POLLEN MORPHOLOGY OF THE POLISH SPECIES OF THE GENUS *RIBES* L.

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ABSTRACT

This paper presents results of studies on pollen morphology of 6 Polish species of the genus *Ribes* L. (family Grossulariaceae). Observations were carried out with LM and SEM. Pollen diagnoses were illustrated by series of microphotographs. Grains of examined species are small to medium-sized and prolate spheroidal or subprolate in shape, rarely prolate. They represent three pollen classes: zonocolporate, pantoaperturate and pantoporate. Three types of ectoapertures have been observed: colpi, pori and colpoids. Endoapertures are pori, in number (4-) 6-7-8 (-14) per grain. Ornamentation is psilate or fossulate, with the exception of the ectoaperture areas, which are granulate. According to the author, the polarity or apolarity, type of pollen class and ectoaperture, number of endopori and ratio of exine thickness to grain diameter are the main diagnostic features of the pollen grains of the native species of *Ribes*. The key to Polish species, basing on the morphological characters of grains is given too.

KEY WORDS: Grossulariaceae, *Ribes*, pollen morphology, SEM, LM.

INTRODUCTION

In many studies the genus *Ribes* was included in the family Saxifragaceae sensu lato (Engler 1930, Pojarkova 1939, Krüssmann 1984, Rheder 1977, Ehrendorfer and Dahlgren 1983); but recently it is placed in the family Grossulariaceae (Lamarck and De Condolle 1805, Hutchinson 1959, Webb 1964, Takhtajan 1966, 1987, Weber 1995). Regardless of different opinions of the relationships within the family Saxifragaceae broadly understood, palynologists agree to include pollen grains of currants into separate pollen type *Ribes*. An appearance of granulate area around the each endoporus is the basic characteristic, which differentiates grains of *Ribes* species from the grains of representatives of Saxifragaceae sensu lato. Currently such area is regarded to be "a more or less irregular, well defined zone where the tectum is clearly missing" (Moore, et al. 1991, Faegri and Iversen 1992) and "normal ectoaperture" (Hideux and Ferguson 1976, Verbeek-Reuvers 1977). Authors of the latest palynological studies as Verbeek-Reuvers (1977) and Moore et al. (1991) mentioned only two types of apertures of grains of *Ribes*: pori (ecto- and endopori) and colpi (ectocolpi). Variable and irregular outline of some *Ribes* ectoapertures was the reason for distinguishing a third type of ectoapertures – colpoids, by the author of this work. These apertures are characterised by intermediate structure between circular pori and proper, elliptic colpi. Probably they are specific, evolutionary elements, linking extreme types of apertures. Distribution of the apertures on the surface of grain is an important, diagnostic feature of *Ribes*. The author used Verbeek-Reuvers's classification (1977), who divided pollen grains of *Ribes* into 3 types: zonocolporate, pantoaperturate and pantoporate.

Until now 3 palynological monographs have been published in which European pollen grains of *Ribes* species are discussed. Agababian (1963) characterised 3 *Ribes* species, Kuprianova and Alyoshina (1972) investigated 5 species and Verbeek-Reuvers (1977) – 6 most common species in Europe (*R. alpinum* L., *R. uva-crispa* L., *R. nigrum* L., *R. petraeum* Wulfen, *R. spicatum* Robson and *R. rubrum* L.). Agababian (l.c.) as well Kuprianova and Alyoshina (l.c.) examined *Ribes* taxa based on light microscope observations (LM). Verbeek-Reuvers (l.c.) was the first, who proposed a key to the European *Ribes* species basing on scanning electron microscope investigations (SEM). As yet nobody has studied pollen grains of the genus *Ribes* in Poland, except Stachurska et al. (1976). They elaborated the pollen diagnosis of only one currant – *R. alpinum*, with LM.

In this article I present results of my studies on pollen morphology of all native species of the genus *Ribes*: *R. alpinum* L., *R. uva-crispa* L., *R. nigrum* L., *R. petraeum* Wulfen and *R. spicatum* Robson. I have also examined pollen grains of *R. rubrum* L. This red currant, native for western Europe, is commonly cultivated and often naturalizes in Poland. It is very similar to *R. spicatum* and difficult to distinguished from this species. For this reason both are frequently discussed jointly as aggregate – *R. rubrum* L. agg.

MATERIALS AND METHODS

Ribes flowers with mature pollen were collected from natural localities of the whole country and only sporadically from cultivated plants. Complete documentation is gathered in herbarium of the Institute of Forest Botany of Agricultural

Figs 1-4. *Ribes uva-crispa* L.

Fig. 1. (LM) – Outline in equatorial view; ectocolpi and endopori visible (x 600).

Fig. 2. (SEM) – Outline in equatorial view; slightly fossulate surface of grain and granulate ectocolpus with 2 opened endopori visible (x 3500).

Fig. 3. (SEM) – Outline in polar view, apocolpium and fragments of ectocolpi with both, closed and opened endopori (x 3500).

Fig. 4. (SEM) – Close-up of granulate ectocolpus with closed endoporus (x 10 000).

University in Poznań. For most species 5-7 samples were examined. Within each specimen 30 pollen grains were measured and 990 grains in all were observed.

All samples were acetolysed according to Erdtman's method (1952), with insignificant modifications. Shrivelled, ground flowers or inflorescences were blent with acetolysis mixture, consisted of acetic anhydride (9 portions) and concentrated sulphuric acid (1 portion). Then suspension was heated to boiling point and kept in water bath for 2-3 minutes. Next the samples were centrifuged in acetolysis mixture, washed with acetic acid and centrifuged again. Finally they were both mixed with alcohol 96% and centrifuged four times. Prepared material was divided into two parts. One half was immersed in alcohol solution of glycerine (for LM) and the other in ethyl alcohol 96% (for SEM).

The observations were carried out both with LM (types BIOLAR 2308 and NIKON OPTIPHOT-2) and SEM (types JOEL JSM-5300, JOEL JSM-T300, ISI 60 and SEM 515) and the series of microphotographs were taken.

The description terminology has been established with regard to Erdtman (1952), Dyakowska (1959), Reitsma (1970), Walker (1974), Hideux and Ferguson (1976), Verbeek-Reuvers (1977), Faegri and Iversen (1978, 1992), Moore, et al. (1991) and Punt et al. (1994). Additionally a new term relative exine thickness have been used. It is a ratio of the

mean exine thickness (measured along D or K axes and along the P or E axes for *Ribes uva-crispa*) to the mean length of D (K) or P (E) axis. This character appeared to be very useful in separation of some taxa.

POLLEN DIAGNOSES OF THE *RIBES* SPECIES

***RIBES UVA-CRISPA* L. (subgen. *Grossularia*) – Figs 1-4**

Size: Medium, P – 25.94 µm (22.00-32.00 µm), E – 22.94 µm (19.00-28.00 µm).

P/E ratio: 1.14 (1.00-1.50); shape of grains is usually prolate spheroidal (52%) or subprolate (45%), and only sporadically prolate (3%).

Outline: In equatorial view grains are mostly elliptic (36%) or rectangular (30%) with convex or straight lateral walls and rounded apices. Besides, circular (11%), elliptic truncate (4%), quinquangular (4%), trapezial (3%) and sexangular equatorial outlines (1%) are noticed too. In polar view grains are mainly elliptic, circular or rectangular with straight or slightly concave lateral walls and rounded apices.

Exine: Thickness 1.42 µm (1.00-2.00) µm. Relative thickness of exine averages 0.05.

Ornamentation: Psilate in LM, fossulate in SEM. Apocolpia and mesocolpia are well marked. Ectocolpus membrane is covered with well-developed granules of variable size and shape.

Pollen class: Zonocolporate.

Apertures: Compound.

Ectoapertures: (3-) 4-5(-7) colpi. Each colpus usually contains 2, rather 1 or 3 endopori. Main length of colpus is 12.0-22.0 μm , width variable, but most often the widest near endopori. Colpi are irregular in shape, narrowly elliptic, with rounded ends, deeply sunken in exine. Margins are well marked, irregular.

Endoapertures: (6-) 8-10 (-14) pori, placed symmetrically on the ends of the colpi or asymmetrically in the variable distance from the middle of the colpi. The longest diameters are (2.0)3.0-4.0(-5.0) μm . Margins are distinctly visible, irregular.

The most characteristic features: Grains are 4-5-zonocolporate, each ectocolpus contains 2 endopori. There are usually 8-10 endopori per grain. Apocolpi and mesocolpi are well visible.

Discussion: Within the Polish *Ribes* species, *R. uva-crispa* is the easiest to identify basing on pollen morphology. Its grains are classified in a separate, zonocolporate pollen type. Reuvers's characteristic (1977) given for this species is similar to that presented here, with the exception of the number of endopori. According to this author grains of *R. uva-crispa* has 5-6, rarely 7 ectocolpi, thus the number of endopori is 10-12(14). That data somewhat differ from my results. Kuprianova and Alyoshina (1972) considered 12-14 endopori as *R. reclinatum* L. Agababian (1963) described pollen grains of this species as having 8 endoapertures.

Provenance of analysed samples of *Ribes uva-crispa*

1. Prov. Piła – near Słomowo (01.05.1993, leg. Wrońska-Pilarek. POZNF)
2. Prov. Kielce – Świętokrzyski National Park, Łysa Góra Mt., ca 550 m (24.05.1993, leg. Wrońska-Pilarek and Maliński. POZNF)
3. Prov. Poznań – Poznań, municipal forest near Rusalka lake (25.04.1993, leg. Wrońska-Pilarek. POZNF)
4. Prov. Poznań – Zielonka forest, 1 km from Promno (railway station 08.05.1993, leg. Wrońska-Pilarek. POZNF)
5. Prov. Krosno – Bieszczady National Park, Krzemień Mt., ca 1300 m (26.05.1993, leg. Wrońska-Pilarek and Maliński. POZNF).

***RIBES RUBRUM* L.** (subgen. *Ribes*) – Figs 5-9

Size: Medium, D – 26.75 μm (20.00-36.00 μm), K – 25.07 μm (20.00-36.00 μm).

D/K¹: 1.07 (1.0-1.25); pollen grains are usually prolate (72% of observed grains), rarely subprolate (28%).

Outline: Most often grains are circular (29%), quinquangular (20%), pentagonal (20%) or trapezial (15%). The others pollen outlines as elliptic (9%), sexangular (5%), rectangular (2%) and elliptic truncate (1%) are much rarer. Apices are always rounded.

Exine: Thickness 1.44 μm (0.80-2.00 μm). Relative thickness of exine averages 0.05.

Ornamentation: Psilate, ectoaperture membrane is granulate.

Pollen class: Pantoaperturate or pantoporate.

Apertures: Compound.

Ectoapertures: Colpoids and pori, size (7.5-) 12.0-19.0 (-25.0) μm . Margins are rather indistinct and irregular. Ectoapertures dispersed irregularly on the surface of the grain, and the distances among them are variable.

Endoapertures: (4-) 6-7-8 (-10) pori, with the diameter (1.4-) 3.5-4.0 (-5.0) μm , placed in ectopori eccentrically, rarely concentrically. Margins are well visible, but irregular.

The most characteristic features: Most often pollen grains are with 6, 7 or 8 endopori. Ectopori look like colpoids or pori. They are dispersed irregularly on the whole surface of the grains. Distances among adjacent apertures are diversified.

Provenance of analysed samples of *Ribes rubrum*

1. Prov. Wałbrzych – Sokołowsko, house garden (16.05.1993, leg. Filipiak. POZNF)
2. Prov. Szczecin – Stargard Szczeciński, house garden (05.05.1993, leg. Wrońska-Pilarek. POZNF)
3. Prov. Koszalin – Kalisz Pomorski, (25.04.1993, leg. Studolski. POZNF)
4. Prov. Poznań – Bolechowskie lake (09.05.1993, leg. Wrońska-Pilarek. POZNF)
5. Prov. Bydgoszcz – Potulice forest inspectorate (30.04.1993, leg. Wrońska-Pilarek and Maciejewska. POZNF)
6. Prov. Zielona Góra – SE shore of Ciecz lake, (09.08.1993, leg. Danielewicz. POZNF)
7. Prov. Poznań – Promno (08.05.1993, leg. Wrońska-Pilarek. POZNF).

***RIBES SPICATUM* ROBSON** (subgen. *Ribes*) = ***RIBES SCHLECHTENDALII* Lange** – Figs 10-14

Size: Medium, D – 28.83 μm (22.00-41.00 μm), K – 26.90 μm (20.00-40.00 μm).

D/K: 1.07 (1.00-1.29); grains are usually prolate spheroidal (75%) in shape, rarely subprolate (25%).

Outline: Variable, but circular (26%) and pentagonal limbs (25%) prevail. Quinquangular (17%) and trapezial (12%) ones are observed too. Grains with elliptic (8%), rectangular (5%), sexangular (4%) or elliptic truncate outlines (3%) are rather rarer. Apices are always rounded.

Exine: Thickness 1.54 (0.80-2.00 μm). Relative thickness of exine averages 0.05.

Ornamentation: Psilate in LM, slightly fossulate in SEM. Ectoaperture membrane is granulate.

Pollen class: Pantoaperturate or pantoporate.

Apertures: Compound.

Ectoapertures: Colpoids and pori, size just the same as for the grains of *Ribes rubrum*. Margins usually distinct and irregular. Ectoapertures dispersed irregularly on the surface of the grain, and the distances among them are variable.

Endoapertures: (5-) 6-7-8 (-11) pori, with the diameter as for *Ribes rubrum*. Margins are distinct, irregular. Pori situated in ectopori eccentrically, rarely concentrically.

The most characteristic features: Pollen grains of *Ribes spicatum* are very similar to the grains of *R. rubrum*. Most often they have 6, 7 or 8 endopori. Ectoapertures are pori or colpoids, placed irregularly on the whole surface of the grain. Distances among adjacent apertures are variable.

Provenance of analysed samples of *Ribes spicatum*:

1. Prov. Słupsk – Gać, nature reserve Olszyna (02.05.1993, leg. Filingier. POZNF)

¹D – the longest axis of the pollen grain, K – shorter axis of the pollen grain, perpendicular to D axis

5

5 µm

6

5 µm

7

5 µm

8

5 µm

9

1 µm

Figs 5-9. *Ribes rubrum* L.

Fig. 5. (LM) – Outline of grain; structure of exine and ectopori areas with endopori (x 600).

Fig. 6. (LM) – Outline of grain; structure of exine and 2 endopori marked (x 600).

Fig. 7. (SEM) – Outline of grain; colpoid with 2 opened endopori visible (x 5000).

Fig. 8. (SEM) – Outline of grain; diversity of ectoapertures visible – colpoid with opened and closed endopori (at the top) and ectoporus with closed endopori (at the bottom) (x 5000).

Fig. 9. (SEM) – Close-up of ectoporus; irregular margin, granules and eccentrically situated endoporus (x 10 000).

2. Prov. Poznań – Owińska over Warta (22.05.1993, leg. Wrońska-Pilarek. POZNF)
3. Prov. Szczecin – Warnowo, over Warnowo lake (05.05.1993, leg. Wrońska-Pilarek. POZNF)
4. Prov. Koszalin – Podczele (07.05.1993, leg. Maciejewska. POZNF)
5. Prov. Bydgoszcz – Mogilno, house garden (04.05.1993, leg. Morkowski. POZNF)
6. Prov. Koszalin – Mielno (07.05.1993, leg. Maciejewska. POZNF).

RIBES PETRAEUM WULFEN (subgen. *Ribes*)

– Figs 15-19

Size: Medium, D – 26.25 μm (22.00-30.00 μm), K – 25.86 μm (22.00-30.00 μm).

D/K: 1.01 (1.00-1.19); grains are mainly prolate spheroidal (96%), rarely subprolate (4%).

Outline: Circular (50%) and square (24%) forms predominate, rarely limb is pentagonal (14%) or trapezoidal (9%) and only sporadically elliptic (2%) and quinquangular (1%). Apices are rounded.

Exine: Thickness 1.41 μm (1.00-2.00 μm). Relative thickness of exine averages 0.05.

Ornamentation: Psilate in LM, psilate or slightly fossulate in SEM. Ectopore membrane is granulate.

Pollen class: Pantoaperturate or pantoporate.

Apertures: Compound.

Ectoapertures: Colpoids and pori, size just the same as for the grains of *Ribes rubrum*. Margins indistinct and irregular. Ectoapertures dispersed irregularly on the surface of the grain, and the distances among them are variable.

Endoapertures: (6-) 7-8-9 (-11) pori, with the diameter as for *Ribes rubrum*. Margins distinct, but irregular. Pori situated in ectopori eccentrically, rarely concentrically.

The most characteristic features: Pollen grains of *Ribes petraeum* are very similar to the grains of *R. rubrum* and *R. spicatum*. In respect of shape however pollen grains of *R. petraeum* are closer to the grains of *R. alpinum* and *R. nigrum* than to *R. rubrum* and *R. spicatum*. The number of endopori for this species ranges from (6-) 7 to 9 (-11) and it is somewhat higher than for *R. rubrum* and *R. spicatum*. Most often there are 6-8 or 9 endopori. Ectoapertures look like both pori and colpoids, placed irregularly on the surface. Distances among adjacent apertures are variable.

Provenance of analysed samples of *Ribes petraeum*:

1. Prov. Nowy Sącz – Mały Giewont Mt. 1728 m (11.06.1993, leg. Wrońska-Pilarek and Maciejewska. POZNF)
2. Prov. Nowy Sącz – Kościeliska valley, over Kościeliski stream (12.06.1993, leg. Wrońska-Pilarek and Maciejewska. POZNF)
3. Prov. Krosno – Krzemień Mt., ca 1300 m. (26.05.1993, leg. Wrońska-Pilarek and Maliński. POZNF)
4. Prov. Bielsko Biała – Babia Góra Mt., 1240 m (25.09.1993, leg. Rzepka. POZNF).

Discussion (concerning *Ribes rubrum*, *R. spicatum* and *R. petraeum*): Pollen grains of *Ribes rubrum*, *R. spicatum* and *R. petraeum* are very alike and hard to distinguish. Thus their pollen grains are gathered in a separate pollen class, with 7-8, rarely 6 or 9 endopori, as distinct from the grains of *R. alpinum* and *R. nigrum*, which usually have 6-7 endopori. Kuprianova and Alyoshina (1972) examined the pollen morphology

of *R. rubrum* and *R. spicatum*. In their opinion these taxa differ from each other in the number of endopori. *R. rubrum* is characterised by 8 endoapertures, while *R. spicatum* – by 10-12. Both, my observations and studies and research works of the others authors have not confirmed Kuprianova and Alyoshina's results (l.c.). I have usually observed grains with 6-9 endopori, rarely with 10-11. Verbeek-Reuvers (1977) noticed pollen grains of *R. rubrum*, *R. spicatum* and *R. petraeum* with 8-14 endopori and only sporadically with 6-7. Hideux and Ferguson (1976) in their monograph of the family Saxifragaceae s.l. characterised pollen grains of *R. petraeum* as the representative of genus *Ribes*. Their description is similar to my observations, but they did not mention the number of endopori. According to Agababian (1963) only 5-6 endopori are typical of *R. rubrum* L. (= *R. vulgare* Lam.) and *R. spicatum* Robson (as *R. pubescens* Hedl.).

RIBES NIGRUM L. (subgen. *Coreosma*) – Figs 20-24

Size: Medium, D – 28.73 μm (20.00-40.00 μm), K – 28.35 μm (20.00-40.00 μm).

D/K: 1.02 (1.00-1.17), most often grains are prolate spheroidal (98%) in shape, rarely subprolate (2%).

Outline: Usually square (68%), rarely circular (18%), pentagonal (6%), elliptic (3%), quinquangular (3%) or trapezoidal (2%). Apices are rounded.

Exine: Thickness 1.16 μm (0.80-1.60 μm). Relative thickness of exine averages 0.04.

Pollen class: Pantoporate or pantoaperturate.

Ornamentation: Psilate in LM, psilate or slightly fossulate in SEM. Ectopore membrane is granulate, granules of variable shape and size.

Apertures: Compound.

Ectoapertures: Mainly pori, sometimes also colpoids; with size (10.0-) 14.0-15.0 (-20.0) μm . Margins distinct or not, irregular. Ectoapertures arranged regularly on the surface of the grain, and the distances among them are similar.

Endoapertures: 6-7 (5-8) pori, with the diameter (2.0-) 3.5-4.5 (-6.0) μm . Pori situated in ectopori slightly eccentrically or concentrically. Margins distinct and irregular.

The most characteristic features: Pollen grains usually have 6-7 endopori. Grains are medium size, the longest diameter is up to 40 μm . Ectoapertures look like pori, rarely colpoids. Relative thickness of exine averages 0.04.

Provenance of analysed samples of *Ribes petraeum*:

1. Prov. Piła – Słomowo (01.05.1993, leg. Wrońska-Pilarek. POZNF)
2. Prov. Zielona Góra – Nietkowice (02.05.1993, leg. Danielewicz. POZNF)
3. Prov. Szczecin – Warnowo, over Warnowo lake (05.05.1993, leg. Wrońska-Pilarek. POZNF)
4. Prov. Bielsko Biała – slope of Szyndzielnia (11.05.1993, leg. Gancarczyk. POZNF)
5. Prov. Poznań – Poznań, house garden (03.05.1993, leg. Maciejewska. POZNF)
6. Prov. Koszalin – Podczele near Kołobrzeg (07.05.1993, leg. Maciejewska. POZNF).

RIBES ALPINUM L. (subgen. *Berisia*) – Figs 25-29

Size: Small, D – 21.48 μm (18.00-24.00 μm), K – 21.13 μm (18.00-24.00 μm); dimensions of individual grains are very similar.

Figs 10-14. *Ribes spicatum* Robson

Fig. 10. (LM) – Outline of grain; exine structure and endopori visible (x 600).

Fig. 11. (SEM) – Group of grains; diversity of ectoapertures visible – colpoids and ectopori (x 2000).

Fig. 12. (SEM) – Outline of grain; strongly elongated colpoid with opened and closed endopori (x 5000).

Fig. 13. (SEM) – Close-up of fragments of 2 colpoids; aperture margins, granules and closed and opened endopori (x 7500).

Fig. 14. (SEM) – Close-up of ectoporus; margin, granules and eccentrically situated endoporus (x 10 000).

D/K: 1.02 (1.00-1.20). prolate spheroidal grains (98%) predominate and subprolate shapes (2%) are only sporadic.

Outline: Most often circular (43%) and square (33%), rarely trapezoidal (8%), quinquangular (8%), pentagonal (5%), elliptical (2%) or sexangular (1%). Apices are rounded.

Exine: Thickness 1.41 µm (1.00-2.00 µm). Relative thickness of exine averages 0.07.

Ornamentation: Psilate in LM, fossulate in SEM. Ectopore membrane is granulate, granules of variable shape and size.

Pollen class: Pantoporate.

Apertures: Compound.

Ectoapertures: Granulate pori, with size (-7.0) 8.0-9.0 (-14.0) µm. Margins are faint and irregular. Adjacent ectopori areas are

usually clearly separate. Ectoapertures arranged regularly on the surface of the grain, and the distances among them are similar.

Endoapertures: Most often 6, rarely 5 or 7 endopori, with the diameter (-1.5) 3.0-3.2 (-4.0) µm. Pori situated in ectopori slightly eccentrically or concentrically. Margins distinct and irregular.

The most characteristic features: Pollen grains usually have 6 endopori. Grains are small, the longest diameter is up to 24 µm. Dimensions of individual grains are very similar. Ectopori are not overlapping, one ectoporus corresponds to only one endoporus. Relative thickness of exine is rather large, averages 0.07.

Figs 15-19. *Ribes petraeum* Wulfen

Fig. 15. (LM) – Outline of grain; exine structure and endopori visible (x 600).

Fig. 16. (SEM) – Outline of grain; numerous granulate ectopori with concentrically or eccentrically situated, opened endopori (x 3500).

Figs 17, 18 (SEM) – Grains with different colpoids (x 5000), (x 3500).

Fig. 19. (SEM) – Close-up of ectoporus; aperture margin, granules and eccentrically situated, opened endopori (x 10 000).

Figs 20-24. *Ribes nigrum* L.

Fig. 20. (LM) – Outline of grain; ectopori and endopori areas visible (x 600).

Fig. 21. (SEM) – Two grains; ectoapertures in the form of colloid and ectoporus visible (x 2000).

Fig. 22. (SEM) – Grain with elliptic ectopori, individually situated on each wall (x 3500).

Fig. 23. (SEM) – Grain with circular ectopori, closed endopori (x 3500).

Fig. 24. (SEM) – Close-up of colloid; aperture margin, granules and opened endopori visible (x 10 000).

Figs 25-29. *Ribes alpinum* L.

Fig. 25. (LM) – Outline of grain; exine structure and 2 endopori visible (x 600).

Fig. 26. (SEM) – Group of grains; grains of similar size, ectopori placed regularly (x 2000).

Fig. 27. (SEM) – Outline of grain; granulate, circular ectopori visible (x 5000).

Fig. 28. (SEM) – Outline of grain; just opened endopori (at the top) and closed endopori (at the bottom) (x 5000).

Fig. 29. (SEM) – Close-up of ectoporus; aperture margin, granules and opened, slightly eccentric endoporus (x 10 000).

Provenance of analysed samples of *Ribes petraeum*:

1. Prov. Poznań – Owińska, (22.05.1993, leg. Wrońska-Pilarek. POZNF)
2. Prov. Szczecin – Woliński National Park (05.05.1993, leg. Wrońska-Pilarek. POZNF)
3. Prov. Zielona Góra – Ciecz lake (09.08.1993, leg. Danielewicz. POZNF)
4. Prov. Piła – Kalina forestry (19.05.1993, leg. Chojnacki. POZNF)
5. Prov. Koszalin – Mielno (07.05.1993, leg. Maciejewska. POZNF).

Discussion (concerning *Ribes alpinum* and *R. nigrum*): Pollen grains of *Ribes alpinum* resemble very much grains of *R. nigrum*. They differ, however in a smaller size, smaller apertures, bigger relative thickness of exine and less variable ectoapertures. *R. alpinum* exclusively possesses ectopori, while *R. nigrum* both ectopori and ectocolpoids. Verbeek-Reuvers (1977) did not take into account differences within the forms of ectoapertures. In connection with it she included pollen grains of *R. alpinum* and *R. nigrum* to the same, pantoporate pollen class. According to this author exine thickness of *R. nigrum* is 1 µm. She did not analyse relative thickness of exine. Stachurska, Sadowska and Kuszell (1976) mentioned about 8-9 endopori for *R. alpinum*. In their opinion the size of grains of this species ranges from 22.5 to 32.0 µm (most often 27.0 µm), which does not correspond to my observations. Kuprianova and Alyoshina (1972) considered 8-10 endopori for *R. alpinum* and *R. nigrum*.

**KEY TO THE NATIVE SPECIES
OF THE GENUS RIBES L. BASING
ON THE MORPHOLOGICAL CHARACTERS
OF POLLEN GRAINS**

- 1A. Grains zonocolporate.....*R. uva-crispa* L.
- 1B. Grains pantoperturate or pantoporate..... 2
- 2A. Grains mainly with 7-8 endopori, ectoapertures formed mainly by irregular colpoids (rarely pori), each colpoid usually with two endopori.....
..... *R. rubrum* L., *R. spicatum* Robson, *R. petraeum* Wulfen
- 2B. Grains mainly with 6-7 endopori, ectoapertures formed mainly by pori, each ectoporus with one endoporus (rarely adjacent ectoapertures connected in colpoids)..... 3
- 3A. Grains of medium size, with diameter (20-) 26-32 (-40) µm. A ratio of exine thickness to grain diameter is 0.04..
.....*R. nigrum* L.
- 3B. Grains of small size, with diameter (18-) 20-22 (-24) µm. A ratio of exine thickness to grain diameter is 0.07.....
.....*R. alpinum* L.

CONCLUSIONS

The main diagnostic features of pollen grains of native species of genus *Ribes* are: polarity or apolarity, type of pollen class and ectoaperture, number of endopori and a ratio of exine thickness to grain diameter. With the aim of specifying ectoaperture classification the author has proposed to separate an intermediate form – colpoids, beside colpi and pori. These apertures have been observed in pollen grains of *R. petraeum*, *R. rubrum*, *R. spicatum* and *R. nigrum*. Colpoids are in elongated outline and usually contain more than one endoporus.

They are halfway between circular pori and proper, elliptic colpi, which can be found in pollen grains of *R. uva-crispa*. They differ from colpi not only in shape, but also in irregular arrangement on the surface of grain. They are probably specific, evolutionary elements, linking extreme types of apertures. Owing to pollen morphology it is easy to distinguish *R. uva-crispa*, *R. nigrum* and *R. alpinum*. However the grains of *R. rubrum*, *R. spicatum* and *R. petraeum* are very similar and impossible to separate in practice. Pollen morphology confirms the existing division of *Ribes* into particular subgenera. It may serve as a supplementary criterion of *Ribes* taxonomy. The structure of grains allows to separate only these native currants, which are representing individual subgenera.

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LITERATURE CITED

- AGABABIAN W.S., 1963. Pollen morphology of the genus *Ribes* L. *Izv. Akad. Nauk. Arm. S.S.R., Biol. Nauki* 16: 93-98 (in Russian).
- DYAKOWSKA J., 1959. *Podręcznik palynologii*. Wydawnictwa Geologiczne. Warszawa.
- EHRENDORFER F., DAHLGREN R. (eds.), 1983. New evidence of relationships and modern systems of classifications of the angiosperms. *Nordic J. Bot.* 3: 1-155.
- ENGLER A., 1930. Saxifragaceae. In: A. Engler and K. Prantl. (ed.) *Natürlichen Pflanzenfamilien*. 2 Aufl., 18a. Verlag von Wilhelm Engelmann. Leipzig.
- ERDTMAN G., 1952. Pollen morphology and plant taxonomy. Angiosperms. An introduction to palynology 1. Almquist and Wiksell. Stockholm.
- FAEGRI K., IVERSEN J., 1978. *Podręcznik analizy pyłkowej*. Wydawnictwa Geologiczne. Warszawa.
- FAEGRI K., IVERSEN J., 1992. *Textbook of pollen analysis*. John Wiley and Sons. Chichester, New York, Brisbane, Toronto, Singapore.
- HIDEUX M.J., FERGUSON J.K., 1976. The stereostructure of the exine and its evolutionary significance in Saxifragaceae sensu lato. In: Ferguson J.K., Muller (ed.), *The evolutionary significance of the exine*: 327-377. Academic Press. London.
- HUTCHINSON J., 1959. *The families of flowering plants I. Dicotyledons*. Clarendon Press. Oxford.
- KRÜSSMANN G., 1984. *Ribes* L. In: *Manual of cultivated broad-leaved trees and shrubs 2*. Timber Press. Beaverton.
- KUPRIANOVA L.A., ALYOSHINA L.A., 1972. Grossulariaceae. In: *Pylca i spory rastenij flory evropejskoj tshasti SSSR*: 149-150. Izdat. Akad. Nauk SSSR, Komarov Bot. Inst. "Nauka" Leningrad.
- LAMARCK J. B.A.P. M., DE CONDOLLE A.P., 1805. Grossulariaceae. In: *Flore Francaise* ed. 3, 4 (2). H. Agasse. Paris.

- MOORE P.D., WEBB J.A., COLLINSON M.E., 1991. Pollen analysis. Blackwell Scientific Publications. London, Edinburgh, Boston.
- POJARKOVA A.I., 1939. *Ribes*. In: Komarov V. (red.). Flora SSSR 9. Izdatelstvo Akademii Nauk SSSR. Moskva, Leningrad.
- PUNT W., BLACKMORE S., NILSSON S., LE THOMAS A., 1994. Glossary of pollen and spore terminology. LPP Foundation. Utrecht.
- REHDER A., 1977. Saxifragaceae Dum. – *Ribes* L. In: Manual of cultivated trees and shrubs 2. Macmillan Publishing Co. Inc. New York: 293-311.
- REITSMA T., 1970. Suggestions towards unification of descriptive terminology of angiosperm. Pollen grains. Rev. Paleobot. Palynol. 10: 39-60.
- STACHURSKA A., SADOWSKA A., KUSZELL T., 1976. *Ribes alpinum* L. In: Kartoteka palinologiczna roślin polskich. Zeszyty Przyrod. Opol. Tow. Przyj. Nauk 16: tab. 225.
- TAKHTAJAN A., 1966. Sistema i filogenija cvetkovych rastenij. Nauka. Moskva, Leningrad.
- TAKHTAJAN A., 1987. Sistema Magnolifitov. Nauka. Leningrad (in Russian).
- VERBEEK-REUVERS A.A.M.L., 1977. Grossulariaceae. In: Punt W., Clarke G.C.S. (ed.). The northwest European pollen flora 12/2: 107-115. Elsevier Science Publishers B.V. Amsterdam.
- WALKER J.W., 1974. Evolution of exine structure in the pollen of primitive angiosperms. Amer. Journ. Bot. 61: 891-902.
- WEBB D.A., 1964. Grossulariaceae. In: Tutin T.G., Heywood V.H., Burges N.A., Valentine D.H., Walters S.M., Webb D.A (ed.). Flora Europaea 1: 382-383. Cambridge University Press. Cambridge, London, New York, Ibadan.
- WEBER H.E., 1995. Grossulariaceae. In: Hegi G. Illustrierte Flora von Mitteleuropa 4, 2a. Spermatophyta: Angiospermae: Dicotyledones 2: 48-68. Blackwell Wissenschaft Verlag. Berlin.

MORFOLOGIA ZIARN PYŁKU KRAJOWYCH GATUNKÓW Z RODZAJU *RIBES* L.

STRESZCZENIE

W pracy przedstawiono wyniki badań morfologicznych nad ziarnami pyłku 6 krajowych gatunków z rodzaju *Ribes* L. (rodzina Grossulariaceae). Obserwacje przeprowadzono przy użyciu różnych typów mikroskopów świetlnych oraz skaningowych. Opisy morfologiczne ziarn zostały zilustrowane seriami zdjęć spod obu typów mikroskopów. Badane ziarna pyłku posiadają małe lub średnie rozmiary, ich kształt jest kulisty wydłużony, lekko wydłużony, rzadziej wydłużony. Skulptura powierzchni ziarn jest gładka. Jedynie w obrębie apertur zewnętrznych występują charakterystyczne ziarnistości. U badanych taksonów z rodzaju *Ribes* obszary apertur zewnętrznych przyjmują postać bruzd, por oraz apertur o pośrednim charakterze – bruzdokształtnych apertur zewnętrznych. Apertury wewnętrzne stanowią pory. Ich liczba waha się w granicach (4-) 6-7-8 (-14). Otwory są rozmieszczone na powierzchni ziarn pyłku strefowo (biegunowo) lub są rozproszone. Za cechy diagnostyczne ziarn pyłku krajowych gatunków rodzaju *Ribes* można uznać: występowanie lub brak biegunowości, rodzaj apertur zewnętrznych i ich rozmieszczenie na powierzchni ziarn, liczbę por wewnętrznych oraz stosunek grubości eksyny do średnicy ziarn. W pracy zamieszczono klucz do oznaczania 6 krajowych gatunków z rodzaju *Ribes*, według cech morfologicznych ziarn pyłku.

SŁOWA KLUCZOWE: Grossulariaceae, *Ribes*, morfologia ziarn pyłku, SEM, LM.