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COMPARATIVE POLLEN MORPHOLOGY STUDIES OF TWO ENDEMIC *NOCCAEA* MOENCH (BRASSICACEAE) TAXA FROM TURKEY

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ABSTRACT. This study is supporting the biological characteristics of the plants to put forward more efficient systematic and evolutionary relationships by pollen morphology study. It is aimed to determine the comparative palynological features of the two endemic taxa from Brassicaceae family which are naturally growing in Turkey. Detailed morphological investigation of the pollen of the Turkish *Noccaea elegans* (Boiss.) Al-Shehbaz and *N. cilicica* (Schott & Kotschy ex Boiss.) Al-Shehbaz were carried out under Light Microscope and Scanning Electron Microscope (SEM). The results are described here for the first time. It was revealed that the pollen grains of two endemic taxa were the tricolpate type and spheroid/suboblate shaped. Exine was seen to be semitectate- reticulate ornamentation. Comparisons which will be made with the collected species and other taxa within the family will make contribution to taxonomy for family.

1. INTRODUCTION

Brassicaceae family is an economically important extended family [1] that hosts 338 genera and 3700 species, spreads mostly on the north hemisphere and rarely on the tropics [2]. There are 85 genera and 515 species of Brassicaceae family in Turkey. It consists of a large number of species as mostly annual plants, some perennial plants and a few bushes or semi- bushes [3].

Brassicaceae family includes lots of economical species as at the outset edible and industrial oil plants, vegetable species, medicinal plants and forage crops. Genus *Thlaspi* L. in which *Noccaea* species have already been included is one of the biggest genera with its 75 species in Brassicaceae (Cruciferae) family [4, 5]. Studies based on classical taxonomy which were done recently shows that *Noccaea* and *Thlaspi* are two different genera [6, 7, 8, 9]. Al-Shehbaz [10] transferred all species (except for one) belonging to whole genera apart from *Noccidium* and *Thlaspi* to *Noccaea* genus by publishing synopsis of *Noccaea* genus. As a result of combinations done in consequence of too complicated

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studies, *Noccaea* genus is represented with 16 taxa according to Mutlu [11] and with 51 taxa according to Al-Shehbaz [10] in Flora of Turkey.

Family is rather complicated with small character differences. In the absence of distinguishing macromorphological characters palynological characters were used to straighten the general and specific restrictions at times. Pollen morphology of Brassicaceae family was investigated by Orcan and Binzet [12], Warwick and Sauder [3], Al-Shehbaz et al. [1], Koch et al. [2] and Pınar et al. [13]. However, any palynological studies about *Noccaea* taxa has not been encountered.

Pollen morphological studies of two endemic *Noccaea* species were done with Light Microscope and SEM. The purpose of the study is to bring light to the unsettled taxonomic and evolutionary problems for Brassicaceae family by taking advantage of pollen morphology.

2. Materials And Methods

Pollen materials of *Noccaea elegans* and *N. cilicica* were obtained from herbarium specimens which stored at the Eskişehir Osmangazi University Faculty of Science and Literature Herbarium (OUFE). The pollen morphology investigated using LM and SEM. In the light microscope investigations, the pollen grains acquired from samples were obtained set by the preparation method described by Wodehouse [14] and Erdtman [15]. Identifications and counts at 10X ocular, and 10X and 40X plan objectives were used; for the purpose of identification a 100X plan oil-immersion objective was used. Pollen identifications and counts were obtained by Prior binoculer microscope. The spacing between each ocular micrometer was 0,98 μm. When prepared according Wodehouse's [14] and Erdtman's [15] methods, the exine and intine thickness pertaining to the taxa are to be measured a minimum of 50 times. From these obtained measurements, a natural mathematical mean is calculated. Microphotograps were taken at the Osmangazi University Science and Art Faculty, Department of Biology by KAMERAM brand digital camera and Nikon 80i type microscope.

For SEM investigations, unacetolyzed pollen grains were directly placed on the stubs, sputter-coated with gold, and examined with a Jeol 5600 LV-SEM [16, 17].

Terminologies for pollen morphology proposed by Wodehouse [14], Kuprianova [18], Erdtman [15], Aytuğ et al. [19], Charpin et al. [20], Faegri and Iversen [21] and Walker, [16, 17] were employed.

3. Results And Discussion

In this study, investigated 2 taxa in Brassicaceae family were found to have tricolpate type and spheroid, suboblat shape and to show semitectate-reticulate ornamentation. There are some contradictions on the idea about that the lengths of pollen and the numbers of chromosome has a correlation.

In some studies it is known that the more chromosome number increases, the more pollen length increases.

Our results reveals that 2 *Noccaea* taxa is more or less spheroid, tectate, amb circular. That was reported in the literature that its aperture characteristics and exosporium structure are among the essential criteria to define the phylogenic relations of species of Brassicaceae family [17, 18, 19]. Morphological characteristics of exosporium layer of all investigated Brassicaceae samples are reported to be the characters that explain the nature of the phylogenic relations among taxa best [17, 18, 19].

Pollen morphology of two endemic taxa belonging to *Noccaea* genus were investigated with LM and SEM. Pollens are radial symmetrical and isopolar. Polar axis (P) is between 19-23 µm, equatorial axis (E) is between 16-20 µm, pollen shape was confirmed as prolate, subprolate, oblate and rarely spheroid. Pollens are tricolpate and rarely pentacolpate, aperture inoperculate, surface ornamentation is reticulate. Colpus length (Clg) is 15-18 µm and colpus width (Clt) is 6-10 µm. Exine tectate is at 1-2 µm width, etexine is thicker than endexine. Intine width was confirmed as between 0.1-0.5 µm (Table 1; Fig.1-2).

TABLE 1. Pollen morphometrical parameters of the investigated *Noccaea* taxa (μm); P: Polar axis; E: Equatorial axis; Clg: Colpus length; Clt: Colpus width; t: Length of polar triangular edge; I: Intine at the thickest area; i: Intine ; Ex: Exine at the thickest area; L: Equatorial diameter.

	P	**E**	**Clg**	**Clt**	**t**	**I**	**i**	**Ex**	**L**
***N. cilicica* (Non-Acetolysed)**	18,2 ±0,76	16,48 ±0,87	14,88 ±1,01	7,2 ±1,00	4,08 ±1,15	0,95 ±0,28	0,39 ±0,13	1,42 ±0,32	15,8 ±0,95
***N. cilicica* (Acetolysed)**	18,72 ±1,02	16,24 ±0,66	15,8 ±0,95	8,12 ±1,05	4,64 ±0,91		0,32 ±0,13	1,55 ±0,24	16,2 ±1,23
***N. elegans* (Non-Acetolysed)**	20 ±0,81	18,76 ±0,96	15,92 ±0,91	8,56 ±1,26	4,68 ±1,02	1,30 ±0,19	0,33 ±0,14	1,34 ±0,30	17,2 ±0,95
***N. elegans* (Acetolysed)**	20,84 ±1,06	18,24 ±1,36	16,52 ±1,08	8,24 ±1,27	4,64 ±0,95		0,32 ±0,13	1,29 ±0,15	17,68 ±1,07

We determined with the variations at the measurements that species investigated during light microscope studies have genetic differences in the analysis so as these seem like completing the claim that pollen constructions have valid morphology characters in the taxonomy. Variation, exine construction, perforation construction, second lumina number at each main lumen, its existence, existence of holes at colpus membrane ornamentation in pollen morphology characters seem to have an obvious value for phylogenic construction. Defining the pollen characters is of vital importance for taxonomic studies [20, 21, 22, 23].

Pollen morphology provides strong evidences to differentiate taxa from each other. Pollen grains have holes in colpus membrane ornamentation. They are differentiated by differences of pollen shape and dimensions from each other.

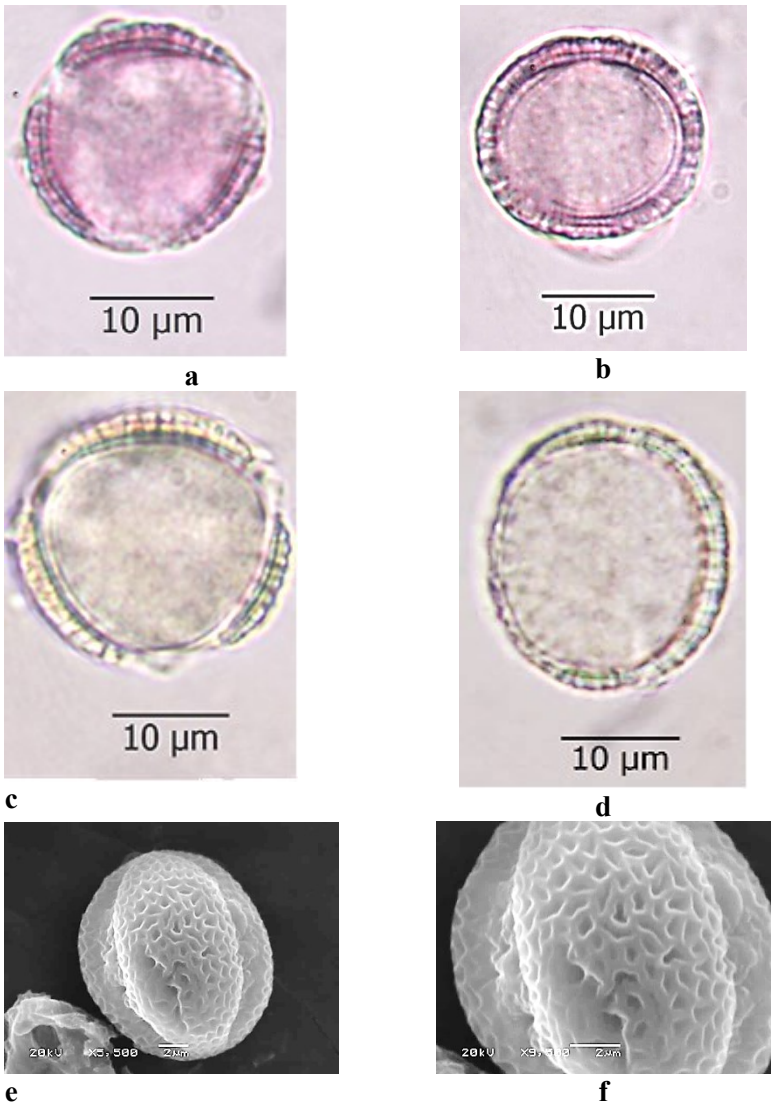

FIGURE 1. *Noccaeae elegans* Pollen Morphology a. Polar view (W), b. Equatorial view (W), c. Polar view (E), d. Equatorial view (E), e. General view. f. Ornamentasyon.

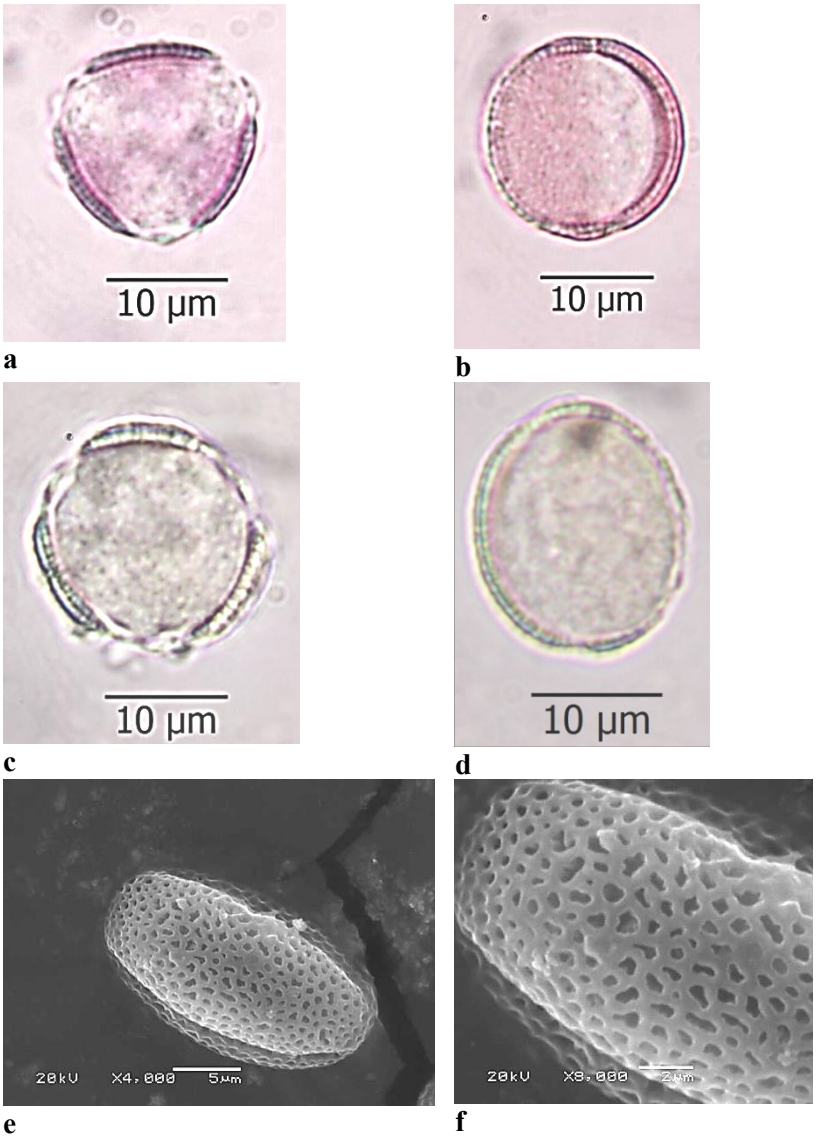

FIGURE 2. *N. cilicica* Pollen Morphology **a.** Polar view (W), **b.** Equatorial view (W), **c.** Polar view (E), **d.** Equatorial view (E), **e.** General view. **f.** Ornamentasyon.

We assume that these taxa in Brassicaceae family have pollen morphologies as a distinctive criterion as well as their systematic features. These study will also bring light to the phylogenic relations among investigated taxa at the same time. We presume that because morphologic construction of pollens have distinctive features in defining taxa, pollen studies will be useful for systematic studies.

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