

## SEED MORPHOLOGICAL STUDIES OF *SILENE* L., FROM TURKEY

KEMAL YILDIZ AND ALI CIRPICI\*

*Department of Biology,  
Faculty of Science, Celâl Bâyyar University,  
45040 Mânisâ, Turkey.*

### Abstract

The genus *Silene* L., (*Caryophyllaceae*) from Turkey have been studied for their seed morphology. A total of 19 species of which 3 are endemic belonging to 12 sections were studied. The seeds show variation in their morphology. The seed morphology as studied show section specific observations.

### Introduction

The genus *Silene* L., is a moderate genus with c.500 species distributed in 44 sections (Willis, 1965; Chowdhuri, 1957). In Turkey, the genus *Silene* L., is well represented with 129 species in 31 sections (Coode & Culen, 1967, Davis, 1988; Baytop, 1992. The *Silene* species viz., *S. alba* and *S. dioica* (L.) Clairv., (Prentice, 1979), *S. thebana* (Orph. ex Boiss.) Melz. (Melzheimer, 1987) and *S. latifolia* (Mastenbroek *et al.*, 1984) raise taxonomical problems.

During studies on the morphology, karyology and pollen morphology of *Silene* species, prominent morphological difference between the species were observed (Melzheimer & Baytop, 1980; Baytop, 1992; Yildiz & Cirpici, 1992, 1996, Yildiz, 1996). Studies on the seed micromorphology of *Silene* species from Turkey showed that structure of the seed coat are suitable for classification of species which is reported here in.

### Materials and Methods

The specimens were collected during various field trips from the Northwest Anatolian region (Table 1) and identified after references to Coode & Cullen (1967), Chater & Walters (1964) and Melzheimer (1977). Microphotographs which showed general view of the seed surface were taken by Olympus WM binocular Stereo dissection microscope and NFK x 3,3 LD 125 lens. The seeds were thoroughly vacuum coated with gold to provide conductivity for the SEM view at Marmara University Electron Microscopy Unit. Micrographs that showed general view of seeds were examined with Jeol JSM 5200 SEM. Description of morphological characteristics of the seeds were made according to Stearn (1978) and Prentice (1978).

\*Department of Biology, Faculty of Ataturk Education, University of Marmara, 81040 Goztepe, Kadikoy - Istanbul/Turkey.

Table 1. Data for the collection of *Silene* L., seeds from Turkey.

Species	Locality	Collector	Herbarium (Mara)
<i>Silene italica</i>	A4 Kastamonu, Ballidag, under forest. 1500-1600 m	Kemal Yildiz	2963
<i>S. viridiflora</i>	A5 Amasya, Ormanozu village, 1000-1100 m	K. Yildiz	3818
<i>S. marschallii</i>	A6 Tokat, Turhal, Kuluk area, slopes, 500 m.	K. Yildiz	2468
<i>S. olympica</i> (E)	A3 Bolu, Kartalkaya near, rocky slopes, 1700 m.	K. Yildiz	1983
<i>S. chlorifolia</i>	A5 Amasya, Tasova near, 350 m	K. Yildiz	3838
<i>S. paphlagonica</i> (E)	A4 Cankiri, Ilgaz hill near, under abies forest, 1700 m.	K. Yildiz	2953
<i>S. otites</i>	A6 Tokat, Gijgij hiil, rocky slopes, 900 m.	K. Yildiz	2800
<i>S. cappadocica</i>	A5 Amasya, Akdag, Derebasalan village, 1000 m.	K. Yildiz	2813
<i>S. spergulifolia</i>	A3 Bolu, Gognuk to Mudurnu 22 km., scrubs, 850 m.	K. Yildiz	3729
<i>S. supina</i> subsp. <i>pruinosa</i>	A6 Tokat, Yesilyurt, rocky slopes, 1000 m.	K. Yildiz	2449
<i>S. sangaria</i> (E)	A3 Sakarya. Karasu seaside, sandysea shoes, dunes	K. Yildiz	3916
<i>S. vulgaris</i> var. <i>vulgaris</i>	A6 Tokat. Topcam hill. scrubs. 1300 m.	K. Yildiz	2465
<i>S. rynchocarpa</i>	A3 Bolu, Kartalkaya, screes, rocky slopes, 2000 m.	K. Yildiz	2981
<i>S. compacta</i>	A6 Tokat, Camlibel hill, rocky slopes, 1350 m.	K. Yildiz	1646
<i>S. alba</i> subsp. <i>ericalycina</i>	A5 Amasya. Tashyayla, rocky slopes, 1600-1800 m.	K. Yildiz	2807
<i>S. noctiflora</i>	A4 Kastamonu, Kastamonu to Boyabat 18 km., scrubs, 800 m.	K. Yildiz	2874
<i>S. dichotoma</i> subsp. <i>sibthorpiana</i>	A4 Bolu. Gerede to Cerkes 1. km. banks, 1200 m.	K. Yildiz	2778
<i>S. gallica</i>	A2(A) Istanbul, Kurtkoy, open places, 200-300 m.	K. Yildiz	1482
<i>S. bellidifolia</i>	A5 Sinop, Sinop to Kastamonu 30, km., fielded. 70 m.	K. Yildiz	3857

Table 2. Seed morphology of *Silene* L., species.

Species	Sections	Seed type	Seed length and width (mm)	Seed length and width ratio	Seed back	Seed tubercle shape	Hylar zone type shape
<i>Silene italica</i>	<i>Siphonomorpha</i>	Reniform	1.01-6x0.7x1.1	1.398	Flat or concave	Tall-conical	Generally recessed
<i>S. viridiflora</i>	<i>Siphonomorpha</i>	Ovate or Reniform	0.8-1.1x0.6-0.8	1.307	Concave	Usually tall-conical, sometimes obtuse	Generally recessed, sometimes flat or prominent
<i>S. marschallii</i>	<i>Lasiostemones</i>	Elliptical or reniform	1.3-1.7x1.0-1.2	1.285	Flat or concave	Generally obtuse conical, sometimes obtuse	Recessed
<i>S. olympica</i>	<i>Lasiostemones</i>	Reniform	1.1-1.4x0.6-1.0	1.643	Flat or concave	Obtuse	Recessed
<i>S. chlorifolia</i>	<i>Sclerocarycinæ</i>	Reniform	2.2-2.8x1.6-2.1	1.340	Concave, flat or rounded	Obtuse rounded	Recessed, sometimes prominent
<i>S. otites</i>	<i>Otites</i>	Reniform	1.2-1.6x0.9-1	1.351	Flat or concave	Obtuse rounded	Recessed
<i>S. cappadocica</i>	<i>Spergulfoliace</i>	Reniform	1.2-1.5x0.8-1.0	1.453	Rounded or concave	Obtuse short-rounded	Prominent and level
<i>S. spergulfolia</i>	<i>Spergulfoliace</i>	Reniform	1.0-1.2x0-1.0	1.417	Flat or rounded, concave	Obtuse rounded	Prominent, level, recessed
<i>S. supina</i> subsp. <i>pruinosa</i>	<i>Spergulfoliace</i>	Reniform	1.0-1.4x0.7-1.0	1.469	Flat or rounded	Obtuse, cylindrical materials	Recessed or level
<i>S. sangaria</i>	<i>Spergulfoliace</i>	Reniform	1.4-1.8x0.8-1.2	1.512	Flat or rounded	Level	Recessed, sometimes level
<i>S. vulgaris</i> var. <i>vulgaris</i>	<i>Inflatae</i>	Ovate or reniform	1.4-1.5x1.0-1.2	1.402	Convex or rounded	Tall-cylindrical, sometimes conical	Prominent or level
<i>S. rhynchocharpa</i>	<i>Auriculatae</i>	Reniform	1.2-1.5x0.9-1.1	1.436	Convex or rounded	Obtuse rounded	Recessed
<i>S. compacta</i>	<i>Compactae</i>	Ovate or reniform	0.5-0.7x0.4-0.6	1.196	Concave	Obtuse, cylindrical materials	Level or recessed

Table 2 (Cont'd.)

<i>S. alba</i> subsp. <i>ertiocalycina</i>	<i>Elisanthe</i>	Ovate or reniform	1.3-1.5x1.0-1.2	1.236	Convex or rounded	Tall-conical	Level, sometimes prom.
<i>S. noctiflora</i>	<i>Elisanthe</i>	Ovate or reniform	1.1-1.3x0.9-1.1	1.230	Convex or rounded	Conical	Level or prominent
<i>S. dichotoma</i> ssp. <i>sibthorpiana</i>	<i>Dichotormae</i>	Reniform	1.0-1.5x0.9-1.0	1.281	Flat	Obtuse conical	Level recessed or prom.
<i>S. gallica</i>	<i>Silene</i>	Winged reniform	0.7-0.9x0.5-0.6	1.435	Convex	Short-conical	Recessed
<i>S. bellidifolia</i>	<i>Silene</i>	Winged reniform	0.8-1.0x0.5-0.7	1.550	Convex	Obtuse, cylindrical materials	Recessed

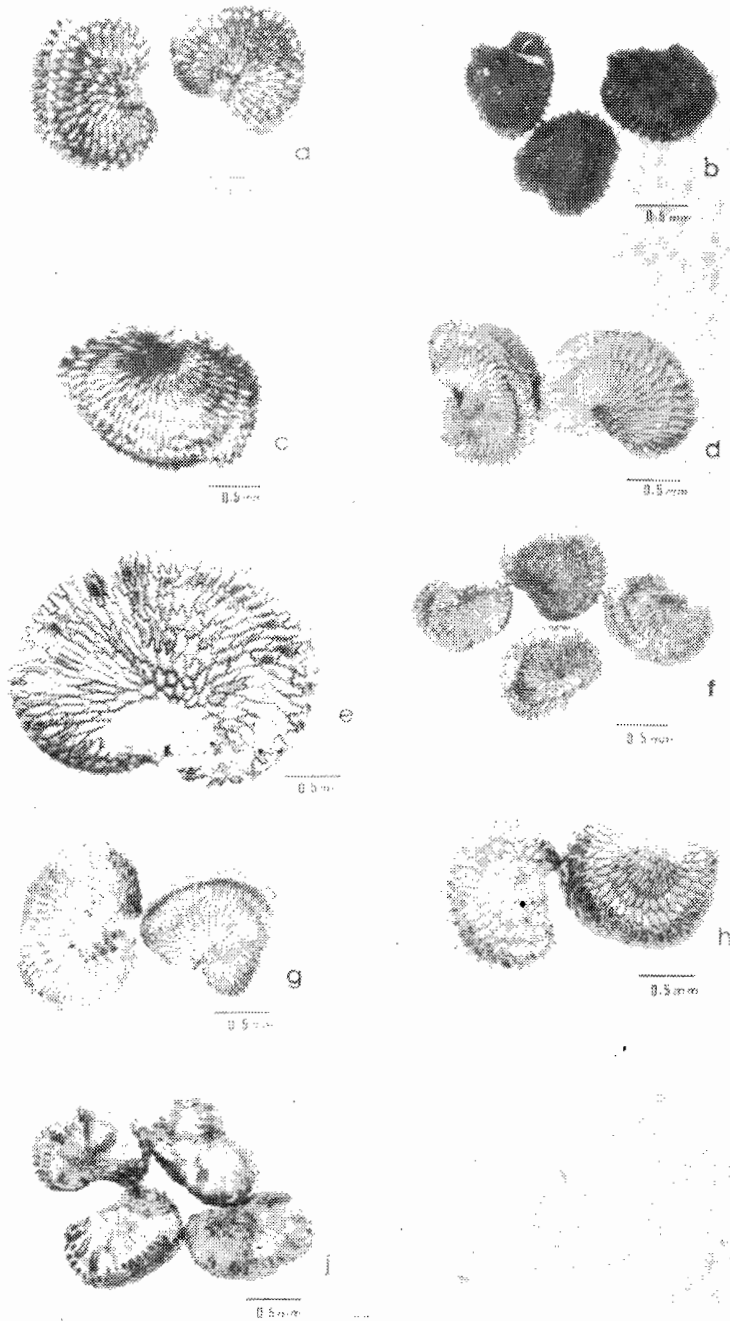


Fig.1. General view of seeds of *Silene* species.  
a) *S. italica*, b) *S. viridiflora*, c) *S. marschallii*, d) *S. olympica*, e) *S. chlorifolia*, f) *S. paphlagonica*, g) *S. otites*, h) *S. cappadocica*, j) *S. spergulifolia*.

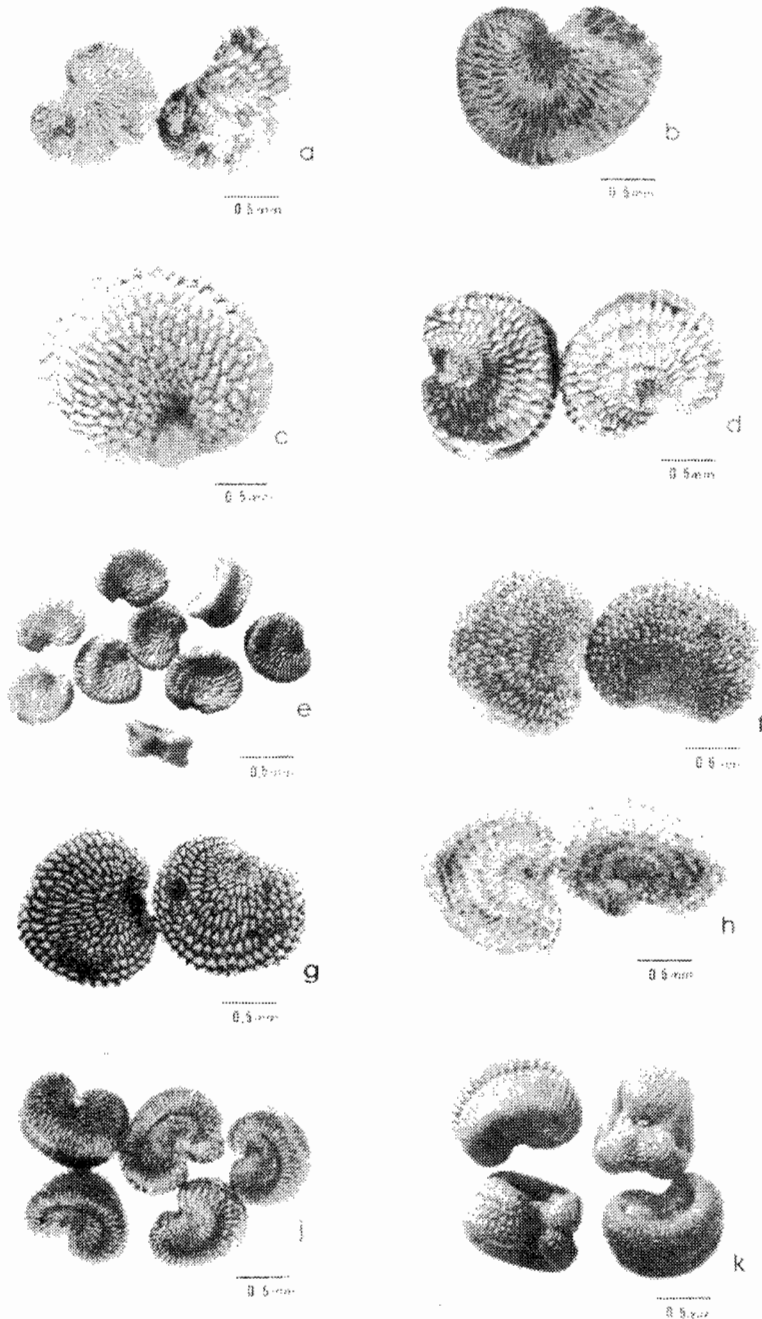


Fig.2. General view of seeds of *Silene* species.

a) *S. supina* subsp. *pruinosa*, b) *S. sangaria*, c) *S. vulgaris* var. *vulgaris*, d) *S. rhynchoarpa*, e) *S. compacta*, f) *S. alba* subsp. *eriocalycina* g) *S. noctiflora*, h) *S. dichotoma* subsp. *sibthorpiana*, j) *S. gallica*, k) *S. bellidifolia*.

Table 3. Seed morphology of *Silene* L., species.

Species	Sections	Seed face type	Seed surface granulation	Seed colour	Seed tubercle tip colour	Seed plate length and width ( $\mu\text{m}$ )	Number of suture point per plate	Suture outline
<i>Silene italica</i>	<i>Siphonomorpha</i>	Flat or concavo-concave	Medium or coarse or fawn	Fuscous Dark brown	Grey or fawn	200-320x50-160	15-23	Serrate digitate
<i>S. viridiflora</i>	<i>Siphonomorpha</i>	Flat or concavo-concave	Fine or medium	Fine or medium	Dark brown or black	120-190x40-65	16-23	Sharply sinuous or lobate
<i>S. marschallii</i>	<i>Lastostemones</i>	Flat, sometimes concavo-concave	Medium or coarse	Fawn or grey	Grey or fuscous black	120-280x65-95	15-23	Digitate or lobate
<i>S. olympica</i>	<i>Lastostemones</i>	Flat and concave	Coarse	Flawn or fuscous	Grey or fawn	160-260x40-75	9-23	Lobate or sinuous
<i>S. chlorifolia</i>	<i>Sclerocalycinae</i>	Flat or concavo-concave	Coarse	Grey or fuscous	Fuscous black	180-550x80-150	15-22	Sharply sinuous
<i>S. paphlagonica</i>	<i>Chloranthe</i>	Flat, partly convex and concave	Fine	Dark brown or fuscous black	Greyish sepia	100-140x30-90	14-18	Serrate or stellate
<i>S. otites</i>	<i>Otites</i>	Usually flat, sometimes concavo-concave	Unvisible or coarse	Grey or fuscous	Grey or fuscous	200-300x60-95	16-23	Serrate, sinuous or stellate

Table 3 (Cont'd.)

Species	Sections	Seed face type	Seed surface granulation	Seed colour	Seed tubercle tip colour	Seed plate length and width ( $\mu\text{m}$ )	Number of suture point per plate	Suture outline
<i>S. cappadocica</i>	<i>Spergulifoliae</i>	Fiat or concavo-concave	Coarse-reticulate	Grey or dark brown	Grey	200-350x70-90	15-20	Serrate or sinuous
<i>S. spergulifolia</i>	<i>Spergulifoliae</i>	Fiat	Medium	Grey	Grey or fuscous black	150-250x45-60	18-23	Serrate
<i>S. supina</i> subsp. <i>pruinosa</i>	<i>Spergulifoliae</i>	Fiat or concavo-concave	Fine	Dark brown or fawn or fawn white	Dark brown or fawn or white	90-150x30-40	20-23	Serrate
<i>S. sangaria</i>	<i>Spergulifoliae</i>	Fiat, sometimes rounded	Absent	Fawn or grey	---	140-170x40-65	10-15	Sinuous
<i>S. vulgaris</i> var. <i>vulgaris</i>	<i>Inflatae</i>	Convex	Medium	Dark brown or fuscous black	Black	200-250x60-90	14-20	Serrate or sinuous
<i>S. rhynchocharpa</i>	<i>Auriculatae</i>	Fiat or concavo-concave	Coarse	Fawn or dark brown	Fawn or dark brown	100-250x50-80	20-23	Serrate or Sinuous
<i>S. compacta</i>	<i>Compactae</i>	Fiat or concavo-concave	Medium	Fawn or dark brown	Fawn or dark brown white	130-210x40-60	20-30	Sharply sinuous or serrate
<i>S. alba</i> subsp. <i>eritocalycina</i>	<i>Elisanthe</i>	Convex	Coarse-reticulate	Grey	Grey or fuscous black	200-250x50-80	10-15	Unvisible sinuous



Table 3 (Cont'd.)

Species	Sections	Seed face type	Seed surface granulation	Seed colour	Seed tubercle tip colour	Seed plate length and width ( $\mu\text{m}$ )	Number of suture point per plate	Suture outline
<i>S. noctiflora</i>	<i>Elisanthe</i>	Flat and convex	Coarse-reticulate	Fuscous black	Black or dark brown	75-150x50-75	15-20	Serrate or sinuous
<i>S. dichotoma</i> ssp. <i>Dichotormae</i> <i>sibthorpiana</i>		Flat, some times concavo-concave	Coarse	Fawn	Fawn	100-150x80-100	20-30	Sharply sinuous or stellate
<i>S. gallica</i>	<i>Silene</i>	Very concavo-concave		Coarse dark brown	Black or dark brown	130-150x50-70	13-17	Serrate, sinuous or labate
<i>S. helladifolia</i>	<i>Silene</i>	Very concavo-concave	Coarse	Black or dark brown	Dark brown	400-150x50-70	20-26	Serrate

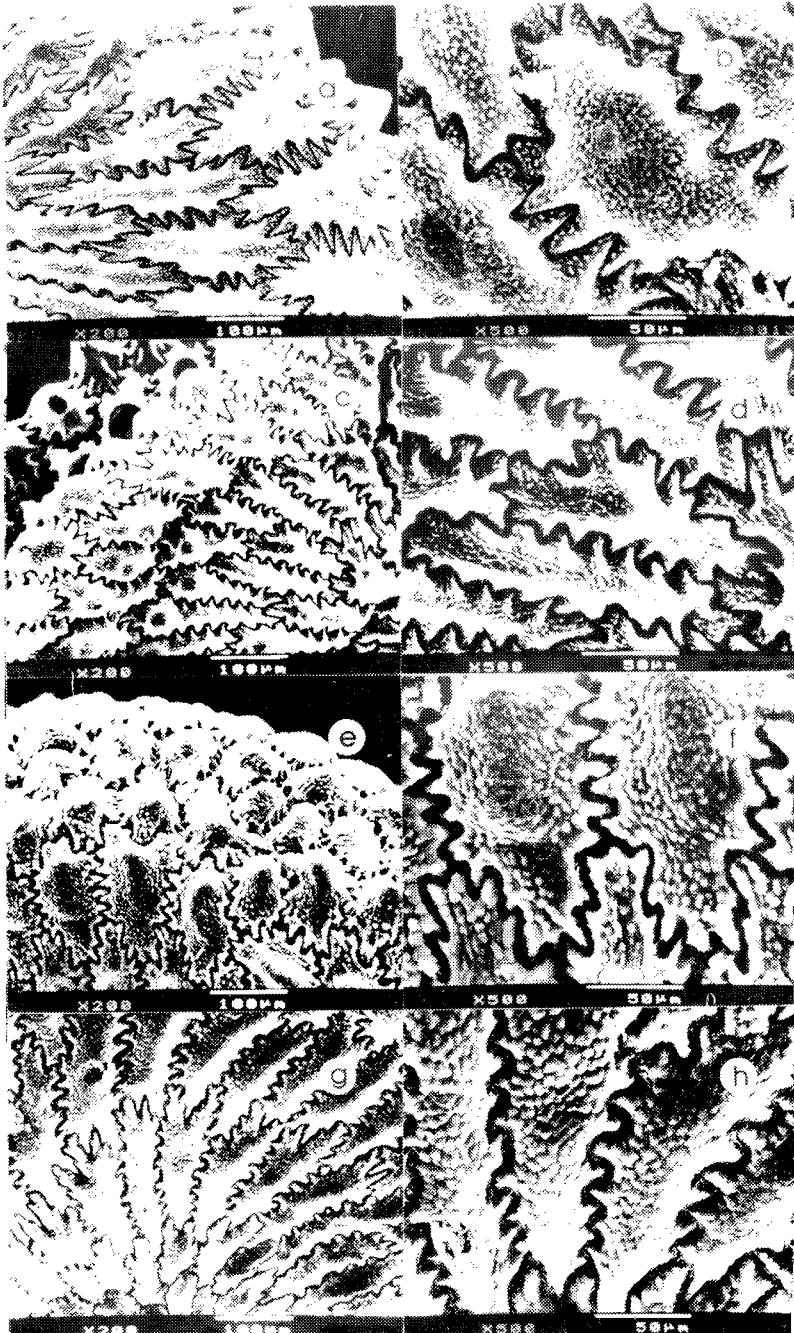


Fig.3. SEM of seed surface of *Sitene* species.  
a,b) *S. italica*, c,d) *S. viridiflora*, e,f) *S. marschallii*, g,h) *S. olympica*.

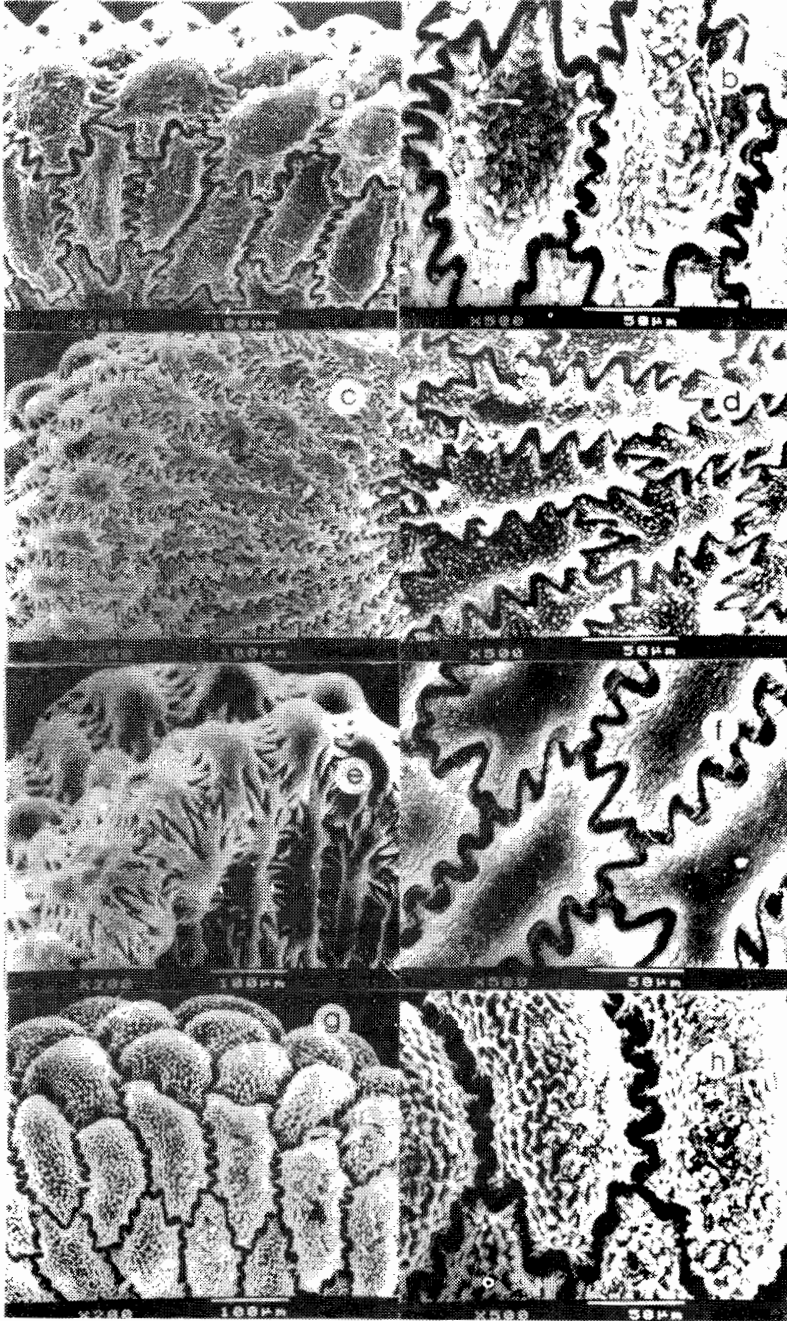


Fig.4. SEM of seed surface of *Silene* species

a,b) *S. czlorifolia*, c,d) *S. paphlagonica*, e,f) *S. vitites*, g,h) *S. cappadocica*.

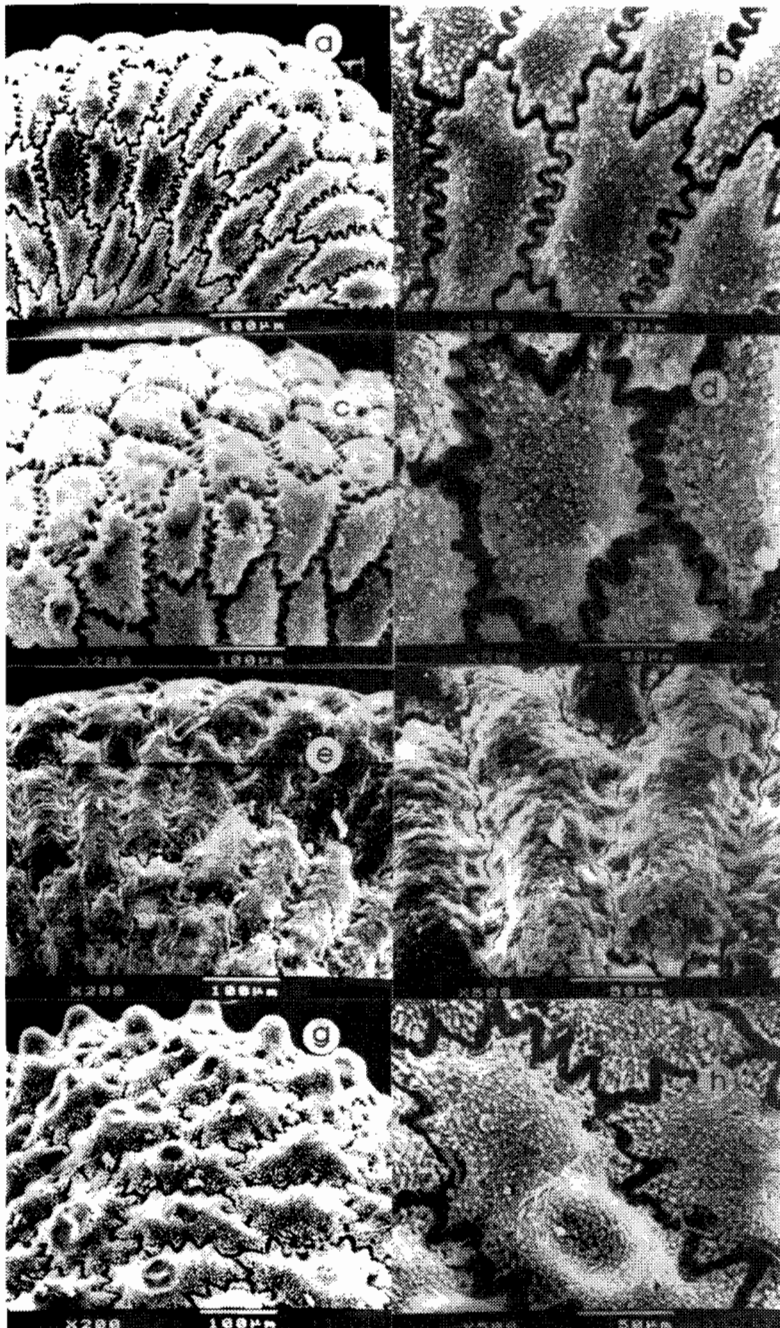


Fig.5. SEM of of seed surface of *Silene* species.

a,b) *S. spergulifolia*, c,d) *S. supina* subsp. *Pruinosa* e,f) *S. sangaria*, g,h) *S. vulgaris* var. *vulgaris*.

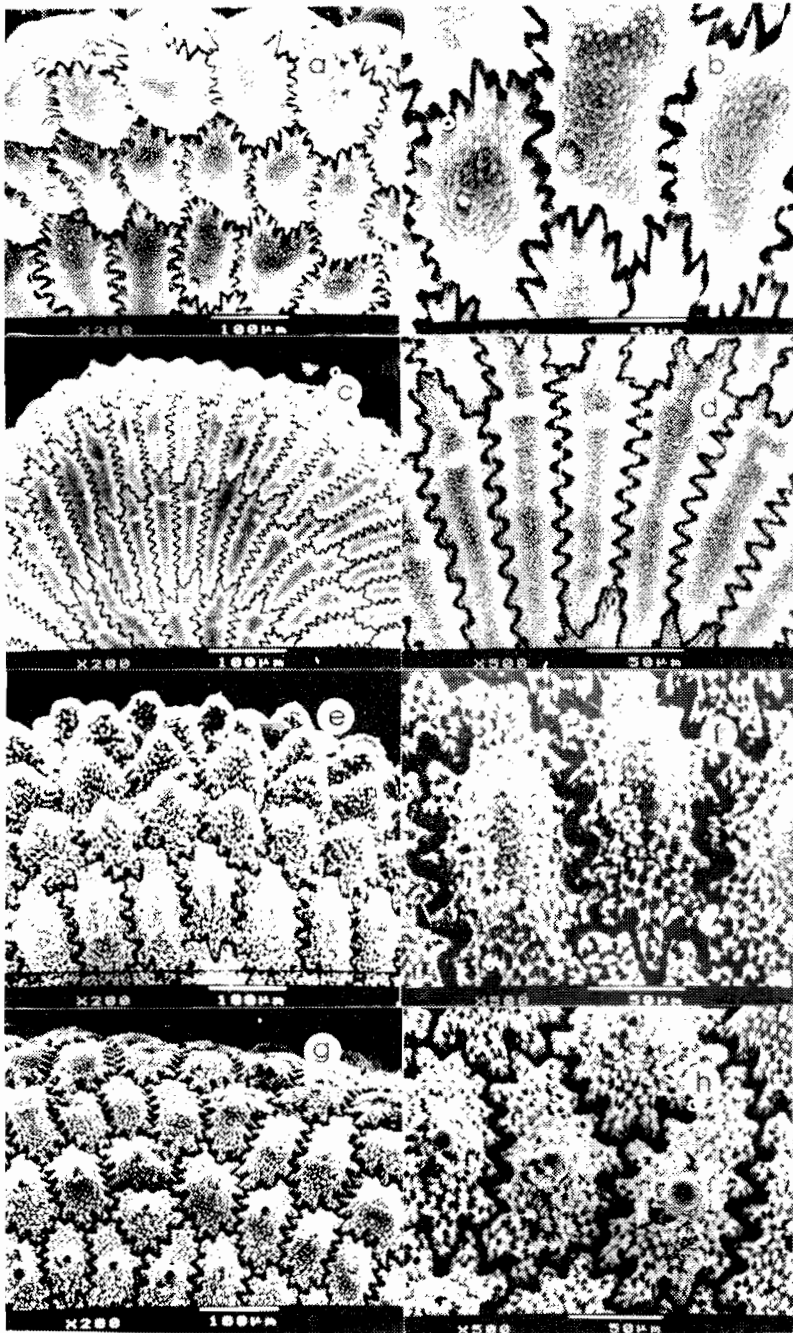


Fig. 6. SEM of seed surface of *Silene* species.

a, b) *S. rhynchoarpa* c, d) *S. compacta*, e, f) *S. aiba* subsp. *ericalycina*. g, h) *S. noctiflora*.

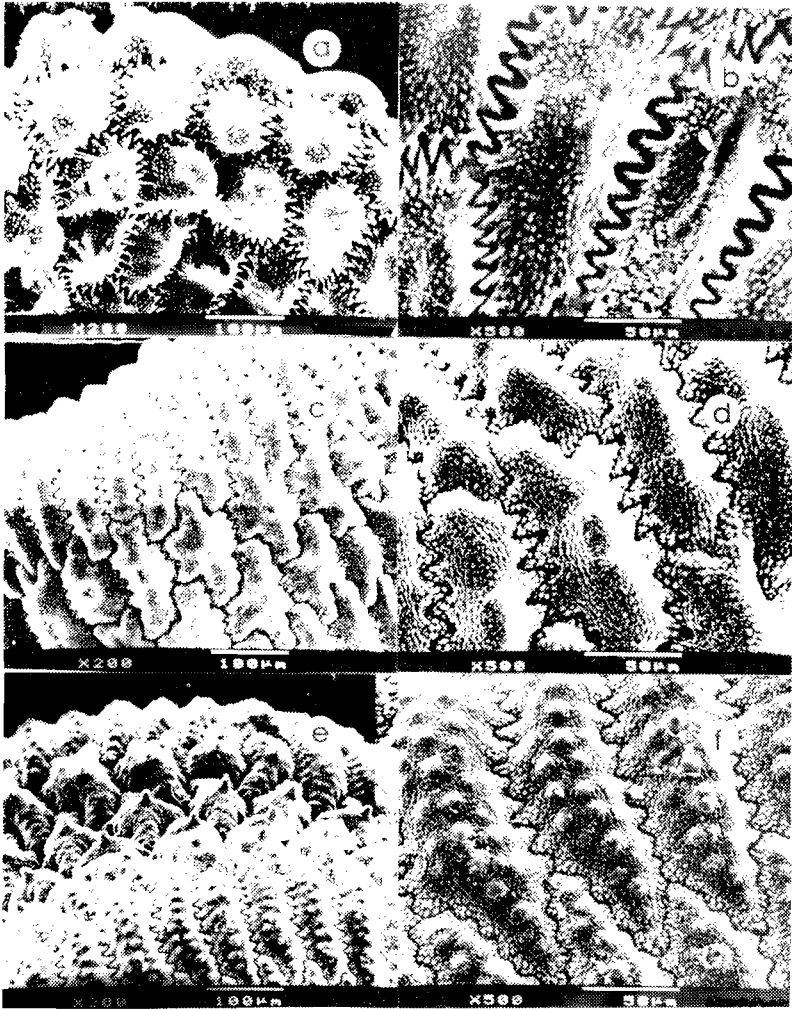


Fig. 7. SEM of seed surface of *Silex* species.

a, b) *S. dichotoma* subsp. *sibiriana* c, d) *S. galica*, e, f) *S. bellidifolia*

## Results and Discussion

A total of 19 species the genus *Silex* of which 3 are endemic belonging to 17 sections collected from Northwest Anatolia, have been studied for their seed morphology. Largest seeds were found in *S. chlorifolia* (2.2-2.8 x 1.6-2.1 mm) and smallest in *S. compacta* (0.5-0.7 x 0.4-0.6 mm). The seed morphology of *S. italica* (Figs. 1a, 3a, 3b, Table 2) and *S. viridiflora* (Figs. 1b, 3c, 3d, Table 2, & 3) are quite similar and both of them belong to section *Siphonomorpha* Oudl., whereas the seeds and the seed plates of *S. italica* are bigger than *S. viridiflora*. There are some dissimilarities

between the seeds of *S. cappadocica* and *S. spergulifolia* of section *Spergulifoliae* Boiss. Although morphologically similar to each other, the seed granulation of *S. cappadocica* are coarse-reticulate, grey, dark brown or fuscous black in colour, suture outline serrate or sinuous, whereas the seeds of *S. spergulifolia* have medium granulation, grey coloured, suture outline serrate. The seeds of *S. cappadocica* are bigger than *S. spergulifolia* (Figs. 1h, 4g, 4h, 1j, 5a, 5b; Table 2 & 3).

The results of the present study are in conformity with these of Prentice (1979) who described the characters of the seeds belonging to *Silene* genus in his study on *S. alba*. *S. alba* subsp. *eriocalycina* and *S. noctiflora* of section *Elisanthe* are represented by 2 species in the Northwest Anatolia. The seeds of *S. alba* subsp. *eriocalycina* are tall conical tubercle, seed plate length and width 200-250 x 50-80  $\mu\text{m}$  (Figs. 2f, 6e, 6f, Table 2 & 3), whereas *S. noctiflora* seed have only conical-tubercle, plate length and width 75-150 x 50-75  $\mu\text{m}$  (Fig.2g, 6g, 6h; Table 2 & 3). Melzheimer (1977) who revised *Silene* in Balkans and studied the structure of the seed surface used these characters in the taxonomy of the genus. Our studies are in conformity with the studies carried out by Melzheimer (1977).

### Acknowledgements

The research work is based on part of Ph.D thesis of Kemal Yildiz submitted to the Celâl Bâyar University, Turkey. We gratefully acknowledge the technical assistance of E. Kurtulus and Y. Ozturk of the Scanning Electron Microscopy Laboratory and Prof. Dr. T. Erbenği of the University of Marmara for discussion.

### Referenes

- Baytop, A., 1992. *Irakya ve Turkiye Florasına ilave kayıtlar*. Doga TU Botanik D. 16, 15-17.
- Chater, A.O. and S.M. Walters. 1964. *Silene* L., In: *Flora Europaeae*, Vol.1, 158-181, (Eds.) T.G. Tutin, V.H. Heywood, N.A. Burges, D.H. Valentine, S.M. Walters & D.A. Webb, Cambridge University Press, Cambridge.
- Chowdhuri, P.K. 1957. Studies in the genus *Silene*. *Notes from the RBG.*, 22, 221-278.
- Celebioglu, T., C.K. Favarger and L. Huynh. 1983. Contribution a la micromorphologie de la testa les granies due genre *Minuartia* (Caryophyllaceae), I sec. *Minuartia*, *Bull. Mus. Natn. Hist. Nat., Paris*, 4e ser., 5, Sect. B, Adonsonia 4, 415-435.
- Coude, M.J.E. and J. Cullen. 1967. *Silene* L. In: *Flora of Turkey and East Aegean Islands*, Vol.2, 179-242. (Eds.) P.H. Davis. Edinburgh University Press, Edinburgh.
- Davis, P.H. 1988. *Flora of Turkey and East Aegean Islands* (Supplement), Vol. 10, Edinburgh University Press, Edinburgh.
- Engel, T. and O. Kucuker. 1994. Micromorphological examination of leaf, fruit, tunica and seed surfaces of Anatolian *Colchicum* species. *Bot. Jahrb. Syst.*, 116: 123-133.
- Heywood, V.H. 1978. *Flowering plants of the world*, pp. 67, Oxford University Press, Oxford.
- Kucuker, O. and T. Celebiolu. 1988. Micromorphological and anatomical structure of the seed-testa of some *Colchicum* (Liliaceae) species. *Candollea*, 43: 129-138.
- Kucuker, O. 1989. Bitkisel yuzeyler ve oxellikleri, *Doga Turk Botanik Derg.*, 13: 555-571.
- Mastenbroek, O., H.C. Prentice, J. Heringa and P. Hogeweg. 1984. Corresponding patterns of geographic

- variation between populations of *Silene latifolia* (= *S. alba* = *S. pratensis*) (*Caryophyllaceae*). *Pl. Syst. Evol.*, 145: 227-242.
- Melzheimer, V. 1977. Biosystematische revision einiger *Silene*-Arten (*Caryophyllaceae*) der Balkanbinsel (Griechenland). *Bot. Jahrb. Syst.*, 98: 1-92.
- Melzheimer, V. and A. Baytop. 1980. A new *Silene* from Turkey. *Notes RBG.*, 38: 449-451.
- Melzheimer, V. 1987. On the taxonomic position of *Silene-thebana* (*Caryophyllaceae*). *Pl. Syst. Evo.*, 1: 251-256.
- Prentice, H.C. 1978. Experimental taxonomy of *Silene* section *Elisanthe* (*Caryophyllaceae*): Crossing experiments. *Bot. J. of the Linnean Society*, 77: 203-213.
- Prentice, H.C. 1979. Numerical analysis of infraspecific variation in European *Silene alba* and *S. dioica* (*Caryophyllaceae*). *Bot. J. of the Linnean Society*, 78: 181-212.
- Stearn, W.T. 1978. *Botanical Latin*. Redwood Burn Limited, London.
- Willis, J.C. 1965. *Flowering Plants and Fern*. Cambridge University Press, Cambridge.
- Yildiz, K. and A. Cirpici. 1992. Tokat ilinin *Silene* L. türleri üzerinde morfolojik araştırmalar, Marmara Univ. *Fen Bil. Enst. Derg. Say*, 9: 1-25.
- Yildiz, K. and A. Cirpici. 1996. Kuzeybatı Anadolu'da yayılıs gösteren bazı *Silene* (*Caryophyllaceae*) taksonlan üzerinde karyolojik araştırmalar. *Tr. J. of Botany*, 20: 73-82.
- Yildiz, K. 1996. Kuzeybatı Anadolu'da yayılıs gösteren bazı *Silene* L. (*Caryophyllaceae*) taksonlarının polen morfolojisi. *Tr. J. of Botany*, 20: 231-240.

(Received for publication 9 September, 1997)