

## Original Article

# Morphological, Palynological and Ecological Study on Potential Ornamental Plant

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## ABSTRACT

**Background and Objective:** *Campanula myritifolia* Boiss. & Heldr. being an endemic, chasmophyte spread into a confined space in the south of Turkey. It is also an element of East Mediterranean phytogeographical region. The morphological, palynological and ecological features of the species has been investigated in this study. Its detailed description was carried out by determining particular differences between its morphological measurements and "Flora of Turkey". Its palynological properties, such as pollen size, thickness of the exine and intine etc., has been examined.

**Materials and Methods:** The plant material was collected from the natural areas in Anatolia. General features were presented by assigning minimum and maximum limits in order for the variation to be determined in the identification of the species. The analysis of 2 kg soil samples with 0-20 cm depth and diameter obtained from the area in which the plant indicated expansion was executed.

**Results:** The pollen is tricolporate, exine sculpturing pattern is rugulate at *C. myritifolia*. Its seed surface morphology has a definite and organized structure with stripes in the shape of long striates. The physical and chemical analysis of the soils in which the plant grows has performed. *C. myritifolia* typically grow best in soils with a pH 7.5 (slightly alkaline) with clayey-loamy constitutions.

**Conclusion:** Morphology, seed surface and pollen structure, phytochemistry are used in solving taxonomic problems of *Campanula* genus. In the section *Tracheliopsis*, which has a problematic structure, contributed with *Campanula myritifolia* with pollen, seed and ecological data to reveal differences and similarities between species.

## INTRODUCTION

*Tracheliopsis* belonging to the *Campanula* genus is comprised of perennial and simultaneously chasmophyte plants in Flora of Turkey. All have imbricated stemless trunk leaves with no appendage in the calyx. The corolla has a infundibular or cylindrical shape. Despite the styli being long and outside of corolla in all of the species. It is different only for *C. myritifolia*. It is easily distinguished from other species as its styli is located inside the corolla. Contandriopoulos has separated *Tracheliopsis tauricum* Contandr., Quézel & Pamukç. from *C. myritifolia* having definitely extensive long hair. This feature may be existing to aid in adapting a special habitat such as a cave entrance. However, it was later accepted as a synonym<sup>1</sup>.

For these reasons, we have come up with the thought to study comprehensive morphology of *C. myritifolia*. The present paper is the first that examines the detailed morphology, ecology, pollen and seed morphology using both light and scanning electron microscopes of endemic *C. myritifolia* which are distributed in Turkey. There

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exists various studies on the pollens of other species, primarily *Campanula*, that are grown in Turkey<sup>2-6</sup>. Seed coat properties are whether used merely or not at all in the family of Campanulaceae<sup>7</sup>. The researches of Akcin<sup>8</sup> and Alcitepe<sup>9</sup> on the seed testa of *Campanula* that is grown in Anatolia are the major ones. Ecology researches on the *C. lyrata* Lam.<sup>10</sup> and *Campanula* genus<sup>11</sup> grown in Turkey can be mentioned. Besides, blue and white flowers of some *Campanula* sp. are used as an ornamental plants in gardens in World. For these reasons, the comprehensive study on *C. myritifoli* was needed. The present paper is the first that examined the detailed morphology, ecology, pollen and seed morphology using both light and scanning electron microscopes of endemic *C. myritifolia* which are distributed in Turkey.

## MATERIALS AND METHODS

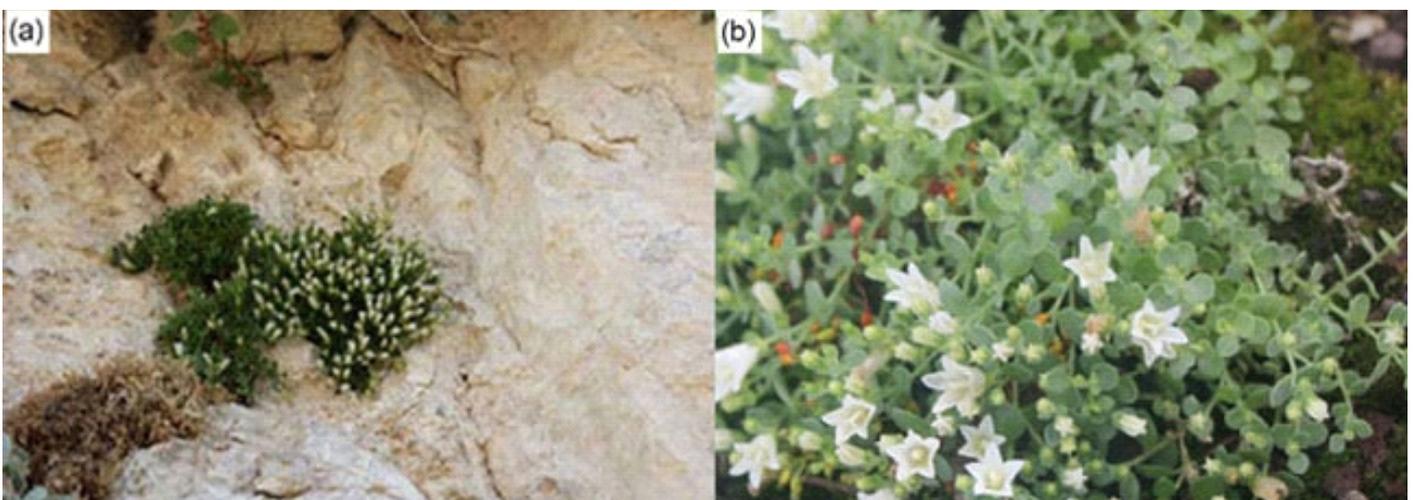
**Procurement and identification of species:** The plant material was collected from the natural areas in Anatolia. C4: Karaman, Ermenek, rocks, cave entrance, environ of hydroelectric dam, 1400 m, 22.07.2011, Alçitepe E. 2517; Ermenek, calcareous rocks, cliffs, 1470 m, 15.08.2013, Gülbağ F., Erken S. 20 (Fig. 1a, b).

**Morphological studies:** General features were presented by assigning minimum and maximum limits in order to the variation that can be determined in the identification of the species.

**Materials used for pollen and seed-coat studies:** For SEM observations, pollen and seed were mounted on stubs and covered. The Selçuk University, Advanced Technology Research and Application Center, Konya were used for investigation and for receiving the micrographs (Fig. 2, 3). Stearn<sup>12</sup> and Barthlott<sup>13</sup> identifications were utilized in the seed coat specifications. LM measurements of both of the pollen and the seed were conducted in the laboratories of Ahmet Keleşoğlu, Faculty of Education, Necmettin Erbakan University. Measurements were done in terms of micrometer with at least 10 samples of seed and at least 30 samples of pollen.

**Ecological studies:** The analysis of 2 kg soil samples with 0-20 cm depth and diameter obtained from the area of plant indicated expansion was executed in Atatürk Central Horticultural Research Institute. In the study, standard methods<sup>14</sup> were applied for total soluble salt, pH, calcium carbonate and organic matter. Bingham<sup>15</sup> and Pizer<sup>16</sup> methods were utilized for the analysis of elements such as phosphorus and potassium.

**Statistical analysis:** Results were expressed as Mean±SD and data was analysed using Microsoft Excel.



**Fig. 1:** General (a) and close up (b) appearance of *C. myritifolia* in natural habitat (Photo: Gülbağ, F. 2013)

## RESULTS AND DISCUSSION

This study included a detailed morphology, palynology and ecology on endemic *Campanula myritifolia* which are naturally occurred in a narrow geographical area.

**Morphology:** It was tufted to cushion-forming and woody-based, with many erect stems to 1.5 to 3-4 cm long. Stem was fragile and have hispidulous. Leaves was 2-6x1-4 mm, minute, elliptic to broadly ovate-elliptic shape, firm, sessile. Leaves had antrorsely strigulose hairs on surface and margin. Flowers was 2-3x4-8 mm, narrowly funnel-shaped. Flowers was solitary or in 2-5 flowered corymb on filiform pedicels. Corolla had 5 or sometimes 4-merous, including the short erect lobes. It was 1-1.5x1 mm, scarcely, triangular shape and have slightly hispidulous outside. It was lavender-blue colour, sometimes white. Calyx lobes were 0.7-1x1-3 mm, linear-lanceolate shape and had strigulose hairs. Calyx appendages was absent. Anthers were ending in a swollen-type mucro. Style was included, 6 mm long and papillate. Stigmas were 3 sometimes 2. Capsule was 2.5-3 mm long. It has opening by 3 basal pores. Seed was 0.15-0.4x0.25-0.5 mm, small, light brown colour. Flowering occurred in August. Habitat was crevices of sloping and limestone rocks at 1070-2100 m in Turkey (Fig. 1a, b; Table 1).

**Table 1:** The measured morphological traits of selected phenotypes of *C. myritifolia*

Parameters	Width		Length	
	Min-Max	(Mean±SD)	Min-Max	(Mean±SD)
Characters				
Stem (mm)	0.6-1.0	0.91±0.08	15.0-40.0	28.28±8.82
Lamina of leaves (mm)	2.0-4.0	3.16±0.80	2.0-6.0	4.77±1.08
Calyx lobe (mm)	0.7-1.0	0.90±0.34	1.0-3.0	1.77±0.52
Corolla (mm)	2.0-3.0	2.50±0.48	4.0-8.0	5.64±1.36
Corolla lobe (mm)	1.0-1.5	1.16±0.25	1.0-1.0	1.0±0.01
Capsule (mm)	2.5-3.0	2.88±0.21	2.5-3.0	2.96±0.19
Seed (mm)	0.15-0.40	0.21±0.08	0.25-0.50	0.38±0.08

min: Minimum value, max: Maximum value, Mean: Arithmetic means, SD: Standard deviation (%)

**Table 2:** Pollen morphological traits of *C. myritifolia*

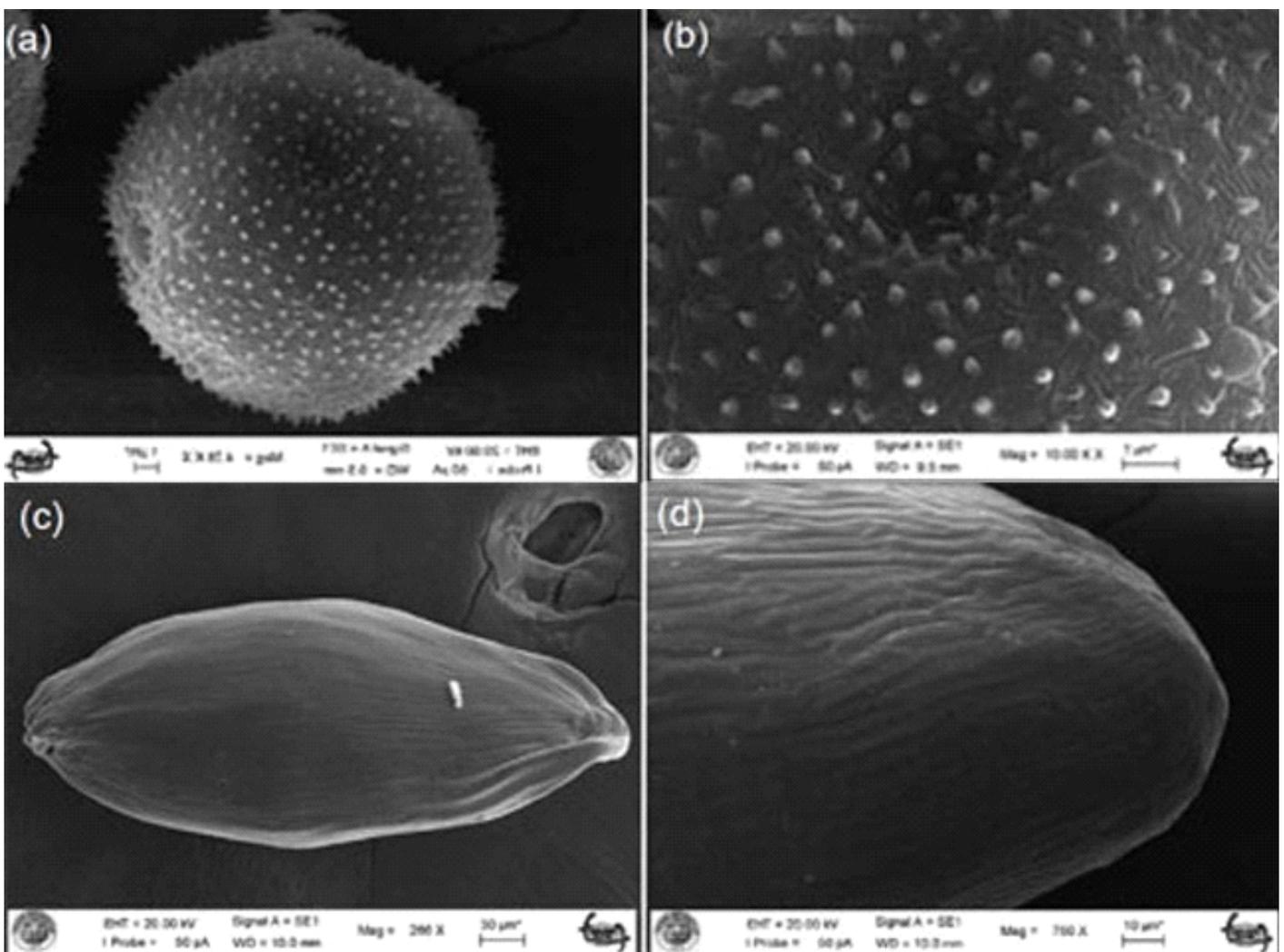
Characters	Mean±SD (Var)
P (µm)	26.56±1.78 (24.34-29.06)
E (µm)	25.87±2.05 (25.52-30.22)
P/E	1.02
Plg (µm)	8.63±1.08 (7.47-10.64)
Plt (µm)	9.11±1.34 (7.08-10.8)
Plg/Plt	0.94
Exine thickness (µm)	1.02±0.19 (0.62-1.28)
Intine thickness (µm)	1.13±0.05 (0.92-1.35)
Microechinate length (µm)	0.55±0.18 (0.25-0.70)
Microechinate width (µm)	0.43±0.13 (0.20-0.60)
Microechinate number (5µm <sup>2</sup> )	34-49

P: Polar diameter, E: Equatorial diameter, P/E: Pollen shape, Plg: Porus length, Plt: Porus width, Plg/Plt: Porus shape, Mean: Arithmetic means, SD: Standard deviation, Var: Variations

**Seed morphology:** *Campanula myritifolia* was ellipticin seed outline. Seeds were small, 0.15-0.4×0.25-0.5 mm and light brown in colour. Areolas were so suppressed from the sides that the seed's surface morphology was observed to have a striped structure in the shape of definite, organized and long striates in the sculpturing of the seed surface as analyzed by SEM (Fig. 2c, d; Table 1).

**Palynology:** The morphological properties and SEM photographs belonging to the examined species' pollen were presented (Fig. 2a, b) (Table 2).

*Campanula myritifolia* had a polar axis of 26.56 µm and an equatorial axis of 25.87 µm. Average thickness of the exine was 1.02 µm (w). Intine was 1.13 µm (w). Plg was 7.47-10.64 µm, plt 7.08-10.8 µm. Pores was circular (plg/plt 0.94 µm). Exine sculpturing pattern was rugulate at *C. myritifolia*. The length and width of the spinules which were on the exine surface changed between 0.25-0.70×0.20-0.60 µm. Spinules in the sexine were obvious. The numbers of spinules of *C. myritifolia* was 34-49 in 5 mm<sup>2</sup>.



**Fig. 2 (a, b):** *C. myritifolia* a, b. pollen (SEM); c, d. seedcoat (SEM) in different positions

**Table 3:** Physical and chemical analysis of the soil of *C. myritifolia*

	Texture	EC25 (1:2.5)	pH	CaCO <sub>3</sub> (%)	Organic matter (%)	P (ppm)	K (ppm)
Characters	Class	(mmhos/cm)	(1:2.5)				
	Clayeyloamy	0.54	7.5	72.82	0.8	4	50

EC: Electrical conductivity, CaCO<sub>3</sub>: Calcium carbonate, P: Phosphorus, K: Potassium

**Table 4:** Comparison of morphological characteristic with Flora of Turkey

Characters	Resulted Values	Flora of Turkey
Stem (width×length)	0.6-1×15-40 mm	15-30-40 mm
Lamina of leaves (width×length)	2-4×2-6 mm	1-4×2-6 mm
Calyx lobe (width×length)	0.7-1×1-3	2-2.8 mm
Corolla length	4-8	7-8 mm
Corolla lobe (width×length)	1-1.5×1	-----
Seed (width×length)	0.25-0.5×0.15-0.4 mm	-----

**Table 5:** Comparative testa cell, thickness of testa wall and lumen

Species	Testa cell (length $\mu\text{m}$ )	Thickness of testa wall ( $\mu\text{m}$ )	Lumen (width $\mu\text{m}$ )
<i>C. myritifolia</i>	37.37±12.90 (15-57)	3.08±1.54 (1.0-4.5)	1.95±0.60 (1.10-3.0)

*C. myritifolia* is endemic South Anatolia. It grows in central part of the Isaurian Taurus (provinces of Konya and Içel, Ermenek) mountains of southern Anatolia. Even though all of the species belonging to the sect. *Tracheliopsis* have long and exerted styli, this rule has reversely operated for *C. myritifolia*. This characteristic is a morphological link which can also be frequently observed in sect *Saxicolae*. The samples collected by Quezel in 1970 from Flank of Kurttepe in the Bolkar region of Içel, are named (*Tracheliopsis tauricum*) as a different species due to their spreading longer hair; yet, they were later accepted as a synonym (Fig. 1b). Physical analysis of the soil indicated the pH as 7.5 (slightly alkaline) total salt as 0.54 (saltless) and  $\text{CaCO}_3$  amount as 72.82% (too much lime)<sup>17</sup>. The class of the soil constitution was clayey-loamy. From the chemical analysis of the soil, phosphorus was discovered to be 4 ppm (low in phosphorus), potassium was 50 ppm (very low)<sup>18</sup> and organic matter was 0.8% (very low) (Table 3). By expanding the defining morphology characteristics of the species with the study conducted, it was compared with "Flora of Turkey"<sup>1</sup> (Table 4). Certain characteristics which were not identified were added and presented with the measurements (Table 1, 4).

Information about the seeds of *C. myritifolia* was never mentioned in the "Flora of Turkey"<sup>1</sup>. Seed surface morphology is observed in type II form as stated by Alcitepe<sup>9</sup> in the study, performed on sect. *Quinqueloculares*. In other words, areoles in *C. myritifolia* are so suppressed from the sides that the seed's surface morphology is observed to have a striped structure in the shape of definite, organized and long striates. It is prevalently encountered in species of *Campanula*<sup>8</sup>. The testa cell height of *C. myritifolia* is measured to be in between 15-57 (37.37±12.90) mm. The radial wall thickness is 1-4.5 (3.08±1.54) mm. Lumen width is 1.10-3 (1.95±0.60) mm (Table 5). Data belonging to the seeds are initially presented with this research.

As observed in this study, the shape of the pollen grains in *C. myritifolia* is spheroidal. The number of pores in the species studied is generally 3; however, 4 can rarely be observed as well. Porate pollens are accepted to be more developed compared to the corporates<sup>19</sup>. Furthermore, although the observance rate of triporate pollens in Campanuloideae is highly common<sup>20</sup>, sometimes this may range between 4-6 pores<sup>21</sup>. Distinguishments between the species<sup>2</sup> considered to be possible by adding differences<sup>6,22,23</sup> to this commonly used property of *Campanula* and its allied such as pollen measurements. An important characteristic in taxonomy is the pollen surface<sup>24</sup>. Rugulate-microreticulate, granulate-scabrate with echinule conditions are mostly observed in *Campanula* species<sup>5,6,21</sup>. The length and width of the spinules which are on the exine surface changed between 0.25-0.70×0.20-0.60  $\mu\text{m}$  in *C. myritifolia*. Spinules

in the sexine are obvious. Sexine is sometimes rugulate. The numbers of spinules of this species is 34-49 in 5 mm<sup>2</sup> (Table 2).

Turkey's soils are generally rich from organic matter. Approximately 64% contain very low or low amounts of organic matter<sup>25</sup>. *Campanula* species in the Mediterranean region are observed to prefer middle and high-class soils in terms of organic matter content. At the same time, they are rich in P and K<sup>11</sup>. However, as expected of taxons whose natural habitats are reefs, both the organic matter content, phosphorus and potassium amounts in *C. myritifolia* is low. Despite lime content indicates great variances for *Campanula* species<sup>11</sup>, its discovery of being high for *C. myritifolia* infers that the plant has a tolerance against excess lime (Table 3). *C. myritifolia* has been previously announced in the LR (cd) category (Lower risk-conservation dependent)<sup>26,27</sup>.

## CONCLUSION

Preparations were made for the studies to be performed among other species in the section with detailed examinations (pollen, seed -coat ecology, etc.) on *C. myritifolia*. It is a saxatile species. Because of its has a large number of flowers in the form of pillows. It can be used as an ornamental plant. The characteristics of the soil on which this will be grown has been revealed for evaluation as an ornamental plant.

## SIGNIFICANCE STATEMENT

When this study is supported with additional characters of morphology, it was revealed why this species is different in section. Hence it is necessary to accurately identify and limit the species. Thus, the necessity of detailed study of plant species in the genus of *Campanula* will be revealed for taxonomists. It is also revealed that it can be grown as an ornamental plant with its form and beautiful flowers.

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