

A MORPHOLOGICAL INVESTIGATION ON *SILENE* L., (CARYOPHYLLACEAE) SPECIES DISTRIBUTED IN WEST ANATOLIA AND NORTH CYPRUS

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Abstract

In this study, the morphology of *Silene sipylea* (L.) O. Schwarz, *S. fabaria* (L.) Sibth. & Sm., *S. tenuiflora* Guss., *S. lydia* Boiss. distributed in West Anatolia (B1, C1, C2) and *S. discolor* Sibth. & Sm., *S. colorata* Poir. var. *colorata*, *S. apetala* Willd. var. *grandiflora* distributed in North Cyprus was investigated. Making use of fresh specimens collected from both geographical regions, drawings of the general view and parts of the plant such as the flower, parts of the flower (sepal, petal), fruit were made, and micrographs of the seeds taken by stereo light microscopy. Significant morphological and seed characters related to the species are presented.

Longest calyx was encountered in *S. sipylea* and the shortest in *S. apetala* var. *grandiflora* while *S. lydia*, *S. discolor*, *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora* had puberulent calyx, *S. sipylea*, *S. fabaria* and *S. tenuiflora* had a glabrous calyx. *S. fabaria*, *S. tenuiflora* and *S. apetala* var. *grandiflora* were found to have 10 anastomotic veins in the calyx, whereas *S. discolor*, *S. colorata* var. *colorata* and *S. sipylea* had 10, and *S. lydia* 25-30 in the calyx. Ligula were observed in the basal petal blades of all the species. Ligula of *S. sipylea* and *S. lydia* are quite small. The anthophore in *S. lydia* is approximately 1 mm and as long as 25-30 mm in *S. sipylea*. The seeds of *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora* are distinct from those of the other species, they are reniform shaped, round, winged and wrinkled. The largest seeds were observed in *S. tenuiflora* and the smallest in *S. discolor*. The tubercles are quite distinct in *S. lydia* and *S. tenuiflora* has an elongated conical shape.

Introduction

In this study, the morphology of *Silene sipylea* (endemic to Turkey), *S. fabaria*, *S. tenuiflora*, *S. lydia*, *S. discolor*, *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora*, distributed in West Anatolia and North Cyprus was investigated.

Silene is represented with about 170 taxa in the Flora of Turkey and with about 20 taxa in the Flora of North Cyprus (Davis, 1967, 1988; Güner *et al.*, 2001; Meikle, 1977; Viney, 1994).

There are no studies on the *Silene* species of North Cyprus except for Yıldız & Gücel (2003) cytotaxonomical and palynological study on North Cyprus endemics and on *Silene gigantea* L. var. *gigantea* and *S. behen* L. distributed in North Cyprus and West Anatolia. A number of taxonomical observations related to *Silene* species in some floristic studies have been made (Meikle 1977; Viney 1994). As for the taxonomical and morphological studies conducted on the *Silene* species distributed in Turkey and surrounding geographical regions outside North Cyprus, one can encounter Melzheimer's (1977) biosystematic revision of the *Silene* taxa distributed in the Balkans. In this study, a comparative examination of seed, calyx and petal characters as well as pollen characteristics was made. In another study in which he discussed the taxonomical

position of *Silene thebana* Orph.ex Boiss. distributed in Greece, Melzheimer (1987) made use of the morphology of leaf, petal and seed as the most distinctive criterion. Prentice (1978, 1979, 1980, 1988) examined the taxonomical and karyological diagnostics of the *Silene* species belonging to section *Elisanthe*. Authier (1992) made morphological examinations on *Silene remotiflora* Vis. species distributed in Northwest Greece. Greuter (1995), classified the *Silene* species available in Greece. In this study systematic characters of the sections were reviewed and the phylogenetic relationships of the genus among species investigated. Desfeux ve Lejeune (1996), made a phylogenetic analysis of 22 species of the European-Mediterranean *Silene* species. In a study on *Silene cserei* Baumg. subsp. *aeniopsis* (Bornm.) Chowdh., which is an endemic taxon, and *Silene vulgaris*, showed quite similar characteristics Vural and Adıgüzel (1996).

Yıldız & Çırpıcı (1992) investigated the morphology of 8 *Silene* species disributed in Tokat province (A5-A6) and its environs. Yıldız & Çırpıcı (1998) also determined the seed morphology of a total of 19 *Silene* species disributed in Turkey, 3 of which are endemic, using stereo and scanning electron microscopy (SEM). Yıldız (2002) also studied the seed morphology of 17 *Caryophyllaceae* species distributed in North Turkey including *Dianthus* and *Silene* species. No detailed morphological studies have been made. The objective of the present study was to determine the morphological characteristics of the *Silene* species growing in West Anatolia and North Cyprus, and to discuss the systematic position of the species that belong in the same section according to these characteristics. The classification of the species studied was made accoding to the Flora of Turkey (Davis, 1967) and the Flora of Cyprus (Meikle, 1977).

Materials and Methods

Specimens of the *Silene* species were collected from West Anatolia (B1, C1, C2) and North Cyprus between the years 2001 and 2003 (Table 1, Fig. 1). Information was gathered from various floristic works covering the investigation area and immediate surroundings (Meikle, 1977; Viney, 1994; Davis 1967, 1988; Güner *et al.*, 2001) and two herbariums [Ege University Faculty of Sciences Herbarium (EGE), North Cyprus Herbarium].

An average of 6-7 specimens belonging to each species were collected from each locality. Some of the specimens were put into 70% alcohol to be used in morphological studies. Tthe plant specimens collected from investigation area were identified after reference to Flora of Turkey and East Eagean Islands (Davis, 1967), Flora of Cyprus (Meikle, 1977) along with An Illustrated Flora of North Cyprus (Viney, 1994). Moreover, the plants were identified and checked in Ege University Faculty of Science Herbarium (EGE) and North Cyprus Herbarium.

In the morphological study, *Silene* species collected from West Anatolia and North Cyprus, the diagnostic features such as plant height, arrangement of the basal and cauline leaves, inflorescence, sepal, petal and fruit are given in table form.

Moreover, drawings of 7 plants belonging to 7 species showing the general view and parts such as the calyx (sepal), petal and fruit were included in the study (Figs. 2-8). The specimens collected were deposited in the Department of Biology, Celal Bayar University, Turkey. The plants were given numbers starting with the letter 'K', as an abbreviation for K.YILDIZ. A map of the investigation area where the specimens were collected was also added to the study.

Table 1. Data for the collection of *Silene* species (B, C: Squares of Flora of Turkey).

Species	Locality, date, number
<i>Silene sipylea</i> (West Anatolia) Endemic for Turkey	B1 Manisa, Sipil mountain, near road, slopes, 800-900 m, 05.06.2002, K060.
<i>S. fabaria</i> (West Anatolia)	C2 Muğla, between Sultaniye-Kaunas, 200-300m, 08.05.2003, K063.
<i>S. tenuiflora</i> (West Anatolia)	C1 Muğla, 40 km from Marmaris to Datça, rocky places, 300-400m, 20.07.2003, K070.
<i>S. lydia</i> (West Anatolia)	1. B1 Manisa, Sipil mountain, near road, slopes, rocky places, 500-600m, 14.05.2003, K067. 2. B1 Manisa, Sipil mountain, near lake, 900-1000m, 14.05.2003, K066.
<i>S. discolor</i> (North Cyprus)	Lefkoşa (Nicosia), Alevkaya (Halevga), in forest and near road, 750-800m, 20.06.2003, K058.
<i>S. colorata</i> var. <i>colorata</i> (North Cyprus)	Girne (Kyrenia), Hz. Ömer shore, sea level, 20.06.2003, K069.
<i>S. apetala</i> var. <i>grandiflora</i> (North Cyprus)	Lefkoşa (Nicosia), Buffavento castle, rocky places, slopes, 800-900m, 23.04.2001, K055.

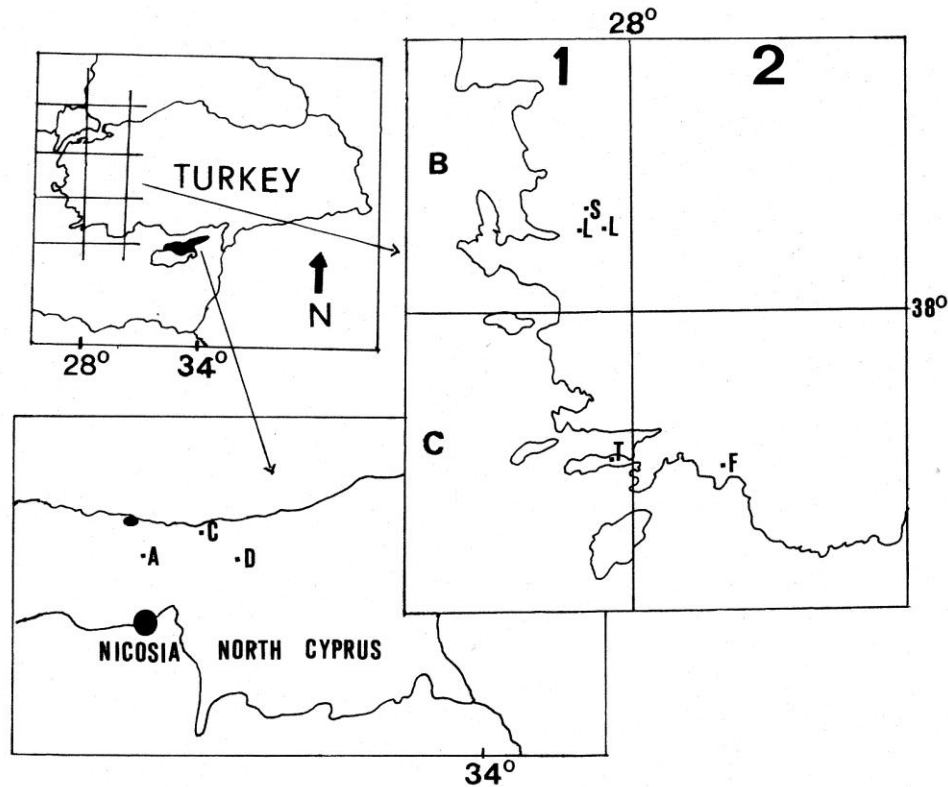


Fig. 1. Map of the investigation area (S: *Silene sipylea*, F: *S. fabaria*, T: *S. tenuiflora*, L: *S. lydia*, D: *S. discolor*, .C: *S. colorata* var. *colorata*, .A: *S. apetala* var. *grandiflora*).

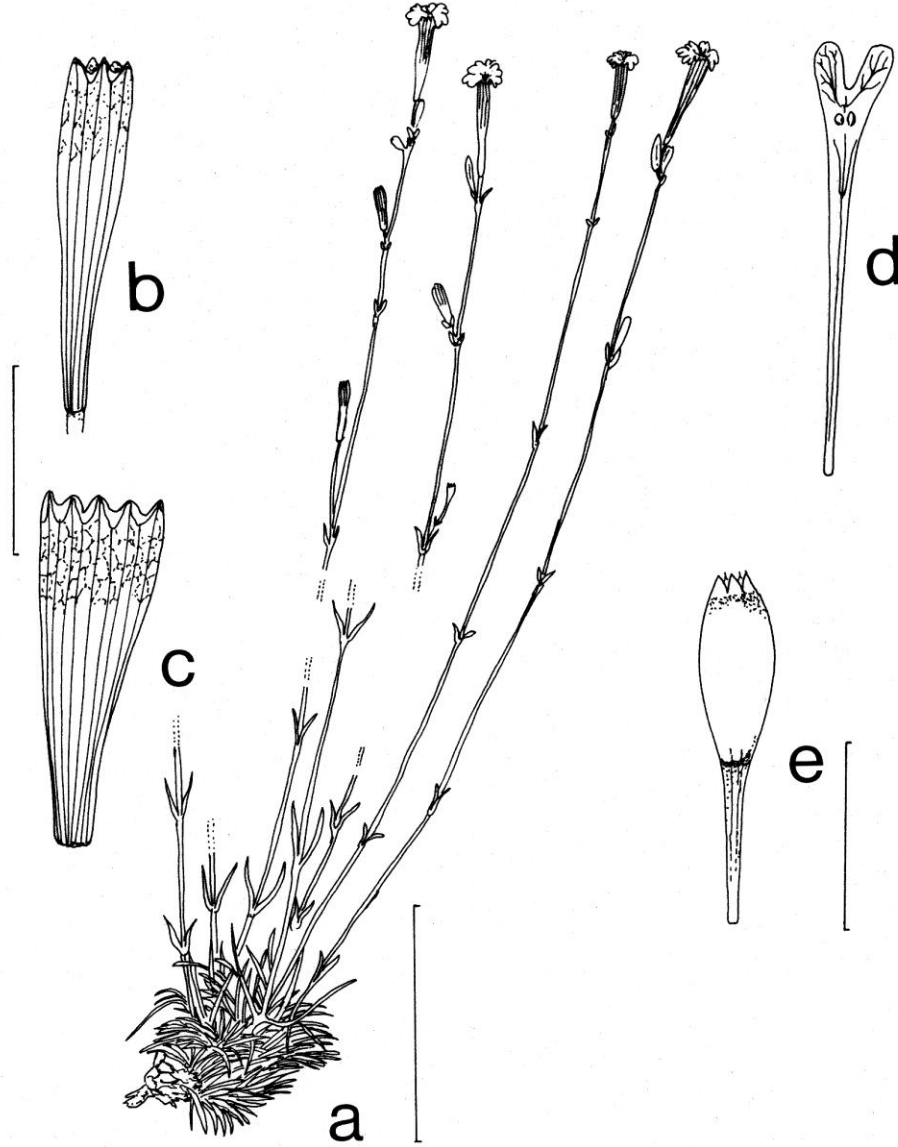


Fig. 2. *Silene sipylea*, (K060, West Anatolia) a. General wiew (—: 5cm), b. Calyx (Flower), c. Calyx (Opened), d. Petal, e. Fruit (Capsule), (b, c, d, e: —: 20 mm).

Micrographs of the seeds were taken using an olympus WM trinocular Stereo dissection microscope (Figs. 9, 10). A NFKx3.3 LD 125 Lens was used during the examination. At least 20 seeds from each species except for the *S. sipylea* and *S. fabaria*, whose seeds could not be obtained, were examined to specify the micromorphological character of the seeds. Morphological characters of the seeds were determined according to Prentice (1978) and Stearn (1996).

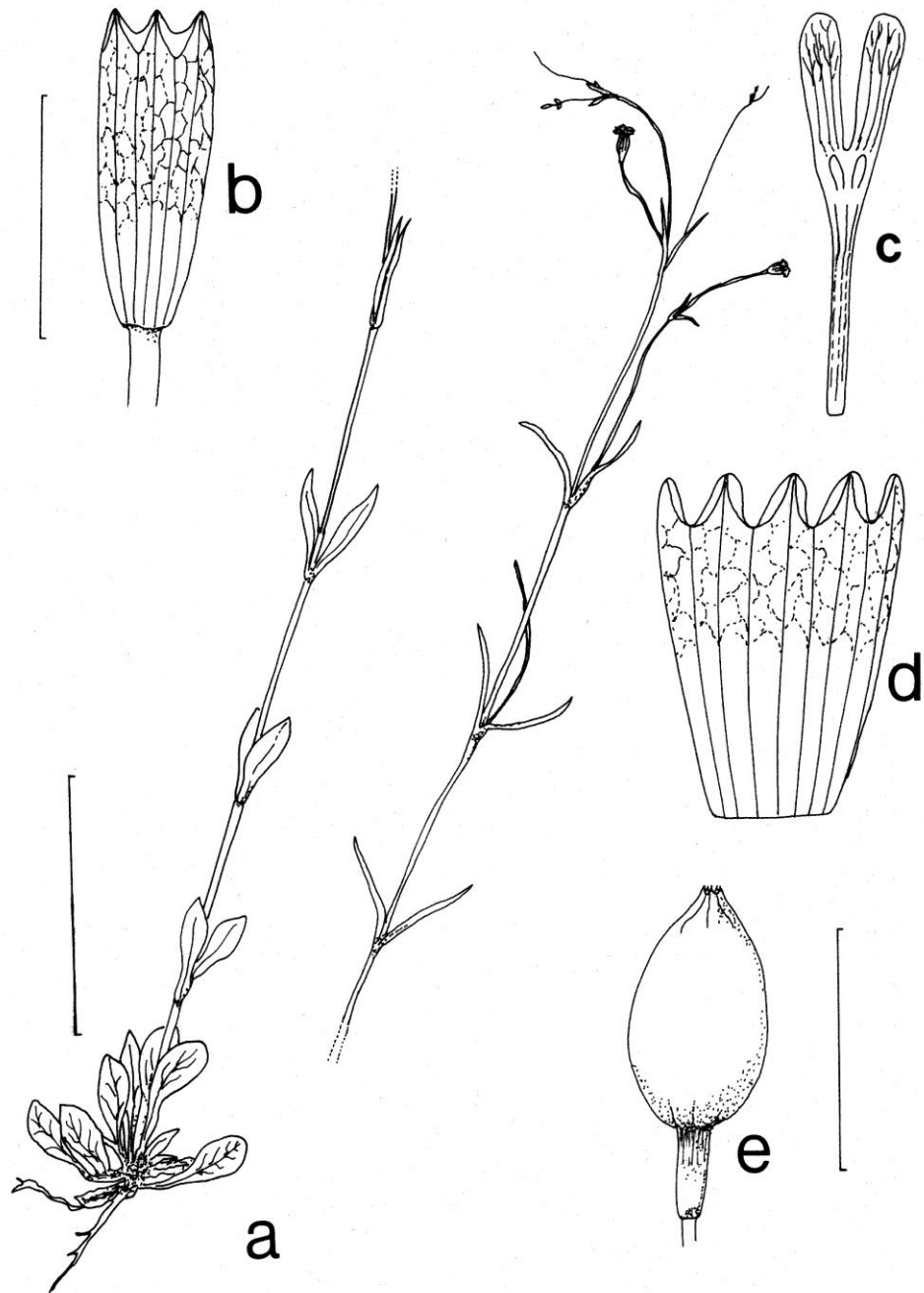


Fig. 3. *S. fabaria*, (K063, West Anatolia) a. General view (—: 10 cm), b. Calyx (Flower), c. Petal, d. Calyx (Opened), e. Fruit (Capsule), (b, c, d, e: —: 10 mm).

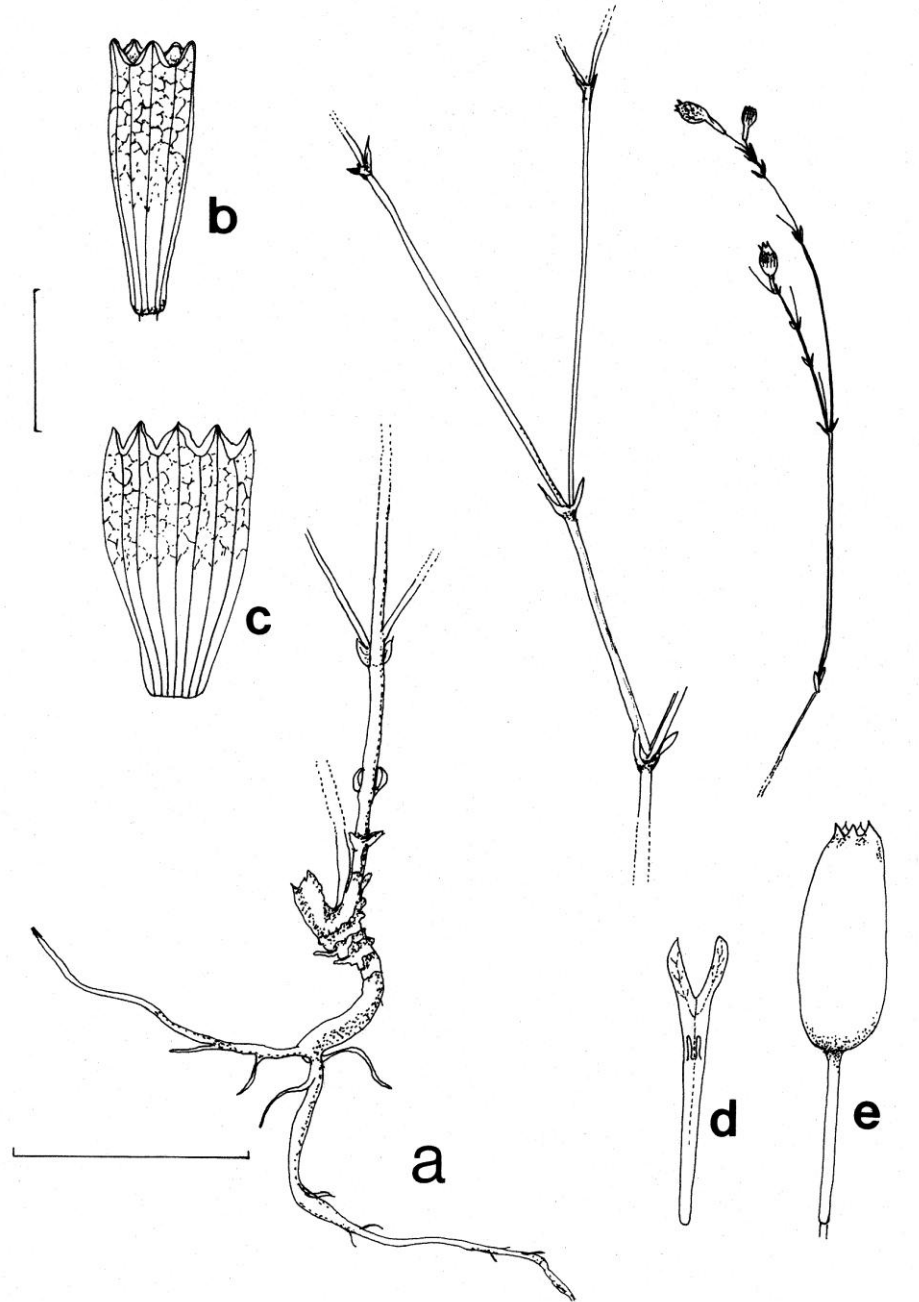


Fig. 4. *S. tenuiflora*, (K070, West Anatolia) a. General view (—:5cm), b. Calyx (Flower), c. Petal, d. Calyx (Opened), e. Fruit (Capsule), (b, c, d, e: —:10 mm).

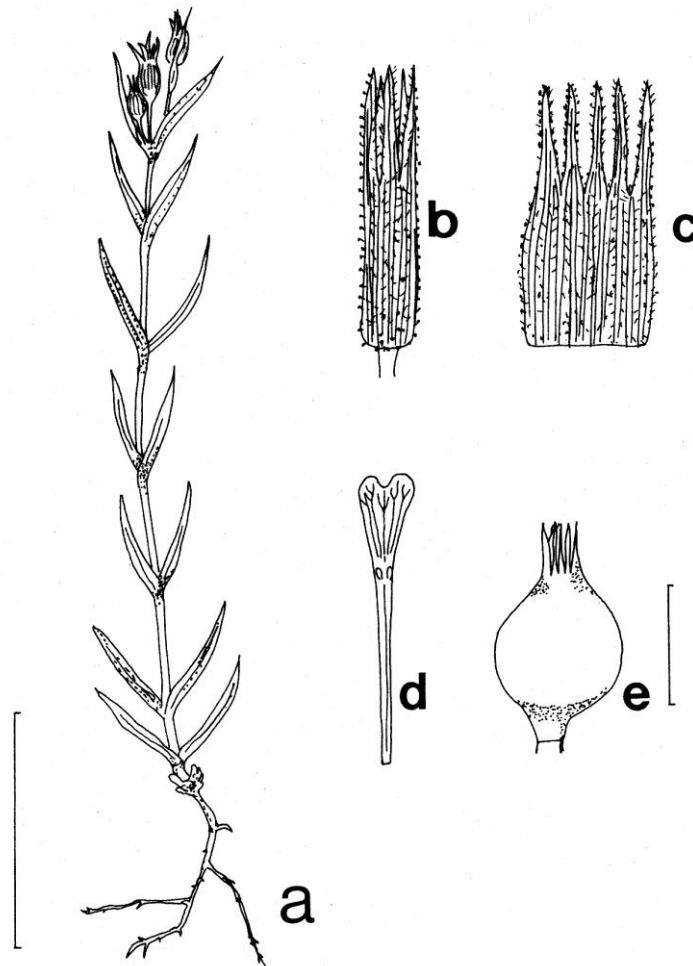


Fig. 5. *S. lydia*, (K067, West Anatolia) a. General view (—:5cm), b. Calyx (Flower), c. Petal d. Calyx (Opened), e. Fruit (Capsule), (b, c, d, e: —:10 mm).

Results and Discussion

A morphological investigation was conducted on *S. sipylea*, *S. fabaria*, *S. tenuiflora*, *S. lydia* from West Anatolia and *S. discolor*, *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora* from North Cyprus, which is represented with nearly 170 taxa in the Flora of Turkey and approximately 20 taxa in the Flora of North Cyprus. The most important morphological characters such as leaves of the plants at the base and cauline, calyx, petal, fruit and seed of *Silene* specimens from different localities were compared in the study. *S. tenuiflora* and *S. apetala* var. *grandiflora* occur in rocky areas, while *S. discolor* mainly grows on beaches at sea level. *S. lydia*, *S. sipylea*, *S. fabaria*, *S. colorata* var. *colorata* on the other hand often occur on slopes.

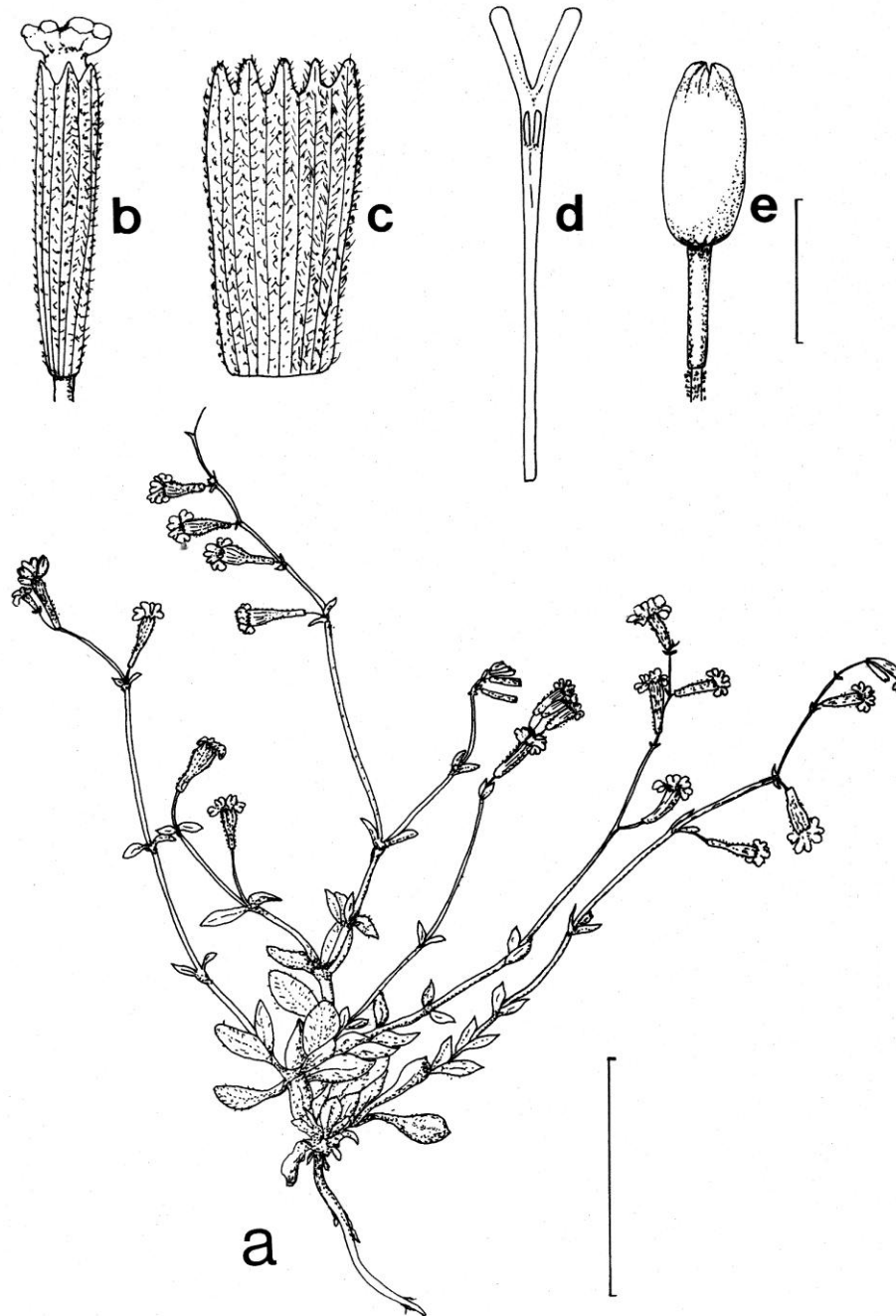


Fig. 6. *S. discolor*, (K058, North Cyprus) a. General view (—: 5cm), b. Calyx (Flower), c. Calyx (Opened), d. Petal, e. Fruit (Capsule), (b, c, d, e: —: 10 mm).

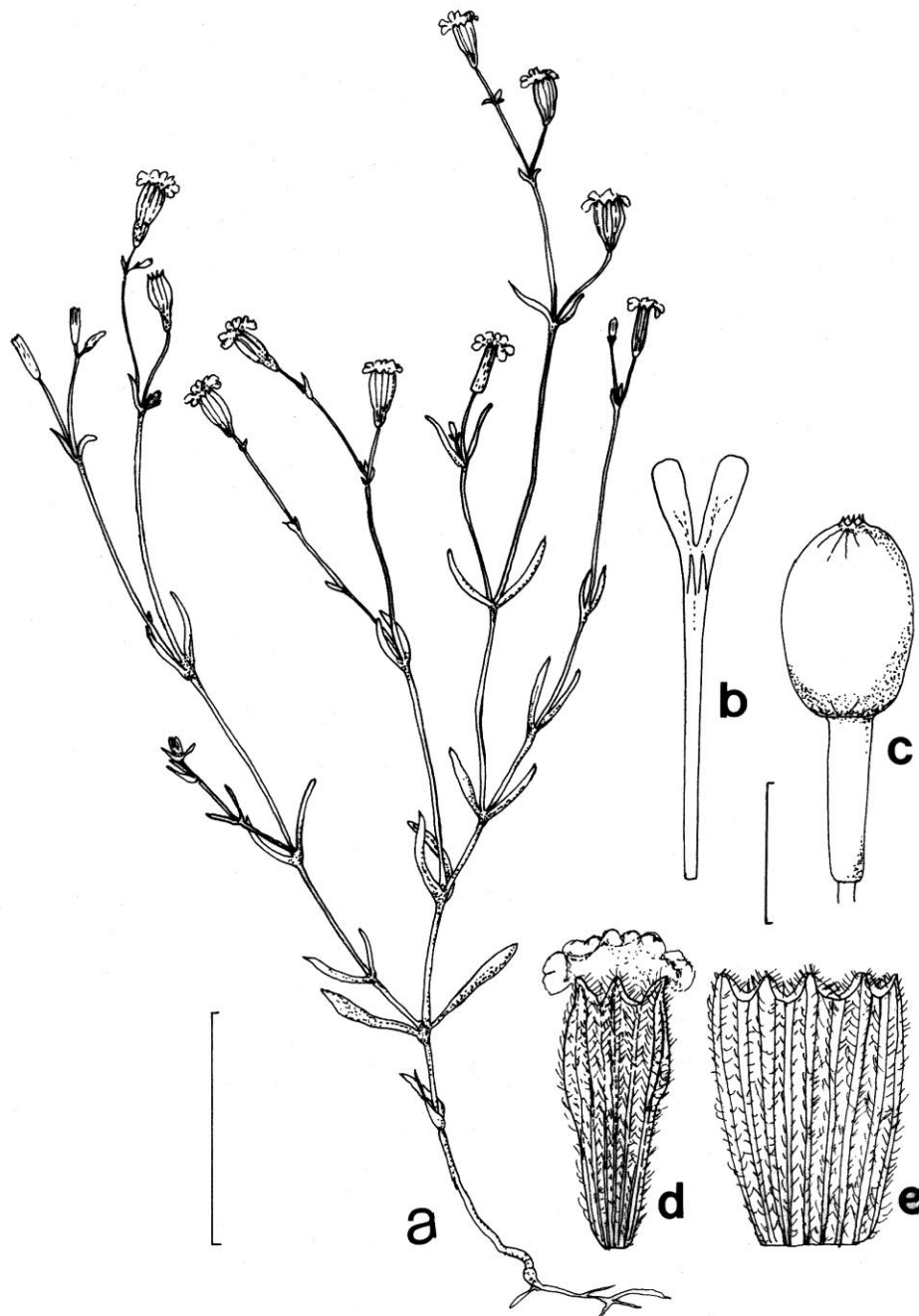


Fig. 7. *S. colorata* var. *colorata*, (K069, North Cyprus) a. General view (—: 5cm), b. Petal, c. Fruit (Capsule), d. Calyx (Flower), e. Calyx (Opened), (b, c, d, e: —: 10 mm).

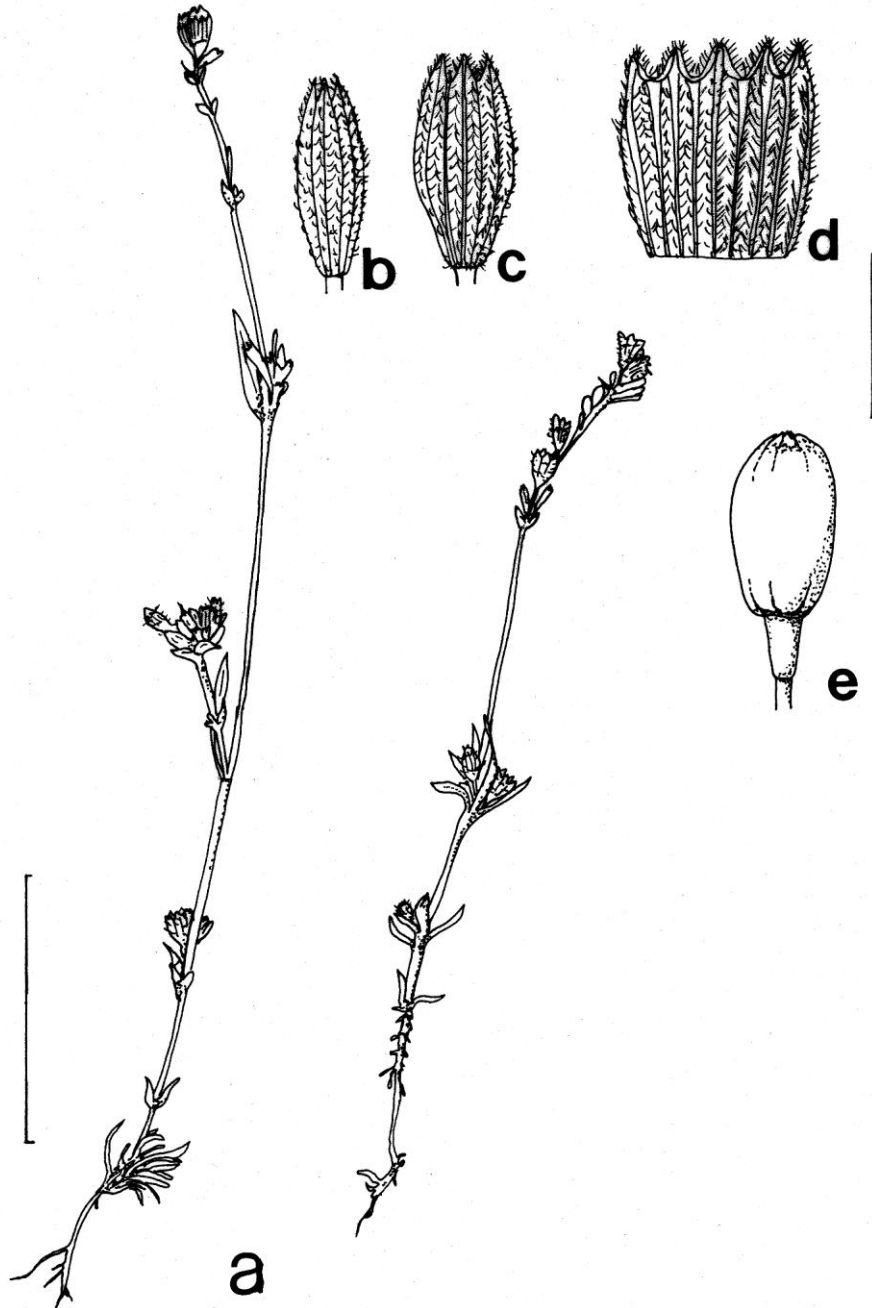


Fig. 8. *S. apetala* var. *grandiflora*, (K055, North Cyprus) a. General view (—: 5cm), b. Calyx (Flower), c. Calyx (on Fruit), d. Calyx (Opened), (b, c, d, e: —: 10 mm).

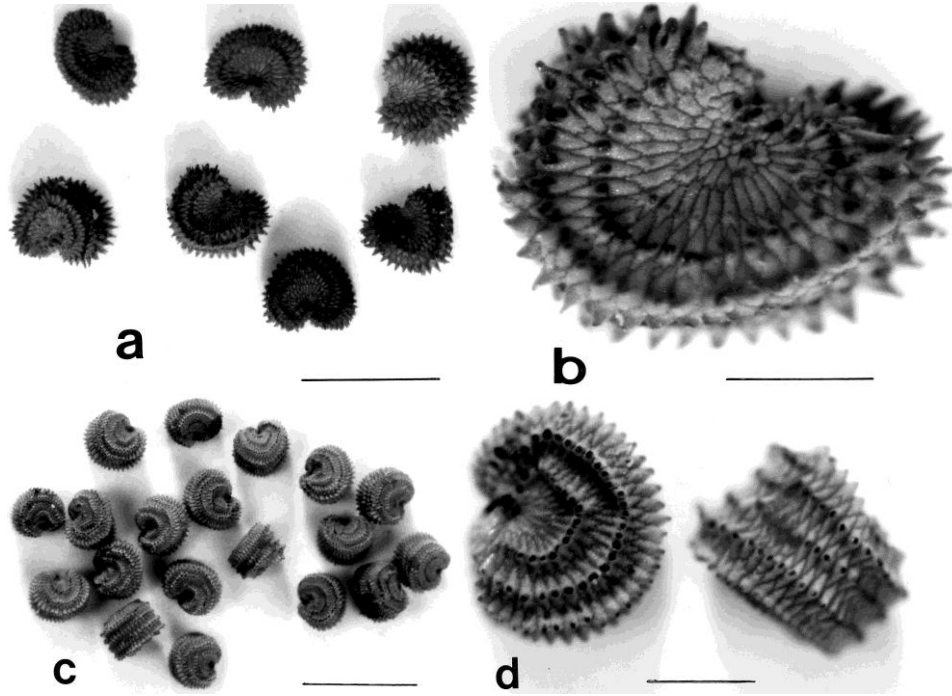


Fig. 9. Light micrographs of *S. tenuiflora* (a, b; K070) and *S. lydia* (c, d; K067) seed. a, c. General view (—: 2 mm), b, d. Seed surface (—: 0.5 mm).

The species with the greatest height is *S. fabaria*, while the shortest is *S. lydia*. The flowers are monochasium and dichasium. The longest calyx is in *S. sipylea* and the shortest in *S. apetala* var. *grandiflora*. The calyx of *S. lydia*, *S. discolor*, *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora* is puberulent, that of *S. sipylea*, *S. fabaria* and *S. tenuiflora* is glabrous. The calyx of *S. fabaria*, *S. tenuiflora* and *S. apetala* var. *grandiflora* had 10 anastomotic veins, whereas *S. discolor*, *S. colorata* var. *colorata* and *S. sipylea* had 10 veins which are not anastomotic. In *S. lydia*, on the other hand, 25-30 veins were observed. *S. apetala* var. *grandiflora* did not have a petal, whereas the longest petal was found in *S. sipylea*. The petal blade of all species that were examined either deeply or slightly cleft (bifid), the deepest cleft being in *S. fabaria* and *S. discolor*, and the slightest in *S. lydia*. Ligula were observed in the basal petal blades of all species. The ligula are quite small in *S. sipylea* and *S. lydia*. In *S. lydia*, the anthophore is about 1 mm, while it reaches 25-30 mm in *S. sipylea*. The capsules of all species are of an ovoid, spherical shape (Figs. 2-8, Table 2, 3).

The seeds of *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora* are distinct from those of other species in that they are reniform, round, winged and wrinkled (Figs. 10 c, d, e, f; Table 2, 3). The largest seeds were observed in *S. tenuiflora* and the smallest in *S. discolor* (Figs. 9a, b; 10a, b; Table 2, 3). Tubercles were relatively distinct and had a long conical shape in *S. lydia* and *S. tenuiflora*, and the deepest hilum indentation was observed in the seeds of *S. colorata* var. *colorata* and *S. apetala* var. *grandiflora*. The seed surface, which is sinuous in *S. apetala* var. *grandiflora*, and flat, convex in *S. discolor* and *S. colorata* var. *colorata*, can be easily distinguished from that of other species.

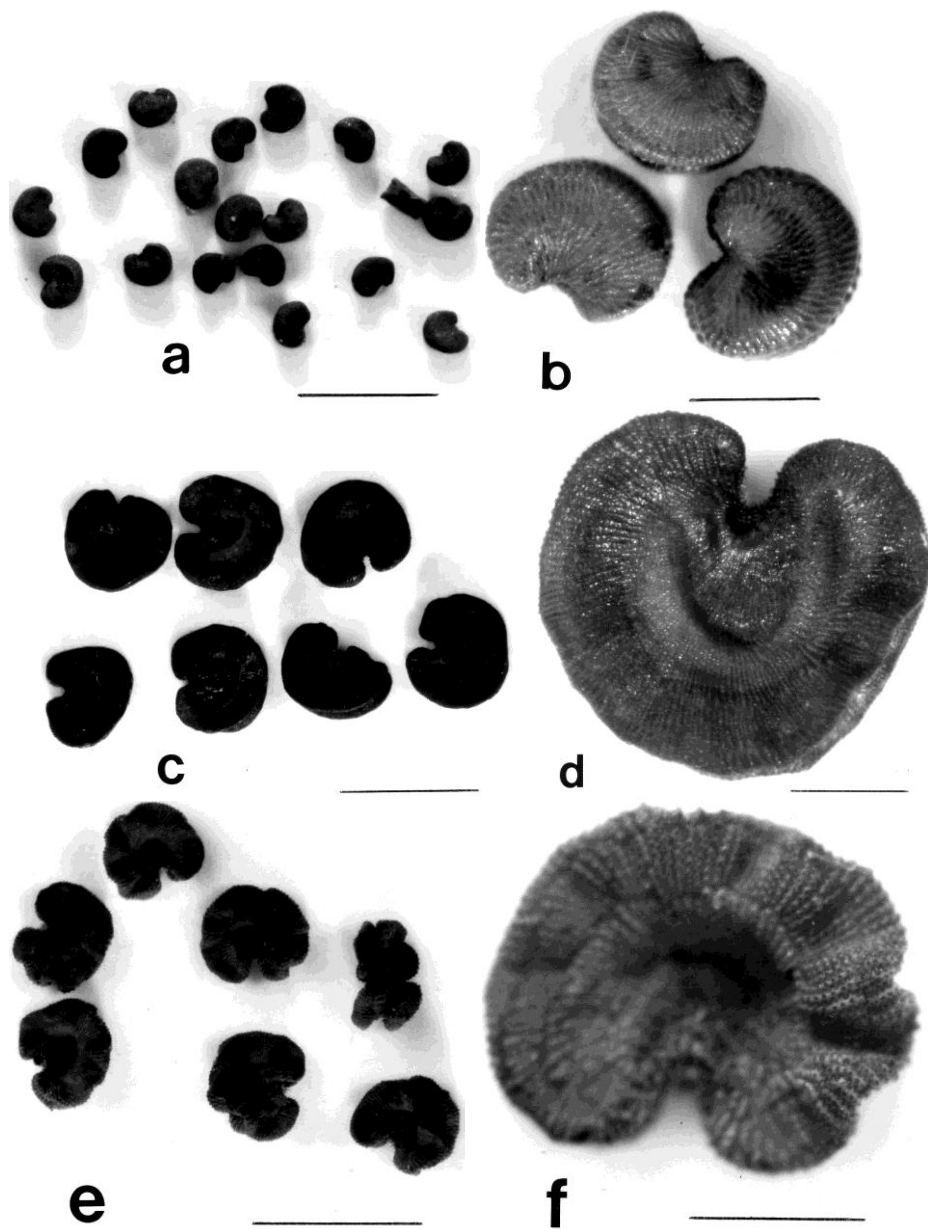


Fig. 10. Light micrographs of *S. discolor* (a, b; K058) , *S. colorata* var. *colorata* (c, d; K069) and *S. apetala* var. *grandiflora* (e, f; K055) seed. a,c, e. General view (—: 2 mm), b,d,f. Seed surface (—: 0.5 mm).

Yıldız & Çırpıcı (1998) worked on seed morphology of the *Silene* species distributed in Turkey, using a stereo and scanning electron microscope. In this study which was conducted on *S. chlorifolia* Sm. from the section *Sclerocalycinae*, also includes *S.*

sipylea and on *S. vulgaris* (Moench) Garcke var. *vulgaris*, *S. fabaria*, from the section *Inflatae*, seed structures were termed reniform, ovate; seed tubercles low round and long cylindrical, demonstrating similar features with the species under study. In this study on *Caryophyllaceae* species of North Anatolia, Yıldız (2002) stated the seed types of the *Silene* species [*S. montbretiana* Boiss., *S. caryophylloides* subsp. *subulata* (Boiss.) Coode & Cullen, *S. conica* L.] as reniform, tubercles as obtuse, seed surface as flat, concave and convex, testa surface cell walls (suture outline) as sinuous and sharp toothed.

In a choronological study on the *Caryophyllaceae* taxa of North Anatolia, Yıldız & Çırpıcı (2002) determined the morphological characteristics of *S. sangaria* Coode & Cullen, which is endemic to Turkey and grows on the Black Sea coast (Izmit), as creeping, leaves obovate-spathulate, flowers panicle, calyx densely puberulent, 12-15 mm, 2 ligula on the deeply bifid blade base, anthophore, 5-6 mm, capsule 5-8 x 4-6 mm. As for the seed characteristics of *S. sangaria*, the surface is flat, sometimes round, cell plate length and width 0.140-0.170 x 0.040-0.065 mm, number of suture point per plate 10-15 and the cell suture outline sinuous (Yıldız & Çırpıcı, 1998). Despite belonging to a different section, *S. discolor*, on which we carried out our studies, demonstrates similar characteristics to *S. sangaria* with respect to the area where it grows, its leaves, calyx pubescence, petal morphology, seed surface, number of suture point per plate and suture outline.

Melzheimer (1987) conducted a study on the taxonomical position of *Silene thebana* and transferred it to *S. fabaria* as a subspecies and expressed as *S. fabaria* (L.) Sm. subsp. *thebana* (Orph. Ex Boiss.) Melzh. The leaves of *S. fabaria* (L.) Sm. subsp. *thebana* (Orph. Ex Boiss.) Melzh. are rather inclined to ovate-oblong from obovate-spathulate, blade usually half the length of the corolla and testa cells often without tubercles. Plant diameter of the thrive specimens 50-70 cm, while that of Dhomokos specimens is 40 cm, perennial, with 5 petals, petal blade split into two, 2 lobbed, each lobe spatulate or oblong and tip round, two ligula at the basal blade, petal base 2.0-2.9 mm, petal blade 3.8-4.3 mm. It was emphasized that seed testa cells varied slightly in the plants in Dhomokos region, but there were significant differences in the plants of the thrive population, and that this population showed greater similarities to subsp. *fabaria* rather than subsp. *thebana*. The subsp. *fabaria*, which we studied, exhibited greater resemblance to *S. fabaria* in that its leaves are oblanceolate-lanceolate obovate, its petal length 16-17 mm and it mostly occurs near the coast. Thus, it can be concluded that the species from West Anatolia, under our study belongs to the taxon *S. fabaria* subsp. *fabaria*, which is also distributed in Greece.

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