

Pollen morphology of Bulgarian species from the section *Orobus* (L.) Gren. et Godr. (genus *Lathyrus*, Fabaceae)

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The pollen morphology of eight species from the section *Orobus* (L.) Gren. et Godr. (*Lathyrus*, Fabaceae) distributed in Bulgaria (*Lathyrus alpestris*, *L. aureus*, *L. linifolius*, *L. niger*, *L. palustris*, *L. transsilvanicus*, *L. venetus* and *L. vernus*.) was studied with light and scanning electron microscope. The pollen grains are 3-zonocolporate of subprolate (semi-erectus) type ($P/E=1.20-1.31$), medium to large in size, elliptical or rectangular-obtuse-convex (equatorial view) and circular to slightly triangular-obtuse-convex (polar view). The ornamentation is predominantly perforate-foveolate but there are pollen grains with perforate-reticulate sculpture (*L. alpestris*, *L. palustris*) or almost reticulate (*L. aureus*).

Key words: pollen, morphology, *Lathyrus*, *Orobus*, SEM, Bulgaria.

Introduction

The genus *Lathyrus* L. (Fabaceae) is a part of the tribe Viciae (Adans.) DC and comprises about 150 species distributed mainly in Europe, Asia and North America, extending also to South America and tropical East Africa (POLHILL and RAVEN 1981).

During the last decades a number of investigations related to different aspects of the genus' taxonomical structure emphasized the necessity of comprehensive biosystematical research by various methods (CZEFRANOVA 1965, 1971, BÄSSLER 1966, 1973, 1981, Rees and HAZARIKS 1969, KUPICHA 1983, ASMUSSEN and LISTON 1998).

An important trend in this research is the investigation of pollen morphological characters. The data on the pollen morphology of genus *Lathyrus* is still incomplete although some information is available in general surveys of the family Fabaceae (subfamily Papilionoideae) and regional studies (FAEGRI 1956, ERDTMAN 1966, GAPOTCHKA and CHAMARA 1972, GAPOTCHKA 1974, CLARKE and KUPICHA 1976, FERGUSSON and SKVARLA 1981, FAEGRI and IVERSEN 1989, MOORE et al. 1991, REILLE 1992, 1995, 1998, HALBRITTER 2000, BEUG 2004).

The most recent general description of the pollen morphological characters of taxa assigned to the *Lathyrus*-type is to be found in BEUG (2004). The pollen grains are described as

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3-zonocolporate, prolate ($P/E = 1.23-1.91$), medium in size (30–50 μm), with supra-reticulate ornamentation, size of lumina up to 2.5–3.0 μm , unlike *Vicia*-type, where the width of lumina is more than 3.0 μm . Sometimes the reticulum is not so well defined and the pollen grains are almost psilate at apocolpium and around the apertures. Each aperture consists of well-defined circular or elliptic endopori and ectocolpi with heavy thick costae. The exine is 1.0–1.5 μm thick, thinner at apocolpium. The endexine is thicker than the tectum.

Other authors assign pollen grains of *Lathyrus* species to the *Vicia cracca*-type (FAEGRI and IVERSEN 1989, MOORE et al. 1991) or the *Vicia*-type (MOORE et al. 1991). The ornamentation is defined mainly as suprareticulate-foveolate (FAEGRI and IVERSEN 1989, MOORE et al. 1991) disappearing at the poles or restricted to a few widely spaced lumina (MOORE et al. 1991; BEUG 2004). CLARKE and KUPICHA (1976) reported the presence of microreticulate ornamentation with wide muri and low lumina. In general, this summary information is also given by FERGUSSON and SKVARLA (1981), POLHILL and RAVEN (1981), and REILLE (1995).

The present paper is the second one of a series of contributions related to the pollen morphological characteristics of Bulgarian representatives of the genus *Lathyrus* (section *Orobus*) studied by the application of LO microscopy and SEM. In the first paper the pollen morphology of four species from the section *Lathyrus* was presented and discussed (TOSHEVA et al. 2003).

Material and Methods

The section *Orobus* is represented in the Bulgarian flora by eight species – *Lathyrus alpestris* (Waldst. et Kit.) Kit., *L. aureus* (Stev.) D. Brândză, *L. linifolius* (Reichard) Bässler, *L. niger* (L.) Bernh., *L. palustris* L., *L. transsilvanicus* (Spreng.) Rchb. f., *L. venetus* (Mill.) Wohlf., and *L. vernus* (L.) Bernh. (KUPICHA 1983). The species *L. alpestris* is endemic to the Balkan Peninsula and represented in Bulgaria by one subspecies – subsp. *friedrichstalii* (Griseb.) Bässler. Two species (*L. transsilvanicus* and *L. palustris*) are considered threatened and are under protection.

Pollen material was collected from natural populations of the taxa concerned (Fig. 1) and from specimens kept in the Herbarium of Sofia University (SO). The voucher specimens are also deposited in this herbarium. The material for analysis of *L. transsilvanicus* was taken from the herbar specimen *Rossia subcarpatica* (SO 47025).

Pollen grains for LO examination were prepared following the standard procedure of ERDTMAN (1960). Nine pollen morphological characters were measured with a microscope Amplival (Carl-Zeiss, Jena) at magnification of 800 x – P (polar diameter), E (equatorial diameter), Lc (colpus length), Lp (porus length), Sp (porus width), M (mesocolpium), A (apocolpium), n (exine thickness) and the P/E ratio. Thirty measurements of each character were made and the mean values and ranges are shown on Table 1. For SEM examination acetolysed pollen grains were first treated in an ultrasonic bath for 30 min and subsequently coated with gold as dry specimens with JEOL-JFC-1200 coater. The microphotographs were obtained with JEOL-JSM-5510 SEM at magnification of 2300–27000 x in the Faculty of Chemistry, Sofia University (Fig. 2, 3, 4).

The pollen morphological descriptions follow the terminology of REITSMA (1970) and PUNT et al. (1994).



Fig. 1. An UTM grid map of Bulgaria showing the location of investigated species mentioned in the text (Scale bar 1: 1500000) – A – *Lathyrus alpestris*, B – *L. aureus*, C – *L. linifolius*, D – *L. niger*, E – *L. palustris*, F – *L. venetus*, G – *L. vernus*.

Results and Discussion

Lathyrus alpestris (Waldst. et Kit.) Kit. ssp. *fridrichstalii* (Griseb.) Bässler (Table 1; Fig 2. – 1, 2). Vitosha Mts., near the Aleko tourist hut, among stands of *Juniperus sibirica* Burgsd., FN 81, 42°34' N, 23°17' E, 14. 09. 2002, A. Tosheva (SO 102671).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.27).

Dimensions: Medium to large size (Px E = 44.2 (46.8) 50.6 x 33.2 (36.9) 41.1 μm).

Apertures: Ectoaertures – colpi: long, wide, broader at the equator, with acute ends, thick costae along the margins of the colpi, colpus membrane covered by very fine granules; endoaertures – pori: large, circular to slightly lalongate, protruding in mesocolpium.

Outlines: Equatorial view – elliptic to slightly rectangular-obtuse-convex; polar view – circular.

Ornamentation: Perforate-reticulate, gradually transformed to suprareticulate in equatorial area. The largest lumina, different in size and shape, are observed in mesocolpium. Apocolpium and aperture area are psilate.

Exine: In mesocolpium the thickness is 1.80 μm and 1.00 μm in apocolpium. The nexine is thinner than sexine.

Previous to the present study no data for the pollen morphology of this species were available.

Tab. 1. Measurements of pollen-morphological characters: P (polar diameter), E (equatorial diameter), Lc (colpus length), Lp (porus length), Sp (porus width), M (mesocolpium), A (apocolpium), n (exine thickness) and the P/E ratio.

| Species | P, μm | E, μm | Lc, μm | Lp, μm | Sp, μm | M, μm | A, μm | n, μm | P/E |
|---------------------------|------------------|------------------|-------------------|-------------------|-------------------|------------------|------------------|------------------|----------------|
| <i>L. alpestris</i> | 44.2(46.8)50.6 | 33.2(36.9)41.1 | 30.0(32.9)34.8 | 5.5(6.2)7.1 | – | 17.4(21.7)25.3 | 12.6(16.4)18.9 | 1.80 – 1.00 | 1.22(1.27)1.38 |
| <i>L. aureus</i> | 39.5(43.6)47.4 | 30.0(35.1)39.5 | 26.9(30.0)31.6 | 4.7(5.7)7.1 | – | 18.9(19.9)22.1 | 14.2(15.5)17.4 | 1.25 – 1.00 | 1.20(1.25)1.32 |
| <i>L. limifolius</i> | 37.9(42.7)45.8 | 30.0(33.6)39.5 | 25.3(28.9)33.2 | 4.7(5.8)6.3 | – | 15.8(19.9)23.7 | 11.1(14.6)18.9 | 1.25 – 0.75 | 1.14(1.23)1.36 |
| <i>L. niger</i> | 30.0(34.6)36.6 | 23.7(26.6)28.4 | 20.1(25.9)28.4 | 3.9(4.9)5.5 | – | 9.5(13.7)17.4 | 4.7(9.0)11.1 | 1.20 – 0.80 | 1.16(1.27)1.37 |
| <i>L. palustris</i> | 34.0(46.7)52.9 | 23.7(36.6)41.4 | 28.4(34.1)41.1 | 6.3(8.8)10.3 | 4.7(7.1)8.7 | 14.2(19.3)23.7 | 9.5(12.9)17.4 | 1.20 – 0.75 | 1.26(1.28)1.43 |
| <i>L. transsilvanicus</i> | 37.9(48.3)50.6 | 31.6(37.4)42.7 | 22.1(30.0)34.8 | 4.7(6.2)7.9 | – | 17.4(22.3)26.9 | 12.6(16.2)20.5 | 1.20 – 0.80 | 1.12(1.20)1.28 |
| <i>L. venetus</i> | 31.6(35.9)37.9 | 23.7(26.6)30.0 | 22.1(25.1)26.9 | 4.0(4.9)5.5 | – | 14.2(16.4)19.0 | 11.1(12.9)14.2 | 1.20 – 0.80 | 1.27(1.30)1.37 |
| <i>L. vernus</i> | 36.3(43.1)47.4 | 30.0(35.1)39.5 | 25.3(30.5)34.8 | 4.7(6.1)7.1 | – | 15.8(19.5)23.7 | 9.5(14.1)17.4 | 1.20 – 0.75 | 1.21(1.23)1.33 |

***Lathyrus aureus* (Stev.) D. Brândză**
(Tab. 1; Fig. 2. – 3, 4) Strandza Mts., Vitanovo Nature Reserve, NG 44, 41°59' N, 27°32' E, 23. 05. 1994, D. Pavlova, (SO 97133).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.25).

Dimensions: Medium size (Px E = 39.5 (43.6) 47.4 x 30.0 (35.1) 39.5 μm).

Apertures: Ectoapertures – colpi: long, nearly reaching the poles, straight, narrow, broader in mesocolpium, with acute ends, thick costae along the margins of the colpi, colpus membrane covered by clearly visible granules; endoapertures – pori: circular.

Outlines: Equatorial view – elliptic to slightly rectangular-obtuse-convex; polar view – triangular-obtuse-convex to circular.

Ornamentation: Suprareticulate, lumina different in size and shape, the largest lumina are in intercolpium and the smallest ones in mesocolpium. Heads of single columellae are visible inside the lumina. The reticulate pattern is present also in apocolpium and around colpus area.

Exine: The thickness is 1.25 μm in mesocolpium and 1.00 μm in apocolpium. The nexine is slightly thinner than sexine.

Previous to the present study no data for the pollen morphology of this species was available.

***Lathyrus linifolius* (Reichard) Bässler**,
(Tab. 1; Fig. 2. – 5–8) Central Stara planina (Mts.) – Central Balkan National Park, Sokolna Nature Reserve, Gjol Tepe locality on a northern slope, LH 42, 42°44' N, 25° 03' E, 17. 07. 2003, A. Tosheva (SO 103046).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.23).

Dimensions: Medium size (Px E = 37.9 (42.7) 45.8 x 30.0 (33.6) 39.5 μm).

Apertures: Ectoapertures – colpi: long, straight and deep, nearly reaching the poles, broader at equator, with acute ends, heavy thick costae along the colpi, colpus membrane covered by fine granules; endoapertures – pori: circular.

Outlines: Equatorial view – elliptic; polar view – circular.

Ornamentation: Perforate-foveolate or microreticulate after CLARKE and KUPICHA (1976); perforations different in size and shape, the largest observed in mesocolpium and decreasing towards apocolpium. In the equatorial area single columellae are visible inside the largest lumina. Colpus area and apocolpium are almost psilate.

Exine: In mesocolpium the thickness is 1.25 μm and 0.75–1.00 μm in apocolpium. The nexine is as thick as the sexine in apocolpium and considerably thinner at the equator. The columellae layer is slightly developed.

Our results confirm the data provided by other authors (FAEGRI and IVERSEN 1989, MOORE et al. 1991, REILLE 1992, 1998, BEUG 2004). Pollen of *L. linifolius* is related to *Lathyrus*-type (BEUG 2004) with well-defined circular or elliptic endopores, heavy thick costae along the margins of the colpi. Other authors assign this pollen to *Vicia cracca*-type (FAEGRI and IVERSEN 1989, MOORE et al. 1991) or *Vicia*-type (MOORE et al. 1991). The ornamentation is described as suprareticulate-foveolate (FAEGRI and IVERSEN 1989, MOORE et al. 1991) to suprareticulate (MOORE et al. 1991, BEUG 2004) disappearing at poles or restricted to a few widely spaced lumina. In addition, MOORE et al. (1991) point out that the exine is roughly of the same thickness all over the surface with the exception of the costae area where it is 2–3 times thicker.

***Lathyrus niger* (L.) Bernh.**, (Tab. 1; Fig.3. – 1, 2) Znepole region, Kalista village, Kostevtzi locality, FN 50, 42°28' N, 22°52' E, 25. 05. 2002, A. Tosheva (SO 102335).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.27).

Dimensions: Medium size (P x E = 30.0 (34.6) 36.3 x 23.7 (26.6) 28.4 μm).

Apertures: Ectoapertures – colpi: long, nearly reaching the poles, straight, shallow, widened at equator, with acute ends, thick costae to the colpi, colpus membrane covered by clearly visible granules; endoapertures – pori: large, circular, protruding in mesocolpium.

Outlines: Equatorial view – elliptic; polar view – circular.

Ornamentation: Perforate-foveolate, perforations different in size and shape, the largest in mesocolpium and decreasing towards apocolpium. Colpus area and apocolpium are psilate.

Exine: In mesocolpium the thickness is 1.20 μm and 0.80 μm in apocolpium. The nexine is slightly thinner than sexine.

Our results confirm the data provided by other authors (GAPOTCHKA and CHAMARA 1972, GAPOTCHKA 1974, HALBRITTER 2000, BEUG 2004). Pollen of *L. niger* is related to *Lathyrus*-type (BEUG 2004) while MOORE et al. (1991) assign this pollen to *Vicia cracca*-type. HALBRITTER (2000) reported the presence of psilate ornamentation. According to GAPOTCHKA and CHAMARA (1972) and GAPOTCHKA (1974) the grain size is P x E = 34.7 x 26.0 μm , the ornamentation is perforate, the exine is composed of tectum, columellae layer, foot layer and endexine, the latter thickened at porus.

***Lathyrus palustris* L.** (Tab. 1; Fig. 3. – 3–5), Znepole region, on wet areas of the former marsh Tschokljovo in Konjavka Mts., FM 59, 42°24' N, 22°51' E, 22. 06. 1958, Leg. D. Jordanov, A. Janev, Det. D. Stojanov (SO 102103).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.28).

Dimensions: Medium size (PxE = 34.0 (46.7) 52.9 x 23.7 (36.6) 41.1 µm).

Apertures: Ectoapertures – colpi: long, nearly reaching the poles, straight, slightly broader at equator, with acute ends, very thick costae along the margins of the colpi, colpus membrane covered by fine granules; endoapertures – pori: large, slightly lalongate.

Outlines: Equatorial view – elliptic; polar view – triangular-obtuse-convex.

Ornamentation: Foveolate-reticulate, larger lumina different in size and shape are observed in mesocolpium. Apocolpium and the surface close to the colpi are psilate.

Exine: In mesocolpium the thickness is 1.20 µm and gradually decreases to 0.75 µm towards apocolpium. The nexine is considerably thinner than sexine. The structural elements of the columellae layer are rods.

Large elliptical and almost circular small pollen grains were also found in the study sample. Most likely, their presence is due to irregular meiosis in connection with the polyploidy established for this species (FEDOROV 1969: 302).

Our results confirm the data provided by other authors (FAEGRI and IVERSEN 1989, MOORE et al. 1991, REILLE 1992, BEUG 2004). Pollen of *L. palustris* is related to *Lathyrus*-type (BEUG 2004) with poorly developed suprareticulate pattern. MOORE et al. (1991) assign this species to the *Vicia cracca* type due to the transitional type of ornamentation. According to FAEGRI and IVERSEN (1989) the pollen grains have distinct reticulum and heavy costae along the colpi.

***Lathyrus transsylvanicus* (Spreng.) Rchb. f.**, (Tab. 1; Fig. 3. – 6–8). Rossia subcarpatica, in graminosis montis Černek, 19. 05. 1931, Ant. Margittai (SO 47025).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.20).

Dimensions: Medium size (PxE = 37.9 (48.3) 50.6 x 31.6 (37.4) 42.7 µm).

Apertures: Ectoapertures – colpi: long, nearly reaching the poles, straight, wider at equator, with acute ends, thick costae to the colpi, colpus membrane covered by clearly visible granules; endoapertures – pori: large, circular to very slightly lalongate, protruding in mesocolpium.

Outlines: Equatorial view – elliptic to slightly rectangular-obtuse-convex; polar view – circular.

Ornamentation: Perforate-foveolate, perforations different in size and shape, the largest in mesocolpium. Colpus area and apocolpium are almost psilate. Polar area has small scattered perforations.

Exine: In mesocolpium the thickness is 1.2 µm and 0.8 µm in apocolpium. The nexine is 1/3 from the sexine. The columellae layer is well developed as thick as the tectum and nexine. The structural elements of the columellae layer are rods.

Previous to the present pollen-morphological study no information in literature was found.

***Lathyrus venetus* (Mill.) Wohlf.**, (Tab. 1; Fig. 4. – 1–3) Znepole region, Kalista village, Kostevtzi locality, FN 50, 42°28' N, 22°52' E, 25. 05. 2002, A. Tosheva (SO 102336).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.30).

Dimensions: Medium size (Px E = 31.6 (35.9) 37.9 x 23.7 (26.6) 30.0 µm).

Apertures: Ectoapertures – colpi: short, not reaching the poles, straight, with slightly obtuse ends, shallow, broader in mesocolpium, thick costae along the margins of the colpi, colpus membrane almost psilate; endoapertures – pori: large, circular to very slightly lalongate.

Outlines: Equatorial view – elliptic to slightly rectangular-obtuse-convex; polar view – circular.

Ornamentation: Perforate-foveolate, perforations different in size and shape, the largest in intercolpium. Colpus area and apocolpium are almost psilate.

Exine: In mesocolpium the thickness is 1.2 µm and gradually decreases to 0.8 µm towards apocolpium. The nexine is well developed, almost as thick as the sexine. The columellae layer is not clearly distinguished.

Our results confirm the data provided by other authors (REILLE 1992, BEUG 2004). Pollen of *L. venetus* is related to *Lathyrus*-type (BEUG 2004).

***Lathyrus vernus* (L.) Bernh.** (Tab. 1; Fig. 4. – 4–6) Western Sredna Gora Mts., Lozenska Mts., close to a forest of *Fagus sylvatica*, GN 91, 42°36' N, 23°29' E, 02. 06. 2002, A. Tosheva (SO 102669).

Pollen class: 3-zonocolporate.

Pollen group: Subprolate (Semi-erectus) (P/E = 1.23).

Dimensions: Medium size (Px E = 36.6 (43.1) 47.4 x 30.0 (35.1) 39.5 µm).

Apertures: Ectocolpi – long, nearly reaching the poles, straight, widened in mesocolpium, with acute ends, very thick costae along the margins of the colpi, colpus membrane covered by granules; endoapertures – pori: circular to very slightly lalongate.

Outlines: Equatorial view – rectangular-obtuse-convex; polar view – circular.

Ornamentation: Perforate-foveolate, perforations different in size and shape, the largest in mesocolpium and decreasing towards apocolpium. Colpus area and apocolpium are almost psilate.

Exine: In mesocolpium the thickness is 1.2 µm and 0.75 µm in apocolpium. The nexine is slightly thinner than sexine.

Our results confirm the data provided by other authors (GAPOTCHKA 1974, CLARKE and KUPICHA 1976, REILLE 1992, HALBRITTER 2000, BEUG 2004). Pollen of *L. vernus* is related to *Lathyrus*-type (BEUG 2004) with suprareticulate ornamentation. According to CLARKE and KUPICHA (1976) the grains are prolate (P/E=1.4–1.8), colpus margins with heavy costae especially near pori, colpus membrane granular, sexine about as thick as nexine. HALBRITTER (2000) reported the presence of psilate ornamentation and circular shape in equatorial view.

The pollen morphology of the taxa studied from section *Orobus* is quite similar to the results obtained for section *Lathyrus* (TOSHEVA et al. 2003). Until now, all pollen grains studied

are 3-zonocolporate, subprolate, medium to large in size. Differences are observed in the shape in polar view as the pollen grains of section *Lathyrus* appear predominantly triangular-obtuse-convex. For section *Lathyrus* the exine ornamentation varies from tectate-perforate to supracreticulate while in section *Orobus* it is most commonly perforate-foveolate.

Apertures, wall stratification and ornamentation appear of greatest value in suggesting relationships among the tribes and species within subfamily *Papilionoideae*. (FERGUSON and SKVARLA 1981; BEUG, 2004).

Conclusions

The present investigation showed that the pollen morphology of the taxa studied from the section *Orobus* (genus *Lathyrus*) is comparatively homogenous and confirmed in broad lines the data previously reported (FAEGRI 1956, ERDTMAN 1966, GAPOTCHKA 1974, CLARKE and KUPICHA 1976, FERGUSON and SKVARLA 1981, FAEGRI and IVERSEN 1989, MOORE et al. 1991, REILLE 1995, 1998, HALBRITTER 2000, BEUG 2004) in the following respects:

1. The pollen grains are 3-zonocolporate of subprolate (semi-erectus) type (P/E = 1.20–1.30), medium to large in size. The smallest pollen grains belong to *L. niger* (Px/E = 30.0 (34.6) 36.6 x 23.7 (26.6) 28.4 µm) while the biggest – to *L. transsilvanicus* (Px/E = 37.9 (48.3) 50.6 x 31.6 (37.4) 42.7 µm). The shape in equatorial view is elliptic or rectangular-obtuse-convex (*L. vernus*). In polar view all pollen grains are circular with the exception of *L. palustris* (triangular-obtuse-convex).
2. The aperture system is composed of ectoapertures – colpi and endoapertures – pori. The colpi are straight, varying in length and width, usually with acute ends and thick costae along the colpus margins. The colpus membrane is covered by granules. The pori are large, circular to slightly lalongate or by exception lolongate (*L. palustris*).
3. The thickness of the exine is 0.70–1.80 µm. Slight differences between the species have been established, regarding the thickness and structure of the sexine and nexine, but as a whole, the sexine is as thick as the nexine.
4. The ornamentation is predominantly perforate-foveolate. However, pollen grains with reticulate (*L. aureus*) and perforate-reticulate (microreticulate) sculpture (*L. alpestris*, *L. palustris*) have also been established. Ornamentation with lumina different in size is most clearly expressed in mesocolpium while the apocolpium and the area just along the apertures is psilate or with small scattered puncta.

In general, the taxa investigated are relatively homogeneous in their pollen morphology with a certain amount of variation in respect to exine ornamentation. Within the genus *Lathyrus* a number of species tend to possess small in size lumina with thick muri. That gives the appearance of a slightly rugulate surface with small puncta. On the other hand, transitions from perforate-foveolate to nearly well defined reticulate ornamentation have also been observed.

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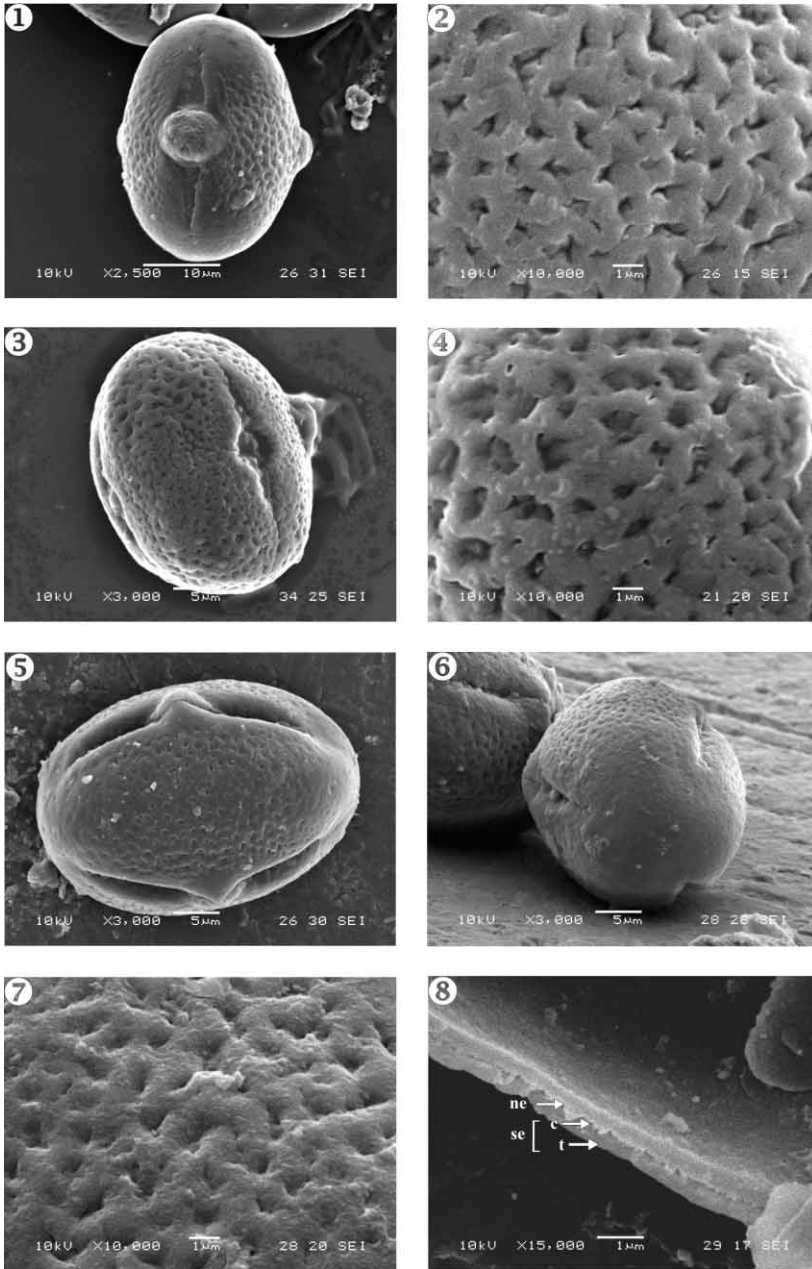


Fig. 2. Pollen grains of *Lathyrus alpestris* (1,2); *L. aureus* (3,4); *L. linifolius* (5–8) (SEM). 1. Equatorial view, outline, apertures, 2500 x, Scale bar = 10 μm. – 2. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μm. – 3. Equatorial view, outline, apertures, 3000 x, Scale bar = 5 μm. – 4. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μm. – 5. Equatorial view, outline, apertures, 3000 x, Scale bar = 5 μm. – 6. Polar view, 3000 x, Scale bar = 5 μm. – 7. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μm. – 8. Exine stratification, se – sexine (t – tectum, c – columellae layer), ne – nexine, 15000 x, Scale bar = 1 μm.

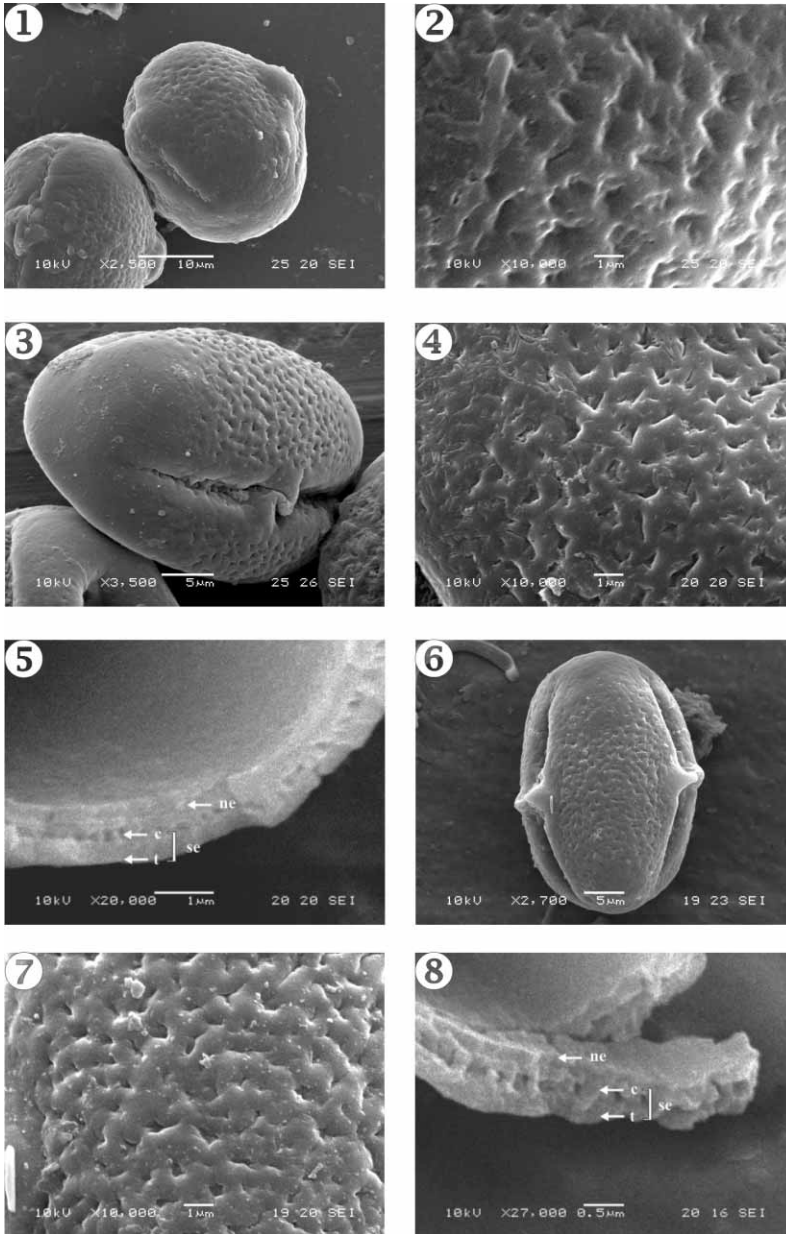


Fig. 3. Pollen grains of *Lathyrus niger* (1,2); *L. palustris* (3–5); *L. transsilvanicus* (6–8) (SEM). 1. Equatorial view, apocolpium, apertures and ornamentation, 2500 x, Scale bar = 5 μ m. – 2. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μ m. – 3. Equatorial view, outline, apertures, 3500 x, Scale bar = 5 μ m. – 4. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μ m. – 5. Exine stratification, se – sexine (t – tectum, c – columellae layer), ne – nexine, 20000 x, Scale bar = 1 μ m. – 6. Equatorial view, outline, apertures, 2700 x, Scale bar = 5 μ m. – 7. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μ m. – 8. Exine stratification, se – sexine (t – tectum, c – columellae layer), ne – nexine, 27000 x, Scale bar = 0.5 μ m.

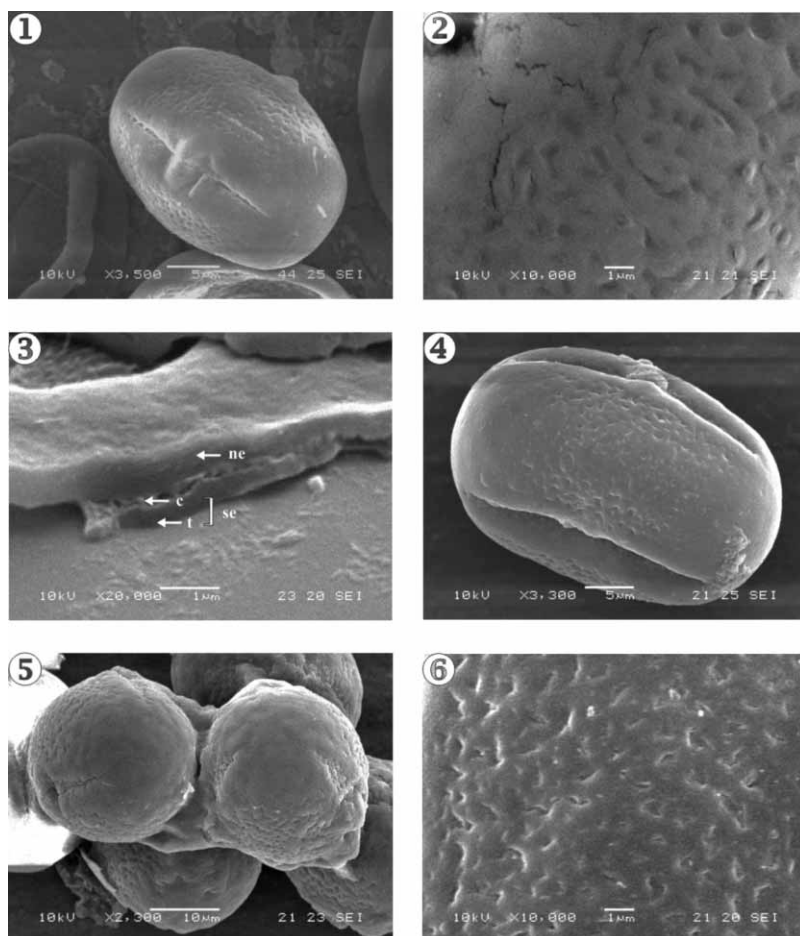


Fig. 4. Pollen grains of *Lathyrus venetus* (1–3); *L. vernus* (4–6) (SEM). 1. Equatorial view, outline, apertures, 3500 x, Scale bar = 5 μ m. – 2. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μ m. – 3. Exine stratification, se – sexine (t – tectum, c – columellae layer), ne – nexine, 20000 x, Scale bar = 1 μ m. – 4. Equatorial view, outline, apertures, 3300 x, Scale bar = 5 μ m. – 5. Polar view, 2300 x, Scale bar = 10 μ m. – 6. Ornamentation in mesocolpium, 10000 x, Scale bar = 1 μ m.

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