

## THE PALYNOLOGICAL TRAITS OF FOUR ENDEMIC *SILENE* L. (CARYOPHYLLACEAE) SPECIES IN TURKEY

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**ABSTRACT.** In the present paper, the pollen morphological traits of 4 endemic *Silene* species: *S. duralii*, *S. ozyurtii*, *S. anatolica*, and *S. salsuginea*, were investigated using light microscopy (LM) and scanning electron microscopy (SEM). The obtained data were presented for the first time herein. Monad, isopolar, and spheroidal pollen grains were observed as common characters in all of the examined species. Pollen shapes among the investigated species were spheroidal, and the ornamentations were microechinate-perforate. The highest pore numbers were found in *S. salsuginea*, while the lowest pore numbers were in *S. ozyurtii*. The interpore distance was greatest in *S. anatolica*, while it was least in *S. salsuginea*. As a result of these detailed examinations, the pore number, interpore distance, shape of the pore and position, and microechinae number are more significant characters for distinguishing the studied species.

### 1. INTRODUCTION

*Silene* L. is a taxonomically complex and the largest genus of the family Caryophyllaceae. It comprises approximately 700 species that are mainly found in Northern temperature regions, Africa, and South America [1]. South-west Asia is one of the main centres of diversity for the genus, and with the addition of the new species, *Silene*, it is represented by 156 species in Turkey [2,3,4,5,6,7,8,9,10].

Previous palynological investigations about the genus *Silene* have provided useful contributions to its systematic position [11,12,13,14,15,16]. Faegri and Iversen (1975) reported that Caryophyllaceae has periporate pollen grains. The number of pores is a diagnostic character for delimitation of the genera [11]. Yıldız (2001) studied the pollen morphology of 45 species belonging to 15 genera of Caryophyllaceae using light microscopy (LM) and scanning electron microscopy (SEM). On the basis of the exine structure, ornamentation, and morphological data, the following 10 distinct types were recognized: 1) *Arenaria*, 2) *Stellaria holoste*, 3) *Cerastium*, 4) *Dianthus*, 5) *Gypsophila repens*, 6) *Lychnis viscaria*,

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7) *Silene vulgaris*, 8) *S. caryophylloides*, 9) *S. conica*, and 10) *Agrostemma githago* [12].

Thus, we aimed to reveal the pollen morphology of *Silene duralii* Y. Bağcı, *S. ozyurtii* Aksoy & Hamzaoğlu, *S. anatolica* Melzheimer & A. Baytop, and *S. salsuginea* Hub.-Mor., distributed in Anatolia. The objectives of this study were to present the pollen characteristics of the species (pollen type, pollen structure, ornamentation, pollen diameter, pore diameter, distance between two pores, exine thickness, and number of pores) and also contribute to their systematic positions.

## 2. MATERIAL AND METHODS

The examined species were collected from their natural habitats, as indicated in Table 1.

TABLE 1. The locality information of investigated species.

Species	Localities
<i>S. duralii</i>	C4 Konya: between Ermenek-Kazancı, Sarıova Plateau, Salur Mountain, 1750–1770 m.
<i>S. ozyurtii</i>	C4 Konya: Beyşehir, Derebucak, town of Çamlık, 1250 m.
<i>S. anatolica</i>	C4 Konya: Hadım, town of Dedemli, 1425 m.
<i>S. salsuginea</i>	C4 Konya: the Salt Lake, Gölyazı, 925 m.

In the palynological investigations, the herbarium materials were used for preparing the pollen slides. For the LM investigations, the Wodehouse technique (1935) was applied [17]. The measurements and observations were performed using a Leica DM 1000 light microscope with a Canon EOS 450D camera. The pollen diameter, pore diameter, exine and intine thickness, number of pores, and distance between two pores was examined for a minimum of 30 pollen grains per specimen. The Simpson and Roe graphical test was used for graphical calculations [18]. For the SEM investigations, the pollen grains were directly put on aluminium stubs, covered with gold using a sputter coater, and microphotographed using a Zeiss Evo Ls10 SEM. The pollen description and terminology used followed that of Punt et al. (2007) [19].

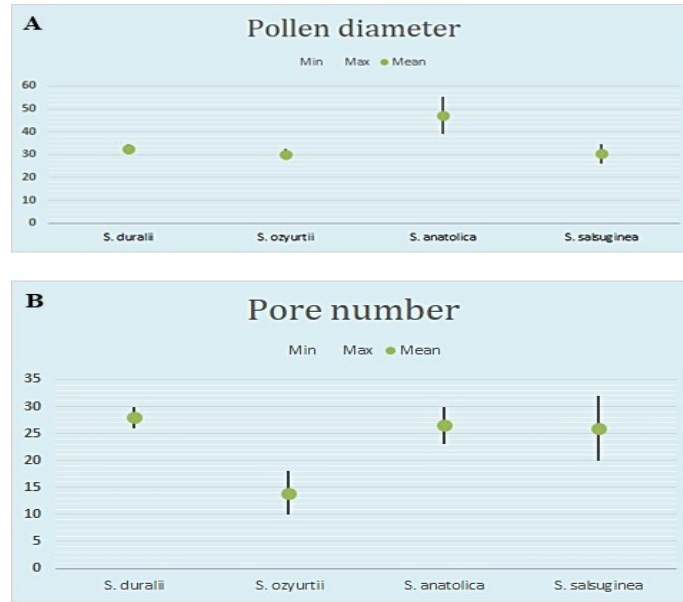


FIGURE 1. Graphical comparison of the dimensions of pollen diameter (C) and pore number in examined *Silene* species (minimum, maximum and mean values).

### 3. RESULTS AND DISCUSSION

#### 3.1. Pollen morphology

The morphological traits of the pollen grains of the examined species are given in Tables 2 and 3, while the captured photographs are presented in Figs. 2-3.

#### 3.2. Shape, size and symmetry

The pollen grains of the studied *Silene* species were determined as radially symmetrical and isopolar. All of the studied species had spheroidal shaped pollen grains measuring 26.09 to 55.47 µm. The dimensions were smaller in *S. ozyurtii* and larger in *S. anatolica* (Table 2; Figures 2-3).

#### 3.3. The apertural system and exine

The pollen grains of the examined *Silene* species were polyaperturate. Pores were spheroidal in shape. The highest pore number values were seen in *S. salsuginea* whereas the lowest ones were seen in *S. ozyurtii*.  $C/D$  rates were smaller than 1 ( $C/D < 1$ ) in all studied species. The microechinea number was very low in *S.*

*anatolica*. Sunken pores were observed in *S. duralii* and *S. ozyurtii*, while the other 2 species had protruding pores (Figure 3).

The exine was tectate and the exine and intine thickness varied from 1.6  $\mu\text{m}$  to 2.38  $\mu\text{m}$  and 0.7  $\mu\text{m}$  to 0.9  $\mu\text{m}$ , respectively (Table 3).

The microechinate-perforate sculpturing was determined in the studied *Silene* species (Figure 3).

TABLE 2. The measurements of pollen grains of examined species.

Species	Pollen diameter (C) ( $\mu\text{m}$ )	Pollen shape	Aperture type	Pore number	Interpore distance (D) ( $\mu\text{m}$ )	C/D	Pore diameter ( $\mu\text{m}$ )	Operculum diameter ( $\mu\text{m}$ )	Ornamentation
<i>S. duralii</i>	30.2-34.6	Spheroidal	Polypan-toporate	26-30	4.89-5.55	0.96	3.65-4.87	3.67	Microechinate-perforate
<i>S. ozyurtii</i>	27.5-32.4	Spheroidal	Polypan-toporate	10-18	5.20-5.22	0.99	5.47-4.36	2.86	Microechinate-perforate
<i>S. anatolica</i>	39.14-55.47	Spheroidal	Polypan-toporate	23-30	5.71-10.74	0.86	5.05-10.94	3.54	Microechinate-perforate
<i>S. salsuginea</i>	26.09-34.62	Spheroidal	Polypan-toporate	20-32	2.42-4.48	0.87	2.26-5.022	3.92	Microechinate-perforate

TABLE 3. The other palynological traits of studied *Silene* species.

Species	Microechinae number on operculum	Size of microechinae height ( $\mu\text{m}$ )	Size of microechinae base ( $\mu\text{m}$ )	Exine ( $\mu\text{m}$ )	Intine ( $\mu\text{m}$ )	Spinules number at 10 $\mu\text{m}^2$	Perforation numbers at 10 $\mu\text{m}^2$
<i>S. duralii</i>	9-18	0.49 $\pm$ 0.08	0.55 $\pm$ 0.10	1.78	0.7	45-50	5-10
<i>S. ozyurtii</i>	18-21	0.81 $\pm$ 0.31	0.54 $\pm$ 0.09	1.6	0.8	40-45	18-20
<i>S. anatolica</i>	6-13	0.50 $\pm$ 0.05	0.78 $\pm$ 0.10	2.38	0.9	30-35	18-20
<i>S. salsuginea</i>	12-16	0.33 $\pm$ 0.09	0.48 $\pm$ 0.06	2.07	0.7	40-45	20-25

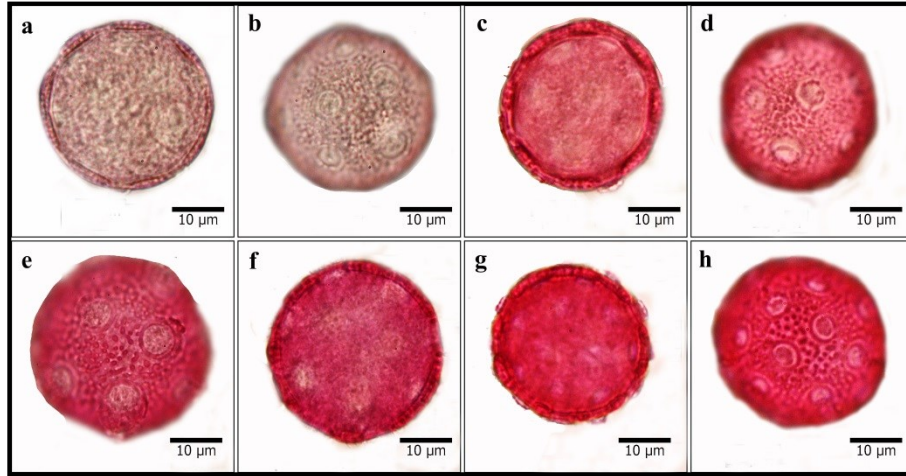


FIGURE 2. The LM microphotographs of *Silene* species. *S. duralii* (a-b). *S. ozyurtii* (c-d). *S. anatolica* (e-f). *S. salsuginea* (g-h).

This is the first report on the palynological characteristics of the studied species of *Silene*, except for *S. ozyurtii*. The pollen morphological traits of *S. ozyurtii* are mainly congruent with the description declared by Atasagun et al. (2016) [16]. However, the dimensions of the microechinae and number are presented here in for the first time.

The pollen characteristics of the examined species are congruent with the results of previous investigations [12,13,14,15,16]. In the examined species, the pollen diameter, pore structure, number of pores, and interpore distance are clearly different from each other. The interpore distance was the farthest in *S. anatolica*. When the pore structure was investigated, the pollen grains of *S. ozyurtii* had the longest spinules, while *S. salsuginea* had the the shortest ones. The ornamentation and pollen type were the same in all of the studied species. The examined species exhibited *Silene vulgaris* pollen grains, according to the study of Yıldız (2001) [12].

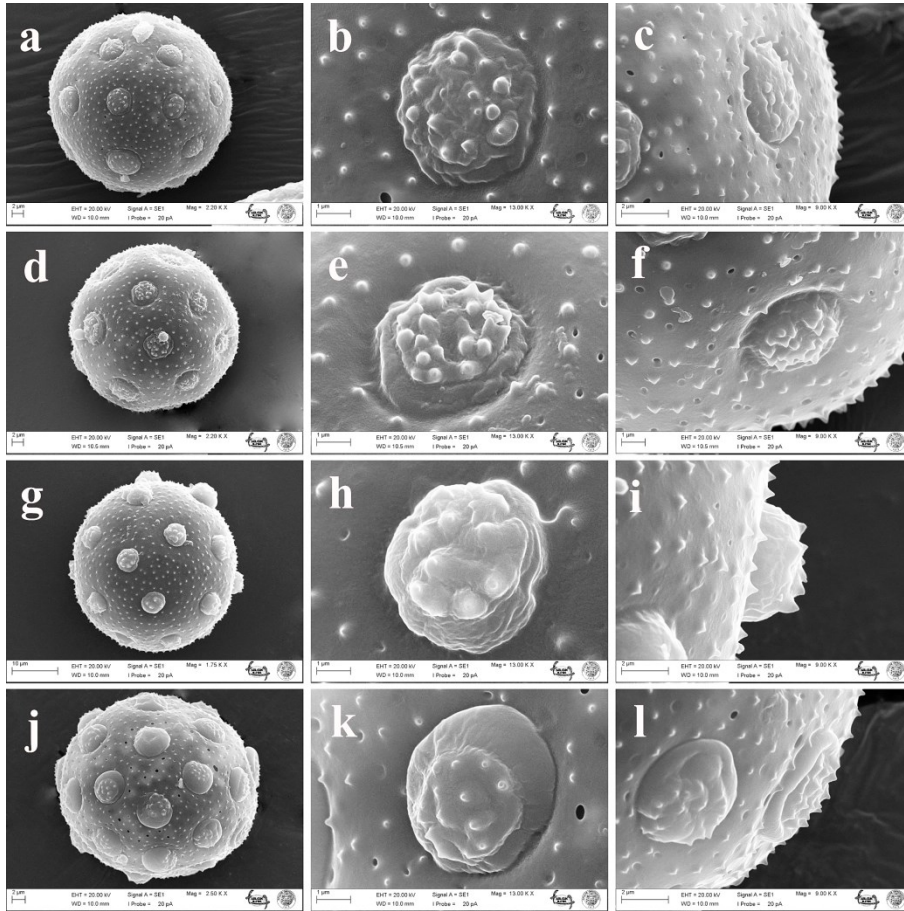


FIGURE 3. The SEM microphotographs of *Silene* species. *S. duralii* (a-c). *S. ozyurtii* (d-f). *S. anatolica* (g-i). *S. salsuginea* (j-l).

Pollen grain ornamentation types are notable morphological properties in taxonomy. Moreover, those with a small number of pores are considered primitive, while those with a large number of pores are regarded as advanced [20,21]. An examination of the species we studied will not aid us in making justifiable comments on the evolutionary process of the species as far as the pollen surfaces are concerned; however, it will demonstrate that species with a greater number of pores, such as *S. salsuginea* (20–32 pores), is more advanced when compared to

other species. Perhaps this halophytic species needs more pores to increase its germination achievement (because of salt stress).

In conclusion, the pollen morphology of the genus *Silene* can be used to distinguish species by evaluating the most valuable properties, the pore diameter and structure, microechinae number, and dimensions and ornamentation.

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