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THE SPORE MORPHOLOGY OF HEPATICAE SPECIES

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Abstract

This paper provides further details to the characterization of the spores of *Hepaticae* species distributed in Hungary. The main spore morphological data of the 29 species are based on light microscopic investigations. These features are: spore-forms, middle size, size range, thickness of spore-walls, ornamentation. Samples are derived from herbarial materials fixed with glycerin. The examined spores are documented with light microscopic photos.

Key words: palinology, *Hepaticae*, LM morphology.

Introduction

The exact description of spore-forms is necessary to characterize moss species (e.g. BISCHLER, 1982; MCQUEEN, 1985; JOVET-AST, 1986) and at the same time taxonomic and systematic conclusions can be drawn from the morphological characterization (SORSA-KOPONEN, 1973; JÁRAI-KOMLÓDI, 1974; JÁRAI-KOMLÓDI and ORBÁN, 1975).

The characterization of spore is very important because there are some genera in which species can be surely determined only on the basis of the spore structure (*Fossombronia, Sphaerocarpos, Riccia*), the handbooks of mosses features of spores are described in (MÜLLER, 1957; LANDWEHR, 1980; ORBÁN and VAJDA, 1983).

The dispersal of the species is influenced by spore sizes. Spores give different reproductive chances to their own species by means of their different sizes and spreading efforts. According to theoretical calculations the spores of 20 μm are transported in a cycle with 1000 km long axis, spores of 50 μm can be carried only to a distance of 40 km and the spores of *Archidium* with 250 μm gets to only 1 km (ZANTEN, 1977; MOGENSEN, 1981).

The examination of the recent Hungarian moss spores consists of mainly the work of JÁRAI-KOMLÓDI (JÁRAI-KOMLÓDI, 1974; JÁRAI-KOMLÓDI and ORBÁN, 1975; BOROS and JÁRAI-KOMLÓDI 1975). In order to describe spores exactly she uses the terminology of ERDTMAN in her works. During my examinations I choose species which are not found in her descriptions.

Material and methods

The examined spores of *Hepaticae* are from some materials of herbaria. Botanical Department of the Hungarian Natural History Museum (TTM). In order to collect spores I went through the herbarium of the Botanical Department in the Teachers' College of Eger (EGR). The species were collected by Á. BOROS and L. VAJDA and were determined mainly by L. VAJDA. The collection includes the whole flora of the Carpathian Basin.

Fixing and photography:

I used two kinds of methods in fixing: fixing with glycerin and the more simple Hoyer solution which is used by the bryologists many times. Sometime this method seemed to be more usable because thinner preparatum could be made and here by it was better for the examination with immersion lens. (It is disadvantage that the spore is getting lighter after a time.) The gelatin with glycerin is made of 38 ml distilled water, 10 g gelatin and 48 ml glycerin (KEDVES, 1986). To make Hoyer solution 50 ml distilled water, 30 g rubber arabicum, 200 g cloralhidrate and 20 ml glycerin is needed (ORBÁN and VAJDA, 1983). The microphotographs were taken with Zeiss automatic photoapparat and mainly with HI 100/1.25 and 40/0.65 objectives.

Results

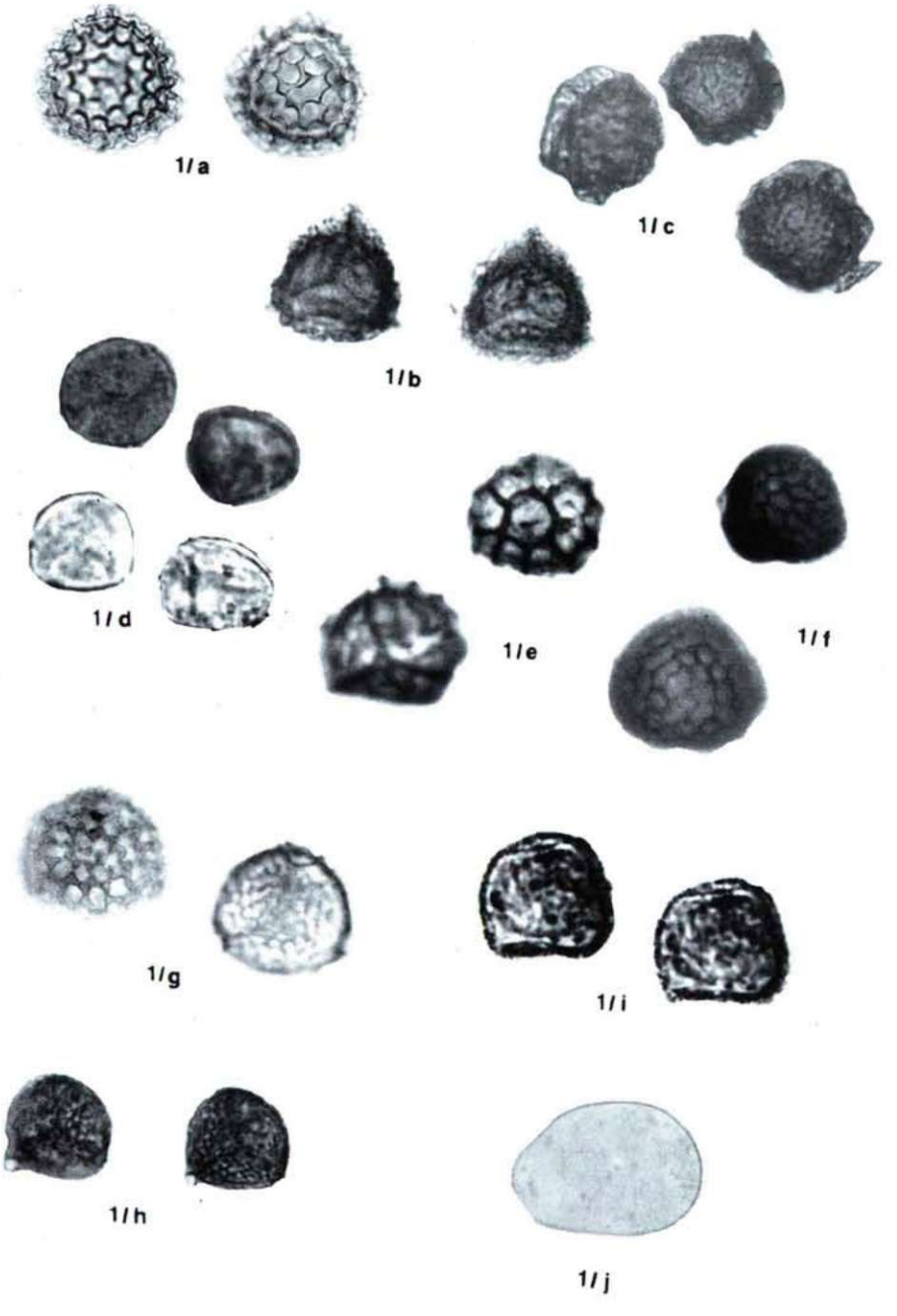
The examined moss spores are characterized on the basis of the following features: form, mean value, size range, spore wall thickness, ornamentation. These data may serve as an inquiry basis for the other fields of biology (e.g. evolution, taxonomy, ecology).

From among the spores of varied shapes of *Hepaticae* three types occurred in the examined material: globose, subtriangular, elliptic. The spores of *Riccia* species (3-3.5 μm) and *Frullania dilatata* (6-8 μm) are conspicuous with their thick walls (these types are subtriangular and they have big size, too).

The thinnest exosporium can be found in the spores of *Marchantia polymorpha* (0.8 μm). The only elliptic form is the spore of *Pellia endivifolia* and this is the biggest spore at the same time (80x65 μm) from among the examined ones.

Ornamentation can be seen well on the light microscopy photos mainly at the spores of big sizes so it is easier to characterize them. One of the most interesting phenomena is the tooth-like bacula of *Frullania dilatata* (see fig 3/I).

Fig. 1. a. *Mannia fragrans* (BALBIS) FRYE et CLARK (x250), b. *Asterella saccata* (WAHLENB) EVANS (x250), c. *Athalamia hyalina* (SOMM.) HATT (x250), d. *Marchantia polymorpha* L. BURGEFF (x1000), e. *Riccia duplex* Lorbeer in K. MÜLL. (x250), f. *Riccia sorocarpa* BISCH. (x250), g. *Riccia bifurca* HOFFM. (x250), h. *Riccia glauca* L. (x250), i. *Riccardia latifrons* (LINDB.) LINDB. (x1000), j. *Pellia endivifolia* (DICKS.) DUM. (x250).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Discussion and conclusions

The examined spores can be divided into three main types:

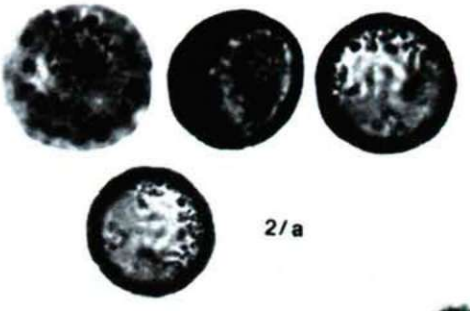
The firs one includes the subtriangular well separated spores which are typical of *Ricciaceae* and *Aytoniaceae* families in the size range of 45 μm and 75 μm with 3.5 μm thick spore-walls and ornamentation which can be hardly described (e.g. *Mannia fragrans, Asterella saccata, Riccia duplex, R. glauca, R. sorocarpa, R. bifurca*).

The second type contains families with globose-like, small (max. 20 μm) spores with thin walls (max. 2 μm). Their ornamentation are sometimes difficult to describe but it is mainly pilate and clavate-like (e.g. *Riccardia latifrons, Lophozia collaris, L. excisa, Jungermannia hyalia, Marsupella emarginata, M. hungarica, Plagiochila porelloides, Lophocoela cuspidata, Chiloscyphus pallescens, Cephaloziella integerrima, C. divaricata, C. stellulifera, C. rubella var. sullivanti, C. hampeana, Lepidozia reptans, Calypogeia suecica, C. trichomanis, C. integristipula, Blepharostoma trichophyllum*).

The third type consists of e.g. *Frullania dilatata* which has got a very interesting spore morphology. It is subtriangular, is 40x51 μm with particularly thick wall (6-8 μm) and its ornamentation is tooth-like bacula which is unique among the examined specimens.

The larger spores with globose type of *Athalamia hyalina* which has got a different morphology from the other and the also big and elliptic shaped spores of *Pellia endivifolia* with surprisingly thin spore walls can not be ranged among any main types either.

Fig. 2. a. *Lophozia collaris* (NEES.) DUM. (x1000), b. *Lophozia excisa* (DICKS.) DUM. (x1000), c. *Jungermannia hyalina* LYELL in HOOK (x1000), d. *Marsupella emarginata* (EHR.) DUM. (x1000), e. *Marsupella hungarica* BOROS et VAJDA (x1000), f. *Plagiochila porelloides* (TORREY et NEES) LINDENB. (x1000), g. *Lophocolea cuspidata* (NEES) LIMPR. (x1000).



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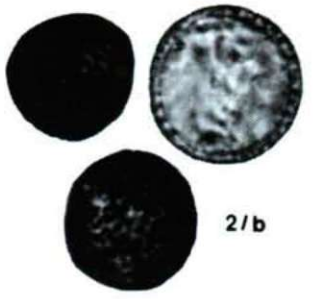

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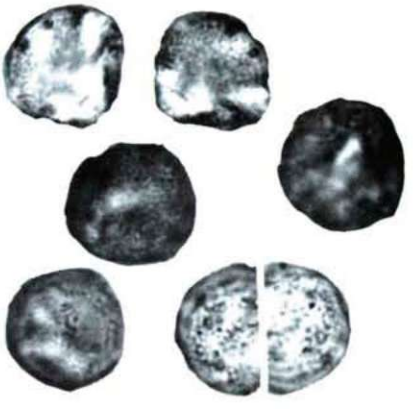

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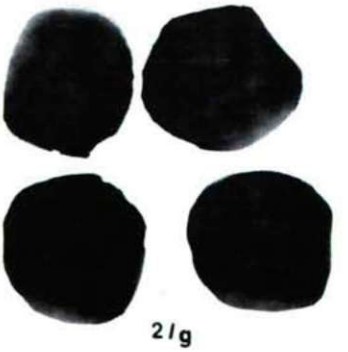

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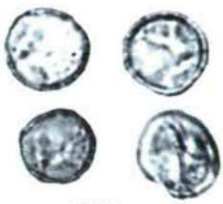

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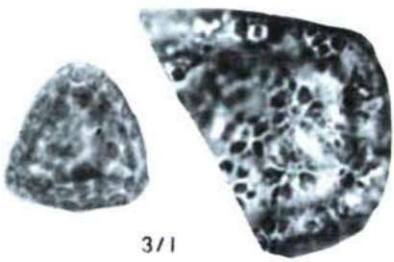

3/l

⇦ Fig. 3. a. *Chiloscyphus pallescens* (Ehrh. ex Hoffm.) Dum. (x1000), b. *Cephaloziella integerrima* (Lindb.) Warnst. (x1000), c. *Cephaloziella divaricata* (Sm.) Schiffn. (x1000), d. *Cephaloziella stellulifera* (Tayl.) Schiffn (x1000), e. *Cephaloziella raddiana* (Massal) Schiffn. (x1000), f. *Cephaloziella hampeana* (Nees) Schiffn. (x1000), g. *Lepidozia reptans* (L.) Dum. (x1000), h. *Calypogeia suecica* (Arn. et Pers) K. Müll. (x1000), i. *Calypogeia trichomanis* (L.) K. Müll. (x1000), j. *Calypogeia integristipula* Steph. (x1000), k. *Blepharostoma trichophyllum* (L.) Dum. (x1000), l. *Frullania dilatata* (L.) Dum. (x250 & x1000).

Table 1. Spore morphological data of Hepaticae

Species	Form	Mean value µm	Size range µm	Spore wall thickness in µm	Ornamentation p: proximal d: distal surface	Fig.
Mannia fragrans (BALBIS) FRYE et CLARK						
Szársomlyó, VAJDA						
1965/III/25.			46-52		p=spinulate	
EGR	subtriangular	52x44	38.5-47	2	d=spinulate	1/a
n=10						
Asterella saccata (WAHLENB) EVANS						
Szársomlyó, VAJDA						
1965/III/25.			52-66		p=pilate	
EGR	subtriangular	55x45	42-47	2	d=pilate	1/b
n=10						
Athalamia hyalina (SOMM.) HATT						
Bucses, VAJDA						
1964/VII/23.						
EGR	globose	59	52-67	1-1.5	rugulate	1/c
n=10						
Marchantia polymorpha L. BURGEFF						
Retyezát, VAJDA						
1968/VII/12.					p=verrucate	
EGR	subtriangular	13.5	11-16	0.8 (0.5)	d=verrucate	1/d
n=10						
Riccia duplex LORBEER IN K. MÜLL.						
Vésztő, VAJDA						
1954/IX/4.			47-70		p=pilate	
EGR	subtriangular	60x55	52-58	3-3.5	d= reticulate	1/e
n=5						
Riccia sorocarpa BISCH.						
Oltárkő, VAJDA						
1957/XI/2			68-80	p=pilate		
EGR	subtriangular	75x60	55-68	3-4	d=reticulate	1/f
n=10						
Riccia bifurca HOFFM.						
Timár, BOROS						
1948/VII/1.			46-53		p=rugulate	
EGR	subtriangular	51x46	44-49	3-3.5	d=reticulate	1/g
n=10						

Table 1. (continued)

Species	Form	Mean value µm	Size range µm	Spore wall thickness in µm	Ornamentation p: proximal d: distal surface	Fig.
Riccia glauca L. Ördögrét, BOROS 1957/XI/4. EGR n=10	subtriangular	71x65	60-75 56-68	3-3.5	p=baculate d=reticulate	1/h
Riccardia latifrons (LINDB.) LINDB. Bélai havasok, VAJDA 1978/VIII. TTM n=10	globose	18	15-20	2	clavate	1/i
Pellia endivifolia (DICKS.) DUM. Mocsárbükk, BOROS 1961/IV/9. EGR n=5	elliptic	80x65	70-100 40-70	1.5-2	verrucate	1/j
Lophozia collaris (NEES.) DUM. Garadna-völgy, VAJDA 1959/VII/28. EGR n=10	globose	20.4	18.2-22.2	1	clavate	2/a
Lophozia excisa (DICKS.) DUM. Nagymező, VAJDA 1957/VIII/27. EGR n=10	globose	23	22.2-24.6	1-1.5	pilate	2/b
Jungermannia hyalina LYELL in HOOK Kab-hegy, BOROS 1968/IV/15. EGR n=10	globose	17	15-19.6	0.8-1	pilate	2/c
Marsupella emarginata (EHR.) DUM. Chopok, SWEYKOWSKI 1956/VIII/28. TTM n=10	globose	12	11-13.8	1.2-1.5	pilate	2/d
Marsupella hungarica BOROS et VAJDA Nagyvasfazék-völgy, VAJDA 1960/VI/2. TTM n=10	globose	11	10-12.8	0.8-1	pilate	2/e
Plagiochila porelloides (TORREY et NEES) LINDENB. Eperjes, VAJDA 1951/IV/15. TTM n=10	globose	17.8	15-20	1.2-1.5	pilate	2/f

Table 1. (continued)

Species	Form	Mean value µm	Size range µm	Spore wall thickness in µm	Ornamentation p: proximal d: distal surface	Fig.
Lophocolea cuspidata (NEES) LIMPR. Bányai-völgy, VAJDA 1952/VII/24. EGR n=10	globose	20.4	17-25	1.5-2	pilate	2/g
Chiloscyphus pallescens (EHRH. ex HOFFM.) DUM. Magosfa, VAJDA 1958/V/2. EGR n=10	globose	15.2	11-18	0.8-1	pilate	3/a
Cephaloziella integerrima (LINDB.) WARNST. Ense et Loir, CH. DONIM 1910/I. TTM n=10	globose	7.2	6-9.6	0.8-1	pilate	3/b
Cephaloziella divaricata (SM.) SCHIFFN. Greinberg, LOESKE 1871/VIII/25. TTM n=10	globose	7	6.2-8.2	0.8-1	pilate	3/c
Cephaloziella stellulifera (TAYL.) SCHIFFN Ördögorom, VAJDA 1951/XII/2. EGR n=10	globose	8.8	7-10	0.8-1	pilate	3/d
Cephaloziella raddiana (MASSAL) SCHIFFN Leány-völgy, VAJDA 1959/VIII/5. EGR n=10	globose	7	6-8	0.8-1	pilate	3/e
Cephaloziella hampeana (NEES) SCHIFFN. Hollóháza, VAJDA 1954/VI/30. TTM n=10	globose	10	9-11.8	0.8-1	pilate	3/f
Lepidozia reptans (L.) DUM. Balázstanya, DEGEN 1911/VII/28. TTM n=10	globose	16.4	15-18	0.8-1.2	clavate	3/g
Calypogeia suecica (ARN. et PERS) K. MÜLL. Szeben, VAJDA 1968/VII/5. TTM n=10	globose	10.2	9.4-11.8	0.8-1	pilate	3/h

Table 1. (continued)

Species	Form	Mean value µm	Size range µm	Spore wall thickness in µm	Ornamentation p: proximal d: distal surface	Fig.
Calypogeia trichomanis (L.) K. MÜLL. 9923/H SCHIFFNER 1899/V/19. TTM n=10	globose	14.2	12-15.6	0.8-1	pilate	3/i
Calypogeia integristipula STEPH. Szent-Anna tó, VAJDA 1965/VIII/25. TTM n=10	globose	16.2	15-17.6	1-1.5	clavate	3/j
Blepharostoma trichophyllum (L.) DUM. Fehérvízvölgy, VAJDA 1974/VII/12. TTM n=10	globose	13.4	12.2-15.6	0.8-1	pilate	3/k
Frullania dilatata (L.) DUM. Krassó-Szörény, ORBÁN 1972/IX/14. TTM n=10	subtriangular	40x51	38-42 45-54	6 (7-8)	baculate (tooth-like)	3/l

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