13. HIGH TEMPERATURE EFFECT ON MONOLETE FERN SPORES

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Abstract

Four species of monolete fern spores were heated during 10s, 1h, 10, 25, 100 and 300 hours. The qualitative and quantitative alterations were investigated by the LM method. The alterations of the diameter of the spores are particular. After short time of heating the size of the spore may diminish or increase. The alterations of the quantitative character may be regular or irregular at the different species investigated.

Key words: Palynology, recent, monolete spores, high temperature effect.

Introduction

During our research program of the secondary alterations of the sporomorphs in consequence of high temperature effect first we investigated *angiosperm* and *gymnosperm* pollen grains (e.g.: KEDVES and KINCSEK 1989, KEDVES, TÓTH and FARKAS, 1991b). At the pollen grains of several *angiosperm* and *gymnosperm* taxa, important alteration were established. Several secondary forms are important from taxonomical and evolutionary points of view. Till this time few spores were investigated in this respect, the investigated species are the following: *Ustilago maydis* (KEDVES and TÓTH, 1993), *Equisetum arvense* (KEDVES, TÓTH and FARKAS, 1991a), microspores of *Selaginella haematodes*, *S. serpens*, micro- and megaspores of *Selaginella inaequalifolia* (KEDVES, 1990).

Till this time the high temperature effect was not investigated on monolete spores. Taking into consideration the importance of the monolete spore forms in the fossil spore-pollen assemblages, and in some cases their peculiar wall structure we carried out such experiments on monolete fern spores. The aim of this paper is to present comparative data to the fossil forms and the previous experimental results on recent species.

Materials and Methods

The investigation material was collected in the Botanical Garden of the J.A. University. The aim of the selection of the species for high temperature effect was that the most important morphological types of the monolete spores be represented. The following species were investigated: *Blechnum occidentale* L. (*Blechnaceae*), *Polypodium crassifolium* L. (*Polypodiaceae*), *Nephrolepis exaltata* SCHOTT (*Oleandraceae*), *Asplenium nidus* L. (*Aspleniaceae*). The taxonomy followed the book of HUANG (1981). Fresh and

heated spores on 200 °C during 10s, lh, 5, 10, 25, and 300 hours were investigated. Experiments numbers: *Blechnum occidentale* L., T9-P-866-870; *Polypodium crassifolium* L., T9-P-846-850; *Nephrolepis exaltata* SCHOTT, T9-P-861-865; *Asplenium nidus* L. T9-P-851-855;

Results

I. Qualitative results (Plate 13.1., figs. 1-21, plate 13.2., figs. 1-10)

1.1. *Blechnum occidentale* L. (Plate 13.1., figs. 1-6)

The exospore of the fresh spores is covered by a thin perispore (Plate 13.1., fig. 1). After heating, 10s, and 1 hour the separation of the perispore started (Plate 13.1., figs. 2,3). After 10 hours the spores are without perispore (Plate 13.1., figs. 4-6). The characteristic bean form became deformed after 300 hours of heating (Plate 13.1., fig. 6).

1.2. *Polypodium crassifolium* L. (Plate 13.1., figs. 7-12)

The characteristic basic verrucate sculpture of the exospore is well shown at the fresh (Plate 13.1., fig. 7) and the heated spore during 10s (Plate 13.1., fig. 8). After 1 hour (Plate 13.1., fig. 9) the elements of the sculpture diminish. After 10 and 25 hours of heating (Plate 13.1., figs. 10,11) the degradation of the ornamental elements is characteristic. Finally after 300 hours of heating (Plate 13.1., fig. 12) the surface is smooth or granular by the remnants of the sculpture. The amb is bean-form as originally, but the exospore is cracked (Plate 13.1., fig. 12).

1.3. *Nephrolepis exaltata* SCHOTT (Plate 13.1., figs. 13-21)

The characteristic verrucate sculpture of the fresh spore (Plate 13.1., fig. 13) has not altered in a remarkable manner in consequence of the temperature. The size of the elements is smaller than originally after 300 hours of heating as well (Plate 13.1., figs. 20,21).

1.4. *Asplenium nidus* L. (Plate 13.2., figs. 1-10)

The perispore of the fresh spores (Plate 13.2., figs. 1,2) is characteristic. After 10s of heating minor alterations were observed only in the spore morphology (Plate 13.2., figs. 3,4). After 1 hour of heating remarkable degradation of the perispore was observed (Plate 13.2., figs. 5,6). After 10 hours of heating remnants of the perispore were only observed (Plate 13.2., fig. 7), and deformations of the characteristic bean form begun. Spores heated 25 and 300 hours (Plate 13.2., figs. 8,9 and 10) are without perispore and with secondarily deformed ambitus.

2. Quantitative results

2.1. Alterations of the equatorial axis

2.1.1. *Blechnum occidentale* L.

	27.5	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0	52.5	55.0	µm
0		1.5	2.5	0.5	4.0	7.0	24.0	**35.0**	22.5	3.0			%
10s					3.0	3.5	6.5	**20.5**	**20.5**	19.0	16.5	10.5	
1h			1.0	1.5	1.5	5.5	15.5	26.0	**28.0**	12.0	7.0	2.0	
10h	1.5		0.5	3.0	4.5	8.5	**21.5**	20.5	**21.0**	14.5	4.5		
25h			0.5	2.5	10.5	17.5	**25.5**	15.5	16.0	9.5	2.5		
300h			5.5	14.0	**21.0**	18.0	17.5	19.5	1.5	2.0		1.0	

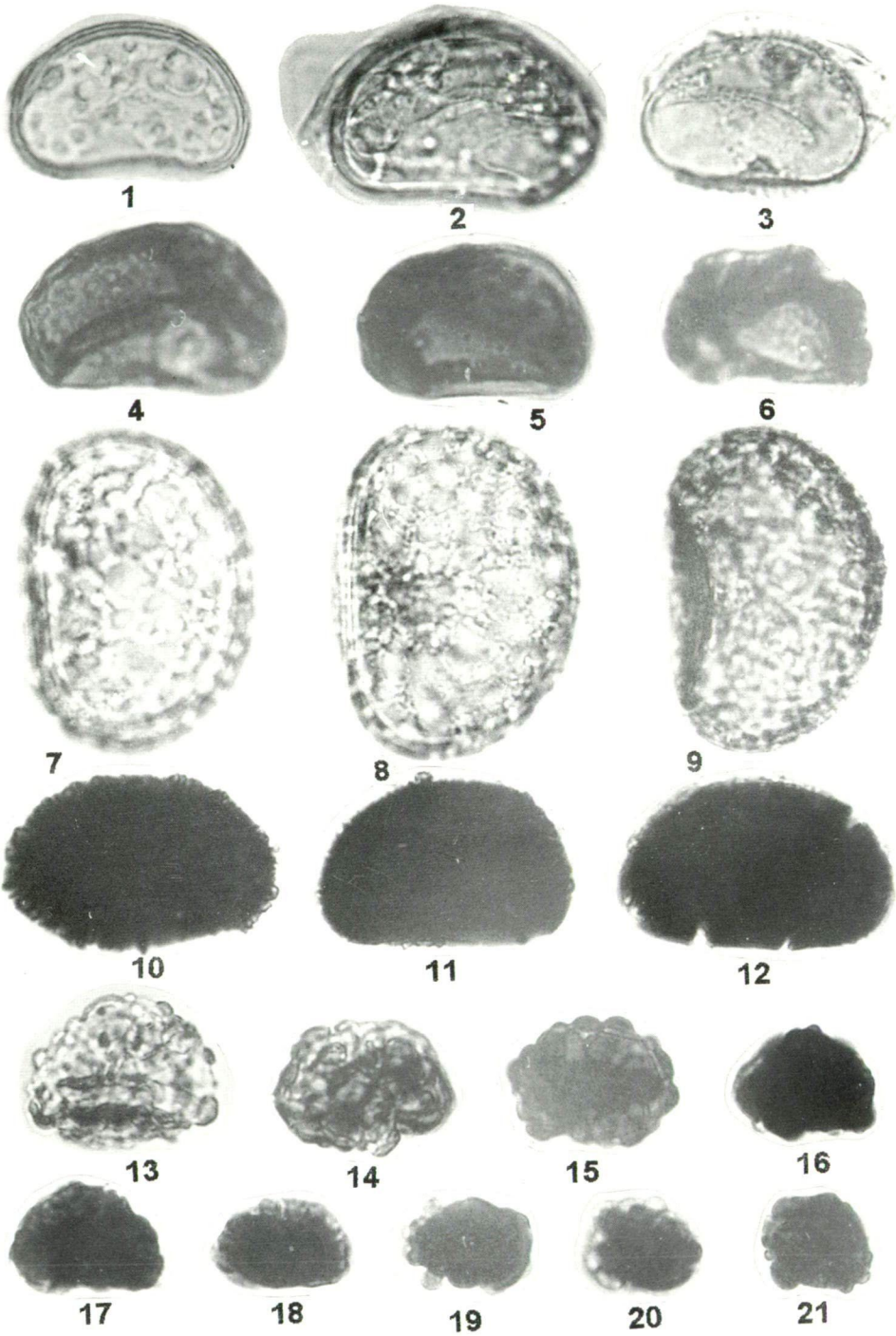

Plate 13.1

After 10s, 1h and 10 hours of heating the size increased in a peculiar manner. After 25 hours of heating the diameter of the spores slightly diminish. Important reduction in the size of the spores appeared after 300 hours.

2.1.2. *Polypodium crassifolium* L.

	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0	52.5	55.0	57.5	60.0	62.5	65.0	67.5	70.0 µm
0								2.5	9.5	**29.0**	26.0	17.5	6.5	4.5	3.0		1.5 %
10s							3.5	5.5	17.0	20.0	**21.0**	20.5	7.0	4.5		1.0	
1h					1.0	1.5	10.5	21.0	**28.0**	22.0	11.0	4.5		0.5			
10h	0.5		1.0	1.0	8.5	26.5	**29.5**	21.0	11.0	1.0							
25h			2.0	5.5	20.5	**28.5**	22.0	15.5	5.0	0.5	0.5						
300h		1.0	0.5	3.5	11.5	20.0	25.5	**26.0**	10.0	0.5	1.5						

10s heating resulted larger secondary forms. 1 hour, 10 and 25 hours of heating the size diminishes in a remarkable manner, but it is interesting that the longest heating (300 hours) resulted in relatively larger forms.

2.1.3. *Nephrolepis exaltata* SCHOTT

	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0	42.5 µm
0			2.5		6.0	21.0	**31.0**	23.5	12.0	3.5	0.5	%
10s					9.0	16.0	**31.0**	20.0	18.0	6.0		
1h	1.0	2.5	5.5	7.0	**19.0**	**19.0**	17.0	13.5	8.0	7.0		0.5
10h		9.5	6.0	9.5	**24.5**	18.5	13.5	15.0	3.5			
25h			1.5	23.0	**34.0**	17.5	21.5	2.5				
300h	2.0	12.0	**22.0**	21.0	16.5	18.0	6.5		2.0			

The size have not altered essentially after 10s of heating. After longer heating the diameter of the spores diminished. Worth of mentioning is that the maxima of the heating at 1 hour, 10 and 25 hours are the same (25.0 µm). Heating during 300 hours resulted in an important diminution in the size.

2.1.4. *Asplenium nidus* L.

	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0	52.5	55.0	57.5	60.0	62.5	65.5 µm
0							0.5	1.0	0.5	1.0	9.5	9.0	18.0	**21.5**	20.0	12.5	2.5	3.0	1.0
10s									1.5	3.0	12.5	18.5	**24.5**	17.0	11.5	10.0	0.5	1.0	
1h							4.5	15.5	**25.0**	23.0	19.5	12.5							
10h		2.0	9.0	7.0	15.5	24.0	**24.5**	15.0	2.5	0.5									
25h			7.5	29.0	**29.5**	21.0	7.5	5.5											
300h	1.5	1.5	16.5	25.0	**31.5**	15.0	8.0	1.0											

At this species the diameter of the spore diminishes more or less regularly by the time of heating.

Plate 13.1.

1-6. *Blechnum occidentale* L.
1. Fresh spore; 2. Experiment No: T9-P-866; 3. Experiment No: T9-P-867; 4. Experiment No: T9-P-868; 5. Experiment No: 869; 6. Experiment No: T9-P-870.

7-12. *Polypodium crassifolium* L.
7. Fresh spore; 8. Experiment No: T9-P-846; 9. Experiment No: T9-P-847; 10. Experiment No: T9-P-848; 11. Experiment No: T9-P-849; 12. Experiment No: T9-P-850.

13-21. *Nephrolepis exaltata* SCHOTT
13. Fresh spore; 14. Experiment No: T9-P-861; 15. Experiment No: T9-P-862; 16,17. Experiment No: T9-P-863; 18,19. Experiment No: T9-P-864; 20,21. Experiment No: T9-P-865.

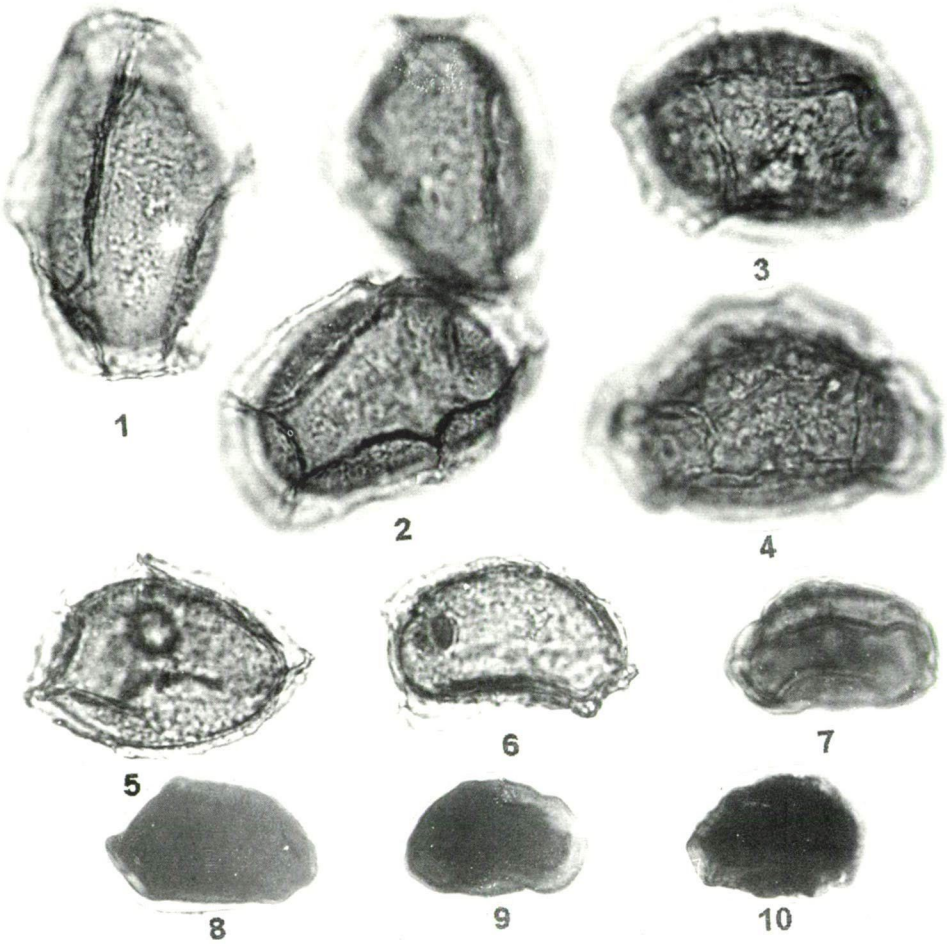

Plate 13.2.

1-10. *Asplenium nidus* L.
1,2. Fresh spores; 3,4. Experiment No: T9-P-851; 5,6. Experiment No: T9-P-852; 7. Experiment No: T9-P-853; 8,9. Experiment No: T9-P-854; 10. Experiment No: T9-P-855.

Discussion and Conclusions

1. At the spores of *Blechnum occidentale* and *Asplenium nidus* after the degradation of the perispore the amb of the monolete spore deformed.

2. The ornamental elements at *Polypodium crassifolium* have been degraded in consequence of high temperature, at the spores of *Nephrolepis exaltata* qualitative changes were not observed.

3. The alterations in the size of the spores based on our up-to-date knowledge are irregular.

4. Such alterations may happen also at the fossil forms in particular at the metamorphic sediments.

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