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POLLEN CARDS OF SOME EASTERN TAXA OF *GENISTA* L. SECT. *SPARTOCARPUS* SPACH (*CYTISEAE*, *FABACEAE*)

Abstract - Pollen cards of some eastern taxa of *Genista* L. sect. *Spartocarpus* Spach (*G. aucheri* Boiss., *G. nissana* Petrović, *G. sessilifolia* DC.) are presented. The acetolized pollen was observed by light and scanning electron microscope.

Key words - *Fabaceae*, *Genista*, pollen cards, sect. *Spartocarpus*.

Riassunto - Schede polliniche di alcune entità orientali di *Genista* L. sect. *Spartocarpus* Spach (Cytiseae, Fabaceae). Vengono presentate le schede polliniche di alcune entità orientali di *Genista* L. sect. *Spartocarpus* Spach (*G. aucheri* Boiss., *G. nissana* Petrović, *G. sessilifolia* DC.). Il polline acetolizzato è stato osservato al microscopio ottico ed elettronico a scansione.

Parole chiave - *Fabaceae*, *Genista*, schede polliniche, sect. *Spartocarpus*.

INTRODUCTION

This paper is part of a series of pollen cards about taxa belonging to *Genista*, the most heterogeneous and complex genus of the tribe *Cytiseae* (*Fabaceae*).

Two groups of pollen cards regarding *Genista* were published. *G. germanica* L. and the *G. sylvestris* group (G1 - G5) were described by Feoli Chiapella & Rizzi Longo (1983), the *G. radiata* group (G6 - G9) by Rizzi Longo *et al.* (2000a). Besides, two morphopalyngological cards [S 278 *G. radiata* (L.) Scop. and S 279 *G. holopetalala* (Koch) Bald.] were published in the Palynological Italian Flora (Rizzi Longo *et al.*, 2000b).

In the present study are presented the pollen cards of some eastern taxa of *Genista* sect. *Spartocarpus*.

Genista sessilifolia DC., *G. nissana* Petrović and *G. aucheri* Boiss. constitute a relatively morphologically homogeneous group, characterized by flowers in long, lax, many-flowered racemes and trifoliate, alternate and subopposite leaves (Gibbs, 1966; Rizzi Longo & Feoli Chiapella, 1994).

While *Genista nissana*, a central Balkan species (southern Serbia and northern Macedonia), and *G. aucheri*, an Anatolian endemic, do not present systematic problems, *G. sessilifolia* is considered differently by various authors. *G. sessilifolia* occurs in two rather separated areas, the former extending in Anatolia, the latter in southern-eastern Europe: Bulgaria, southern Romania, Macedonia and northern Greece (Gibbs, 1966; Greuter *et al.*, 1989). Two subspecies have been distinguished by Gibbs (1966): ssp. *romanica* (Prodan) P. Gibbs, which occurs only in

Dobruja region in Romania and ssp. *sessilifolia*, distributed in central-southern Balkans and in Anatolia. On the contrary, Greuter *et al.* (1989) placed only the Anatolian populations in ssp. *sessilifolia*, and referred all the European ones to ssp. *romanica*. We have thus preferred to keep separate the populations of Turkey, those European of central Balkan Peninsula (Macedonia, Bulgaria) and those of Danubian delta (Dobruja - Romania).

Cards G10 - G14 relate thus to the following taxa:

- *Genista aucheri* Boiss., Turkey;
- *G. nissana* Petrović, Serbia;
- *G. sessilifolia* DC. ssp. *sessilifolia* sensu Greuter *et al.* (1989), Turkey;
- *G. sessilifolia* DC. ssp. *romanica* (Prodan) P. Gibbs sensu Greuter *et al.* (1989), Bulgaria and Macedonia;
- *G. sessilifolia* DC. ssp. *romanica* (Prodan) P. Gibbs sensu Gibbs (1966), Romania.

MATERIALS AND METHODS

For each taxon, specimens from two distinct populations were examined. Voucher specimens are deposited in the Herbarium of the Department of Life Sciences of the University of Trieste (TSB) and in the Herbarium of the Department of Botany, Slovenian Academy of Sciences and Arts (LJU). The nomenclature follows Gibbs (1966) and Greuter *et al.* (1989).

The cards were compiled according to the procedure proposed by Della Casa Accorsi & Bertolani Marchetti (1974), subsequently modified by Accorsi & Forlani (1976) and by Accorsi *et al.* (1983). The data, concerning both qualitative and quantitative characters, were obtained by means of light microscopy (LM) with the exception of the data on the sculpture of exine which derive from scanning electron microscopy (SEM). For the pollen terminology see Erdtman (1952), Faegri *et al.* (1989), Punt *et al.* (1994).

For LM studies, pollen samples from herbarium specimens were acetolysed according to Erdtman (1960), included in glycerol 50% and observed by light microscope. Measurements were taken using a filar ocular micrometer mounted on a Zeiss Axioscop within a standard period after preparation (4 hours), in order to avoid alterations in dimensions (Rizzi Longo, 1986). Given that the means appear to stabilise after 20-25 measurements, a minimum of thirty measurements was taken per character per sample.

For SEM studies, acetolysed pollen grains were dehy-

drated in acetone, dried according to the critical point technique (Anderson, 1951), coated with gold-palladium and examined with a Philips Scanning Electron Microscope SEM 500.

LM micrographs of the glycerol-jelly preparations were taken using a Macophot ORT 25c, 25 ASA film, developed in Rodinal 1:20 for 6 minutes at 20°C. SEM micrographs were taken using an Ilford Pan F film.

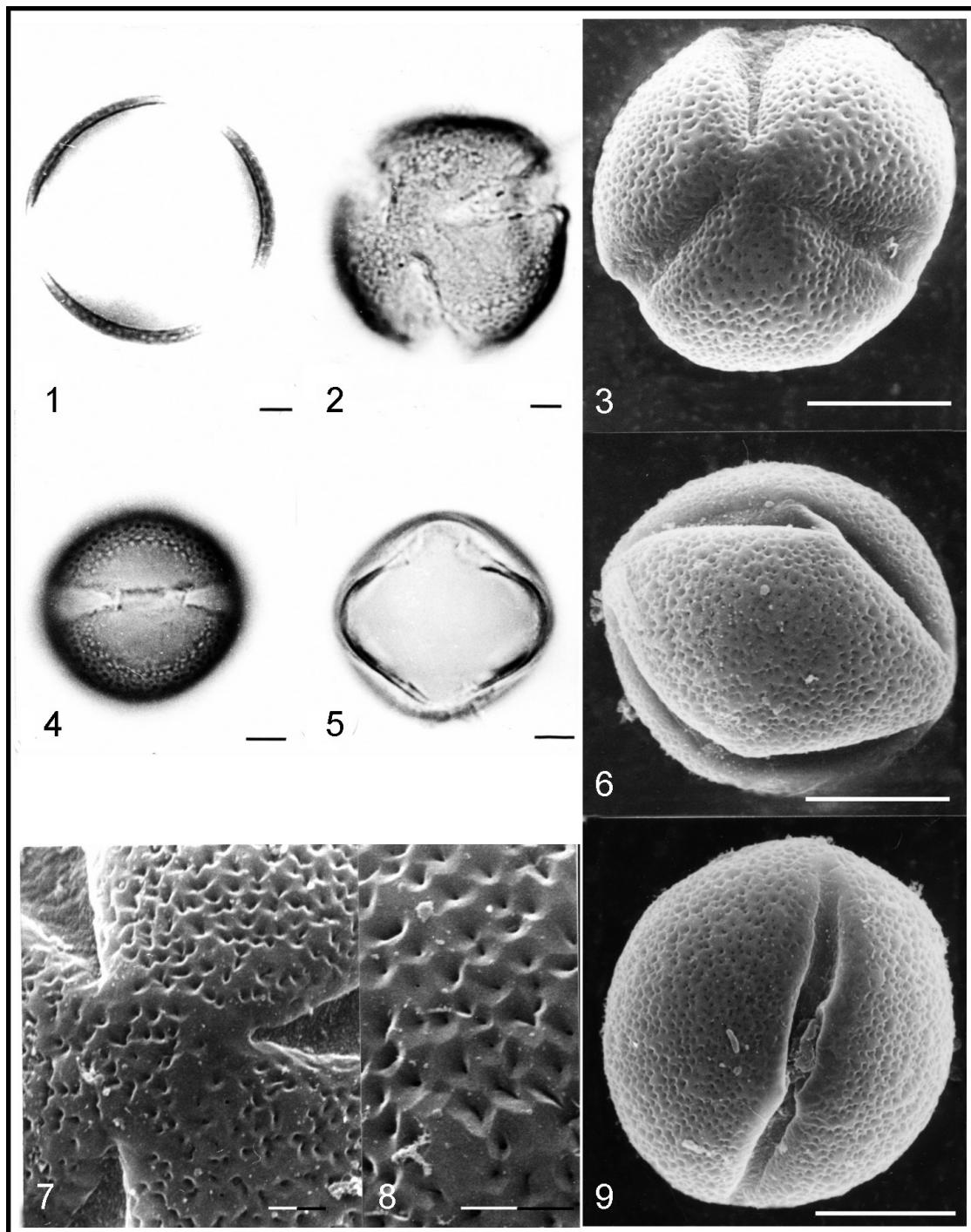
Genista aucheri Boiss.

G 10

PRINCIPAL POLLEN CHARACTERS	monads; 3 - zonocolpate (3 - zonocolporoidate) grains						
POLLEN UNIT	monads						
SYMMETRY	radially symmetric grains						
POLARITY	isopolar grains						
OUTLINE	in polar view: circular flat (40.0%), circular with intruding furrows (43.3%), subcircular with intruding furrows (10.0%), subcircular open (6.7%) in equatorial view: subcircular (76.7%), elliptical (23.3%)						
SHAPE	subprolate: prolate spheroidal: oblite spheroidal:	23.3% 61.7% 15.0%	P/E ratio	1.10 (0.91 - 1.33)	0.10	1.05 1.08	
	3 - zonocolpate: 3 - zonocolporoidate:	23.3% 76.7%	NPC 343				
APERTURES	colpi rectangular or with equatorial constrictions ; apices pointed or rounded (LM); colpus membrane nanogranulate or psilate; colpi rarely marginate (SEM)		colpus length colpus breadth mesocolpium width distance between the apices of two ectocolpi (d) apocolpium index (d/E ratio)	22.9 (16.1 - 32.0) µm 2.1 (1.7 - 3.2) µm 17.5 (12.4 - 23.2) µm 4.8 (3.2 - 6.6) µm 0.18 (0.10 - 0.27)	3.0 0.3 2.9 1.0 0.04	24.4 2.2 17.1 4.1 0.23	22.3 2.1 17.1 4.6 0.18
EXINE	tectate perforate, supramicro(nano)reticulate punctate, rarely fossulate, sometimes with unperforate areas (SEM)		exine thickness at mesocolpium (Ex) Ex/E ratio	2.1 (1.5 - 2.9) µm 0.08 (0.05 - 0.12)	0.4 0.01	2.0 0.08	2.0 0.08
SIZE	medium sized grains: small grains:	93.3% 6.7%	polar axis length (P) equatorial diameter (E)	29.1 (23.2 - 37.8) µm 26.6 (20.7 - 32.0) µm	3.0 2.7	29.3 28.3	29.1 27.2
MATERIALS AND METHODS	Examined specimens: 1) Taltaban, Szandschak Gümüşchkane (Armenia turcica, Turkey); 2) Sultandagh, supra Akscheher (Phrygia - Turkey). Technique for preparing pollen: acetolysis (Erdtmann, 1960). Analysis: pollen included in water and glycerine 1:1 (LM); dehydrated, dried and coated with gold - palladium (SEM). Examined grains: 60.						

Genista aucheri Boiss.

G 10



Figs. 1-9 - *Genista aucheri* Boiss. 1: optical cross-section in polar view; 2: low focus, subpolar view; 3: pollen grain in polar view; 4: low focus, long colpus with diffuse endoaperture in equatorial view; 5: colpi in equatorial view; 6: pollen grain in equatorial view; 7: apocolpium exine sculpture in polar view; 8: mesocolpium exine sculpture in equatorial view; 9: pollen grain in subequatorial view with a marginate colpus. Figs. 1-2, 4-5: LM; Figs. 3, 6, 7-9: SEM. Scale line: Figs. 1-2, 4-5 = 3 µm; Figs. 3, 6, 9 = 10 µm; Figs. 7-8 = 1 µm.

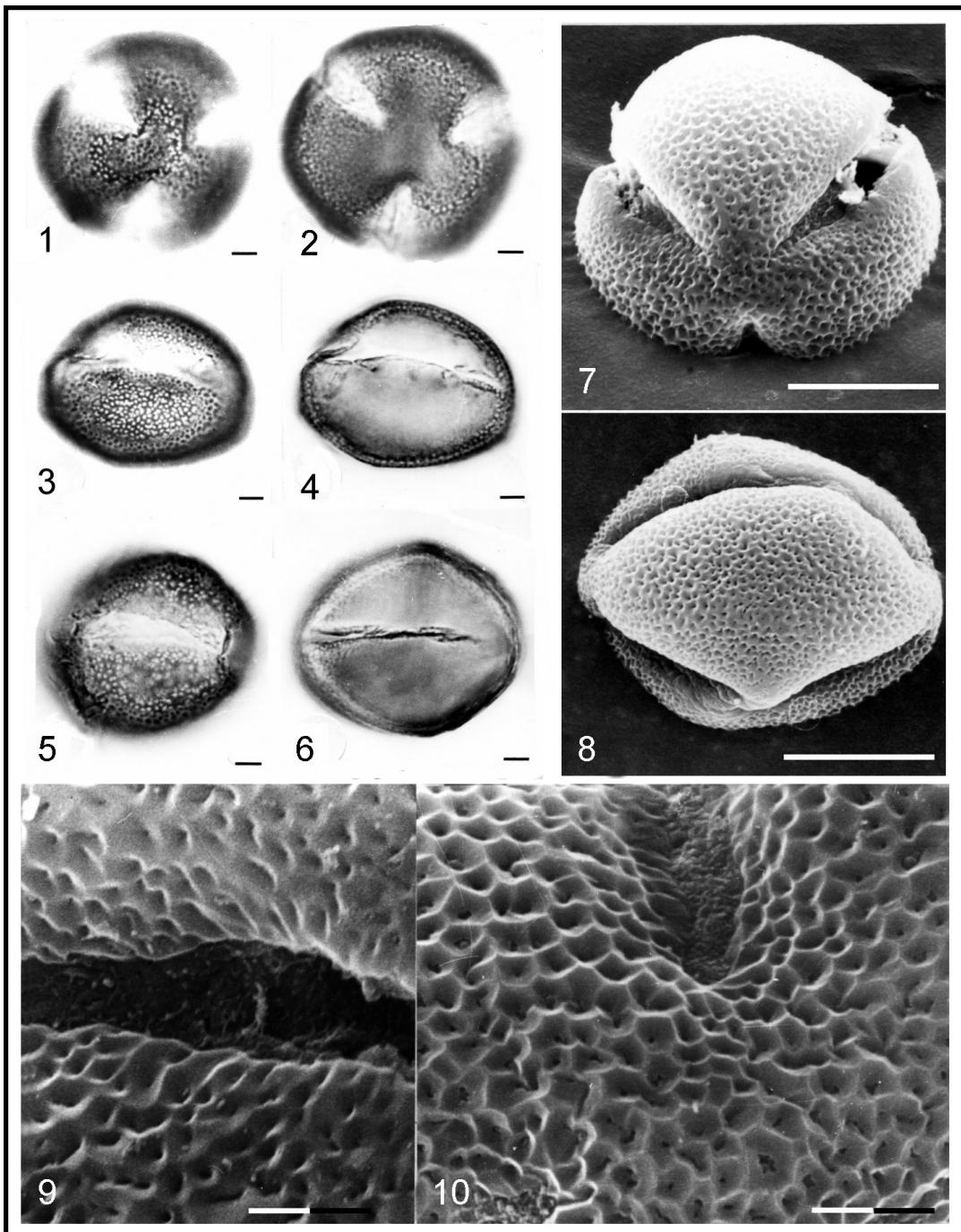
Genista nissana Petrović'

G 11

PRINCIPAL POLLEN CHARACTERS	monads; 3 - zonocolpate (3 - zonocolporoidate) grains					
POLLEN UNIT	monads					
SYMMETRY	radially symmetric grains					
POLARITY	isopolar grains					
OUTLINE	in polar view: circular with intruding furrows (50.0%), circular open (43.3%), subcircular open (6.7%) in equatorial view: subcircular (96.7%), elliptical (3.3%)					
				sd	mode	median
SHAPE	subprolate: prolate spheroidal: oblite spheroidal:	3.3% 76.7% 20.0%	P/E ratio	1.03 (0.95 - 1.29)	0.05	1.00 1.03
	3 - zonocolpate: 3 - zonocolporoidate:	66.7% 33.3%	NPC 343			
APERTURES	colpi rectangular or with equatorial constrictions, rarely elliptic acuminate; apices pointed or rounded (LM); colpus membrane nanogranulate, rarely granulate (SEM)		colpus length colpus breadth mesocolpium width distance between the apices of two ectocolpi (d) apocolpium index (d/E ratio)	26.6 (21.7 - 31.7) µm 1.69 (1.46 - 1.95) µm 19.9 (17.1 - 23.9) µm 5.2 (3.7 - 7.1) µm 0.18 (0.13 - 0.24)	1.7 0.1 1.6 0.8 0.03	26.8 1.7 21.5 4.9 0.17 26.6 1.7 18.8 5.1 0.18
EXINE	tectate perforate, supramicro(nano)reticulate punctate, rarely with unperforate areas (SEM)		exine thickness at mesocolpium (Ex) Ex/E ratio	1.7 (1.5 - 1.9) µm 0.06 (0.05 - 0.08)	0.2 0.01	1.7 0.06 1.7
SIZE	medium sized grains:	100%	polar axis length (P) equatorial diameter (E)	29.2 (25.4 - 33.9) µm 28.4 (25.1 - 31.2) µm	1.4 1.5	29.3 28.8 29.3 28.5
MATERIALS AND METHODS	Examined specimens: 1) in valle fluvii Treska (Macedonia); 2) Niš (Serbia - Yugoslavia). Technique for preparing pollen: acetolysis (Erdtmann, 1960). Analysis: pollen included in water and glycerine 1:1 (LM); dehydrated, dried and coated with gold - palladium (SEM). Examined grains: 60.					

G. nissana Petrović

G 11



Figs. 1-10 - *Genista nissana* Petrović. 1-2: pollen grain in subpolar view with exine sculpture at different focus; 3: pollen grain in subequatorial view with mesocolpium exine sculpture; 4: colpus with diffuse endoaperture in subequatorial view; 5: boat-shaped colpus in equatorial view; 6: narrow and parallel-sided colpus in equatorial view; 7: pollen grain in subpolar view; 8: pollen grain in equatorial view; 9: exine sculpture at the margin of the aperture in equatorial view; 10: apocolpium exine sculpture and nanogranulate colpus membrane. Figs. 1-6: LM; Figs. 7-10: SEM. Scale line: Figs. 1-6 = 3 µm; Figs. 7-8 = 10 µm; Figs. 9-10 = 1 µm.

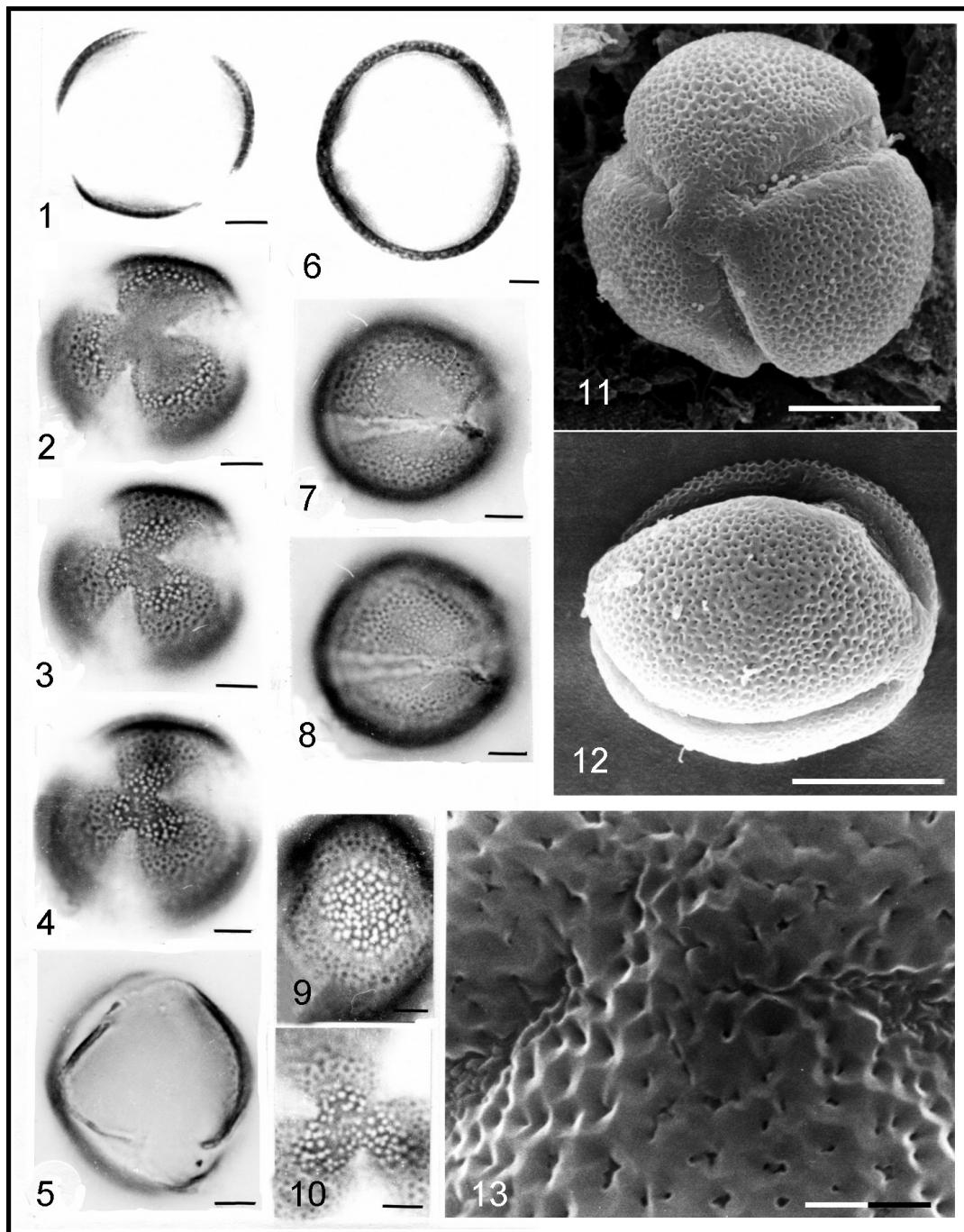
Genista sessilifolia DC. ssp. *sessilifolia* sensu Greuter *et al.* (1989)

G 12

PRINCIPAL POLLEN CHARACTERS	monads; 3 - zonocolpate (3 - zonocolporoidate) grains						
POLLEN UNIT	monads						
SYMMETRY	radially symmetric grains						
POLARITY	isopolar grains						
OUTLINE	in polar view: circular with intruding furrows (91.0%), subcircular open (9.0%) in equatorial view: subcircular (40.0%), elliptical (60.0%)						
				sd	mode	median	
SHAPE	subprolate: prolate: prolate spheroidal: oblade spheroidal:	51.7% 8.3% 31.7% 8.3%	P/E ratio	1.17 (0.89 - 1.68)	0.14	1.07	1.17
	3 - zonocolpate: 3 - zonocolporoidate:	53.3% 46.7%	NPC 343				
APERTURES	colpi rectangular, sometimes with equatorial constrictions; apices rounded sometimes pointed (LM); colpus membrane nanogranulate, sometimes granulate; colpi rarely marginate (SEM)		colpus length colpus breadth mesocolpium width distance between the apices of two ectocolpi (d) apocolpium index (d/E ratio)	25.2 (20.5 - 29.8) µm 1.9 (1.7 - 2.4) µm 15.0 (9.8 - 21.0) µm 4.9 (3.9 - 6.1) µm 0.21 (0.14 - 0.30)	2.4 0.1 2.0 0.6 0.04	23.4 2.0 14.6 4.4 0.18	25.1 2.0 14.9 4.9 0.20
EXINE	tectate perforate, supramicro(nano)reticulate punctate, rarely fossulate, rarely with unperforate areas (SEM)		exine thickness at mesocolpium (Ex) Ex/E ratio	1.8 (1.7 - 2.0) µm 0.08 (0.06 - 0.09)	0.1 0.01	1.7 0.08	1.7 0.08
SIZE	medium sized grains: 88.3% small grains: 11.7%		polar axis length (P) equatorial diameter (E)	27.9 (22.7 - 32.9) µm 24.0 (18.5 - 28.8) µm	2.4 2.3	30.5 24.4	27.6 24.1
MATERIALS AND METHODS	Examined specimens: 1) Zile, Amasya (E-Anatolia, Turkey); 2) Kanvak - Tschesme, Kastambuli (Paphlagonia, Turkey). Technique for preparing pollen: acetolysis (Erdtmann, 1960). Analysis: pollen included in water and glycerine 1:1 (LM); dehydrated, dried and coated with gold - palladium (SEM). Examined grains: 60.						

G. sessilifolia DC. ssp. *sessilifolia* sensu Greuter *et al.* (1989)

G 12



Figs. 1-13 - *Genista sessilifolia* DC. ssp. *sessilifolia* sensu Greuter *et al.* (1989). 1: optical cross-section in polar view; 2-4: exine sculpture at different focus in subpolar view; 5: colpi in subequatorial view; 6: optical cross-section in equatorial view; 7-8: low focus, constriction to the colpus in subequatorial view; 9: detail of the mesocolpium exine sculpture in equatorial view; 10: apocolpium exine sculpture in polar view; 11: pollen grain in subpolar view; 12: pollen grain in subequatorial view; 13: apocolpium exine sculpture. Figs. 1-10: LM; Figs. 11-13: SEM. Scale line: Figs. 1-10 = 3 µm; Figs. 11-12 = 10 µm; Fig. 13 = 1 µm.

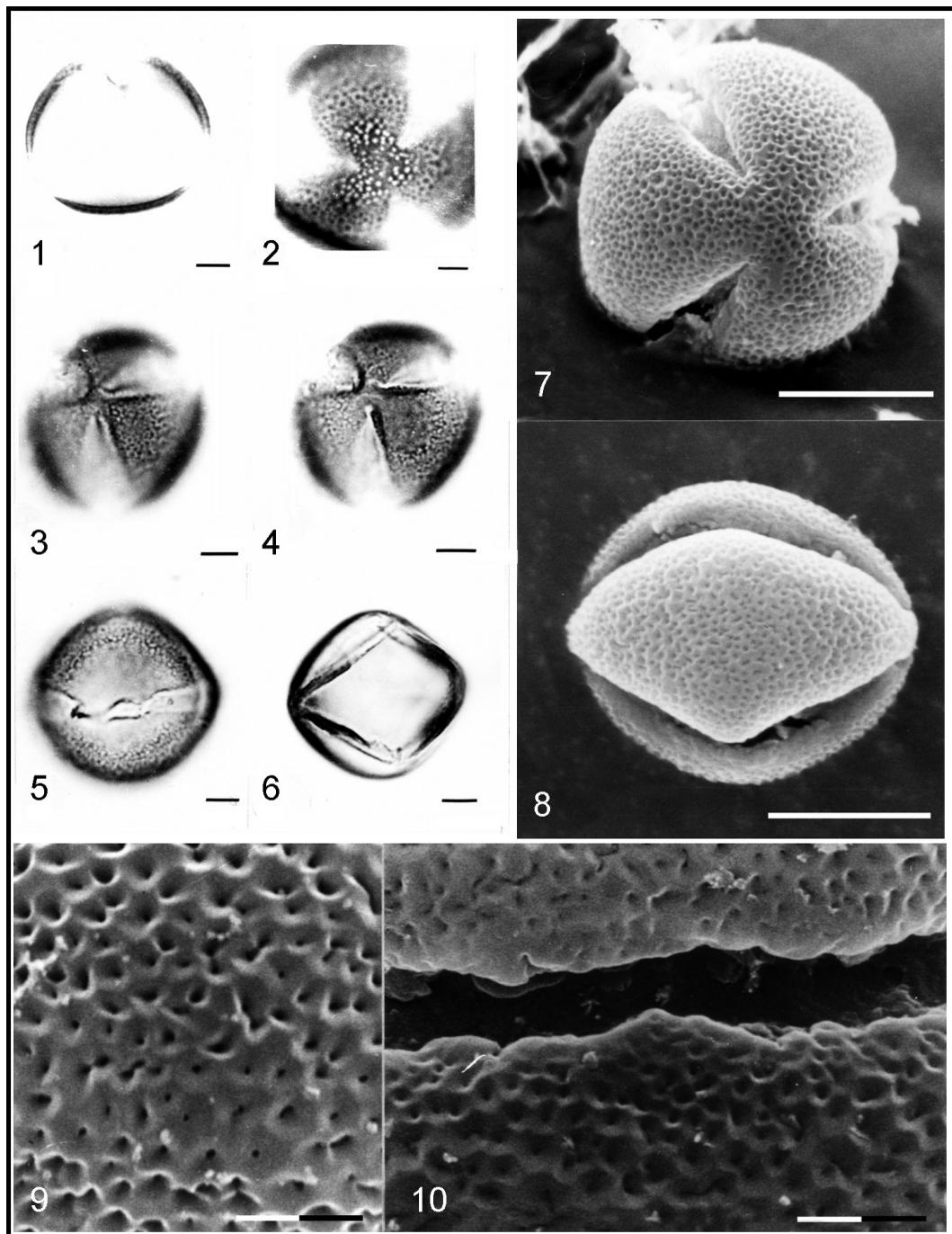
Genista sessilifolia DC. ssp. *romonica* (Prodan) P.Gibbs sensu Greuter *et al.* (1989)

G 13

PRINCIPAL POLLEN CHARACTERS	monads; 3 - zonocolpate (3 - zonocolporoidate) grains					
POLLEN UNIT	monads					
SYMMETRY	radially symmetric grains					
POLARITY	isopolar grains					
OUTLINE	in polar view: circular with intruding furrows (86.7%), subtriangular open (13.3%) in equatorial view: subcircular (86.7%), elliptical (13.3%)					
				sd	mode	median
SHAPE	subprolate: prolate spheroidal: oblite spheroidal:	13.3% 68.3% 18.4%	P/E ratio	1.07 (0.94 - 1.31)	0.08	1.10 1.07
	3 - zonocolpate: 3 - zonocolporoidate:	50.0% 50.0%	NPC 343			
APERTURES	colpi rectangular or with equatorial constrictions; apices pointed sometimes rounded (LM); colpus membrane nanogranulate, sometimes psilate, rarely nanoverrucate (SEM)		colpus length colpus breadth mesocolpium width distance between the apices of two ectocolpi (d) apocolpium index (d/E ratio)	26.3 (20.7 - 33.4) µm 1.8 (1.5 - 2.0) µm 18.5 (11.2 - 25.6) µm 5.3 (3.7 - 7.8) µm 0.20 (0.12 - 0.35)	3.6 0.1 3.3 0.9 0.06	23.9 1.7 19.0 4.9 0.25 25.9 1.7 18.2 5.1 0.19
EXINE	tectate perforate, supramicro(nano)reticulate punctate, rarely fossulate, rarely with unperforate areas (SEM)		exine thickness at mesocolpium (Ex) Ex/E ratio	1.8 (1.5 - 2.0) µm 0.07 (0.05 - 0.09)	0.1 0.01	1.7 0.07 1.7
SIZE	medium sized grains: small grains:	88.3% 11.7%	polar axis length (P) equatorial diameter (E)	28.9 (23.2 - 35.9) µm 27.3 (19.0 - 33.9) µm	3.5 3.9	26.1 24.4 28.4
MATERIALS AND METHODS	Examined specimens: 1) M. Cepan, Krašter (Sofia, Bulgaria); 2) inter Gradsko et Titov Veles in valle fluvii Vardar (Macedonia). Technique for preparing pollen: acetolysis (Erdtmann, 1960). Analysis: pollen included in water and glycerine 1:1 (LM); dehydrated, dried and coated with gold - palladium (SEM). Examined grains: 60.					

G. sessilifolia DC. ssp. *romanica* (Prodan) P. Gibbs sensu Greuter *et al.* (1989)

G 13



Figs. 1-10 - *Genista sessilifolia* DC. ssp. *romanica* (Prodan) P. Gibbs sensu Greuter *et al.* (1989). 1: optical cross-section in subpolar view; 2: apocolpium exine sculpture in subpolar view; 3-4: low focus, subcircular-open pollen grain in subpolar view; 5: wide colpus in subequatorial view; 6: colpi in subequatorial view; 7: pollen grain in subpolar view; 8: pollen grain in equatorial view; 9: mesocolpium exine sculpture; 10: exine sculpture at the margin of the aperture in equatorial view. Figs. 1-6: LM; Figs. 7-10: SEM. Scale line: Figs. 1-6 = 3 µm; Figs. 7-8 = 10 µm; Figs. 9-10 = 1 µm.

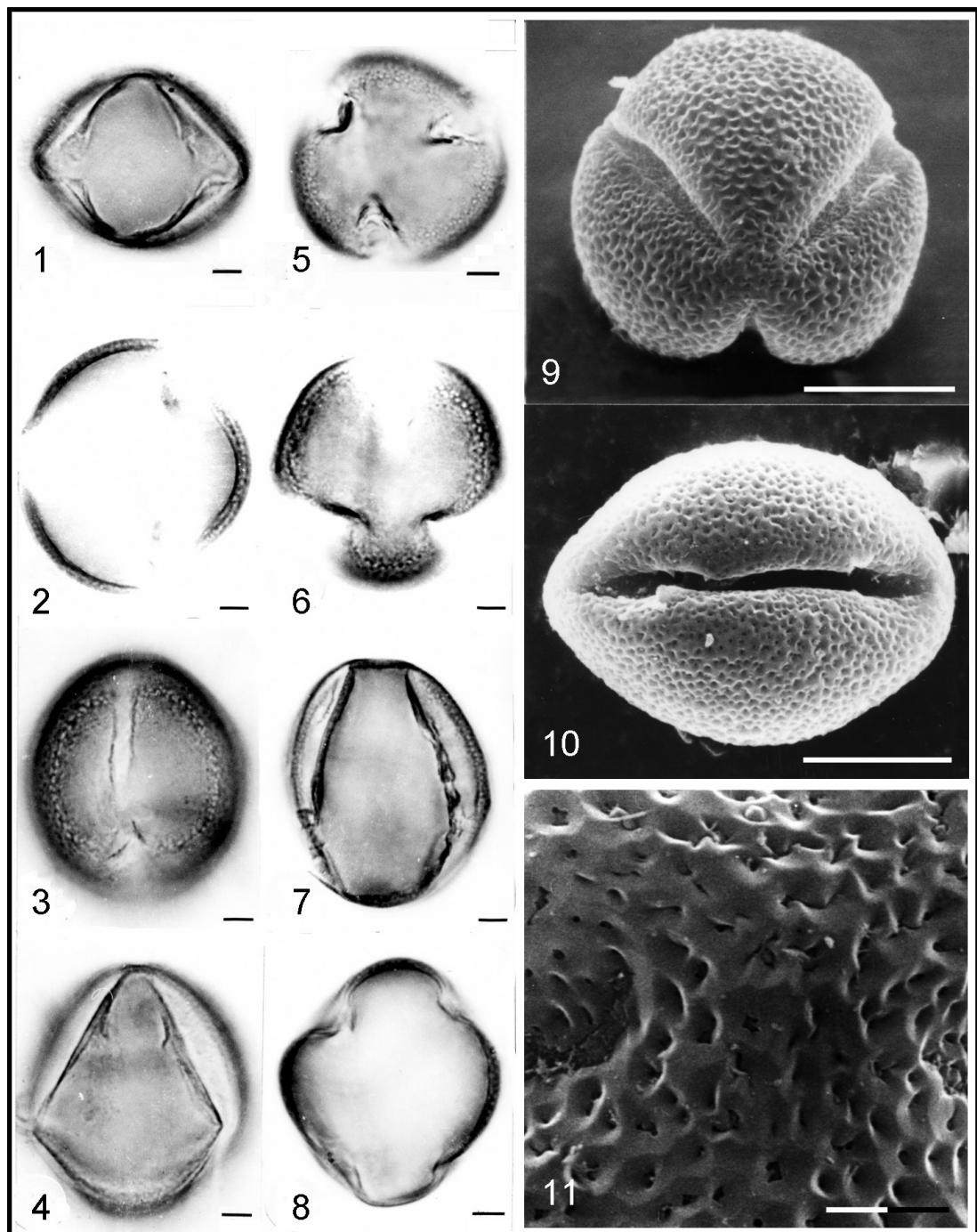
Genista sessilifolia DC. ssp. *romonica* (Prodan) P.Gibbs sensu Gibbs (1966)

G 14

PRINCIPAL POLLEN CHARACTERS	monads; 3 - zonocolpate (3 - zonocolporoidate) grains						
POLLEN UNIT	monads						
SYMMETRY	radially symmetric grains						
POLARITY	isopolar grains						
OUTLINE	in polar view: circular with intruding furrows (76.7%), subcircular with intruding furrows (23.3%) in equatorial view: subcircular (70.0%), elliptical (30.0%)						
				sd	mode	median	
SHAPE	subprolate: prolate spheroidal: oblance spheroidal:	30.0% 56.7% 13.3%	P/E ratio	1.10 (0.90 - 1.30)	0.10	nd	1.08
	3 - zonocolpate: 3 - zonocolporoidate:	60.0% 40.0%	NPC 343				
APERTURES	colpi rectangular, sometimes with equatorial constrictions; apices pointed sometimes rounded (LM); colpus membrane nanogranulate, sometimes nanoverrucate, rarely psilate (SEM)		colpus length colpus breadth mesocolpium width distance between the apices of two ectocolpi (d) apocolpium index (d/E ratio)	27.8 (22.7 - 35.9) µm 1.7 (1.5 - 2.0) µm 18.9 (13.9 - 24.4) µm 6.0 (3.9 - 8.8) µm 0.22 (0.13 - 0.32)	3.3 0.1 2.6 1.1 0.05	24.6 1.7 21.5 6.8 0.26	27.3 1.7 18.7 6.1 0.22
EXINE	tectate perforate, supramicro(nano)reticulate punctate, rarely fossulate, rarely with unperforate areas (SEM)		exine thickness at mesocolpium (Ex) Ex/E ratio	1.8 (1.5 - 2.0) µm 0.07 (0.05 - 0.08)	0.1 0.01	1.7 0.06	1.7 0.07
SIZE	medium sized grains: small grains:	98.3% 1.7%	polar axis length (P) equatorial diameter (E)	30.6 (24.4 - 38.3) µm 27.9 (23.2 - 33.7) µm	3.4 3.0	27.3 26.1	29.9 27.2
MATERIALS AND METHODS	Examined specimens: 1) Hagieni, Costanta (Dobrogea, Romania); 2) Cavarna, Balcic (Dobrogea, Romania). Technique for preparing pollen: acetolysis (Erdtmann, 1960). Analysis: pollen included in water and glycerine 1:1 (LM); dehydrated, dried and coated with gold - palladium (SEM). Examined grains: 60.						

G. sessilifolia DC. ssp. *romanica* (Prodan) P. Gibbs sensu Gibbs (1966)

G 14



Figs. 1-11 - *Genista sessilifolia* DC. ssp. *romanica* (Prodan) P. Gibbs sensu Gibbs (1966). 1: oblate spheroidal pollen grain in equatorial view with broadly extruding colpi; 2: optical cross-section in subpolar view; 3: low focus, constriction to the colpus in equatorial view; 5: pollen grain in subpolar view; 6: pollen grain in subpolar view; 4-7-8: different aspect of colpi in subequatorial view; 9: pollen grain in subpolar view; 10: pollen grain in equatorial view; 11: apocolpium exine sculpture. Figs. 1-8: LM; Figs. 9-11: SEM. Scale line: Figs. 1-8 = 3 µm; Figs. 9-10 = 10 µm; Fig. 11 = 1 µm.

DISCUSSION

Genista aucheri, *G. nissana* and *G. sessilifolia* display grains that are single, isopolar, radially symmetric, 3-zonocolpate or 3-zonocolporoidate (3-zonocolporate with a diffuse endoaperture, Moore *et al.*, 1991), medium-small sized, spheroidal or subprolate (rarely prolate), with perforate tectum and supramicro(nano) reticulate punctate exine.

Some differences in pollen characters have been found among the *taxa* examined.

Pollen grains are all medium-sized in *Genista nissana*, medium-small sized in *G. sessilifolia* of Turkey and central Balkan Peninsula (Bulgaria and Macedonia). *G. aucheri* and *G. sessilifolia* of Romania show a very low percentage of small-sized grains. The Turkish populations of *G. sessilifolia* display the lowest values in most quantitative characters, while the Rumenian ones show the highest.

Pollen grains of examined *taxa* appear mostly prolate spheroidal, except Turkish populations of *Genista sessilifolia*, which are mostly subprolate. Among the European populations of *G. sessilifolia*, those from Bulgaria and Macedonia show a higher percentage of oblate spheroidal grains, those from Romania a higher percentage of subprolate grains.

The outline in polar view is generally circular for all examined *taxa*. The outline in equatorial view is prevalently subcircular in *Genista nissana*, *G. aucheri* and in the European populations of *G. sessilifolia*; only in the Turkish ones it is mainly elliptical.

At the SEM, the exine of all *taxa* examined shows a very low percentage of unperforate areas (higher in *Genista aucheri*) and sometimes of fossulae (which lack only in *G. nissana*). *G. aucheri* and *G. sessilifolia* of Turkey display a trend of reduction of the exine reticulum at the margin of the apertures (*margo*). In all *taxa* the colpus membrane appears nanogranulate, in *G. aucheri* and in the European populations of *G. sessilifolia* sometimes it is nanoverrucate and psilate. The populations of *Genista sessilifolia* result thus rather different: the Turkish ones present the smallest pollen size, those of Romania the largest; the outline in equatorial view is mainly elliptical in the Turkish populations, mainly subcircular in all the European ones; only those of Romania show also a significant percentage of elliptic grains and marginate colpi.

Palynological evidence appears congruent with the arrangement proposed by Greuter *et al.* (1989), which distinguished two subspecies in *Genista sessilifolia*: ssp. *sessilifolia*, an Anatolian endemic, and ssp. *romonica*, SE-European. However, the pollen differences between the Rumenian populations and the Bulgarian and Macedonian ones, together with the distinctive morphologi-

cal characters and the markedly different habitat (flat open marshlands instead of mountain terrain), suggest further studies to consider the appropriateness of revaluing the taxon endemic to Dobruja [corresponding to ssp. *romonica* (Prodan) P. Gibbs sensu Gibbs, acknowledged also by Fukarek (1964), sub *Cytisanthus trifoliatus* ssp. *romanicus* (Prodan) Fukarek].

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