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Palynology of Taxa of *Crepis* L. Genus Growing in Çanakkale, Türkiye

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ABSTRACT

This study investigated the pollen morphology of the taxa belonging to the genus *Crepis* L. collected from various localities in Çanakkale in 2015. Wodehouse (1935) and Acetolysis (Erdtman, 1960) methods were used in the research. Pollen morphologies of 3 species and two subspecies belonging to the *Crepis* L. genus were defined according to light microscopy (LM) and scanning electron microscopy (SEM) examinations. In LM, pollens are monad, radially symmetrical and isopolar. Pollens are suboblate and oblate spheroidal, Amb shape is inter-hexagonal-subtriangular. The pollen of the genus is tricolporate. The view from the equator is circular and oval. In the examinations made with LM, the ornamentation is echinulophate. Pollen has 15 lacunae as 3 poral, 6 abporal, 6 paraboral. Ornamentation is echinulophate; the tectum surface is microperforate. SEM micrographs of *C. smyrnaea* and *C. commutata* pollen show depressions at the corners of the polar field. The collapses are located on the paraboral lacunae and are distinctly lacuna-like. As a result, in this study, palynological features of *C. smyrnaea* DC., *C. micrantha* Czerep., *C. commutata* (Spreng.), *C. reuterana* Boiss. & Heldr. subsp. *reuterana* taxa were studied for the first time. *C. smyrnaea* DC. ex Froel. was collected for the first time in Çanakkale within the scope of this study, according to the type records in Flora of Turkey.

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Çanakkale Bölgesinde Yetişen *Crepis* L. Cinsine Ait Taksonların Palinolojisi

ÖZET

Bu çalışmada 2015 yılında Çanakkale ilinde çeşitli lokalitelerden toplanılan *Crepis* L. cinsine ait taksonların polen morfolojisi araştırılmıştır. Araştırmada Wodehouse (1935) ve Asetoliz (Erdtman, 1960) yöntemleri kullanılmıştır. *Crepis* L. cinsine ait 3 tür ve 2 alt türün polen morfolojileri ışık mikroskobu (LM) ve taramalı elektron mikroskobu (SEM) incelemelerine göre tanımlanmıştır. LM incelemelerinde polenler monad, radyal simetrili ve izopolardır. Polenler suboblat ve oblat sferoidal, Amb şekli interhegzagonal-subtriangular biçimdedir. Cinsin polenleri trikolporattır. Ekvatordan görünüş sirkular, ovaldir. LM ile yapılan incelemelerde ornamentasyon ekinülofattır. Polenler 3 poral, 6 abporal, 6 paraboral olmak üzere 15 lakunaya sahiptir. Ornamentasyon ekinülofat, tektum yüzeyi mikroperforat bir yapıdadır. *C. smyrnaea* ve *C. commutata* polenlerinin SEM mikrograflarında polar alanın köşelerinde çöküntüler mevcuttur. Çöküntüler paraboral lakunalar üstünde bulunmakta ve belirgin olarak lakuna görünümündedir Sonuç olarak bu çalışmada *C. smyrnaea* DC., *C. micrantha* Czerep., *C. commutata* (Spreng.), *C. reuterana* Boiss. & Heldr. subsp. reuterana taksonlarının palinolojik özellikleri ilk defa çalışılmıştır. *C. smyrnaea* DC. ex Froel. Flora of Turkey'deki tip kayıtlarına göre Çanakkale'de ilk defa bu çalışma kapsamında toplanmıştır.

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INTRODUCTION

The Asteraceae family spreads all over the world except Antarctica. With more than 1100 genera and more than 20.000 species, it ranks first in diversity among flowering plants. Among the species belonging to the family, there are annual and perennial ones. The most characteristic feature of this family is that its flower shows a flower state structure called a capitulum (Yıldız & Aktoklu, 2010). Plants are primarily found in mountain vegetation, open grasslands, and open forest areas. They are less common in humid tropical forests (Kadereit & Jeffrey, 2007).

Crepis L., the genus number 129 in the Lactuceae tribus, is in the Asteraceae family. There are 40 taxa of the genus *Crepis* registered in the 5th volume of Flora of Turkey. The genus *Crepis* was written by Lamond (Davis, 1975). In the List of Plants of Turkey, *C. foetida* L. subsp. *commutata* (Spreng.) Babcock has been upgraded from subspecies to *C. commutata* (Spreng.) Greuter (Güner et al., 2012).

The Asteraceae family was divided into nine pollen types, and the *Crepis* genus was studied within the Helianthus type (Erdtman et al., 1961). İnceoğlu and Karamustafa (1977) described light microscopy measurements of various genera in their pollen morphology studies for the Compositae family and evaluated the genus within the Lacunae. On the other hand, Enke (2009) reclassified *Crepis* (Cichorieae, Compositae) phylogenetics according to achene, pappus feathers, and pollen morphology characteristics. Wang et al. (2009) defined pollen morphological features of four *Crepis* species by light (LM) and scanning electron microscopy (SEM).

Peng et al. (2013) reported the pollen characteristics of three species of the *Crepis* genus with SEM images in their research belonging to the Asteraceae family. Yildirim et al. (2011) stated the morphological features, pollen, and seed SEM images of the *C. gemicii* species grown in Van province in Eastern Anatolia. However, researchers were not specified measurement values related to the pollen characteristics. Qureshi et al. (2002) defined the pollen morphology of *C. flexuosa*, *C. multicaulis*, *C. sancta*, and *C. thomsonii* species belonging to the *Crepis* genus in Pakistan by light microscopy.

This study aims to examine in detail the pollen morphology of the taxa of the *Crepis* genus growing in the Çanakkale province belonging to the Asteraceae family. The results obtained are intended to contribute to the genus systematic studies and the pollen atlas that can be created for Turkey.

MATERIAL and METHOD

Sampling Method

Specimens of flowering plants belonging to *Crepis* were collected during field studies in Çanakkale in 2015 (Table 1). The samples were dried and turned into a herbarium sample. Pollen slides were prepared from dried samples for microscope examination. Identification of plant samples was made by Prof. Dr. Bayram YILDIZ (Retired lecturer) and Assoc. Dr. Gül TARIMCILAR (Uludağ University, Faculty of Arts and Sciences, Department of Biology). Plant herbarium samples are kept in the Palynology Laboratory of the Biology Department of the Faculty of Science of ÇOMÜ and the IZEF Herbarium of the Faculty of Pharmacy of Ege University.

Laboratory Analysis

Preparations of pollen were prepared by Wodehouse (1935) and Acetolysis (Erdtman, 1960) methods for LM analysis. Measurements of pollen were made with a Leica 2500 DM light microscope. Pollen photos were taken with a Cence 2.0 MP camera connected to a Leıca 2500 DM microscope. Immersion oil, ocular 10X, and objective 100X were used for light microscope measurements. Each taxa in the preparations under the light microscope was measured on an average of 50 samples, excluding spins. According to the method of Wodehouse and Erdtman, P (polar axis), E (equatorial axis), P/E ratio, Meso (mesocolpium), Amb (the length of diameter in the polar view of the pollen), Icrl (inter colpus ridge length), Icsn (inter colpus spinules number), Ilgl (interlacunal gaps length), Ilgw (interlacunal gaps width), Alw (Abporal lacuna width), All (Abporal lacuna length), Pw (pore width), Pl (pore length), Plw (poral lacuna width), Pll (poral lacuna length), Pasn (number of spinules in the polar area), Pad (polar area diameter), Slle (spinule length equatorial view), Sllp (spinule length polar view) An (Aperture number) was measured.

For electron microscopy studies, according to the acetolysis method (Erdtman, 1960), pollen was placed on the stup with double-sided adhesive tape by taking it from the tube with the help of a clean, thin needle. Stups are plated with gold. JEOL SM 7100F brand SEM from Çanakkale Onsekiz Mart University Science and Technology Application and Research Center (ÇOBİLTUM) was used for electron microscope examinations. Surface ornamentations, polar and equatorial images, and spin properties of pollen were examined in detail, and photographs were taken. Some morphological features of pollen in SEM images; SLAL (spinule length at abporal lacuna), SBWAL (spinule base width at abporal lacuna), DBSICR (the distance between spinules at inter colpus ridge), SLICR

(spinule length at inter colpus ridge), SBWICR (spinule base width at inter colpus ridge), SLP (spinule length at polar area), SBWPA (spinule base width at polar area), ILGW (interlacunal gaps width) were measured using the freely available software ImageJ 1.36b (Wayne Rasband, NIH, MD, USA).

Wodehouse (1935), Erdtman (1943, 1960, 1969), Skvarla & Turner (1966, 1971), Moore & Webb (1983), Faegri & Iverson (1992), Punt et al. (2007), Türkmen et al. (2010), Pınar et al. (2016) sources were used in pollen terminology. Pollen slides are in the Palynology Laboratory of Çanakkale Onsekiz Mart University.

Table1. The places where the taxa belonging to the genus *Crepis* were collected, the dates they were collected, the collectors and the descriptors.

Tablo 1. Crepis L. cinslerine ait taksonların toplandığı yerler, toplandığı tarihler, toplayan kişiler ve teşhis edenler

TAXA	Location	Collected Date	Collectors	Descriptors
C. foetida L. subsp. *rhoeadifolia* (M.Bieb.)	Çanakkale Science High School, Çınarlı Village, Çanakkale, 35447402 D. 4435386 K., 98 m.	09.06.2015	Hanife AKYALÇIN Sunay ALTAN	Bayram YILDIZ İZMİR Gül TARIMCILAR BURSA
C. commutata (Spreng.) Greuter	Dümrek Village,Çanakkale, 35445310 D. 4426339 K.,81m.	11.06.2015	Hanife AKYALÇIN Sunay ALTAN	Bayram YILDIZ İZMİR Gül TARIMCILAR BURSA
C. smyrnaea D.C	İntepe Village, Çanakkale, 35441869 D. 4427628 K.,92m.	09.05.2015	Hanife AKYALÇIN Sunay ALTAN	Gül TARIMCILAR BURSA
C.micrantha Czerep.	Çanakkale Science High School, Çınarlı Village, Çanakkale, 35447402 D. 4435386 K.,98 m.	08.06.2015	Hanife AKYALÇIN Sunay ALTAN	Bayram YILDIZ İZMİR
C. reuteriana Boiss. & Heldr. subsp. *reuteriana*	Between İntepe and Gökçalı Village Çanakkale, 35441869 D. 4427628 K.,92m.	11.06.2015	Hanife AKYALÇIN Sunay ALTAN	Bayram YILDIZ İZMİR

Statistical Analysis

The mean (M), standard deviation (S) and min-max values of the measurements of the light microscope images and the min-max values of the electron microscope images were made in the IBM SPSS Statistics 22 program.

RESULTS and DISCUSSION

In light microscopy observations of five taxa of the genus *Crepis,* pollens are radially symmetrical, monad, and isopolar. In the pollen slides prepared according to the Wodehouse method, all the taxa are oblata spheroidae shape pollens. In slides made according to the Erdtman method, *C. smyrnaea, C. reuterana* subsp. *reuteriana* are suboblate shape, *C. foetida* subsp. *rhoeadifolia*, *C. commutata, C. micrantha* are oblatae spheriodal shape pollen. Equatorial axis values of pollens are between 19-30 µ (W) and 20-29 µ (E), and polar axis values are between 16-27 µ (W) and 17-28 µ (E) (Table 2). Pollen has a tricolporate aperture. Amb shape in pollen grains is inter-hexagonal-subtriangular (Figure 2).

The view from the equator is circular and oval. In the examinations made with LM, ornamentation is echinulophate. Pollen grains have 15 lacunae (3 poral, 6 abporal, 6 paraboral). The pollen slides examined have an operculum on the pore, and the pores are elliptical-circular. The pore length is in the range of 4.10-6.04 µ (W), 4.17-5.98 µ (E), and the pore width is in the range of 4.76-6.96 µ (W), 4.86-7.06 µ (E). The average spinule number in the polar area is 3.27-7.52 in the examinations made with LM in the Wodehouse and Erdtman method. The ornamentation is echinulophate (Table 2, Figure 2).

In SEM micrographs (Table 3, Figures 2, 3 and 4), the ends of the spinules have obtus-acute endings. Spinules are upright or curved in different directions. Ornamentation is echinulophate, tectum surface is microperforate. In the taxa belonging to this genus, collapses were observed in the polar area. The collapses, which are very prominent in the polar area of the pollens of *C. smyrnaea* and *C. commutata*, seem to be separate lacuna at the polar area border of the paraboral lacunae (Figure 2, 3).

C. commutata by Güner et al., (2012) *C. foetida* subsp. *commutata* has been upgraded from subspecies to *C. commutata*.

Except for *C. micrantha*, no significant variations were observed in pollen shape, sexin, aperture, abporal lacuna, inter lacunal gaps, spinule, mesocolpium, aperture features, and polar area features in the pollen of the genus *Crepis* according to light microscopy measurements (Table 2).

Table 2. Pollen morphological data of *Crepis* taxa in light microscopy analyses.
Tablo 2. Işık mikroskobu analizlerinde Crepis taksonlarının polen morfolojik verileri.

				POLAR AXES						EQUATORIAL AXES											MEAN OF MEASUREMENTS							
TAXA	Methods	P/E	Pollen Shape	Mean	Std. Deviation	Min-Max	Mean	Std. Deviation	Min-Max	Meso	Nexine	Sexine	Exine	Amb	Icrl	Icsn	Ilgl	Ilgw	Alw	All	Pw	Pl	Plw	Pll	Pasn	Pad	Slle	Sllp	An
C. foetida* subsp. *rhoeadifolia	E	0.88	oblatae spheroidae	24.38	1.24	23-28	27.7	0.99	25-29	14.8	1.24	2.68	4.14	25.78	10.31	5.67	2.92	1.78	6.08	6.90	7.06	5.98	8.22	7.04	5.57	7.59	2.00	2.00	3
	W	0.88	oblatae spheroidae	25.74	0.82	24-27	29.25	0.65	28-30	16.68	0.87	2.83	3.66	24.53	10.09	5.60	2.97	1.86	6.46	6.12	6.96	6.04	9.00	8.13	5.96	9.52	1.93	2.00	3
C. commutata	E	0.88	oblatae spheroidae	23.04	1.11	20-25	26.19	1.31	24-29	13.73	1.06	2.71	3.86	23.64	9.35	4.41	2.78	1.39	5.58	5.76	6.36	5.18	7.69	6.27	4.63	7.90	1.57	1.52	3
	W	0.90	oblatae spheroidae	25.14	0.84	24-27	27.96	0.69	27-29	15.23	1.00	2.85	3.80	25.47	9.43	5.08	2.96	1.85	6.12	6.02	6.75	5.80	8.69	7.73	5.81	9.19	1.84	1.89	3
C. smyrnaea	E	0.87	suboblatae	24.88	0.85	23-27	28.58	1.16	25-30	15.29	1.07	2.33	3.22	25.11	10.88	6.61	2.59	1.58	6.15	5.94	5.25	4.74	6.79	5.79	7.52	9.19	1.51	1.57	3
	W	0.88	oblatae spheroidae	25.28	1.06	23-27	28.56	1.17	25-30	15.72	1.02	2.61	3.59	25.53	10.31	5.52	2.79	1.67	5.45	6.25	5.10	4.29	7.01	6.16	5.28	8.43	1.76	1.87	3
C. micrantha	E	0.89	oblatae spheroidae	18.67	0.84	17-20	21.00	0.95	20-23	12.02	0.52	1.82	2.32	18.04	8.34	4.36	2.01	1.13	4.73	5.16	4.86	4.17	6.09	5.30	3.50	5.75	1.17	1.26	3
	W	0.91	oblatae spheroidae	18.70	1.09	16-20	20.42	0.92	19-23	11.71	0.51	1.94	2.52	19.18	7.53	4.14	2.05	1.28	4.67	5.55	4.76	4.10	6.56	5.89	3.27	5.13	1.20	1.24	3
C. reuteriana* subsp. *reuteriana	E	0.86	suboblatae	22.74	1.29	20-25	26.46	1.65	21-29	14.71	1.09	2.16	3.46	23.98	10.09	5.60	2.33	1.27	5.57	6.19	62017	5.23	7.46	6.44	4.34	5.96	1.23	1.16	3
	W	0.89	oblatae spheroidae	24.88	0.74	23-26	27.78	0.73	26-29	15.26	1.00	2.82	3.83	24.87	10.02	5.45	2.86	1.80	5.62	6.30	6.14	5.32	8.10	7.24	5.17	7.20	1.90	1.87	3

Meso, mesocolpium; Amb, the length of diameter in the polar view of the pollen; Icrl, inter colpus ridge length; Icsn, inter colpus spinules number; Ilgl, interlacunal gaps length; Ilgw, interlacunal gaps width; Alw, Abporal lacuna width; All, Abporal lacuna length; Pw, pore width; Pl, pore length; Plw, poral lacuna width; Pll, poral lacuna length; Pasn, number of spinules in polar area; Pad, polar area diameter; Slle, spinule length equatorial view; Sllp, spinule length polar view; An, Aperture number, all measurements in µm.

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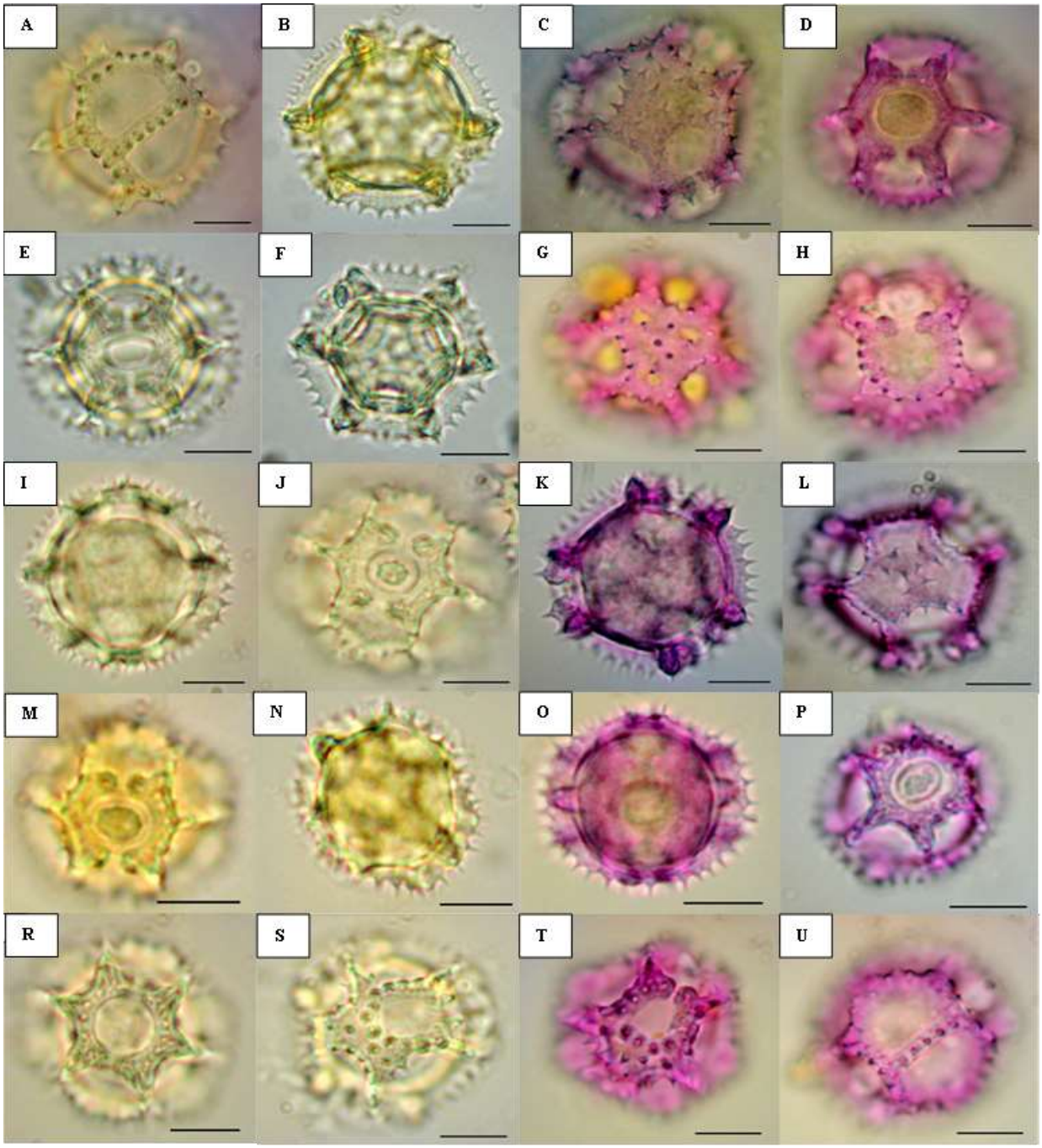

Figure 1. Pollen morphology of Crepis by light microscopy (LM). A-B (E), C-D (W) C. foetida subsp. rhoeadifolia; E-F (E), G-H C. commutata; I-J (E), K-L (W) C. smyrnaea; M-N (E), O-P (W), C. micrantha; R-S (E), T-U (W) C. reuteriana subsp. reuteriana. Erdtman (E), Wodehouse (W). Scale bar 10 µ.

Şekil 1. Erdtman ve Wodehouse yöntemine göre ışık mikroskobu resimleri. A-B (E), C-D (W) C. foetida subsp. rhoeadifolia; E-F (E), G-H C. commutata; I-J (E), K-L (W) C. smyrnaea; M-N (E), O-P (W), C. micrantha; R-S (E), T-U (W) C. reuteriana subsp. reuteriana. Erdtman (E), Wodehouse (W). Ölçek çubuğu 10 µ.

Polar and equatorial axis dimensions were smaller and significantly different between the taxa whose *C. micrantha* pollens were studied, compared to the Erdtman and Wodehouse methods—the investigated *C. reuteriana* subsp. *Reuteriana,* while the P/E ratios have a wide range in the Erdtman method, the range is very narrow according to the Wodehouse method (Table 2).

In SEM micrographs, the ends of the spinules have obtus-acute endings. Spinules are upright or curved in different directions. Ornamentation is echinulophate, and the tectum surface is microperforate. There are

apparent collapses in the polar area. Pollen morphological studies of the genus *Crepis* are limited. *C. foetida* subsp. *rhoeadifolia* was also studied by İnceoğlu and Karamustafa (1977), and light microscope measurements of the taxa were given. *C. foetida* subsp. *rhoeadifolia* pollen grain is 27.7 X 31.6 (E), 24 X 27.6 µ (W), triporate, oblate spheroid, amb inter-hexagonal. Pollen grains have been described as lacunae. In this study, pollens were observed as 24.38 X 27.70 µ (E), 25.74 X 29.25 µ (W), tricolporate, oblate spheroidal, amb subtriangular-subhexagonal (Table 2,3 and Figure 1). There is no significant difference between the results obtained and the results of the study conducted by İnceoğlu and Karamustafa (1977), except for the number of apertures. The aperture of *C. foetida* subsp *rhoeadifolia* is tricolparate, not triporate, as stated by İnceoğlu and Karamustafa (1977).

Table 3. Ornamentation and spine measurements of *Crepis* species in SEM analyses
Tablo 3. SEM analizlerinde Crepis türlerinin ornamentasyon ve spin ölçümleri

	DBSPL	SBWPL	SLPL	DBSAL	SLAL	SBWAL	DBSİCR	SLİCR	SBWİCR	SLP	SBWPA	İLGW
	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min
C. foetida subsp. *rhoeadifolia*	1.79-0.66	1.82-1.23	2.00-1.24	1.54-0.62	2.25-0.96	1.74-1.12	1.69-0.54	1.84-0.91	1.69-0.95	2.01-1.04	1.84-0.95	0.99-0.58
C. commutata	—	—	—	—	1.60-0.92	1.25-0.82	0.87-0.71	2.02-0.93	1.56-0.86	1.41-1.14	1.38-1.14	1.19-0.43
C. smyrnaea	—	—	—	—	1.57-1.01	1.24-1.03	—	1.69-1.12	1.88-0.84	1.87-0.84	1.36-0.82	0.68-0.38
C. micrantha	—	—	—	—	1.52-1.07	1.48-0.95	0.46-0.35	1.51-1.02	1.17-0.90	—	—	0.69-0.54
C. reuteriana subsp. *reuteriana*	—	—	—	—	2.08-1.46	2.08-1.20	0.97-0.31	1.92-1.27	1.65-1.24	1.75-0.95	1.61-1.22	—

DBSPL, the distance between spinüls at paraboral lacuna; SBWPL, spinüle base width at paraboral lacuna; SLPL, spinüle length at paraboral lacuna; DBSAL, the distance between spinüls at abporal lacuna; SLAL, spinüle length at abporal lacuna; SBWAL, spinüle base width at abporal lacuna; DBSİCR, distance between spinüls at inter colpus ridge; SLİCR, spinüle length at inter colpus ridge; SBWİCR, spinüle base width at inter colpus ridge; SLP, spinüle length at polar area; SBWPA, spinüle base width at polar area; İLGW, interlacunal gaps width; –, unmeasured, all measurements in µ.

Qureshi et al. (2002) examined the four species of *Crepis* in Pakistan. Qureshi et al. (2002) are similar to the results in this study, but according to their measurement results, the pollen is more prominent in size than the pollen examined in this study.

Wang et al. (2009) reported that *Crepis* pollen has small polar areas with 1-10 spines. This study observed that the polar areas are small, and the number of spinules is low (Figures 1, 2, 3 and 4). In addition, there are visible collapsed areas in the polar regions of the pollen in this study. However, this is not reported by Wang et al. (2009).

In the study of Enke (2009), pollen of *C. foetida* was specified as echinolophate between 26-32 µ. In this study, *C. foetida* subsp. *rhoeadifolia* pollen is echinulophate with a size of 23-30 µ. The results obtained in this study regarding pollen size and ornamentation characteristics are in harmony with the results of Enke (2009). Unlike the polar region of *Crepis foetida*, depressive areas are seen in the polar region of the pollen of *C. foetida* subsp. *rhoeadifolia* (Figures 1 and 2).

The results of this research are similar to the results of the study conducted by Osman (2006). In his study, Osman (2006) evaluated the *Crepis* genus within the Launaea pollen type. Palynological features observed in Launaea pollen type and morphological features of *Crepis* pollens in this study are similar. To summarise, both Launaea type and *Crepis* pollens have 15 lacunae (3 poral, 6 abporal, 6 paraboral). Osman (2006) examined *Crepis* species within the pollen species of Launaea and expressed the polar axis length in the range of 32-44 µ. However, the polar-equatorial axis dimensions of the pollens measured in this study are shorter than the lengths specified in the pollen type of Launaea, and the pollens are small.

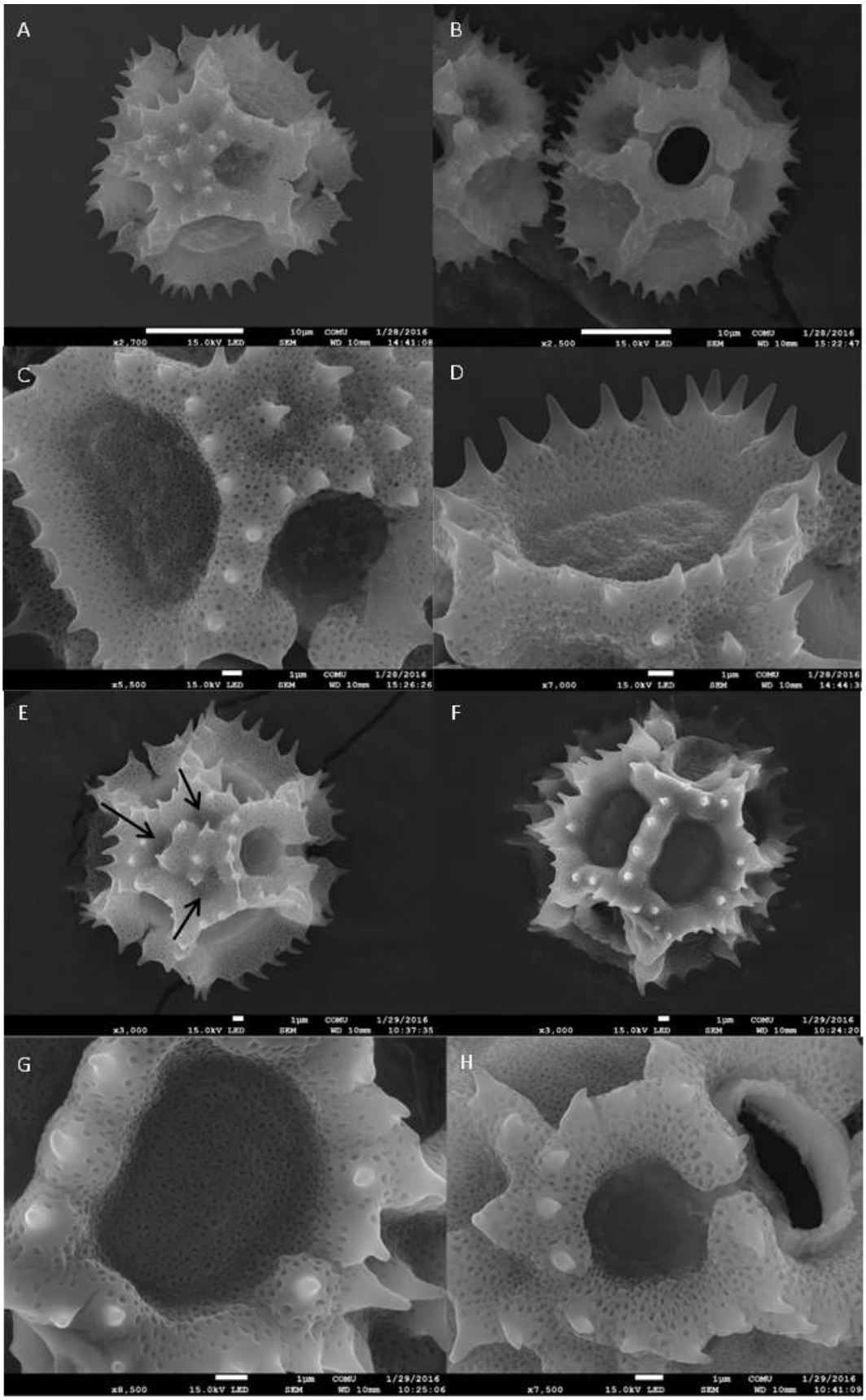

Figure 2: Pollen morphology of Crepis by SEM. A-D C. foetida subsp. rhoeadifolia; E-H C. Commutata
Şekil 2. SEM ile Crepis polen morfolojisi. A-D C. foetida subsp. rhoeadifolia; E-H C. Commutata

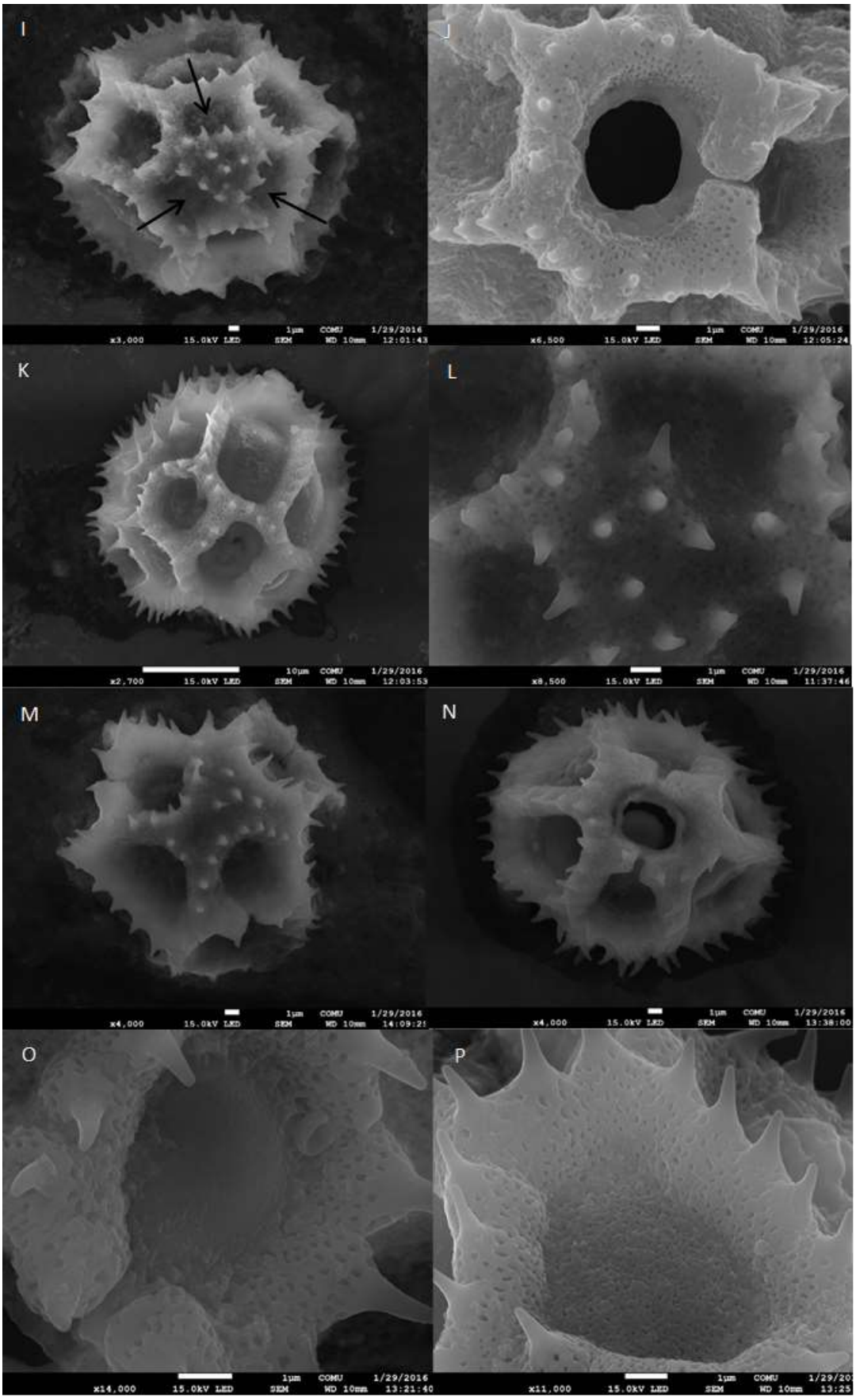

Figure 3: Pollen morphology of Crepis by SEM. I-L C. smyrnaea; M-P C. micrantha
Şekil 3: SEM ile Crepis polen morfolojisi. I-L C. smyrnaea; M-P C. micrantha

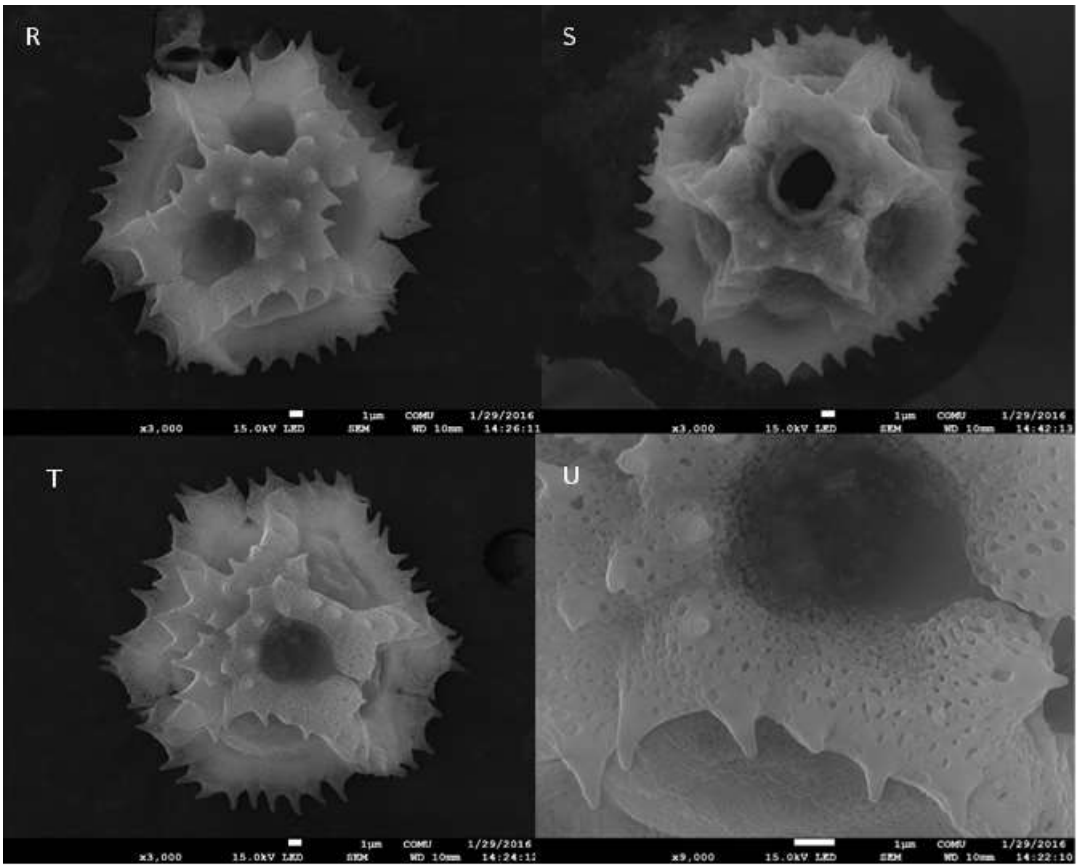

Figure 4: Pollen morphology of Crepis by SEM. R-U C. reuteriana subsp. reuteriana
Şekil 4: SEM ile Crepis polen morfolojisi. R-U C. reuteriana subsp. reuteriana

Peng et al. (2013) defined the morphological characteristics of the *Crepis* genus pollen in their study. They show similarities with the results of this study, except for the pollen sizes.

Dauti et al.(2018) compared the pollen morphology of *C. albenica* with the pollen morphology of four *Crepis* species. As a result, he stated that the pollen of *C. albenica* is larger than the other species. The taxa of *Crepis* examined in this study are similar to other taxa except for *C. albenica.*

Qiu et al. (2020) described a new species from the genus *Crepis* with morphological and molecular data. The results of this study show similarities, except for pollen sizes.

CONCLUSION

This study revealed pollen morphological characteristics of *Crepis* taxa for the first time, except for light microscopy measurements of the *C. foetida* subsp. *rhoeadifolia* taxa. The pollens of the genus *Crepis* examined within the scope of this research are compatible with the results of research in other countries regarding general pollen morphological characteristics. The most important difference of this study from other studies is that the pollen sizes are smaller, and *C. micrantha* has the smallest pollen among the taxa studied. The second significant difference is the presence of depressions in the polar areas of the studied taxa. However, the depressions are very prominent in the polar areas of *C. commutata* and *C. smyrnea* pollens. These depressions are so obvious that they appear as separate lacuna at the polar area border of paraboral lacunae. According to the type records of the Flora of Turkey (Davis, 1975), *C. smyrnaea* was collected for the first time in Çanakkale within the scope of this study. It is thought that it would be helpful to carry out pollen morphology studies, including all taxa of the genus *Crepis* and to evaluate the results of the genus by systematists. We believe the data obtained from this study will be an essential source for the pollen atlas of Turkish plants to be prepared in the future.

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Author Contributions

Hanife Akyalçın: Project management, laboratory analysis, article writing and editing. Sunay Altan: Laboratory analysis, article writing and editing.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

KAYNAKLAR

Dauti, A., Kapidani, G., Pupuleku, B., Kallajxhiu, N., & Jançe, A. (2018). Pollen grains morphology of Crepis albanica (jav.) Babcock (Sin. C. Baldaccii subsp. Albanica jav.). *Thalassia Salentina*, *40(supp2),* 39-44.

Davis P., H. (1975). *Flora Of Turkey And The East Aegean Islands*. Edinburg at the University Press, Edingburg, 5, 609.

Enke N. (2009). Contributions Towards a Revised İnfrageneric Classification of *Crepis* (Cichorieae, Compositae). *Willdenowia,* Berlin-Dahlem, *39*, 229-245.

Erdtman G. (1943). *An Introduction to Pollen Analysis*. *Chronica Botanica*, Waltham, Mass. USA, 1-293 p.

Erdtman G. (1960). *The Acetolysis Method*. A Revised Description Svensk. Bot. Tidskr. 54, 561-564.

Erdtman G. (1969). *Handbook of Palynology*. Munksgaard, Copenhagen, 486 p.

Erdtman G., Berglund, B., & Praglowski, J. (1961). An Introduction to a Scandinavian Pollen Flora*. Grana Palynologica, 2* (2), 3–92.

Faegri K., & Iverson J. (1992). *Textbook of Pollen Analysis*. Haffner Press, New York, 1-328 p.

Güner A., Aslan S., Ekim T., Vural M., & Babaç M.T. (edlr.) (2012). *Türkiye Bitkileri Listesi (Damarlı Bitkiler)*. Nezahat Gökyiğit Botanik Bahçesi ve Flora Araştırmaları Derneği Yayını, İstanbul,758 p.

İnceoğlu Ö., & Karamustafa F. (1977). The Pollen Morphology of Plants In Ankara Region I. Compositae. *Ankara Üniversitesi Basımevi Fen Fakültesi Tebliğler Dergisi*, *21*, 77-105.

Kadereit J., W., & Jeffrey C. (eds) (2007). *Flowering Plants. Eudicots: Asterales. In Kubitzki K (ed.)*. The Families and Genera of Vascular Plants, Vol. 8. Springer, Verlag Berlin Germany, 62 p.

Moore P.D., & Webb J.A. (1983). *An Illustrated. Guide To Pollen Analysis*. Printed in Hong Kong, Hodder and Stoughton Educational, London, Sydney, Auckland, Toronto, 1-129 p.

Osman A., K., E. (2006). Pollen types of the Egyptian species of tribe Lactuceae (subfamily Cichorioideae-Compositae). *Acta Botanica Croatica, 65* (2), 161–180.

Peng Y., Gao X., & Peng L. (2013). Pollen Morphology of *Youngia* and Six Related Genera (Asteraceae: Cichorieae) and its Systematic Significance. *Phytotaxa, 139* (1), 39-62.

Pinar N. M., Coskuncelebi K., Simsek D., Okur S., Makbul S., & Acar, A. (2016). Pollen morphology of Scorzonera (Asteraceae) in Turkey. *Phytotaxa, 252*(4), 233-262. http://dx.doi.org/10.11646/ phytotaxa.252.4.1

Punt W., Hoen P. P., Blackmore S., Nilsson S., & Le Thomas A. (2007). *Glossary of Pollen and Spore Terminology*. Rev. Palaebot. *Palynol., 143*, 1-81.

Qiu, J., Zhang, J., Gao, T., & Tan, D. (2020). *Crepis* desertorum (Asteraceae, Cichorieae), a new species from northern Xinjiang (China) based on morphological and molecular data. *Plant Diversity*, *42* (2), 74-82.

Qureshi S., J., Awan A., G., Khan M., A., & Bano S. (2002). Palynological Study of the Genus *Crepis* from Pakistan. *Asian Journal of Plant Sciences*, *1* (2), 182-187.

Skvarla J., J., & Turner B., L. (1966). Systematic İmplications From Electron Microscopic Studies of Compositae Pollen. *Annals of the Missouri Botanical Garden, 53* (2), 220-256.

Skvarla J., J., & Turner B., L. (1971). Fine structure of the Pollen of *Anthemis nobilis* L. (Anthemideae-Compositae). *Proceedings of the Oklahoma Academy of Science, 51*, 61-62.

SPSS, (2013). IBM SPSS Statistics 22.0 for Windows. Armonk, NY.

Türkmen Z., Makbul S., Çoşkunçelebi K., & Beyazoğlu O. (2010). Palynological observations on the genus Scorzonera L.(Asteraceae) from north-east Anatolia (Turkey). *Turkish Journal of Botany, 34*(6), 495-512. http://dx.doi.org/10.3906/bot-0909-17

Wang H., Wortley A., H., & Blackmore S. (2009). Pollen Morphology of Crepidinae and Lactucinae (Asteraceae: Cichorieae) and its Systematic Significance. Grana, 48, 160–178.

Wodehouse R.P. (1935). *Pollen Grains.* Their Structure, Identification and Significance in Science and Medicine. Mc. Graw-Hill, New York, 574 p.

Yıldırım H., Bingöl Ö., & Armağan M. (2011). *Crepis gemicii* sp. nov. (Asteraceae) from east Anatolia, Turkey. *Nordic Journal of Botany*, *29*, 14-19.

Yıldız B., & Aktoklu E. (2010). *Bitki Sistematiği İlkin Karasal Bitkilerden Bir Çeneklilere*. Palme Yayıncılık, Ankara, 1-396 sy.