has 12 metacentric chromosomes, two of which are microsatellited, and four submetacentric chromosomes, two being macrosatellited (Fig. 5A, 6A).

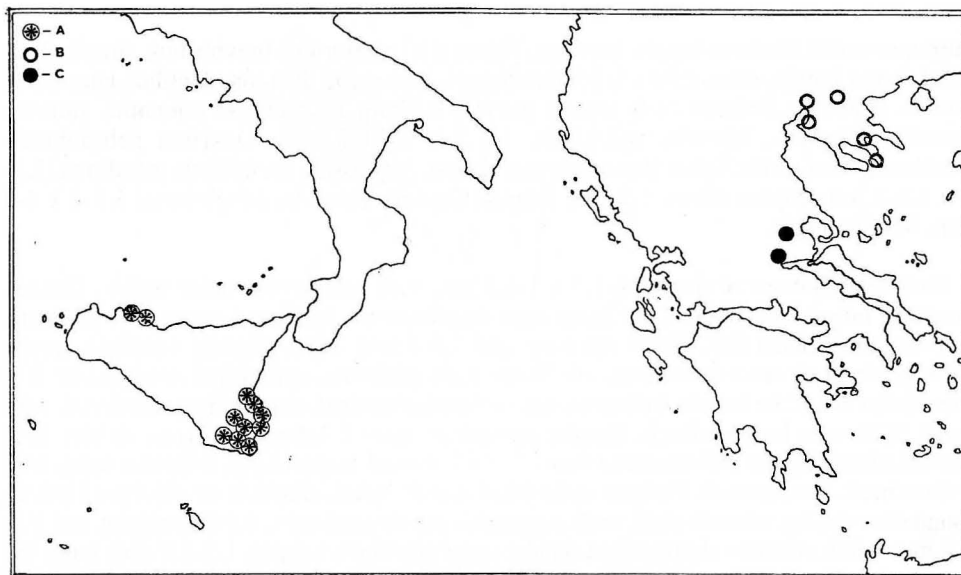


Fig. 4. Geographical distribution of *Allium obtusiflorum* (A), *Allium erythraeum* (B) and *Allium thessalicum* (C).

Leaf anatomy

Leaf cross sections from the three species show remarkable differences of size, shape and anatomy (Fig. 7). All leaves have a uniform epidermis covered by a well developed cuticle. The stomata are distributed all over the surface. The one-layered palisade tissue is regular and compact, with cylindrical cells. The spongy tissue is formed by cells of variable size, with several secretory canals in its periphery. The vascular bundles vary in number and dimensions. As regards the differences, *A. obtusiflorum* has the most slender leaves (up to 0.8 mm wide), with a subcylindrical or semicylindrical shape, a compact spongy tissue and nine vascular bundles, four of which are adaxial (Fig. 7C). The *A. erythraeum* leaves are semicylindrical, flattish (1-1.5 mm wide), with a wide central hollow and with 12-14 vascular bundles, seven of which are adaxial. Finally, *A. thessalicum* has flat leaves that are wider (1.5-3 mm) than in the other two species, more or less fistulose in the centre, with 13 vascular bundles, seven of which are adaxial.

Discussion

The three investigated species must be placed in *Allium* sect. *Scorodon* Koch because they have a spathe that is shorter than the inflorescence, few bostryces (6), simple stamens not exerted from the perigon and an ovary with well developed nectariferous pores.

Allium erythraeum and *A. thessalicum* are more closely related one another than with *A. obtusiflorum*, which is taxonomically more isolated. The first two species both have a spathe with a 5-nerved and a 3-nerved valve, yellow anthers and an ovary and capsule devoid of purplish spots; while *A. obtusiflorum* is characterized by a spathe with two 3-nerved valves, purplish-violet anthers and an ovary and capsule with purplish spots in the upper part.

However several differences allow *A. erythraeum* to be distinguished from *A. thessalicum*. In particular, *A. erythraeum* is characterized by bulbs with coriaceous dark-brown outer tunics, semicylindrical 1-1.5 mm wide leaves, long-beaked spathe valves,

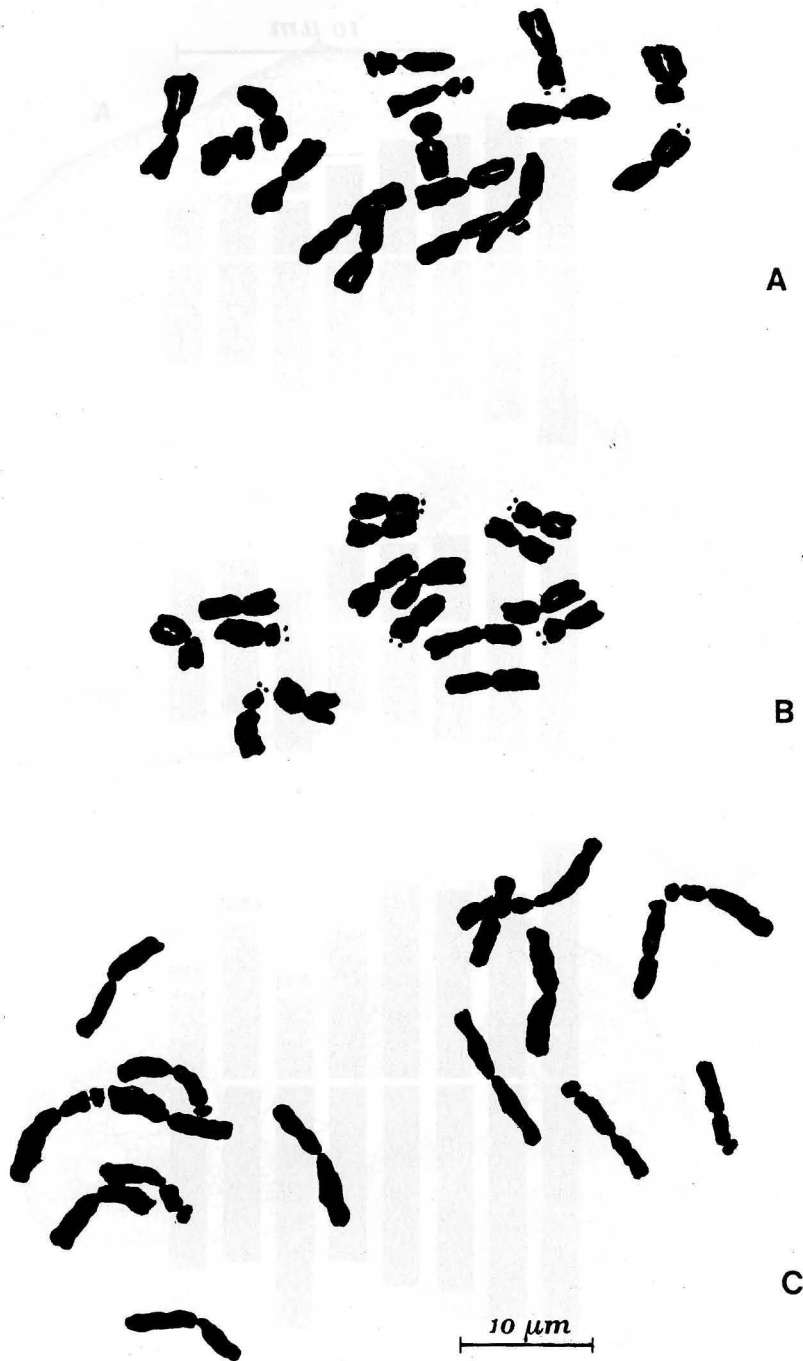


Fig. 5. Mitotic chromosome plates of *Allium thessalicum* from Volos (A), *Allium erythraeum* from Sithonia (B) and *Allium obtusiflorum* from Modica (C).



Fig. 6. Idiograms of *Allium thessalicum* (A), *Allium erythraeum* (B) and *Allium obtusiflorum* (C).

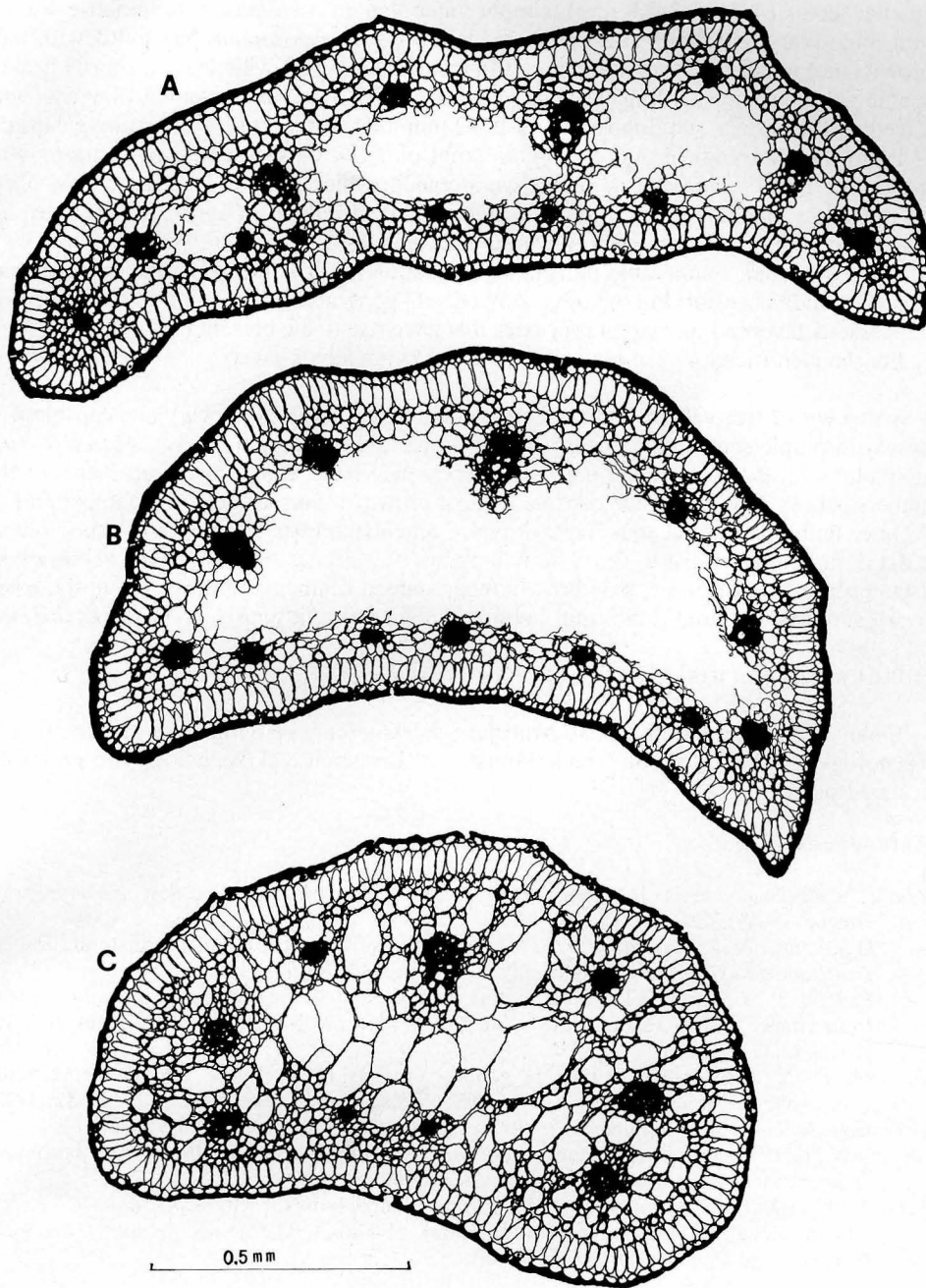


Fig. 7. Leaf cross sections of *Allium thessalicum* (A), *Allium erythraeum* (B) and *Allium obtusiflorum* (C).

smaller tepals (4-4.5 x 2-2.6 mm), simple inner stamen filaments, a subglobose 1.2-1.3 mm long ovary and 2.5-3 mm long capsule; while *A. thessalicum* has bulbs with pale brown outer tunics breaking into parallel fibres, flat 1.5-3 mm wide leaves, shortly beaked spathe valves, somewhat longer tepals (4.5-5 x 1.7-2.3 mm), inner stamen filaments with 2 teeth at the basis, a subglobose-ovoid 1.5-2 mm long ovary and 3.5-4 mm long capsule.

From the chorological and ecological point of view, these species, in common with most other taxa of *Allium* sect. *Scorodon*, are geographically quite localized. They occur on the coast and inland, mainly in crevices and on ledges of cliffs, where they are associated with many other early flowering microphytes.

In view of their remarkable morphological similarity, it is probable that these species had a common ancestor; but the obviously ancient geographical isolation of the respective populations favoured speciation processes that gave rise to the present taxa.

For the identification of these species the following key is given:

- 1 Spathe with 2 free valves, both 3-nerved; anthers purplish-violet; ovary and capsule with brownish-purple spots in the upper part.....*A. obtusiflorum*
 1 Spathe with 2 valves sheathing the inflorescence base, 3 and 5-nerved respectively; anthers pale yellow; ovary and capsule without brownish-purple spots in the upper part..2
 2 Outer bulb coats coriaceous, dark brown; stamen filaments simple; ovary subglobose, 1.2-1.3 mm long; capsule 2.5-3 mm long.....*A. erythraeum*
 2 Outer bulb coats fibrous, pale brown; inner stamen filaments with 2 teeth at the basis; ovary subglobose-ovoid, 1.5-2 mm long; capsule 3.5-4 mm long.....*A. thessalicum*

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