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# Karyological study of some plant taxa from Greece

**Abstract**

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Chromosome numbers and karyotype morphology are given for four taxa of the Greek flora together with distributional and taxonomic notes. The chromosome number ($2n = 16$) and karyotype morphology of *Allium sphaerocephalon* subsp. *arvense* is reported for the first time in material from Kithnos island (Kiklades). The studied population of *Cyclamen graecum* subsp. *graecum* shows the chromosome number $2n = 84$, which is in accordance with previous reports from Greek material of unknown origin. A new subpopulation of *Cynara cyrenaica* from E Crete is presented and karyologically investigated confirming the previous chromosome number ($2n = 34$), whereas microphotograph of the karyotype is provided here for the first time. Furthermore, chromosome data for *Ornithogalum fimbriatum* subsp. *fimbriatum* reveal a diploid karyotype ($2n = 12$), which constitute the first karyological contribution from a Greek population belonging to the typical subspecies.

Keywords: *Allium sphaerocephalon* subsp. *arvense*, *Cyclamen graecum* subsp. *graecum*, *Cynara cyrenaica*, *Ornithogalum fimbriatum* subsp. *fimbriatum*, chromosome number, karyotype morphology, Greek flora.

## Introduction

Greece represents one of the biodiversity hotspots in the Mediterranean Basin (Médail & Quezél 1999). The high plant diversity in combination to its extent places the Greek flora among the richest compared to other European countries (Phitos & al. 2009).

In this paper, we present new karyological data for four phytogeographically interesting taxa from Greece together with distributional and taxonomic comments, in the framework of accumulating karyological data of plants from the Mediterranean region and especially Greece (Bareka & al. 2008: “PhytoKaryon database”).

**2004.** ***Allium sphaerocephalon*** subsp. ***arvense*** (Guss.) Arcang. — $2n = 2x = 16$ (Figs 1a & 1b).

**Gr:** Isl. Kithnos, Kiklades Islands (Kik): Above Merichas port, alt. ca. 50 m., 37° 23' 20.81'' N, 24° 23' 37.11'' E, 12 Jul 2013, *E. Liveri & V. Ketsilis-Rinis 99* (Herb. Phitos & Kamari in UPA).

*Allium sphaerocephalon* L. (*Alliaceae*) is a Mediterranean-European element, which presents great morphological variability. Four subspecies of *A. sphaerocephalon* have been recognized in Greece: a) subsp. *sphaerocephalon*, widely distributed across the entire area of the species; b) subsp. *aegaeum* (Heldr. & Halácsy) Karavok. & Tzanoud., endemic to Greece, restricted in Kiklades Islands (ins. Naxos) (Kik) and East Aegean Islands (EAe) (Karavokyrou & Tzanoudakis 1990; Karavokyrou 1994; c) subsp. *arvense* (Guss.) Arcang., which occurs in C & E Mediterranean region (Sicily, Malta, Albania, Greece, Anatolia) (Kollmann 1984); d) subsp. *trachypus* (Boiss. & Spruner) K. Richt., growing in Greece and Turkey (Karavokyrou 1994; Govaerts 2005; Dimopoulos & al. 2017+).

*Allium sphaerocephalon* subsp. *arvense*, which is characterized by white or greenwhitish tepals, has been placed in several taxonomic ranks, ie. *arvense* type (Bothmer 1972), variety (Fiori 1923), subspecies (Arcangeli 1882; Stearn 1980; Mathew 1996) and species (Garbari 1982; Marcucci & Tornadore 1997).

The basic chromosome number for the whole *A. sphaerocephalon* complex, is x = 8 (Bothmer 1970). The karyological studies for *A. sphaerocephalon* subsp. *arvense* reveal two chromosome numbers: 2*n* = 2x =16 in material from Sicily and Italy (Maggini & Garbari 1977; Bartolo & al. 1978; Tornadore 1989; Johnson & Özhatay 1996; Marcucci & Tornadore 1997), Malta (Brullo & al. 1997), Greece (Bothmer 1970; Tzanoudakis 1985) and 2*n* = 4x = 32 in material from Egypt (Hamoud & al. 1990). Marcucci & Tornadore (1997) observed additionally 0-2 B-chromosomes in populations from Sicily and Italy.

The chromosome number and the karyotype morphology presented here are given for the first time in material from Kithnos island (Kik). The karyotype of diploid *A. sphaerocephalon* subsp. *arvense* is symmetrical, consisting of 2*n* = 2x = 16 metacentric hromosomes (Figs 1a & 1b). The size ranges from 8.0 to 10.5 μm. The given chromosome number hereby is in accordance with previous references from different localities in Greece but some differences in karyotype morphology are noted. Bothmer (1970) reported for *A. sphaerocephalon* in material from the Prov. Arkadia (Peloponnisos) a karyotype consisting of 2*n* = 16 metacentric chromosomes with a large satellite in one pair. One more population from Kea island (Kik) investigated by the same author, who found 16 metacentric and metacentric/submetacentric chromosomes and 1 submetacentric B-chromosome (2*n* = 16+1B). In this karyotype, two pairs are bearing large satellites. Bothmer (1970) did not mention the subspecific level for the above mentioned populations. However, in his subsequent article Bothmer (1972) showed a distribution map of *A. sphaerocephalon* in Greece and indicated the populations from Kiklades as *arvense* type, whereas the populations from Arkadia as *trachypus* type. Thus, we assume that the population from Kea most possibly belongs to subsp. *arvense* and the other one to subsp. *trachypus*. Tzanoudakis (1985) examined karyologically three populations of *A. sphaerocephalon* subsp. *arvense* from Prov. Achaia (Peloponnisos) and also resulted to 2*n* = 16 metacentric and submetacentric chromosomes with large satellites in two pairs. In our studied material, no B-chromosomes were observed but some variation in satellited chromosomes was noted (Figs 1a & 1b).

**2005.** ***Cyclamen graecum*** Link subsp. ***graecum*** **—** 2*n* = 84 (Fig. 1c).

**Gr:** Prov. Messinia, Peloponissos (Pe): close to Stoupa village, uncultivated fields, alt. ca. 20 m, 36° 50' N, 22° 15' E, 30 Oct 2017, *E. Liveri & V. Ketsilis-Rinis 364* (Herb. Phitos & Kamari in UPA).

*Cyclamen* L. (*Primulaceae*) is an important horticultural genus, native to the Mediterranean Basin, including more than 20 species (Grey-Wilson 2003; Compton & al. 2004; Yesson & Culham 2006; Marhold 2011; Curuk & al. 2016). One of the most common species in Greece is *Cyclamen graecum*, which also occurs in Cyprus and Turkey (Moore & Jope 2011). Three subspecies of *C. graecum* are currently recognized based mainly on flower and leaf morphology as well as geographic distribution: a) subsp. *graecum*, found in mainland Greece and islands; b) subsp. *anatolicum* Grey-Wilson, which occurs in Rodos island (East Aegean Islands), Cyprus and coastal areas of S Turkey; c) subsp. *candidum* Grey-Wilson, endemic to Crete (Moore & Jope 2011; Mathew 2013; Culham & Konyves 2014; Dimopoulos & al. 2017+). However, some doubts for the status of *C. graecum* subsp. *anatolicum* have been raised (Culham & Konyves 2014).

Several chromosome numbers have been given for *C. graecum*, but the number 2*n* = 84 is the most common. Glasau (1939) gives an approximate chromosome number, ie. 2*n* = 78-80, as well as De Haan & Doorenbos (1951), who give 2*n* = 84-85 in material from Greece without mentioning the exact localities. Legro (1959) additionally reports several chromosome numbers (2*n* = 84, 85, 86, 136) but based mainly on cultivars. However, Ishizaka (1996, 2003) gives the chromosome number 2*n* = 84 for wild form of *C. graecum* obtained from the Cyclamen Society in UK.

Two interesting hypotheses about the basic number and the origin of 2*n* = 84 in *C. graecum* have been suggested so far. Anderberg (1994) assumes that the basic chromosome number of *C. graecum* is x = 12 and the origin of 2*n* = 84 could be the result of hybridization between the morphologically related *C. hederifolium* Aiton and *C. persicum* Mill. Ishizaka (2003) considers *C. graecum* as autoploid based on cytogenetic experiments stating though that diploids plants became extinct since they have never been found in either wild or cultivated form.

The studied population of *C. graecum* subsp. *graecum* shows chromosome number 2*n* = 84 (Fig. 1c), which is in accordance with the previous references (De Haan & Doorenbos 1951; Legro 1959; Ishizaka 1996, 2003). The karyotype consists of mostly metacentric (m), small chromosomes varying in size (1.0-2.0 μm).

**2006.** ***Cynara cyrenaica*** Maire & Weiller **—** 2*n* = 2x = 34 (Fig. 1d).

**Cr:** Isl. Crete (KK): Prov. Lasithiou: At the road between the village Kalo Chorio and the city of Ag. Nikolaos, in place named Xerokambi, alt. 100-150 m, 35° 07' N, 25° 43' E, 13 Jun 2020, *G. Afordakos s.n.* (Herb. Phitos & Kamari in UPA).

The genus *Cynara* L. (*Asteraceae*) is a Mediterranean genus comprised of 10 species, which are characterized by restricted distribution in most cases (Greuter 2006). A disjunct

distribution pattern is found in *Cynara cyrenaica*, native to E Crete (Greece) and Cyrenaica (NE Libya) (Boulos 1979; Ali & Jafri 1983; Wiklund 1992; Jahn & Schönfelder 1995; Greuter 2006; Turland 2009). The presence of *C. cyrenaica* in Cyprus (Robba & al. 2005) proved to be an error (Makris 2007; Hand & Hadjikyriakou 2009). The species, which is included in the Red Data Book of the flora of Cyprus categorized as Vulnerable (VU) under the name *C. cyrenaica* (Makris 2007) refers to *C. makrisii* Hand & Hadjik., a morphologically similar species, described a few years later (Hand & Hadjikyriakou 2009). *Cynara cyrenaica* is included in Red Data Book of Rare and Threatened Plants of Greece (Phitos & al. 2009) as Endangered (EN) since it was known only from two small subpopulations in E Crete (Turland 2009). Recently, a new third small subpopulation was discovered by G. Afordakos (in Jun 2020), cultivated and karyologically studied here.

The chromosome number $2n = 34$ has been reported for *C. cyrenaica* in material from Crete (Turland 2009). All the other species for the genus counted so far have the same chromosome number except one single report for *C. tournefortii* Boiss. & Reut., which has $2n = 22$ chromosomes (for references see Chromosome Counts Database - Rice & al. 2015).

The chromosome number $2n = 2x = 34$, which is presented here from the new subpopulation of *C. cyrenaica*, is in accordance with the previous unpublished reference cited in the Red Data Book of Greece (Phitos & al. 2009). The karyotype is diploid and symmetrical, consisting of metacentric (m) and submetacentric (sm) chromosomes varying in size from 1.1 to 2.4 μm. The karyotype and microphotograph for *Cynara cyrenaica* are provided here for the first time.

**2007. *Ornithogalum fimbriatum*** Willd. subsp. ***fimbriatum* —** $2n = 2x = 12$ (Figs 1e & 1f).

**Gr:** Thraki, Prov. Evrou (NE): At the river Evros, close to the village Gemisti, alt. ca. 30 m, 40° 58’ N, 26° 19’ E, 10 Mar 2017, *G. Mitsainas 29254* (Herb. Phitos & Kamari in UPA).

*Ornithogalum fimbriatum* (*Hyacinthaceae*) is a variable species of a taxonomically difficult genus, which contains ca. 35 species in Greece (Dimopoulos & al. 2017+). The species occurs in SE Europe and NW Turkey forming two subspecies: a) the widespread subsp. *fimbriatum* and b) the Greek endemic subsp. *gracilipes* (Zahar.) Landström, which differs in several morphological characters, geographic distribution and chromosome number (Landström 1989). Zahariadi (1983) defined the Greek populations from Sterea Hellas (StE) as different species, ie. *O. gracilipes* Zahariadi, whilst distinguished the populations from Samothraki island (North Aegean Islands – NAe) placing them in var. *ciliatum* (Boiss.). Subsequently, Landström (1989) studied populations from Sterea Hellas and Peloponnisos, recognized as *O. fimbriatum* subsp. *gracilipes* but mentioned that the material from Samothraki (NAe) and Chios (EAe) islands may represent the typical subspecies.

Most karyological studies for the species revealed the chromosome number $2n = 12$ in material from Turkey (Cullen & Ratter 1967; Dalgiç & Özhatay 1997; Johnson & Brandham 1997), Bulgaria (Markova & al. 1972, 1974), Crimea (Van Loon & Oudemans 1976) and also in cultivated material of unknown origin (Zhukova 1967). Agapova

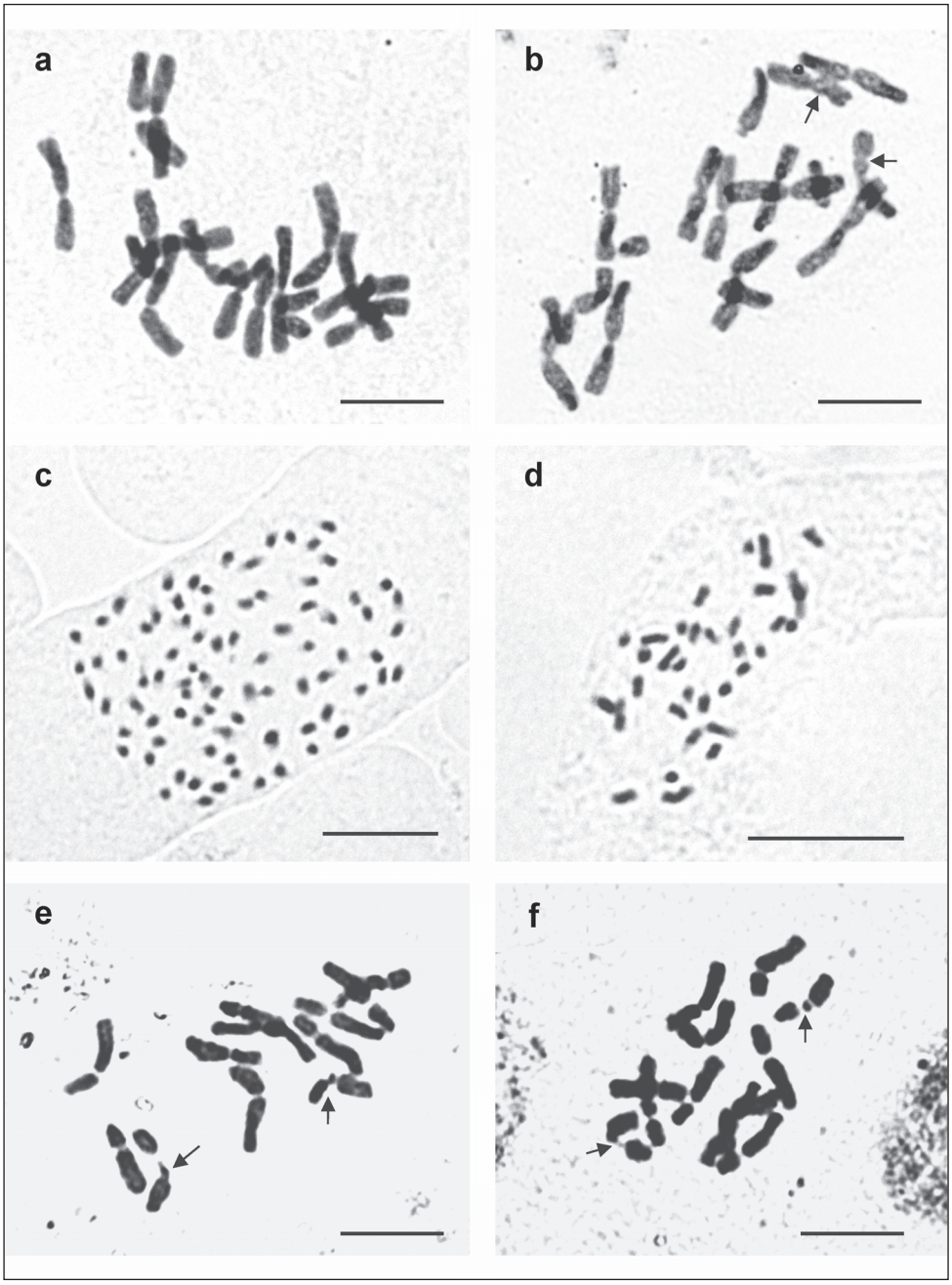


Fig. 1. Microphotographs of mitotic metaphase plates of: **a, b,** *Allium sphaerocephalon* subsp. *arvense*, 2*n* = 2x = 16; **c,** *Cyclamen graecum* subsp. *graecum*, 2*n* = 84; **d,** *Cynara cyrenaica*, 2*n* = 2x = 34; **e, f,** *Ornithogalum fimbriatum* subsp. *fimbriatum*, 2*n* = 2x = 12. – Arrows indicate secondary constrictions and/or SAT-chromosomes; Scale bars = 10 μm.

(1980) reports the same chromosome number with 0-3 B-chromosomes (2*n* = 12+0-3B) in plants from the former USSR. Johnson & al. (1991) indicated trisomy (2*n* = 2x+1 = 13) and polyploidy with one B-chromosome (2*n* = 20+1B) in material from Turkey. The chromosome number 2*n* = 35+0-2B reported in Turkish populations of *O. fimbriatum* by Cullen & Ratter (1967) probably belong to *O. umbellatum* group according to Landström (1989). For all the above mentioned references, the subspecific level is not mentioned but most probably belongs to the typical subspecies. In addition, Landström (1989) gives the chromosome number 2*n* = 14 for *O. fimbriatum* subsp. *gracilipes* in material from Sterea Hellas.

The examined population of *O. fimbriatum* subsp. *fimbriatum* shows the diploid chromosome number 2*n* = 2x =12 (Figs 1e & 1f). The karyotype is symmetrical and consists of 2*n* = 8m + 4sm = 12 chromosomes, varying in size from 6.0 to 9.5 μm. One pair of metacentric chromosomes has a secondary constriction close to the centromere, while no B-chromosomes have been observed. To our knowledge, the chromosome number and karyotype morphology given here in Greek material of the typical subspecies are reported for the first time. The same chromosome number has been reported for *O. fimbriatum* originated from other countries (see references above).

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