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Pollen Morphology of Some Taxa Belonging to *Polygonum* L. and *Rumex* L. (Polygonaceae) and Its Taxonomic Significance

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Abstract

In this article, the pollen morphologies of 14 samples in total, 12 taxa from *Polygonum* L., *Rumex* L. (Polygonaceae), and two variations of *Rumex scutatus* L. were studied in detail by light microscopy and SEM. Solutions to taxonomic problems of these species were sought with palynological information. Pollen grains of some taxa belonging to *Polygonum* are studied as a result of palynological research; 3-colpate, 3-colporate, pantoporate, oblate-spheroidal, prolate, prolate-spheroidal, tectate, and exine surface are microechinate-perforate and reticulate with the free-standing columella. Pollen grains of some taxa belonging to *Rumex*; 3-colporate, rarely 4-colporate, pollen shapes are oblate-spheroidal, suboblate, tectate, and exine surface are microechinate-perforate.

Keywords: Pollen morphology, Polygonaceae, *Polygonum*, *Rumex*, SEM

Polygonum L. ve *Rumex* L.'ye (Polygonaceae) ait Bazı Taksonların Polen Morfolojisi ve Taksonomik Önemi

Öz

Bu makalede, *Polygonum* L., *Rumex* L. (Polygonaceae)'den 12 takson ve *Rumex scutatus* L.'nin iki varyasyonu olmak üzere toplam 14 örneğin polen morfolojileri ışık mikroskobu ve SEM ile detaylı olarak incelenmiştir. Palinolojik bilgilerle bu türlerin taksonomik problemlerine çözüm aranmıştır. Palinolojik araştırmalar sonucunda *Polygonum* cinsine ait bazı taksonların polenleri incelenmiş; 3-kolpat, 3-kolporat, pantoporat, oblate-sferoidal, prolat, prolat-sferoidal, tektat, ekzin yüzeyi mikroekinat-perforat ve serbest kolumellalı retikulat yapıdadır. *Rumex* cinsine ait bazı taksonların polenleri; 3-kolporat, nadiren 4-kolporat, polen şekilleri oblat-sferoidal, suboblate, tektat ve ekzin yüzeyi mikroekinat-perforattır.

Anahtar Kelimeler: Polen morfolojisi, Polygonaceae, *Polygonum*, *Rumex*, SEM

INTRODUCTION

Although the distribution of Polygonaceae is cosmopolitan, there are 51 genera and 1200 species mainly in northern temperate regions (Leeuwen et al., 1998; Freeman and Reveal, 2005; Sanchez and Kron, 2008). In our country, there are 10 genera and around 87 species from the Polygonaceae family (Özer et al., 1999). *Polygonum* is a taxonomically difficult genus that classification of *Polygonum* taxa in Turkey is made more difficult by the apparent under-collecting of the weedy species. The genera in the Polygonaceae family are more common in meadows and pastures in our country. It has been stated that plants belonging to the Polygonaceae family, especially *Polygonum* L. and *Rumex* L., are used for food and medical purposes among the people (Şimşek et al., 2002).

A comprehensive study of pollen morphology in Polygonaceae was published by Wodehouse (1931). Hedberg (1946), in his classic article on pollen morphology in the genus *Polygonum* L., identified ten main pollen types and a number of abnormal types, proposing a new taxonomic classification based on pollen morphology, and also provided a key for pollen types. According to Nowicke and Skvarla (1977), Polygonaceae is considered to be one of the most important eurypalynous families among dicotyledons. According to Godwin (1975), pollen from *Polygonum* and *Rumex*, which are members of

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the Polygonaceae family, was first discovered in Hoxnian (Holsteinian) and Pastonian (early Cromerian) glaciers, respectively. These are known indicators of Devensian (Weichselian) periglacial vegetation. The pollen grains of *Rumex* are also indicative of arable land in the lower boreal period (Holocene), which can find habitat in forest areas. Two taxa very common in the Arctic, *Koenigia islandica* L. and *Oxyria digyna* Hill, were found in the Devensian glacier in England. Andersen (1961) described several different pollen species from the Devensian glacier in Denmark in his study. Based on the data of Hedberg (1946), he defined a limited number of species such as Bistorta type and Persicaria type. Andersen (1961) revealed that 18 species of the *Rumex* genus in Europe can be divided into four different pollen groups.

Zhong-ze et al., (1999) investigated the pollen morphology of 3 genera and 46 species from Polygonaceae in Anhui province of the People's Republic of China using light microscopy and electron microscopy. Based on the morphological features of the pollen grains of this family; they defined 13 types based on species. Mosaferi and Keshavarzi (2011) proved that the micromorphological character traits of Persicarieae pollen in Iran are effective in distinguishing them from other families. As a result of their studies, they concluded that *Polygonum* and *Persicaria* are different genera belonging to Iran.

Hong et al. (2005) examined a total of 30 taxa belonging to *Polygonum* L. and *Polygonella* Michx genera with a light microscope and SEM. They observed that the pollens examined were spheroidal and prolate, the apertures were tricolporate, and rarely 5-6 colporate. They stated that the biggest difference between the pollens was the difference in the exine ornamentation and this difference was in 3 different types. These are Avicularia type, Pseudomollia type, and Duravia types.

Raycheva et al., (2021) described a new species belonging to the Polygonaceae in Bulgaria. This species is the *Rumex kerneri* Borbás species of *Rumex*. Exine ornamentation was microechinate-perforate, 3 or 4 colpate. They also stated that the structure of the sporoderm did not show any differences.

The aim of the study is to perform pollen morphology analyses of 12 taxa from *Polygonum*, *Rumex* and two variations of *Rumex scutatus* to determine the usefulness of these features for taxonomic applications.

MATERIALS and METHODS

Plant specimens were obtained from the specimens of Bitlis Eren University Herbarium and Gazi University herbarium (GAZI). The list of voucher specimens is deposited in Bitlis Eren University and GAZI Herbaria.

Specimens investigated;

Polygonum alpinum L.; B8-Bitlis Nemrut Cratet Lake Slopes 2375 m. MK 6094, Det.: M. Kursat. *P. bistorta* L.; A8 Trabzon Hayrat Klerson Site, field edge, 1100 m, 27.07.2004, S. Aslan (GAZİ). *P. salicifolium* L.; A3 Sakarya Karasu Denizköy lakeside marsh 8 m, 29.04.2012, D. Karaduman 1594 (GAZİ). *P. lapathifolium* L.; B8-Bitlis, Ağaçköprü Village, 26.07.2013, 38° 20' 11.95" N, 42° 00 10,88" E, 1350-1450 m, M. Karataş 1382, Det.: M. Kurşat. *P. arenastrum* Boreau.; A2 Kocaeli, Atakent Arslanbey Road 90 m, 30.08.2008, D. Aslan 1466 (GAZİ). *Rumex acetocella* L.; B8-Bitlis, Ağaçköprü Village, 08.07.2013, 38° 20' 11.95" N, 42° 00 10.88" E, 1350-1450 m, MK 6095, Det.: M. Kurşat. *R. scutatus* L.; B8-Bitlis, East of Kambos Mountain (Valley), 18.06.2014, 38° 19' 29.58" N, 42° 00' 33.33" E, 1400-1600 m, M. Karataş 2184, 2185, Det.: M. Kursat. *R. scutatus* L.(yellowish flowers)/(reddish flowers); B9-Van Artus Mountain, northern slopes, 2100 m. MK 6098-a/ MK6098-b. *R. tuberosus* subsp. *horizontalis* (K.Koch) Rech.f.; B8-Bitlis, South of Kambos Mountain, 15.05.2014, 38° 17' 52.83" N, 41° 59' 15.31" E, 1240-1650 m, MK 6096, Det.: M. Kurşat. *R. alpinus* L.; B8-Muş, northern slopes of Kurtik Mountain, 2450 m. 11.05.2020. MK 6093, Det.: M. Kursat. *R. ponticus* E.H.L. Krause; B8-Bitlis, North Front of Kambos Mountain, 06.06.2014, 38° 19' 23.26" N, 41° 59' 42.29" E, 1800-1950 m, MK 6092 Det.: M. Kurşat. Endemic. *R. crispus* L.; B8-Bitlis, North Slopes of Kambos Mountain, 31.05.2014, 38° 19' 23.26" N, 41° 59' 42.29"D, 1800-1950m, M. Karataş 1981, Det.: M. Kurşat. *R. conglomeratus* Murray; B8-Bitlis, North Slopes of Kambos Mountain, 16.06.2015, 38° 19' 23.26" N, 41° 59' 42.29" E, 1800-1950 m, M. Karataş 2698, Det.: M. Kurşat.

For light microscopy (LM) studies, pollen slides were prepared using the Wodehouse (1935) technique. The pollen grains were mounted in unstained glycerine jelly, stained with safranin, and

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studies were made using an Olympus BX-31. Measurements were performed on at least 30 pollen grains per specimen for each morphological character; polar axis (P), equatorial diameter (E), porus length (Plg), porus width, (Plt),colpus length (Clg), colpus width (Clt), mesocolpium (L), apocolpium (t), exine, and intine with LM using an oil immersion 100U objective lens.

For SEM studies, pollen grains were dried, mounted on stubs, and coated with gold by a sputter coaster, and the SEM examination was carried out using a ZEISS Supra 55 Scanning Electron Microscope at the SEM Laboratory of the Central Research Laboratory (MERLAB), Yuzuncu Yil University, Van. In general, the terminology used is in accordance with Punt et al. (2007) and Hesse et al. (2009).

RESULTS

The pollen morphological properties of the examined *Polygonum* and *Rumex* taxa are summarized in Table 1 and Table 2. Representative pollen grains are illustrated in Figures 1–2.

Size, symmetry, and shape

Polygonum; the pollen grains of the investigated species are dispersed as a monad. They can be described as isopolar symmetrical and based on SEM and LM. The shape of the pollen grains in the equatorial view are prolate and oblate-spheroidal, whilst their shape in the polar view is triangular and circular. The pollen grains are prolate (*P. bistorta* and *P. aranestrum*) and others are oblate-spheroidal. The polar axis varies from 25.16-52.49 µm and the equatorial diameters from 17.37-37.40 µm. mesocolpium 33.15-38.14 µm, apocolpium 12.30-14.07 µm. Their dimensions are smaller in *P. aranestrum* and larger in *P. bistorta* (Tables 1-2; Figures 1-2).

Rumex; the pollen grains of the investigated species are dispersed as a monad. They can be described as isopolar symmetrical and based on SEM and LM. The shape of the pollen grains in equatorial view are suboblate, prolate-spheroidal, and oblate-spheroidal, whilst their shape in polar view aretriangular. The pollen grains are prolate-spheroidal (*R. conglomeratus*), suboblate (*R. scutatus*), and others are oblate-spheroidal. The polar axis varies from 19.48-34.98 µm and the equatorial diameters from 20.53-38.76 µm. Mesocolpium 20.43-34.54 µm, apocolpium 4.14-6.63 µm. Their dimensions are smaller in *R. tuberosus* subsp. *horizantalis* and larger in *R. ponticus* (Tables 1-2; Figures 1-2).

Apertures

Polygonum; In the investigated taxa, there are 3 taxa with pantoporate, 3-colpate (*P. alpinum*), and 3-colporate (*P. bistorta*). Pore length (Plg) is 4.45-9.62 µm, and the pore width (Plt) is 4.52-5.93 µm. The shape of the porus is circular. The colpus length (Clg) is 24.00-32.53 µm, and the colpus width (Clt) is 2.37-6.59. Mesocolpium (L) is measured as 18.49-38.14 µm, and apocolpium (t) is measured as 9.69-14.07 µm (Table 1; Figures 1-2).

Rumex; In the investigated taxa, there are 3-colporate rarely 4-colporate (*R. acetocella, R. ponticus*, and *R. crispus*), others are 3-colporate. Pore length (Plg) is 4.62-8.19 µm, and the pore width (Plt) is 3.39-4.92 µm. The shape of the porus is circular. The colpus length (Clg) is 14.21-28.38) µm and the colpus width (Clt) is 0.46-1.51 µm (Table 1; Figures 1-2).

Exine, intine, and ornamentations

Polygonum; The exine ranges from 1.13 to 2.44 µm. Ectexine is thicker than endexine. The intine is 0.48-0.91 µm thick. Exine sculpturing showed two distinct types of surface structures: microechinate-perforate and reticulate free-standing columella. The pollen species with the highest number of perforae at 25 µm^2 is *P. bistorta* (175), the least species is *P. alpinum* (31), and the species with the highest number of spinules at 25 µm^2 is *P. bistorta* (55.5), the least species *P. alpinum* (21), the species with the highest spinule width *P. alpinum*, the lowest species P. bistorta, the highest number of reticulae at 25 µm^2, *P salicifolium*, the least It is observed that the species with the highest lumina diameter was *P. salicifolium*, the species with the least diameter is *P. laphothifolium*, the species with the highest muri thickness is *P. anenastrium*, and the species with the least is *P. laphothifolium*. In addition, it is observed that the perforae of the *P. bistorta* is larger in diameter and less in number in the polar regions, while the perforae in other regions are much smaller in diameter and more in number (Table 1-2; Figures 1-2).

Rumex; The exine ranges from 0.58 to 2.15 µm. Ectexine is thicker than endexine. The intine is 0.38-0.60 µm thick. Exine sculpturing, showed one distinct types of surface structures: microechinate-perforate. The pollen species with the highest number of

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perforae at 25 µm^2 is *R. tuberosus* subsp. *horizontalis* (121) the smallest species is *R. acetosella* (22.4), the species with the most spinulae at 25 µm^2 is R. alpinus (207) the least species is *R. scutatus* (61.5), the species with the highest spinulae width is *R. conglomeratus* (1.91), the smallest species *R. scutatus* (0.05), the longest spinulae length *R. tuberosus* subsp. *horizontalis* the least species is *R. scutatus* (0.27) (Table 1-2; Figures 1-2).

Table 1. Pollen morphological data for the *Polygonum* and *Rumex* taxa

Taxon	Pollen Type	P	E	P/E	Plg	Plt
Polygonum alpinum	3-colpate	36.14±1.88	37.02±2.53	Oblate-spheroidal	-	-
P. bistorta	3-colporate	52.49±6.19	37.40±3.83	Prolate	9.62±1.20	5.93±1.12
P. salicifolium	Pantoporate	35.76±4.47	35.83±4.19	Oblate-spheroidal	5.10±0.90	4.99±0.88
P. laphothifolium	Pantoporate	37.02±2.75	37.26±2.59	Oblate-spheroidal	4.55±0.87	4.55±0.81
P. arenastrum	Pantoporate	25.16±2.10	17.37±1.30	Prolate	4.45±1.08	4.52±1.13
Rumex acetocella	3-colporate, rarely 4-colporate	24.07±1.99	26.04±1.43	Oblate-spheroidal	5.61±1.22	3.67±0.63
R. scutatus	3-colporate	21.86±1.65	24.82±1.86	Suboblate	5.06±0.71	3.17±0.80
***R. scutatus* (reddish flowers)**	3-colporate	22.83±2.53	24.78±2.86	Oblate-spheroidal	5.74±0.78	2.49±0.47
***R. scutatus* (yellowish flowers)**	3-colporate	22.37±3.33	24.20±3.32	Oblate-spheroidal	5.86±0.93	2.19±0.38
R. tuberosus* subsp. *horizantalis	3-colporate	19.48±1.44	20.53±1.90	Oblate-spheroidal	4.62±0.49	3.39±0.49
R. alpinus	3-colporate	24.85±2.52	25.56±2.66	Oblate-spheroidal	5.27±1.05	3.84±0.65
R. ponticus	3-colporate rarely 4-colporate	34.98±4.12	38.76±4.33	Oblate-spheroidal	8.19±1.88	4.92±0.78
R. crispus	3-colporate rarely 4-colporate	31.58±3.04	33.52±3.29	Oblate-spheroidal	5.59±0.99	2.15±0.65
R. conglomeratus	3-colporate	22.74±2.01	23.39±1.70	Prolate-spheroidal	5.01±0.79	3.46±0.48

Table 1. (Continued) Pollen morphological data for the *Polygonum* and *Rumex* taxa

Taxon	Ex	In	L	t	Clg	Clt	Orn.
Polygonum alpinum	1.98±0.22	0.54±0.17	38.14±1.66	14.07±1.66	24.00±2.45	6.59±0.97	Microechinate-Perforate
P. bistorta	1.87±0.19	0.53±0.15	33.15±2.66	12.30±1.65	32.53±3.29	2.37±0.36	Microechinate-Perforate
P. salicifolium	2.44±0.41	0.48±0.15	-	-	-	-	Free-standing columella reticulate
P. laphothifolium	2.22±0.37	0.91±0.24	-	-	-	-	Free-standing columella reticulate
P. arenastrum	1.13±0.19	0.61±0.11	-	-	-	-	Free-standing columella retikulate
Rumex acetocella	1.02±0.38	0.60±0.12	25.60±1.93	4.76±0.56	21.11±2.30	1.51±0.21	Microechinate-Perforate
R. scutatus	0.79±0.21	0.51±0.160	23.05±2.44	5.33±1.04	18.63±1.98	0.88±0.17	Microechinate-Perforate
***R. scutatus* (reddish flowers)**	0.77±0.21	0.45±0.16	25.32±2.87	4.48±0.63	18.61±2.26	0.84±0.19	Microechinate-Perforate
***R. scutatus* (yellowish flowers)**	0.58±0.22	0.31±0.10	22.88±2.83	3.64±0.86	19.55±3.51	0.46±0.10	Microechinate-Perforate
R. tuberosus* subsp. *horizantalis	0.82±0.20	0.45±0.166	20.43±2.15	4.14±0.63	14.21±1.10	0.68±0.17	Microechinate-Perforate
R. alpinus	1.31±0.20	0.51±0.11	26.31±3.24	5.23±0.95	22.06±2.84	1.32±0.24	Microechinate-Perforate
R. ponticus	1.89±0.23	0.45±0.18	34.54±3.56	6.63±1.13	28.38±4.33	0.62±0.17	Microechinate-Perforate
R. crispus	2.15±0.65	0.49±0.18	33.32±2.44	4.41±0.90	25.80±2.52	1.51±0.42	Microechinate-Perforate
R. conglomeratus	1.13±0.16	0.57±0.11	22.50±1.96	6.30±0.60	20.77±1.35	0.89±0.19	Microechinate-Perforate

Polar axis (**P**), equatorial axis (**E**), Pollen shape (**P/E**), pore length (**Plg**), pore width (**Plt**), colpus length (**Clg**), colpus width (**Clt**) exine (**Ex**), mezocolpium (**L**), apocolpium **(t),** Intine (**In**), ornamentation (**Orn.)**

Table 2. SEM analysis results of studied *Polygonum* L. and *Rumex* L. taxa (µm)

In 25 µm^2

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Taxon	Perforae diameter	Perforae number	Spinule number	Reticulae number	Spinule width	Spinule length	Lumina diameter	Muri thickness
Polygonum alpinum	4.90	31	21	---	2.30	1.34	---	---
P. bistorta	11.25	60	55.50	---	1.30	1.05	---	---
P. salicifolium	---	---	---	1.40	---	---	5.50	0.75
P. laphothifolium	---	---	---	1.26	---	---	4.70	0.43
P. anenastrum	---	---	---	1.30	---	---	5.30	6.20
Rumex acetosella	---	22.40	105	---	1.20	1.05	---	---
R. scutatus	---	60	61.50	---	0.05	0.27	---	---
R. scutatus **(reddish flowers)**	---	34.50	112	---	0.85	0.66	---	---
R. scutatus **(yellowish flowers)**	---	104	198	---	0.85	0.58	---	---
R. tuberosus **subsp. *horizantale***	---	121	147	---	0.85	1.20	---	---
R. alpinus	---	120	207	---	1.81	1.05	---	---
R. ponticus	---	49	91.50	---	1.17	0.82	---	---
R. crispus	---	72.50	112	---	1.00	0.98	---	---
R. conglomeratus	---	111	134	---	1.91	0.76	---	---

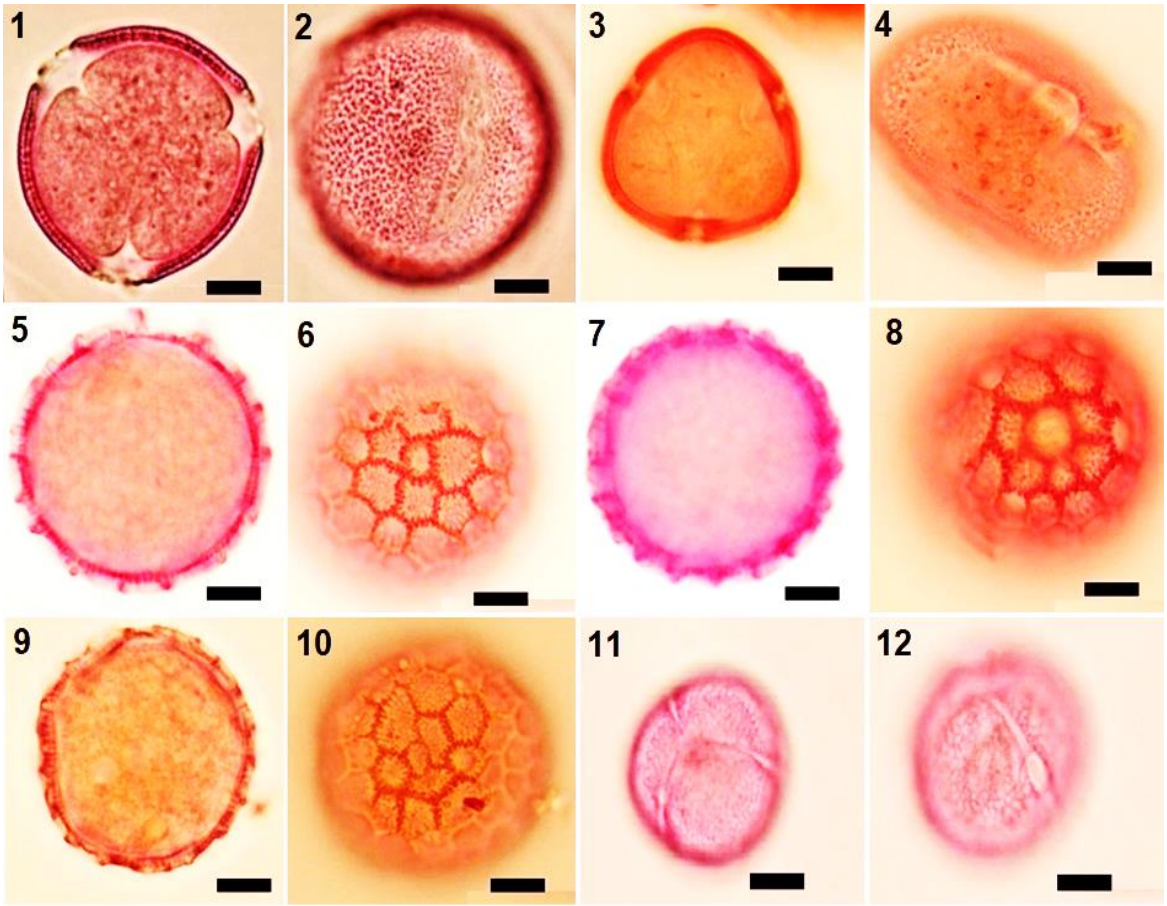

Fig. 1. Pollen grains LM photos of studied taxa: **(1-2)** *Polygonum alpinum*, **(3-4)** *P. bistorta*, **(5-6)** *P. salicifolium*, **(7-8)** *P. laphothifolium*, **(9-10)** *P. arenastrum*, **(11-12)** *Rumex acetocella* (Scale bar **10 µm**)

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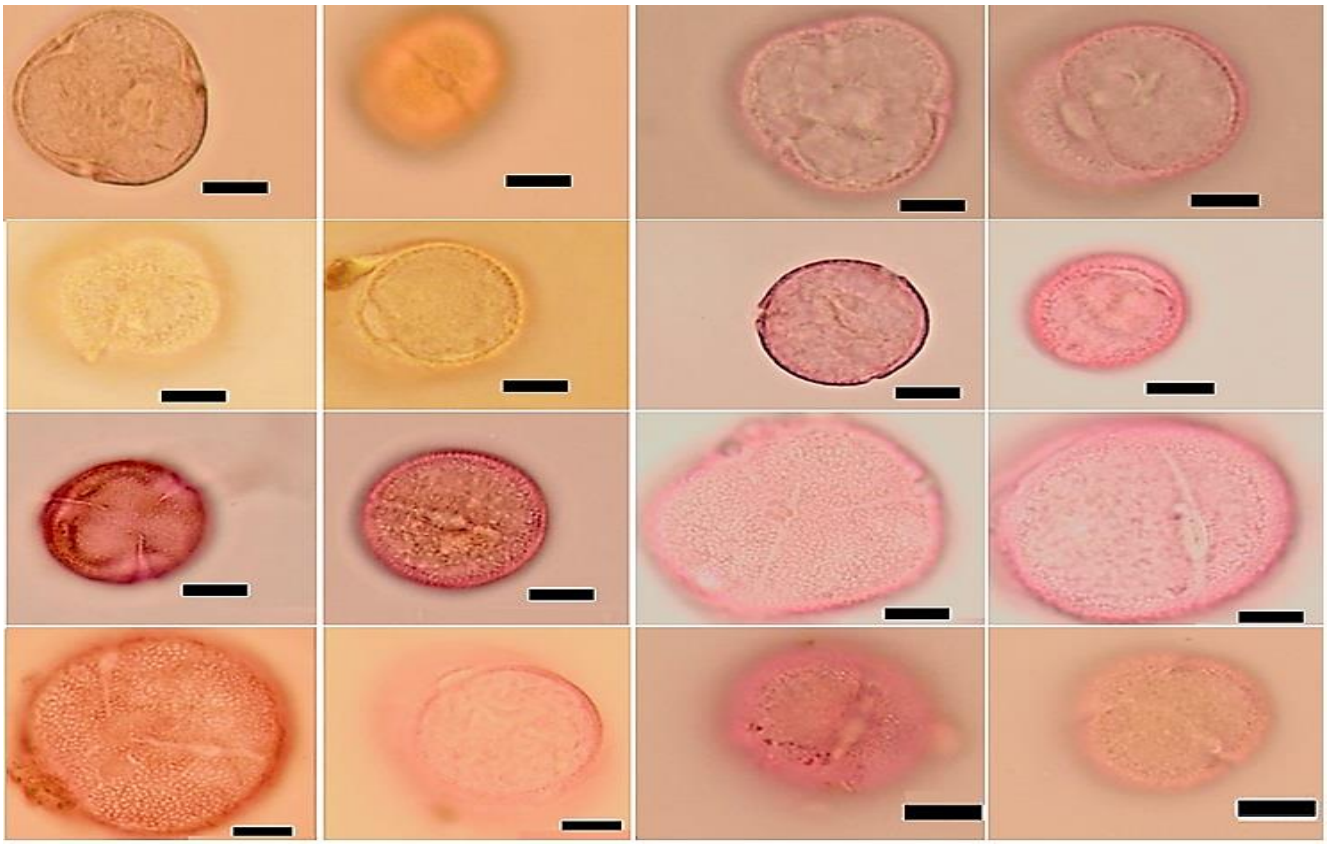

Fig. 1. (Continued) **(13-14)** *Rumex scutatus*, **(15-16)** *R. scutatus* (reddish flowers), **(17-18)** *R. scutatus* (yellowish flowers), **(19-20)** *R. tuberosus* subsp. *horizantalis*, **(21-22)** *R. alpinus*, **(23-24)** *R. ponticus*, **(25-26)** R. crispus, **(27-28)** *R. conglomeratus* (Scale bar **10 µm**).

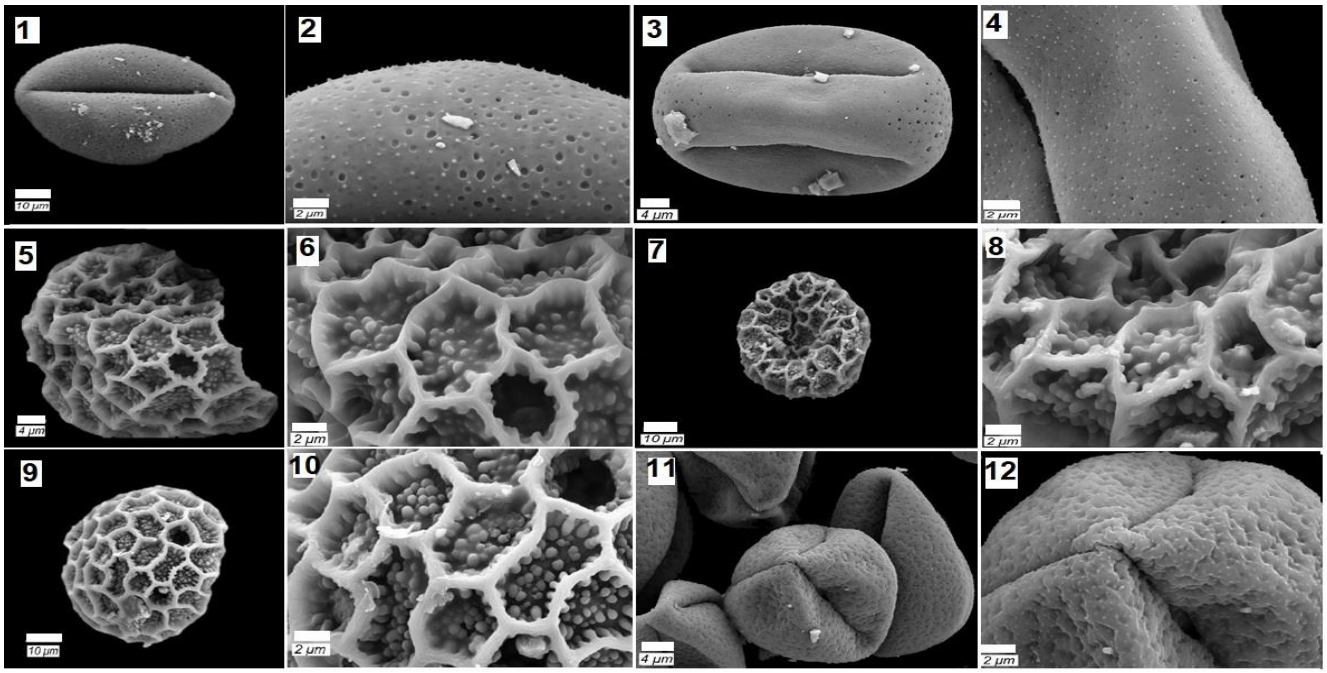

Fig. 2. Pollen grains SEM photos of studied taxa: **(1-2)** *Polygonum alpinum*, **(3-4)** *P. bistorta*, **(5-6)** *P. salicifolium*, **(7-8)** *P. laphothifolium*, **(9-10)** *P. arenastrum*, **(11-12)** *Rumex acetocella*

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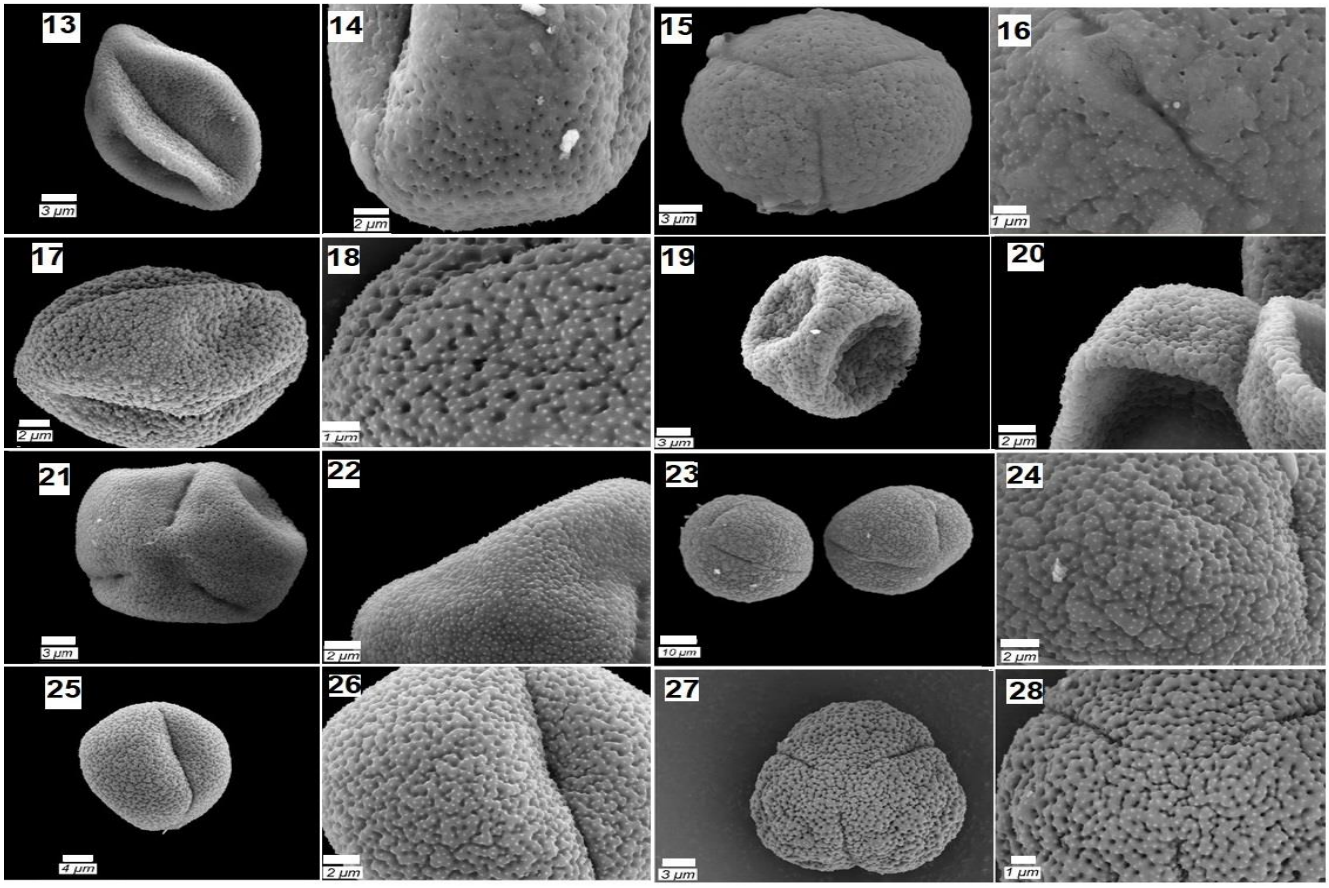

Fig. 2. (Continued) **(13-14)** *Rumex scutatus*, **(15-16)** *R. scutatus* (reddish flowers), **(17-18)** *R. scutatus* (yellowish flowers), **(19-20)** *R. tuberosus* subsp. *horizantalis*, **(21-22)** *R. alpinus*, **(23-24)** *R. ponticus*, **(25-26)** *R. crispus*, **(27-28)** *R. conglomeratus*

DISCUSSION

Pollen morphology of the Polygonaceae has been proven eurypalynous family and contributed to the infrafamilial systematics (Wodehouse 1931; Hedberg 1946; Erdtman 1966; Norwicke and Skvarla 1977). Pollen grains characteristics of 12 taxa from *Polygonum*, *Rumex*, and two variations of *Rumex scutatus* are summarised in Tables 1-2 and are shown in Figs. 1-2. Pollen grains are monad, 3-colporate, rarely 4-colporate, and 3-colparate (tricolpate), it has also been observed that there are taxa that are periporate (pantoporate). Pollen shapes of *Polygonum* were observed to be prolate and oblate-spheroidal, pollen shapes of *Rumex* genera were oblate-spheroidal, prolate-spheroidal, and suboblate, SEM photographs showed pollen with prolate and subprolate shape as well as prolate-spheroidal shape. In taxa that have pore as aperture, pantoporate, pori are generally round, their borders are clear, their arrangement is regular, colpi are narrow and long and their ends are pointed. It was observed that the exine was thicker than the intine in the examined taxa.

It has been observed that there are differences between *Rumex scutatus*, which we studied, and *R. scutatus*, which has two different variations, with yellowish flowers and *R. scutatus* with reddish flowers. *R. scutatus* collected from Bitlis Kamboz Mountain at an altitude of 1400-1600 m was yellowish, the pollen shape was suboblate (0.87) in the examination made under IM, the perforae number was 60 at 25 μm^2, the spinule number was 61.5, and the 2100 m altitude Van Artus Mountain. The pollen shapes of *R. scutatus* yellowish flowers and *R. scutatus* reddish flowers variations collected from the same locality were oblate-spheroidal (0.92), and the perforae number was 34.5 in *R. scutatus* reddish flowers in 25 μm^2, in R. scutatus yellowish flowers 104 in *R. scutatus* yellowish flowers in the

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observation made from the same locality. As a result, at 25 μm^2, the spinule number was measured as 112 in *R. scutatus* with reddish flowers and 198 in *R. scutatus* with yellowish flowers. Some palynological differences were observed as the altitude increased. With increasing altitude, the spinule number, spinule width and spinule length of *R. scutatus* reddish flowers and *R. scutatus* yellowish flowers variations increased significantly observed to be excessive.

Palynologically, Polygonaceae is considered the eurypalynous family (Wodehouse 1931; Hedberg 1946; Nowice and Skvarla, 1977), and its distinct variations have great systematic potential, especially at the genus level (Nowicke and Skvarla, 1977). Differences in the size and surface structure of their pollen grains are useful for distinguishing Polygonaceae species. Exine and its ornamentation make pollen, different genera, and even species highly distinguishable structures (Moore and Webb, 1978).

Soleimani et al. (2014) stated that the palynological findings in the species belonging to *Rumex* genera in Iran, in SEM, pollen grains have panporate, tricolporate, tetracolporate, granulate, microechinate and punctate. They found the P/E value of (1.12) *R. crispus*, (1.32) *R. tuberosus*, and (0.86) *R. conglomeratus*. In our analysis of the species, we found spheroidal, In our examination; *R. crispus*, *R. tuberosus* subsp *horizontalis* are spheroidal, *R. conglomeratus* is prolate-spheroidal, and all three pollen species were tricolporate.

El Naggar and El Huessini (2001) observed 20 species belonging to seven genera belonging to the Polygonaceae family in Egypt with light microscope and SEM. They thought that the shape, size, external appearance, and differences in exine ornamentation of the pollen helped them to distinguish between different pollen types. As a result of their studies, they observed that the shapes of pollen belonging to Atraphaxis type, Calligonum-Oxygonum type, Persicaria type, Polygonum type and Rumex-Emex types are prolate and spheroidal, apertures are tricolporate and pantoporate, ornamentation; reticulate, scabrate and perforate, microreticulate-foveolate, they observed that the colpus is narrow and long. El Naggar and El Huessini (2001) observed in their study in Egypt that the polar axis and equatorial axis lengths of *R. crispus* varied between 22.5-25 μm. They observed that *R. crispus* is spheroidal, tricolporate, ornamentation microreticulate-foveolate, and they also stated that *R. crispus* belongs to Rumex-Emex pollen type. As a result of our study, it was observed that the polar axis and equatorial axis length of *R. crispus* were 31.58-33.52 μm, spheroidal and tricolporate, and the ornamentation was microechinate-perforate. El Naggar and El Huessini (2001), in their observations on the genus *Polygonum*, determined that the pollen shapes are tricolporate, prolate, isopolar, and the ornamentation is scabrate or microechinate.

Leeuwen et al. (1988), conducted a detailed study of the Polygonaceae family in Northwest Europe, as a result of which P. arenastrum type was assigned to P. aviculare type, P. bistorta to P. bistorta type, P. lapathifolium to P. persicaria type, *Rumex crispus, R. conglomaratus, R. scutatus and R. acetosella* pollen species were determined to belong to the R. acetosa type.

Yasmin et al. (2010) investigated the pollen morphology of 7 species belonging to *Rumex* genus in Pakistan with light microscopy (IM) and scanning electron microscope (SEM) and stated that the genus is eurypalynous. Pollen grains are radial and isopolar symmetrical, generally 3-4 colporate, the P/E ratio varies between 1.01-1.24, the polar view is circular, whilst the shape of the pollen grains in equatorial view have different variations from spheroidal, prolate-spheroidal, subprolate, prolate to mild to rhomboidal appearance. they observed three different pollen types based on ornamentation; Chalepensis type, Dentatus type, and Acetosa type. They revealed that under SEM, ornamentation is granulate in some species, and perforate-punctate and reticulate in some species. As a result of our investigations on seven species belonging to the *Rumex* genus; We observed that the polar axis length of the species is 19.48-34.98 μm, the equatorial axis length is 20.53-38.76 μm, the P/E ratio varies between 0.87-0.97, the colpus is generally narrow and long, the exine thickness varies between 0.58-2.15, and the ornamentations are microechinate-perforate.

Raycheva et al. (2021), described a new species of *Rumex kerneri* Borbás, belonging to the Polygonaceae family in Bulgaria. They observed microechinate-perforate ornamentation of 3-4 colpate, pollen diameter 38.55±2.28 μm. They also stated that the structure of the sporoderm did not show any differences.

Yasmin et al. (2010), in their study under SEM, defined 4 different types as Patulum type, Plebijum

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type, Cognatum type and Avicularia type belonging to *Polygonum* genus according to the differences in exine ornamentation. They observed that the exine ornamentation of *P. arenastrum*has granulate, tricolporate, spheroidal, prolate-spheroidal, circular, exine thickness was 3.5 µm, polar axis length 22-25 µm, and equatorial axis length changed between 21.6-23 µm in SEM and LM. they also stated that *P. arenastrum* belonged to the Plebijum type from the types they defined. As a result of our investigations, *P. arenastrum* pantoporate is prolate, exine thickness is 1.13 µm, intine thickness is 0.61 µm, polar axis x equatorial axis is 25.16 x 17.37±1.3 µm, and its ornamentation is free-standing columella reticulate we observed.

Yurtseva et al. (2014), in their study, found that pollen belonging to the *Atraphaxis* L. genus belonging to Polygonaceae were morphologically similar to *Polygonum*. The pollen grains are tricolporate, prolate and subprolate. In our study *Polygonum* is prolate-spheroidal, prolate, microechinate, some of them do not have colpus, there is a pore, the tricolporate structure, reticulate-perforate being morphologically similar to the *Atraphaxis* and *Polygonum* genera.

In the study (Anonim2021a)with *P. bistorta*, under the light microscope (IM); pollen size: measured as 41-50 µm, pollen type tricolporate, isopolar, circular in shape, observed under the light microscope that the ornamentation is reticulate. In our studies, the polar axis x equatorial axis length of *P. bistorta* is 52.49 x 37.40 µm, pollen shape is observed as prolate, ornamentation as microechinate-perforate.

Keskin et al. (2021), conducted a study on the morphology of the pollen *Polygonum istanbulicum* Keskin. They determined that the pollens of the genus *Polygonum* are generally tricolporate or rarely 6-colporate, prolate, and rarely prolate-spheroidal, the polar views of the pollen grains is circular or triangular and the morphological characteristics of *P. istanbulicum*, tricolporate and P/E ratio is 1.76, with these features Avicularia type.

Kong et al. (2021), 19 taxa of the genus *Persicaria* and 4 taxa of the genus *Koenigia* from the Cephalophilon section of Polygonaceae were investigated. In the study conducted with *Persicaria* taxa, they observed that the polar diameters ranged from 13.44–51.16 µm on average and that the majority of the pollens belonging to the *P. cephalophilon* type were tricolpate pollens together with other pantoporate or 9-colpate. They stated that *Persicaria criopolitana, P. palmata, Koenigia nepalensis, K. pilosa,* and *K. islandica* pantoporate and 9-colpate pollen is only found in *K. delicatula*. Reticulate, microechinate-reticulate, and microechinate ornamentation types are defined. We think that *P. salicifolium, P. laphothifolium,* and *P. anenastrium* species belonging to *Polygonum* that we studied are similar to those of Kong et al. 2021.

We think that our study will contribute to plant systematics and other fields of palynology by revealing the morphological features of The pollen morphologies of 14 samples in total, 12 taxa from *Polygonum*, *Rumex* (Polygonaceae), and two variations of *Rumex scutatus*.

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CONFLICT OF INTEREST

The Author report no conflict of interest relevant to this article

RESEARCH AND PUBLICATION ETHICS STATEMENT

The author declares that this study complies with research and publication ethics.

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