

**A KARYOLOGICAL STUDY ON THREE TAXA OF *SILENE* L.
(CARYOPHYLLACEAE) BY USE OF AN IMAGE ANALYSIS
SYSTEM**

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ABSTRACT

Karyological analyses of three taxa of *Silene* (Caryophyllaceae) from Turkey were carried out in this study. Somatic chromosome numbers of $2n = 24$ were determined for *S. lycaonica* and *S. duralii* and $2n = 48$ for *S. cappadocica*. The basic chromosome numbers is $x = 12$ in all taxa. The karyotype analyses were studied by using an Image Analyzing System supported with computer. Also, karyograms and their idiograms were drawn.

KEY WORDS: Caryophyllaceae, *Silene*, Imaging techniques, karyotype, Turkey

Silene (Caryophyllaceae) is one of the largest plant genera in the world with approximately 700 species, almost half of which grow in the Mediterranean region. Southwest Asia is one of the main centers of diversity for the genus, which is represented by 136 species in Turkey (Coode and Cullen, 1967; Davis et al., 1988; Tan and Vural, 2000; Duran and Menemen, 2003; Deniz and Düşen, 2004; Bağcı, unpub. data 2007).

Silene has been studied using taxonomical (Duran and Menemen, 2003; Deniz and Düşen, 2004), morphological (Yıldız, 2006), molecular (Sandbrink and Brederode, 1991; Popp and Oxelman, 2001), palynological (Yıldız, 2006), chemical (Larhsini et al., 2003;

Dötterl et al., 2005) and cytotaxonomical data (Kruckeberg, 1955; Morisset and Bozman, 1969; Abdel Bari, 1973; Yıldız and Çırpıcı, 1996; Široký et al., 2001; Yıldız and Gücel, 2006). However, karyotypic studies have not been published for *Silene lycaonica* and *S. duralii*.

The chromosome numbers of the genus *Silene* are reported as $2n = 20, 24$ and 28 in 40 taxa in the Turkish Flora (Coode and Cullen, 1967; Davis et al., 1988; Özhatay et al., 2000).

In the present study, the chromosome number and karyotype of the species has been studied (except *S. cappadocica*) for the first time.

MATERIALS AND METHODS

Voucher specimens for the present study were obtained as follows:

Section: *Sclerocalycinea* Boiss.

Silene lycaonica Chawdh. Caespitose, glabrous, perennial. Stems erect c. 25 cm. Calyx 12-16 mm, Anthophore 6-7 mm. Capsule included in the calyx. Konya: Konya-Taşkent-Ermenek road, 5 kilometers away from Taşkent., steppe, 15.07.2004. *Ertuğrul* 3175 & *Bağcı*. This species is endemic to Turkey.

Section: *Macranthae* (Rohrb.) Chowdh.

Silene duralii Y. *Bağcı* A densely tufted aerial suffruticose perennial, flowering stems 22-34 cm tall, canescent below, viscid above. Inflorescence in compound dichasia or in a widely branched compound dichasium, viscid, glaucous. Calyx (6)7-9 mm long, glabrous. Capsule mature, ovoid, exserted from the calyx, 6-11(-12) mm long. Anthophore glabrous, 1.5-2.0 mm long. Karaman: Ermenek-Kazancı, Sarıova plateau, Kartalkaya, mountain steppe, 1750-1770 m., 16.06.2006, *Bağcı* 3476. This species is endemic to Turkey.

Section: *Spergulifolia* Boiss.

Silene cappadocica Boiss & Heldr. Perennial, stems ascending to erect, retrorsely puberulent, 10-50 cm. high. Calyx 3-5 mm long in functionally female flowers, 5-11 mm long in hermaphrodite flowers. Anthophore 3-4 mm long. Capsule included in the calyx. Konya: Ermenek-Bucakışla, Yelibel aisle, Teke Çatı vicinity, 1610 m., 17.07.2004. *Ertuğrul 3291, Bağcı & Dural.*

All of the cytological observations were made on root tips, germinated on wet filter paper in Petri dishes. After germination, fresh root tips pretreated in α -mono-bromonaphthalene at 4°C for 16 hours, and then fixed with glacial acetic acid: absolute alcohol (1:3) 4°C for 24 hours. These were deposited in 70% ethanol at 4°C. The root tips were hydrolyzed in 1N HCl at room temperature for 12 minutes. Finally, they were squashed and stained in 2% aceto-orcein. Permanent slides were prepared using standard liquid nitrogen method. Karyotypes were determined using Image Analysis System (BsPro200) on a personal computer (Martin et al., 2006).

RESULTS AND DISCUSSION

Chromosome number and ploidy level

Both chromosome number and morphology are analyzed for the first time for *S. duralii* and *S. lycaonica*. Diploid chromosome numbers of $2n = 24$ were determined for *S. lycaonica* and *S. duralii* (Figs. 1, 2); *S. cappadocica* was found to be tetraploid with $2n = 48$. Karyogram and idiograms of these taxa (Figs. 4-5) were drawn by use of an Image Analysis System.

Chromosome length

Based on total length, the chromosomes were organized in decreasing order for each species. Arm ratios of each were found to be 1.88 for *S. lycaonica*, 1.31 for *S. duralii* and 1.38 for *S. cappadocica*. The absolute chromosome lengths were measured for each species and differences were seen. The smallest chromosomes were those in *S. cappadocica*, ranging between 1.31-3.02 μm . A similar chromosome

length (1.78-3.72 μm) was observed in *S. duralii*. Finally, *S. lycaonica* had the largest chromosomes, ranging between 2.30-5.31 μm (Table 1).

Genome length

Differences between chromosome lengths of the three species were correlated with their mean genome length. The genome lengths of each taxon are given in Table 1. The smallest genome length was that of *S. duralii* (28.88 μm) and the largest that of *S. cappadocica* (49.52 μm). *Silene lycaonica* showed an intermediate genome length value of 44.34 μm (Table 1).

Karyotype analyses

Differing karyotype formulas were seen only in *S. lycaonica* (which was 8m+3sm+1st) and in *S. duralii* (which was 11m+1sm); the tetraploid, *S. cappadocica* had a karyotype formula of 20m+4sm. The karyotypes of these species were similar, consisting of metacentric and submetacentric chromosomes; *S. lycaonica* differed by having one pair of subtelocentric chromosomes.

In this study, we observed chromosome numbers and morphology that were comparable to previous cytotaxonomic studies on the genus *Silene* (Yıldız & Çırpıcı, 1996). In their cytotaxonomic study of 19 *Silene* species, 15 species were diploids ($2n = 24$) and four species (including *S. cappadocica*) were tetraploids ($2n = 48$). In addition, the basic chromosome number was determined as $x = 12$ (Yıldız & Çırpıcı, 1996).

Chromosome study of the autotetraploid, *Silene latifolia*, revealed the chromosome number as $2n = 4x = 48$, much as in *S. cappadocica* (Široký et al., 1999). Široký et al., (2001) reported on four species of *Silene* (*S. latifolia*, *S. vulgaris*, *S. pendula* and *S. chalconica*) with diploid numbers of $2n = 2x = 24$, much as found in the present study.

Ghazanfar (1983) determined the karyotypes of 14 species belonging to sections *Siphonomorpha* and *Auriculatae* of *Silene*. In *Silene viridiflora* and *S. nodulosa* there are satellites on metaphase

chromosomes and in *S. boryi* and *S. vallesia* tetraploidy was observed. In the present study, satellites were not observed *Silene* but in *S. cappadocica* tetraploidy was observed as previously reported.

Abdel Bari (1973) made a karyotype study of 22 taxa of *Silene*. Two different basic chromosome numbers were revealed: $x = 10$ and $x = 12$. Tetraploidy was only found in *S. vulgaris* subsp. *macrocarpa* ($2n = 48$).

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Table 1. Chromosome comparison in the four studied taxa of *Silene*. AR: arm ratio; CI: centromeric index; THC: total length of haploid complement; M: metacentric; SM: submetacentric; ST: subtelocentric.

Species	2n	Chromosome sizes (μm)	AR	CI	THC (μm)	M	SM	ST
<i>S. lycaonica</i>	24	2.30-5.31	1.88	3.09	44.3	8	3	1
<i>S. duralii</i>	24	1.78-3.72	1.31	3.61	28.9	11	1	-
<i>S. cappadocica</i>	48	1.31-3.02	1.38	1.78	49.5	20	4	-

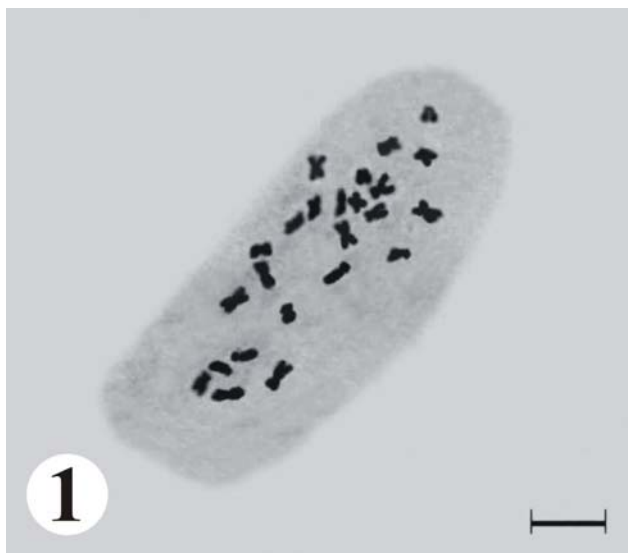


Figure 1. *Silene lycaonica* ($2n = 24$). Scale = 10 μm .

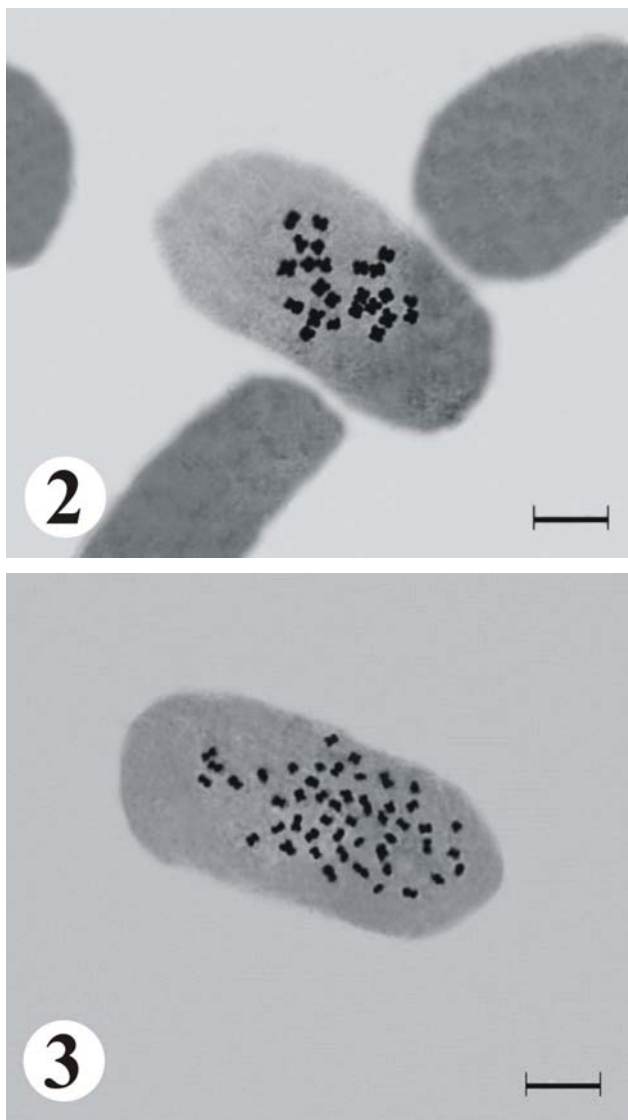


Figure 2. *S. duralii* ($2n=24$), 3. *S. cappadocica* ($2n=48$). Scale: 10 μm .

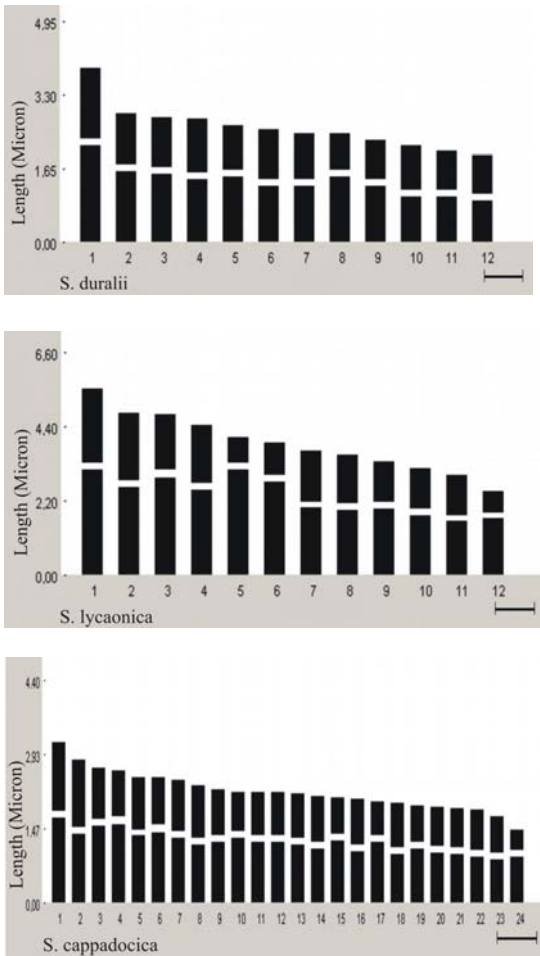
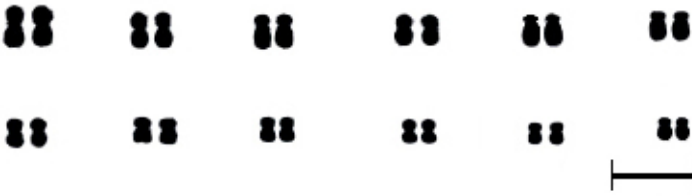


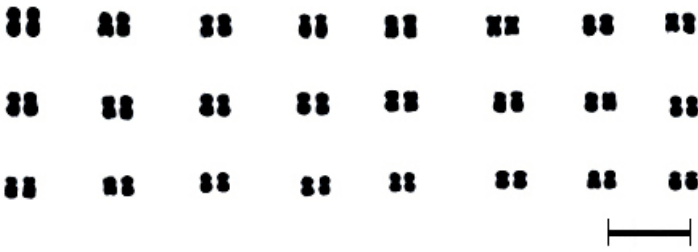
Figure 4. Idiograms of taxa belonging to *Silene*. Scale Bar: 10 μ m.



S. lycaonica



S. duralii



S. cappadocica

Figure 5. Karyograms *Silene lycaonica*, *S. duralii* and *S. cappadocica*. Scale Bar: 10 μ m.