Studia bot. hung. 27–28, pp. 109–115, 1996–97 (1998)

RELATIONSHIPS BETWEEN THE MORPHOLOGY OF THE SPORES OF HUNGARIAN HEPATICAE SPECIES AND THEIR STRATEGY TYPES

A. VOJTKÓ

Dept. of Botany, Eszterházy Károly Teachers' Training College
H–3301 Eger, Pf. 43, Hungary

The paper includes the strategy types of the Hungarian Hepaticae species from the point of view of spore morphology of the taxa. The comparison is based on the data of 46 species. The most important strategy types are: colonist, annuals, perennial shuttles, perennial stayers and short life shuttles.

Key words: life strategy, Hepaticae, spore wall, spore morphology

INTRODUCTION

We can get closer to the answers for taxonomic and systematic questions with the morphological characterization of the spores of bryophytes (CLARKE 1979, SORSA and KOPONEN 1973, MOGENSEN 1981). In addition to it some species can be classified only on the basis of their spores. At the same time the spores of different sizes get their own species to different reproductive chances so the strategies of the species will be different (DURING 1979, RICHARDSON 1981). One of the most important elements of life strategy is the reproduction tactics and the most essential parts of it are the size and number of the spores. The small size of the spores is paired with the large number of them so it guarantees the quickest and the widest distribution. The disadvantage of the small size is that they are surrended to the air current (ZANTEN 1978, RICHARDSON 1981). The topic of the paper covers these themes and the author would like to serve data in order to know better the life strategy of Hepaticae.

MATERIALS AND METHODS

The examination is based on the morphological characterization of the spores of the Hungarian Hepaticae which could be found in the herbaria and on the results of the descriptions in the literature (JOVET-AST 1972, 1986, BOROS

Table 1. Spore morphology data of the colonist (C) species

Species	Form	Mean value (μm)	Size range (μm)	Spore wall thickness (in μm)	Ornamentation p = prox. surface d = distal surface
Marchantia polymorpha L. emend. Burgeff	sub-triangular	13.5	11–16	0.8 (0.5)	p = verrucate d = verrucate
Riccardia latifrons (Lindb.) Lindb.	globose	18	15–20	2	clavate
Lophozia collaris (Nees.) Dum.	globose	20.4	18.2–22.2	1	clavate
Lophozia excisa (Dicks.) Dum.	globose	23	22.2–24.6	1–1.5	pilate
Jungermannia hyalina Lyell in Hook.	globose	17	15–19.6	0.8–1	pilate
Marsupella emarginata (Ehrh.) Dum.	globose	12	11–13.8	1.2–1.5	pilate
Marsupella hungarica Boros et Vajda	globose	11	10–12.8	0.8–1	pilate
Cephaloziella integerrima (Lindb.) Warnst.	globose	7.2	6–9.6	0.8–1	pilate
Cephaloziella divaricata (Sm.) Schiffn.	globose	7	6.2–8.2	0.8–1	pilate
Cephaloziella stellulifera (Tayl.) Schiffn.	globose	8.8	7–10	0.8–1	pilate
Cephaloziella raddiana (Massal.) Schiffn.	globose	7	6–8	0.8–1	pilate
Cephaloziella hampeana (Nees) Schiffn.	globose	10	9–11.8	0.8–1	pilate
Calypogeia suecica (Arn. et Pers.) K. Müll.	globose	10.2	9.4–11.8	0.8–1	pilate
Calypogeia trichomanis (L.) K. Müll.	globose	14.2	12–15.6	0.8–1	pilate
Calypogeia integristipula Steph.	globose	16.2	15–17.6	1–1.5	clavate
Blepharostoma trichophyllum (L.) Dum.	globose	13.4	12.2–15.6	0.8–1	pilate
Frullania dilatata (L.) Dum.	sub-triangular	40 × 51	38–42 45–54	6 (7–8)	baculate (tooth-like)
Riccardia pinguis (L.) S. Gray	globose	24	25–23	2	clavate
Metzgeria conjugata Lindb.	globose	14.1	15.8–12.9	0.7	baculate
Nowellia curvifolia (Dicks.) Mitt.	globose	10.2	12.2–9.1	1	reticulate
Lophozia bicrenata (Schmid. ex Hoffm.) Dum.	globose	20.4	22.3–17.1	1	pilate
Gymnocolea inflata (Huds.) Dum.	sub-triangular	20.2 × 15.6	21.7–16.5 19.0–14.1	1	p = reticulate d = reticulate
Anastrophyllum michauxi (F. Web.) Buch. ex Evans	globose	14.5	15.7–13	1	pilate

and JÁRAI-KOMLÓDI 1975, BISCHLER 1982, BOROS *et al.* 1993, VOJTKÓ 1993). There are only Hungarian Hepaticae in the investigations.

The species of each life strategy type were characterized according to the 4 morphological features which are thought to be the most important:

- **size (spore size)**: it is the most important factor of dispersal and distribution. The size range consists of 10 observed values which include the smallest and the biggest representations of the species.
- **form (the type of the spore)**: it has mainly taxonomic and evolutionary importance.
- **the thickness of the spore wall**: it determines the life span and viability of the spore. It is mainly necessary for separating the species of the short life shuttle (SL) and the long-lived (perennial) shuttle (LS) strategy types. The spore wall of mosses is often very thin and simple except for Hepaticae species which have very complicated structure and it can be hardly described, opposite to mosses.
- **ornamentation**: this feature gives the variability of bryophytes. Together with form this feature has also mainly taxonomic importance. But if we take into account that the species from the same family are in the same strategy types then it is usually quite informative, too. Sometimes the spore wall is almost smooth but in most cases it is changing and more or less determined with visible ornamentation.

RESULTS AND DISCUSSION

Colonist: C

Examined species/All the Hungarian species: 23/89 (25.8%).

Size range: 7–29 µm. Spores are mainly of globose type with 0.7–2µm thin spore wall. The ornamentation is light pilum or gemma (Table 1).

Annual shuttle: AS

Examined species/All the Hungarian species: 8/10 (80%)

Size range: 40–75 µm. Subtriangulare spores, the spore wall is 1–5 µm thin. The ornamentation is quite complicated and very difficult to describe. The surface is reticulate (Table 2).

Long-lived (perennial) shuttle: LS

Examined species/All the Hungarian species: 2/11 (18.2%)

Size range: 25–30 µm. Spores are of globose type. The spore wall 1–2 µm thin, its ornamentation is small bacule (Table 3).

Table 2. Spore morphology data of the annual shuttle (AS) species

Species	Form	Mean value (µm)	Size range (µm)	Spore wall thickness (in µm)	Ornamentation p = prox. surface d = distal surface
Riccia duplex Lorbeer in K. Müll.	subtriangular	60 × 55	47–70 52–58	3–3.5	p = pilate d = reticulate
Riccia sorocarpa Bisch.	subtriangular	75 × 60	68–80 55–68	3–4	p = pilate d = reticulate
Riccia bifurca Hoffm.	subtriangular	51 × 46	46–53 44–49	3–3.5	p = rugulate d = reticulate
Riccia glauca L.	subtriangular	71 × 65	60–75 56–68	3–3.5	p = baculate d = reticulate
Anthoceros laevis L.	subtriangular	45.2 × 40.4	49.6–42.2 42.5–38.6	3–5	spinulate spinulate
Fossombronia pusilla (L.) Nees		55.2 × 45.7	57.5–53.2 48.3–42.5	1.5	spinulate spinulate
Fossombronia wondraczekii (Corda) Dum.		45.4 × 40.2	48.1–43.7 42.8–38.6	1	spinulate spinulate
Riccia frostii Austin		53.2 × 49.6	56.5–49.1 53.3–43.8	4–5	reticulate reticulate

Table 3. Spore morphology data of the long-lived shuttle (LS) species

Species	Form	Mean value (µm)	Size range (µm)	Spore wall thickness (in µm)	Ornamentation p = prox. surface d = distal surface
Ptilidium pulcherrimum (Weber) Vainio	globose	25.6	28.3–24.1	2	verrucate
Radula complanata (L.) Dum.	globose	29.4	32.2–27.6	1	spinulate

Perennial stayers: P

Examined species/All the Hungarian species: 6/14 (42.8%)

It is a quite homogeneous group. The size range is rather narrow, it is between 13–20 µm. All of the spores are of globose type with thin walls (1–2 µm) and small ornamentation which is not considerable (Table 4).

Short life shuttle: SL

Examined species/All the Hungarian species: 7/36 (19.4%)

It is a heterogeneous group. The spores of these species are in the size range of 40–130 µm with varied forms: subtriangulare, globose and elliptic. However,

Table 4. Spore morphology data of the perennial stayers (P) species

Species	Form	Mean value (μm)	Size range (μm)	Spore wall thickness (in μm)	Ornamentation p = prox. surface d = distal surface
Plagiochila porelloides (Torrey et Nees) Lindenb.	globose	17.8	15–20	1.2–1.5	pilate
Lophocolea cuspidata (Nees) Limpr.	globose	20.4	17–25	1.5–2	pilate
Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dum.	globose	15.2	11–18	0.8–1	pilate
Lepidozia reptans (L.) Dum.	globose	16.4	15–18	0.8–1.2	clavate
Lophocolea heterophylla (Schrad.) Dum.	globose	13.5	15.5–10.8	0.8	pilate
Chiloscyphus polyanthus (L.) Corda	globose	20.2	24.8–15.5	1	granulate

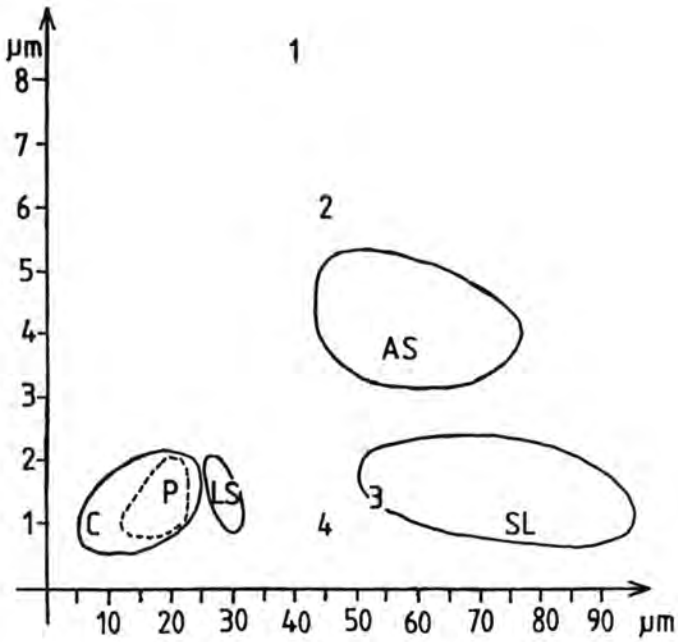
Table 5. Spore morphology data of the short life shuttle (SL) species

Species	Form	Mean value (μm)	Size range (μm)	Spore wall thickness (in μm)	Ornamentation p = proximal surface d = distal surface
Mannia fragrans (Balbis) Frey et Clark	sub-triangular	52 × 44	46–52 38.5–47	2	p = spinulate d = spinulate
Asterella saccata (Wahlenb.) Evans	sub-triangular	55 × 45	52–66 42–47	2	p = pilate d = pilate
Athalamia hyalina (Somm.) Hatt.	globose	59	52–67	1–1.5	rugulate
Pellia endiviifolia (Dicks.) Dum.	elliptic	80 × 65	70–100 40–70	1.5–2	verrucate
Reboulia hemisphaerica (L.) Raddi	sub-triangular	40.5	44.7–36.3	8–12	spinulate
Conocephalum conicum (L.) Lindb.	globose	92.7	130–65.5	1	verrucate
Preissia quadrata (Scop.) Nees	globose	72.4	93–58.9	1.5	reticulate

the spore wall is quite thin compared with its size; it is 1–2 μm! (In one case it is 8–12 μm). Its ornamentation is very diverse (Table 5).

Considering the examined species and on the basis of previous data it can be established that there is a relationship between the spore size, the thickness of the spore wall and the different strategy types.

Fig. 1. Relationship between the life strategies and the spore morphology 1: *Reboulia hemisphaerica* (SL), 2: *Frullania dilatata* (C), 3: *Fossombronia pusilla* (AS), 4: *Fossombronia wondraczekii* (AS)



Considering these features the annual shuttle (AS) and the short life shuttle (SL) groups are separated from each other and also from the others. The species of the long-lived (perennial) shuttle groups (LS) have only informative importance because of the low number of species. We had further problems with the species of perennial stayer (P) and colonist types (C). In order to separate them more perfectly we need further examinations.

*

Acknowledgements. Many thanks to Dr SÁNDOR ORBÁN for his support who helped my work with his useful advice and with placing the literature at my disposal.

LITERATURE

BISCHLER, H. (1982): Marchantia L. Morphologie sporale, germination et rang taxonomique des Section Marchantia et Chlamidium (Carda) Nees. – *Cryptogamie* **3**(4): 351–364.

BOROS, Á. and JÁRAI-KOMLÓDI, M. (1975): *An atlas of recent European moss spores.* – Akadémiai Kiadó, Budapest, 466 pp.

BOROS, Á., JÁRAI-KOMLÓDI, M., TÓTH, Z. and NILSSON, S. (1993): *An atlas of recent European bryophyte spores*. – Scientia Kiadó, Budapest, 321 pp.

CLARKE, G. C. S. (1979): *Spore morphology and bryophyte systematics*. – In: CLARKE, G. C. S. and DUCKETT, J. G. (eds): Bryophyte Systematics. Academic Press, London and New York, pp. 231–250.

DURING, H. J. (1979): Life strategies of bryophytes: a preliminary review. – *Lindbergia* **5**: 2–18.

DURING, H. J. and HORST, B. (1985): Life span, mortality and establishment of bryophytes in two contrasting habitats. – *Abstracta Botanica* **9**(Suppl. 2): 145–158.

JÁRAI-KOMLÓDI, M. (1974): Comparative spore morphological examinations in Funaria and Physcomitrium species. – *Acta Bot. Hung.* **20**: 71–81.

JÁRAI-KOMLÓDI, M. and ORBÁN, S. (1975): Spore morphological studies on recent European Encalypta species. – *Acta Bot. Hung.* **21**: 305–345.

JOVET-AST, S. (1972): Distinction de Riccia gougetiana Mont. et de Riccia ciliifera Link. d'après les spores. – *Revue Bryol. et Lichénol.* **38**: 161–176. (1971–1972).

JOVET-AST, S. (1986): Les Riccia de la region mediterraneenne. – *Cryptogamie, Bryol. Lichénol.* **3**: 287–431.

LONGTON, R. E. (1988): Life-history strategies among bryophytes of arid regions. – *J. Hattori Bot. Lab.* **64**: 15–28.

MÄGDEFRAU, K. (1982): *Life-forms of bryophytes*. – In: SMITH, A. J. E. (ed.): Bryophytes Ecology. Chapman and Hall, London, New York, pp. 45–58.

MOGENSEN, R. G. S. (1981): The biological significance of morphological characters in bryophytes: the spore. – *The Bryologist* **84**: 187–207.

ORBÁN, S. (1983): *A magyarországi mohák stratégiái, összefüggésük a környezet ökológiai és cönológiai jellemzőivel*. (The ecological and coenological connections of the life strategies of bryophytes). – PhD Dissert., manuscript, Budapest, 115 pp.

ORBÁN, S. (1984): A magyarországi mohák stratégiái és T, W, R értékei. (The life strategies and the T, W, R indicator values of Hungarian bryophytes). – *Acta Acad. Paed. Agr.* **17**: 755–765.

ORBÁN, S. and VAJDA, L. (1983): *Magyarország mohaflórájának kézikönyve*. (The bryoflora of Hungary). – Akadémiai Kiadó, Budapest, 518 pp.

RICHARDSON, D. H. S. (1981): *The biology of mosses: 3. Spore dispersal mechanism*. – Blackwell Scientific Publications, Willey, New York, pp. 65–82.

SORSA, P. and KOPONEN, T. (1973): Spore morphology of Mniaceae Mitt. (Bryophyta) and its taxonomic significance. – *Ann. Bot. Fennici* **10**: 187–200.

VOJTKÓ, A. (1993): The spore morphology of Hepaticae species. – *Acta Biol.*, Szeged, **39**: 59–69.

ZANTEN, B. O. (1978): Experimental studies on transoceanic long-range dispersal of moss spores in the Southern Hemispere. – *J. Hattori Bot. Lab.* **44**: 455–482.

ZANTEN, B. O. and PÓCS, T. (1981): *Distribution and dispersal of bryophytes*. – In: SCHULTZE-MOTEL, W. (ed.): Advances in Bryology **1**: 479–562.

(Received on 16 December, 1996)