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The genus Erysiphe in Serbia

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A search for powdery mildew agents present in central, west and east Serbia was carried out during the period 1986-1995. A total of twenty-seven fungal species of the genus Erysiphe were observed, causing powdery mildews on 123 plant species. Twenty of the identified fungal species are recorded for the first time in Serbia, and powdery mildews are newly recorded on 83 host plant species.

Key words: Erysiphe, powdery mildew, host plant

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V průběhu let 1986-1995 byl prováděn výzkum onemocnění rostlin padlím ve středním, západním a východním Srbsku. Celkem bylo zjištěno 27 druhů z rodu Erysiphe, které byly příčinou chorob u 123 druhů rostlin. Dvacet z určených druhů je uvedeno poprvé pro Srbsko a choroba padlí je nově zaznamenána na 83 rostlinných druzích.

INTRODUCTION

Fungi causing powdery mildews are widely distributed and parasitize on many plant species. They can reproduce very quickly, and expand in a very short time all over the surfaces of the plant organs causing great damage. Therefore attention has been paid to the study of these fungi since long. The first monograph was written by the French mycologist J.H. Léveillé in 1851, a second Salmon in 1900. Investigations into powdery mildews in our country are scarce and they mainly refer to crop plants (Radosavljević 1924; Josifović 1929; Perišić 1952; Grujić and Tomašević 1956; Jovičević 1958; Arsenijević 1983, etc.). Papers on the presence and distribution of these fungi are few (Ranojević 1910; Ranković 1988, 1989, 1991).

The present paper deals with the study of the fungal genus *Erysiphe*, predominantly a listing their host plants, besides their distribution and frequency in Serbia.

MATERIAL AND METHODS

Powdery mildew agents were searched for during several vegetation periods in Serbia. Samples of diseased plants were collected during 1986-1995. The following taxonomic characteristics of the fungal species were studied: mycelium appearance and distribution on the surface of the infected host plant organs; conidiophore type; conidial shape and size; method and rate of germination; distribution of germ tubes and types of appressoria; cleistothecium diameter, shape and size; structure of appendages; number, shape and size of ascospores. The obtained values of the above mentioned characteristics are based on the microscopic study of 200 samples of the respective elements from each host plant, and the values of the characteristic features have been statistically processed and are presented for each fungal species in Table 1. The systematic of the causal agents of powdery mildews has been based on the works by Blumer, 1967; Junell, 1967a, 1967b; Sałata, 1985; Braun, 1987 and others.

Material of the collections examined has been deposited at the Mycological Herbarium of the Institute of Biology, Kragujevac (MHIB).

RESULTS AND DISCUSSION

Based on a long-term study, 27 species of the fungal genus *Erysiphe* causing powdery mildews in Serbia, have so far been observed as parasites of 123 plant species. Twenty of these species are recorded for the first time in Serbia.

Erysiphe aquilegiae DC.

Powdery mildews on *Aquilegia vulgaris* L. and *Thalictrum aquilegiifolium* L. in Serbia were reported by Ranojević, (1910) who indicated *Erysiphe polygoni* DC. as the causal agent. During the present study, *E. aquilegiae* was found on *Aquilegia vulgaris* in the region of Kragujevac, in July and October 1988 and 1990 (rare), Topola, September 1988 (rare), MHIB No 352; and on *Thalictrum aquilegiifolium* in the district of Kragujevac, July-October 1986-1995, (rare), MHIB No. 428.

This is the first record of the powdery mildew on *Aquilegia vulgaris* in Serbia.

Erysiphe artemisiae Grev.

Powdery mildew on *Artemisia absinthium* L. and *A. vulgaris* was first reported by Ranojević (1910), and *Erysiphe cichoracearum* DC. was indicated as the causal agent.

E. artemisiae was found on: *Artemisia absinthium*, in the vicinity of Valjevo, July-October 1989, 1991 and 1992 (rare), MHIB No. 734; *A. vulgaris* in the

Table I. Biometric characteristics of fungi of the genus *Erysiphe* in Serbia

FUNGUS	MICROSTRUCTURES						
	Cleisto-thecia	App	As (N)	As (D)	Sp (N)	Sp (D)	Con
Erysiphe aquilegiae	100-135	3-10	2-8	45-65,3×30-45	2-5	20-25,5×10-14,5	30-46,5×18-24
Erysiphe artemisiae	100-135	1	7-20	58-85×27-40	2	22-29×13-18	30-36×19-22
Erysiphe betae	80-135	1	4-12	55-72×30-42	2-5	18-25×12-15	31-51×16-22
Erysiphe biocellata	85-132	1-2	6-15	54-75×27-40	2	18-26×13-17	28-38×17-24
Erysiphe buhrii	90-130	1	3-8	55-77×28-45	3-5	19-27×11-15	36-51×17-22
Erysiphe catalpae	81-117	1-3	4-8	57-78×31-45	3-6	20-26×11-16,5	30-40×19-23
Erysiphe cichoracearum	80-140	1-4	4-20	52-90×24-45	2-(4)	19-30×12-18	25-45×15-19
Erysiphe circaeae	78-115	2-4	3-5	57-65×28-42	(2-)3-5(-6)	15-22×9-12	28-42×15-20
Erysiphe convolvuli	96-113	1-3	4-10	52-80×30-45	2-7	20-23×11-16	17-60×15-22
Erysiphe cruciferarum	95-120	1-3	4-10	54-71×27-40	2-6	18-24×9-14	30-50×15-20
Erysiphe cynoglossi	98-138	1-2	10-20	60-80×27-42	2(-3)	18-28×13-19	31-41×18-23
Erysiphe depressa	110-136	1	8-16	65-90×30-45	2	22-32×15-21	31-43×22-27
Erysiphe fischeri	118-168	1-2	14-20	63-88×30-43	2	20-28×13-19	28-36×17-21
Erysiphe galeopsidis	87-150	1-2	6-16	50-72×23-40	—	—	25-39×17-22
Erysiphe galii	103-138	1-2	4-10	38-54×30-40	—	—	25-34×16-19
Erysiphe heraclei	82-123	1-2	3-10	50-74×30-50	2-6	19-30×10-16	32-55×14-22
Erysiphe lythri	90-120	1-3	4-10	52-72×30-42	3-5	20-25×12-16	—
Erysiphe magnicellulata	100-138	1-3	12-22	61-80×25-37	2-4	21-27×13-16	29-36×17-22
Erysiphe mayorii	100-135	1/2-2	6-22	55-80×24-40	4-8	16-21×9-21	—
Erysiphe pisi	85-126	2-3	3-10	50-72×31-40	3-6	19-28×11-16	30-42×16-22
Erysiphe pisi var. *cruchetiana*	92-125	1-2	4-10	55-70×30-42	2-5	19-25×11-14	31-43×21-25
Erysiphe polygoni	80-122	1-2	3-10	55-75×30-40	2-4	19-29×10-15	30-51×15-23
Erysiphe ranunculi	76-108	1-4	2-8	50-70×27-40	2-5	18-25×11-15	30-40×21-24
Erysiphe sordida	88-127	short	6-16	51-68×28-36	2	20-26×12-16	30-39×16-21
Erysiphe thesii	93-115	1-5	4-10	54-70×30-38	3-5	18-24×10-13	31-40×16-18
Erysiphe trifolii	90-132	1-7	4-12	50-80×27-45	2-6	18-26×10-15	30-45×16-23
Erysiphe urticae	95-125	short	3-12	58-72×30-45	3-6	20-25×11-15	30-42×18-22
Erysiphe verbasci	115-140	short	10-20	60-78×30-37	2	20-35×14-18	33-43×21-27

Abbrevations: Cleistothecia — diameter of cleistothecia (μm); **App** — length of appendages (in relation to the diameter of the cleistothecia); **As (N)** — number of asci; **As (D)** — dimensions of asci (μm); **Sp (N)** — number of ascospores; **Sp (D)** — dimensions of ascospores (μm); **Con** — dimensions of conidia (μm)

districts of Belgrade, August 1987 (common), Kragujevac, July-October 1986-1995 (common), Valjevo, August 1987 and 1988 (common), Arandjelovac, October 1987 (common), MHIB No. 378.

Erysiphe betae (Vanha) Weltz.

Powdery mildew on sugar beet was earlier reported by Marić and Kovačević (1964) and Marković (1985).

During the present study *E. betae* was observed near Belgrade, in September 1986 and 1988 (common), and Kragujevac, June-October 1986-1995 (common), MHIB No. 471; on *Beta vulgaris* var. *cycla* L., in Kragujevac, September 1986 and 1987 (rare), and in Valjevo, September 1987 (rare), MHIB No. 407.

Erysiphe biocellata Ehrenb.

Powdery mildews on *Salvia pratensis* L., and *S. verticillata* L. were found (Ranojević, 1910), and *Erysiphe galeopsidis* DC. was reported as the causal agent.

E. biocellata was found on *Lycopus exaltatus* L. in Kragujevac, October 1990 (rare), MHIB No. 632; on *L. europaeus* L. near Kraljevo, September 1987 and 1988 (rare), MHIB No. 611; on *Mentha arvensis* L. in the districts of Valjevo, October 1986 (rare), MHIB No. 297; on *Salvia pratensis* L. in Kragujevac, July-October 1987-1988, and Valjevo, 1986, 1987 (common), MHIB No. 377; and *S. verticillata* L., Kragujevac and Valjevo, August 1986, 1987 (common), MHIB No. 627. The biometric characteristics, presented in Tab. 1, vary in ranges reported by other investigators (Braun, 1987; Sałata, 1985; Blumer, 1967 etc.).

B. biocellata on *Lycopus europaeus* and *Mentha arvensis* are recorded for the first time in Serbia. According to the available references, *Lycopus exaltatus* is reported as a new host plant for the first time in Europe and other regions.

Erysiphe buhrii U. Braun

E. buhrii was found on *Silene alba* (Mill.) Krause in Kragujevac, August-October 1987 (rare), MHIB No. 531; on *S. viridiflora* L., near Koceljeva, July-October 1988-1989 and 1991 (rare), MHIB No. 644. Powdery mildews on these species, as well as the agent *Erysiphe buhrii*, are recorded for the first time in Serbia.

Erysiphe catalpae Simon.

E. catalpae was found on *Catalpa bignonioides* Walt. in Belgrade, October 1988 (rare) and in Kragujevac, August-October 1988-1989 (rare), MHIB No. 597.

This fungus, as well as powdery mildew on *C. bignonioides*, are recorded for the first time in this country.

Erysiphe cichoracearum DC.

Powdery mildews on *Sonchus arvensis* L., *S. asper* (L.) Hill, and *S. oleraceus* L. were observed by Ranojević (1910); on *Cucumis melo* L., *C. sativus* L., *Cucurbita maxima* L. and *C. pepo* L. they were reported by Spasić (1961); on *Nicotiana tabacum* L. by Grujičić and Tomašević (1956); on *Cucumis sativus* L. (Ristić 1985), etc.

During the present study *E. cichoracearum* was found on *Aster* spp. (cult.) in Kragujevac, July-October 1986-1995 (common); Belgrade, August 1987 (common); Valjevo, September 1987-1988 (common), MHIB No. 361; *Carduus crispus* L., in the vicinity of Valjevo, August 1987 (rare), Knić, September 1988 (rare), MHIB No. 531; on *Centaurea cyanus* L., in the vicinity of Kragujevac, August-October 1986-1987 and 1988 (common), and Valjevo, July 1987 (common), MHIB No. 297; on *Centaurea jacea* L., vicinity of Kragujevac, August-October 1986-1987 (common) and Valjevo, July 1987, September 1989 (common), MHIB No. 316; on *Cichorium intybus* L., in the districts of Kragujevac, July-October 1986-1987 (rare), and Valjevo, September 1986 (common), MHIB No. 334; on *Cirsium arvense* (L.) Scop., in the district of Kragujevac, June-October 1986-1995 (common) and Valjevo and Užice, July-October 1987, 1988, 1989 (common), MHIB No. 373; on *Cirsium vulgare* (Savi) Ten., in Belgrade, August 1986 (rare), MHIB No. 446; on *Dahlia variabilis* (Willd.) Desf., in Belgrade, September 1988 (rare), [abac, October 1986, 1987 (rare), MHIB No. 371; on *Cucumis sativus* L., *C. melo* L., and *Cucurbita pepo* L. throughout the investigated region, June-October 1986-1995 (common), MHIB No. 281; on *Inula britannica* L., *Inula salicina* L., Kragujevac, October 1988 (common), MHIB No. 592, 610; on *Lactuca quercina* L ., *Lactuca saligna* L., *Lactuca serriola* L., in the vicinity of Kragujevac, July-October 1987-1988 (common), MHIB No. 451, 467, 506; on *Nicotiana tabacum* L., in the district of [abac, September 1993 (rare), MHIB No. 645; on *Picris hieracioides* L., *Sonchus arvensis* L., *S. asper* (L.) Hill, and *S. oleraceus* L., throughout the study region, June-October 1986-1995 (common), MHIB No. 300, 406, 423, 471; on *Tragopogon pratensis* L., in the vicinity of Kragujevac and Valjevo, September 1989 (rare), MHIB No. 699; on *Tanacetum vulgare* L., *Solidago virgaurea* L., and *Viola tricolor* (cult.), in the vicinity of Belgrade, September 1988, and Kragujevac, September 1987 and 1988 (common), MHIB No. 483, 512 and 603.

Aster spp. , *C. crispus, C. cyanus, C. jacea, C. intybus, C. arvense, C. vulgare, D. variabilis, I. britannica, I. salicina, L. quercina, L. saligna, L. serriola, P. hieracioides, S. arvensis, T. pratensis, T. vulgare, S. virgaurea* and *V. tricolor* are recorded for the first time as host plants of powdery mildews in Serbia.

Erysiphe circaeae L. Junell

E. circaeae was found on *Circaea lutetiana* L. in Kragujevac, September 1988 (rare), MHIB No. 691.

Powdery mildew on this plant, as well as *Erysiphe circaeae*, are recorded for the first time in the region investigated.

Erysiphe convolvuli DC.

Powdery mildew on *Convolvulus arvensis* L. was earlier observed by Ranojević (1910).

In the course of the present study *E. convolvuli* was found on *Convolvulus arvensis* L. in many sites throughout the investigated region during June-October 1986-1995 (common), MHIB No. 703, on *Calystegia sepium* (L.) R. Br., in Kragujevac, only in October 1991 (rare), MHIB No. 455.

Powdery mildew on *C. sepium* and its causal agent, *Erysiphe convolvuli* are recorded here for the first time.

Erysiphe cruciferarum (Opiz) L. Junell

Powdery mildew on *Armoracia rusticana* G., M. et Sch. was observed by Ranojević (1910), who identified the causal agent as *Erysiphe polygoni* DC. The same author observed powdery mildews on *Brassica nigra* L. and *Sisymbrium officinale* (L.) Scop., the disease being attributed to *Erysiphe pisi* DC.

E. cruciferarum was found on *Armoracia rusticana* G., M. et Sch. in many sites of the investigated region during June-October 1986-1995 (common), MHIB No. 307; on *Brassica napus* L. and *B. nigra* L. in vicinity of Kragujevac and Topola, September 1988 (rare), MHIB No. 513 and 518, on *Capsella bursa-pastoris* L. in Kragujevac, September 1989 (rare), MHIB No. 639, on *Sinapsis arvensis* L., near Topola, September 1988 (rare), MHIB No. 546; on *Sisymbrium loeselii* L. and *S. officinale* (L.) Scop., in the vicinity of Kragujevac and Valjevo, September 1987-1988 (rare), MHIB No. 582 and 583.

Powdery mildews on *Capsella bursa-pastoris*, *Sinapsis arvensis*, *Sisymbrium loeselii*, as well as the causal agent *Erysiphe cruciferarum* are reported for the first time in Serbia.

Erysiphe cynoglossi (Wallr.) U. Braun

Ranojević (1910) observed powdery mildew on *Symphytum officinale* L. and the agent was identified as *Erysiphe cichoracearum* DC.

E. cynoglossi was found on *Echium vulgare* L. in the Kragujevac area in September 1986 and 1988 (rare); Belgrade, October 1987 (rare) and Kragujevac,

August-October 1987 and 1989 (rare), MHIB No. 392; on *Symphytum officinale* L. in the vicinity of Belgrade, September 1986 and 1988 (common); Kragujevac, July-October 1986, 1987 and 1989 (common) and Valjevo, September 1988 (rare), MHIB No. 443; on *S. tuberosum* L. near Kragujevac, September 1987 (rare); Paračin, October 1988-1989 (common) and Jagodina, September 1988 (rare), MHIB No. 392.

Powdery mildews on *Symphytum tuberosum* and *Echium vulgare* had not been reported so far in this country.

Erysiphe depressa (Wallr.) Schlecht.

Powdery mildews on *Arctium lappa* L. and *A. minus* L. were reported in Serbia by Ranojević (1910) who attributed the disease to *Erysiphe cichoracearum* DC.

Now, *E. depressa* was identified on *Arctium lappa* L. throughout the investigated region, during June-October 1986-1995 (common), MHIB No. 317; on *A. minus* (Hill) Bernh. and *A. tomentosum* L., in the districts of Kragujevac, September 1993 (rare), and Valjevo, September 1992, (rare), MHIB No. 871 and 982.

Powdery mildew on *A. tomentosum* and its agent *Erysiphe depressa* are recorded for the first time in Serbia.

Erysiphe fischeri Blumer

E. fischeri was found on *Senecio vulgaris* L. in Kragujevac, October 1989 (rare), MHIB No. 763. Its biometric characteristics, presented in Tab. 1, are similar to those reported by Braun (1987), Blumer (1967) and others.

In Serbia, *Erysiphe fischeri* is recorded for the first time on this plant.

Erysiphe galeopsidis DC.

Powdery mildew on *Galeopsis speciosa* Mill. was reported by Ranojević (1910).

Erysiphe galeopsidis was now found on *Chaiturus marrubiastrum* (L.) Ehrh. ex Spenn. and *Lamium galeobdolon* L., Topola, September 1988, (rare), MHIB No. 673, 674; on *Galeopsis tetrahit* L. in Valjevo, October 1988, (rare), MHIB No. 632; on *Ballota nigra* L., Niš, October 1987 (rare), MHIB No. 562 ; *Lamium album* L. and *L.maculatum* L., Čačak, September 1990, (rare), MHIB No. 427, 428; on *L. purpureum* L., *Melittis melissophyllum* L. and *Galeopsis speciosa* Mill., in the district of Belgrade, September 1989, (rare), MHIB No. 717, 718 and 719; on *Galeopsis pubescens* Bess., and *Stachys palustris* L. in the vicinity of Arandjelovac, October 1987, (rare), MHIB No. 531 and 532.

Erysiphe galeopsidis on *B. nigra, C. marrubiastrum, G. pubescens, G. tetrahit, L. album, L. galeobdolon, L. maculatum, L. purpureum, M. melissophyllum* and *S. palustris* are recorded in Serbia for the first time.

Erysiphe galii S. Blumer

Ranojević (1910) observed powdery mildew on *Galium aparine* L. and attributed it to *Erysiphe polygoni* DC.

Now, *E. galii* was identified on *Galium aparine* L. in numerous sites of the investigated region, during July-October 1986-1995, (common), MHIB No. 577, and on *G. verum* L. in the vicinity of Kragujevac, September 1989,(rare), MHIB No. 511.

Powdery mildew on *G. verum* and its causal agent are reported in this paper for the first time in Serbia.

Erysiphe heraclei DC.

Powdery mildews on *Carum carvi* L., *Daucus carota* L., *Falcaria vulgaris* Bernh., *Pastinaca sativa* L. and *Tordilium maximum* L. were observed by Ranojević (1910).

Erysiphe heraclei was now identified on *Angelica sylvestris* (L.) Hoff., vicinity of Valjevo, September 1987 (rare), MHIB No. 587; on *Carum carvi* L., vicinity of Kragujevac, August 1986, (rare), MHIB No. 391; on *Daucus carota* L., Kragujevac, September 1987, 1988 (rare), MHIB No. 464; *Eryngium campestre* L., *Falcaria vulgaris* Bernh. and *Heracleum sphondylium* L., vicinity of Kragujevac, September 1986 (rare), MHIB No. 356, 371 and 412; on *Pastinaca sativa* L. and *Petroselinum sativum* L. in numerous sites of the investigated region, July-October 1986-1994 (common), MHIB No. 419 and 478; on *Peucedanum alsaticum* L. and *P. cervaria* (L.) Guss. in the vicinity of Kragujevac, September 1988, MHIB No. 621 and 637; on *Pimpinella saxifraga* L. troughout the investigated region, July-October 1986-1995 (common), MHIB No. 374; on *Tordylium maximum* L. in the district of Kragujevac, September 1989, MHIB No. 768; on *Torilis arvensis* (Huds.) Link in the surroundings of Knić and Kraljevo, September 1989, MHIB No. 747.

Erysiphe heraclei on *A. sylvestris, E. campestre, H. sphondylium, P. alsaticum, P. saxifraga* and *T. arvensi* s are recorded for the first time in Serbia.

Erysiphe lythri L. Junell

Erysiphe lythri was found on *Lythrum salicaria* L., Kragujevac, October 1988 (rare), MHIB No. 614. Its biometric characteristics, presented in Tab. 1 vary in ranges reported by other investigators (Braun, 1987; Sałata, 1985; Junell, 1967; etc.).

The occurrence of powdery mildew on this species, as well as its agent *Erysiphe lythri,* in Serbia are recorded for the first time.

Erysiphe magnicellulata U. Braun

E. magnicellulata was found on *Phlox paniculata* L. in Belgrade, September 1989 (rare), MHIB No. 706.

This is the first record in Serbia of *Erysiphe magnicellulata.*

Erysiphe mayorii S. Blumer

E. mayorii was observed on *Cirsium arvense* (L.) Scop. by Ranković et al. (1991).

E. mayorii was found on *C. arvense* in Kragujevac, September-October 1987-1990 (rare), MHIB No. 429.

Erysiphe pisi DC.

Powdery mildews on *Pisum sativum* L. and *Medicago sativa* L. were observed by Ranojević (1910) and Radosavljević (1924).

Erysiphe pisi was found on: *Medicago lupulina* L., Kragujevac, September 1988-1989 (common), MHIB No. 633; *M. sativa* L., Kragujevac and [abac, August 1988 (rare), MHIB No. 671; *Pisum sativum* L. in numerous sites of the investigated region, MHIB No. 607; *Vicia cassubica* L., in the surroundings of Valjevo, August 1986, 1987 (common), MHIB No. 378; *V. cracca* L. and *V. sepium* L., in the districts of Kragujevac and Valjevo, September 1988 (common), MHIB No. 646.

Its presence on *Medicago lupulina, Vicia cracca* and *V. sepium* are reported for the first time, so are new host plants of this fungus in Serbia.

Erysiphe pisi var. **cruchetiana** (S. Blumer) U. Braun

Powdery mildew on *Ononis spinosa* L. as well as the fungus *Erysiphe cruchetiana* were reported from Serbia by Ranković and Čomić (1991).

E. pisi var. *cruchetiana* was found on *Ononis spinosa* L. in the vicinity of Gornji Milanovac and Kragujevac during July-October 1987-1992 (common), MHIB No. 564.

Erysiphe polygoni DC.

Powdery mildew on *Polygonum aviculare* L. was observed by Ranojević (1910).

Erysiphe polygoni was found on: *Polygonum aviculare* L. and *Persicaria hydropiper* (L.) Spach, *Rumex crispus* L. and *R. sanguineus* L., during June-October 1986-1995, throughout the investigated region (Kragujevac, Belgrade,

Valjevo, Šabac, Gornji Milanovac, Čačak, Kraljevo, Jagodina, etc.) (common), MHIB No. 277, 286, 319 and 407.

Erysiphe polygoni is here recorded for the first time on *Persicaria hydropiper, Rumex crispus* and *R. sanguineus* in the investigated region.

Erysiphe ranunculi Grev.

Ranojević (1910) observed powdery mildew on *Clematis integrifolia* L. and attributed the disease to *Erysiphe polygoni* DC.

During the present study, *E. ranunculi* was found on *Clematis integrifolia* in the surroundings of Šabac, September 1986 (rare), MHIB No. 392; *Ranunculus lanuginosus* L., in the districts of Kragujevac and Valjevo, September 1988 (rare), MHIB No. 633; *R. acris* L., *R. repens* L., *R. sardous* Crantz., in the districts of Kragujevac, September 1988 (rare), MHIB No. 577, 609 and 588.

Erysiphe sordida L. Junell

Powdery mildew was observed by Ranojević (1910) on *Plantago major* L. and the disease was attributed *Erysiphe cichoracearum* DC.

Erysiphe sordida was now found on *Plantago major* and *P. media* L., widely distributed throughout Serbia (Belgrade, Kragujevac, Valjevo, Čačak, Kraljevo, Topola, Gornji Milanovac, Paračin, etc.), during June-October 1986-1995 (common), MHIB No. 116 and 117.

P. media is a new host plant for this species in Serbia.

Erysiphe thesii L. Junell

Powdery mildew on *Thesium linophyllon* L., as well as the fungus *Erysiphe thesii*, were reported from Serbia, by Ranković et al. (1991).

Erysiphe thesii was found on *Thesium linophyllon* in the surroundings of Kragujevac, Gornji Milanovac and Topola, August-October 1988-1989 (rare), MHIB No. 579.

Erysiphe trifolii Grev.

Jovanović (1969) observed powdery mildew in this country on *Trifolium pratense* L. and the causal agent was cited as *Erysiphe communis* Grev. f. *trifolii* Rabenh. Ranojević (1910) observed powdery mildews on *Melilotus officinalis* (L.)Pallas, *Trifolium pratense* L., *T. hybridum* L., and attributed them to *Erysiphe polygoni* DC.

E. trifolii was now found on *Galega officinalis* L., *Lathyrus aphaca* L., *Lathyrus pratensis* L. and *Lathyrus tuberosus* L. in the vicinity of Kragujevac,

June-October 1987-1988 (common), MHIB No. 562, 583, 633, 642; on *Lotus corniculatus* L., Valjevo, 1986 (rare), MHIB No. 392; *Melilotus albus* Med. and *M. dentatus* (W. et K.) Pers. in the vicinity of Kragujevac and Šabac, September 1988-1989, (common), MHIB No 637 and 638; *M. officinalis* (L.) Pallas in the district of Kragujevac, September 1988 (common), MHIB No. 589; *Trigonella coerulea* (L.) Ser. in Koceljeva, September 1987 (rare), MHIB No. 537; *Trifolium arvense* L., *T. campestre* Schreb. and *T. hybridum L.*, throughout the investigated region (Kragujevac, Kraljevo, Valjevo, Užice, Niš, etc.), June-October 1986-1995 (common), MHIB No. 331, 493 and 514.

Powdery mildews on *G. officinalis, L. aphaca, L. pratensis, L. tuberosus, L. corniculatus, M. albus, M. dentatus, T. coerulea, T. arvensis* and *T. campestre* are reported for the first time in Serbia.

Erysiphe urticae S. Blumer

E. urticae was found on *Urtica dioica* L. in numerous localities of Serbia (Belgrade, Kragujevac, Arandjelovac, Topola, Valjevo, etc.), July-October 1986-1994 (common), MHIB No. 296.

Powdery mildew on *U. dioica,* as well as its causal agent *Erysiphe urticae*, were so far not observed in this region.

Erysiphe verbasci (Jacz.) S. Blumer

Ranojević (1910) reported powdery mildew on *Verbascum nigrum* L. and cited *Erysiphe taurica* Arn. as its causal agent.

E. verbasci was now identified on *Verbascum nigrum* in the surroundings of Kragujevac, Gornji Milanovac and Lajkovac, September 1988 (rare), MHIB No. 627; and on *V. thapsus,* Kragujevac, September 1988 (rare), MHIB No. 589. Biometric characteristics, presented in Tab. 1, are similar to those established by others authors (Braun 1987; Sałata 1985; Blumer 1967; etc.).

Erysiphe verbasci on *Verbascum thapsus* is recorded for the first time in Serbia.

CONCLUSIONS

Based upon the study of powdery mildews on plants collected on the territory of Serbia during the period of 1986-1995, 27 different species belonging to the fungal genus *Erysiphe* were identified, 20 of which are recorded here for the first time in Serbia. They were found as the cause of powdery mildews of 123 plant species, 83 of which represent new hosts for *Erysiphe* fungi in Serbia.

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CZECH MYCOL. 49 (2), 1996

Two new Capronia species from the Czech Republic

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Réblová M. (1996): Two new Capronia species from the Czech Republic. – Czech Mycol. 49: 77–83

Two new species of Capronia, C. perpusilla and C. svrcekiana, are described from rotten wood in near natural forests in the Czech Republic. The intraspecific relationships and autecology of these species are discussed.

Key words: Capronia perpusilla, Capronia svrcekiana, Herpotrichiellaceae, Ascomycotina.

Réblová M. (1996): Dva nové druhy rodu Capronia z České republiky. – Czech Mycol. 49: 77–83

Jsou popsány dva nové druhy rodu Capronia: C. perpusilla a C. svrcekiana podle sběrů na zetlelém dřevu z pralesovitých porostů České republiky. Jsou diskutovány jejich mezidruhové vztahy a autekologie.

The genus *Capronia* Sacc. of the family Herpotrichiellaceae Munk includes lignicolous, herbaceous and hypersaprobic species possessing dark coloured superficial ascomata, rarely immersed in the stromata, with dark setae or irregulary roughened peridia by protruding dark brown to black, thick-walled cells; asci are octo- to plurisporous, interthecial filaments are lacking; ascospores are light to dark coloured, smooth-walled, one to pluriseptate, phragmosporous or dictyosporous. The majority of anamorphs described for this genus belong to the *Exophiala-Ramichloridium-Rhinocladiella* complex, known as the "black yeasts" (Untereiner et al. 1995), and also to *Cladosporium* Link (Müller et al. 1987), all species with holoblastic conidiogenesis.

On the basis of cultural and morphological criteria Müller et al. (1987) united the genera *Berlesiella* Sacc., *Dictyotrichiella* Munk, *Didymotrichiella* Munk, *Herpotrichiella* Petrak and *Polytrichiella* Barr into the genus *Capronia* Sacc. According to the literature, the characters of ascospore septation and stroma development are unreliable and do not have large significance for the separation of the genera in question. Only the two genera *Capronia* and *Acanthostigmella* Höhn. (Barr 1977) were accepted within the family, which the authors (Müller et al. 1987) have separated on the basis of ascomatal colour, ascospore septation and the number of ascospores in the ascus and on the presence or absence of stromata. Eriksson and Hawksworth (1990)

followed Müller et al. (1987) to accept these two genera and enlarged the family to include *Berkelella* (Sacc.) Sacc., *Pleomelogramma* Speg. and *Taphrophila* Scheuer. The latter genus is recently placed in *Tubeufiaceae* Barr. The taxonomic position of *Acanthostigmella* has long been discussed (Barr 1977, 1980; von Arx and Müller 1975; Müller et al. 1987; Rossman 1987). Untereiner et al. (1995) excluded *Acanthostigmella* from Herpotrichiellaceae and considered it close to Tubeufiaceae and also excluded and transferred *Capronia pinicola* Petrini et Fisher, a species with delicately striate ascospores and multiple germ slite, trabeculate pseudoparaphyses and the anamorph belonging to *Helicodendron pinicola* Goos, to the new genus *Tyrranosorus* Untereiner et Malloch.

Barr (1987) took a somewhat different view of the genus *Capronia* and preferred to divide it into five genera according to ascospore septation and octo- or polysporous asci. In her latter study, Barr (1991) discussed important generic characters within Herpotrichiellaceae as polyspory and octospory of asci contrary to other groups of ascomycetous fungi.

The species of *Capronia* have a very inconspicuous appearance and occur especially on rotten wood or on dead stems and leaves covered by litter, which helps to retain the necessary moisture for ascoma development. They are able to grow on decorticated wood beneath the raised margins of the bark, especially on somewhat drier sites where litter is absent. They can also occur as hypersaprobes on remnants of stromata of other Pyrenomycetes or on old decayed fruit-bodies of resupinate Basidiomycetes. Nevertheless, so far a lot of species of *Capronia* have been described. Müller et al. (1987) recorded 25 species and Barr (1991) listed 15 new species or combinations from North America. According to Barr (1991) only a few taxa from North America can be identified with the described European species.

The author agrees with this opinion becouse based on the comparison of the original descriptions and drawings of the North American and European species it seems that some of them are rather intermediate than identical. Several finds from the Czech Republic on decaying wood could not be identified with any of the hitherto known species. Therefore, two new species are proposed.

Capronia perpusilla Réblová, sp. nov. Fig. 1 a–e.

Ascomata superficialia, solitaria vel gregaria, globosa vel subglobosa, denique collapsa, papillata, fusca, 100–200 μm alta vel (80)100–180 μm lata, pariete 30–35 μm crassa, cellulis protrudentibus atque setis fuscis, flexuosis 50–54 × 3 μm praedita. Asci 70.5–103 × 15.5–17.2 μm, bitunicati, saccati. Filamenta interthecialia desunt. Ascosporae (17.2)20.6–22.4(25) × 6.8–7.8(8.9) μm, fuscae vel

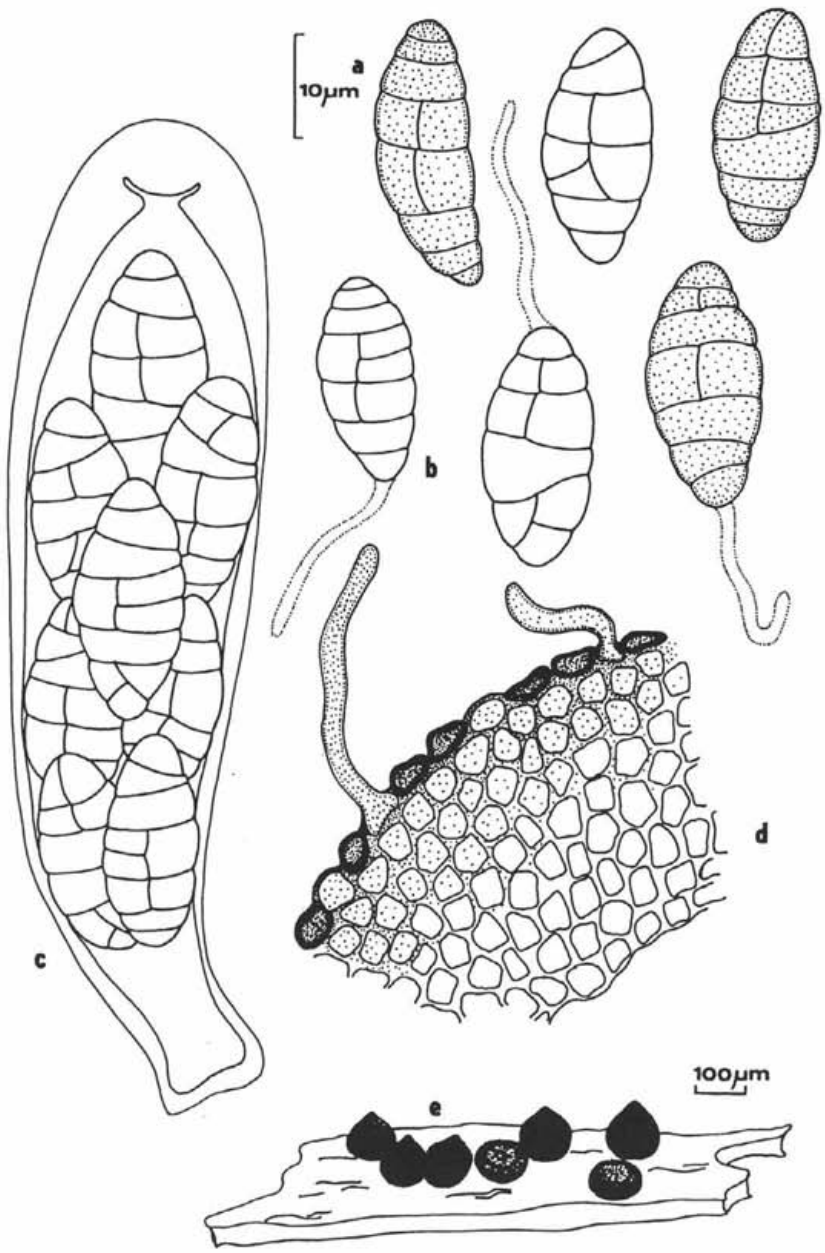

Fig. 1. *Capronia perpusilla* Réblová (PRM 842931).
a-ascospores, b-ascospores with germinating hypha, c-ascus with ascospores, d-vertical section of ascoma, e-ascomata. Del.: M. Réblová.

griseo-fuscae, fusoideae, septis 5–7 transversalibus, 1–3 longitudinalibus praeditae.

Holotypus: Bohemia meridionalis: Montes Šumava, in declivibus meridionalibus montis "Ždánidla" (1308 m s.m.) dictis prope Prášily apud Železná Ruda; ad ramum putridum deiectum *Fagi sylvaticae*, 20.VI.1995, leg. et det. M. Réblová (PRM 842931).

Ascomata superficial, solitary to gregarious in small groups of 3 to 5, seated on sparse, dark brown mycelium, globose to subglobose, minutely papillate, collabent when dry, 100–200 μm high and (80)100–180 μm wide; ascomatal wall 30–35 μm wide, composed of pseudoparenchymatous cells, its surface bearing scattered protruding thick-walled, darker brown to black cells and in upper half with sparse, in bottom part with dense, pallid to median brown flexuous setae 50–54 μm long and 3 μm wide at base, obtuse at the ends. Asci 70.5–103 × 15.5–17.2 μm, bitunicate, octosporous, saccate, broadly rounded above. Interthecial filaments lacking. Ascospores (17.2)20.6–22.4(25) × 6.8–7.8(8.9) μm, irregularly 2–3-seriate, brown to grey-brown, broadly fusiform with obtuse ends, 5–7 transverse septa and 1–3 longitudinal or oblique septa in middle cells, occasionally in end cells, slightly constricted at the septa, smooth-walled.

Habitat: on rotten decorticated wood of *Fagus sylvatica*, often covered by a litter or buried in soil; associated with hyphomycetous fungi, e.g. *Brachysporium nigrum*, *Pseudospiropes obclavatus*, *P. simplex*.

Distribution: Czech Republic.

Additional specimen examined: Southern Bohemia: Šumava Mts., Černý Kříž near Volary, on the slopes of Mt. "Srnčí vrch" (1068 m a.s.l.); on decorticated fallen branch of *Fagus sylvatica*, 13.IX.1995, leg. et det. M. Réblová (Herb. M. Réblová 720/95).

C. mansonii (Schol-Schwarz) E. Müll. et al. is closely related but differs in having densely setose ascomata, smaller asci (40–45 × 11–13 μm) and ascospores with longitudinal septum in each transverse segment. *C. collapsa* (Mathiassen) Barr is related but has smaller asci (45–65 × 9–12 μm) and ascospores ((10)12–18 × 3.5–5.5 μm) with three transverse septa only. *C. chlorospora* Barr reported from North America (Barr 1991) has noncollabent ascomata bearing very short dark setae and has somewhat smaller ascospores (12–18(20) × (5.5)7–9 μm) and longitudinal septa in all middle cells.

Rhinocladiella —like hyphomycetous species with holoblastic conodiogenesis growing out of the peridia of old ascomata have been observed, it has not been grown in culture.

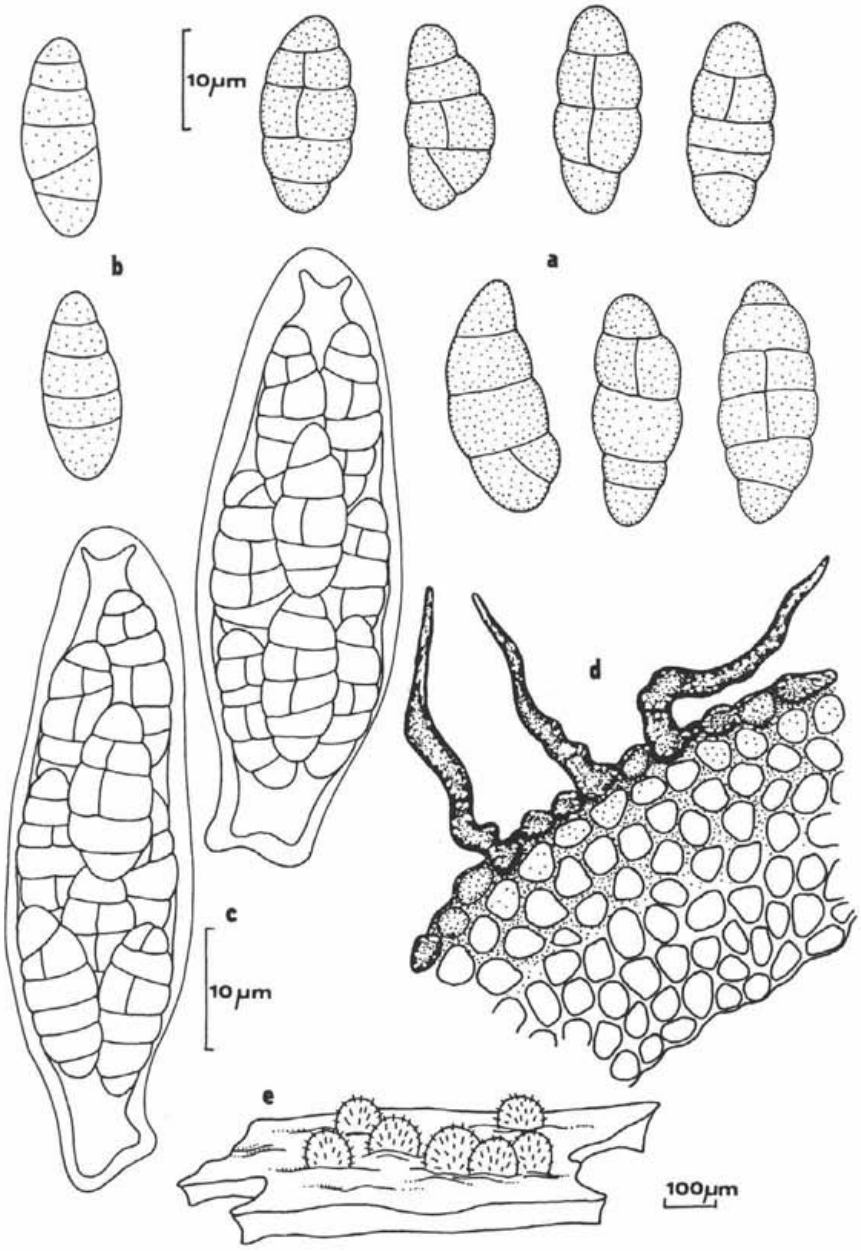

Fig. 2. *Capronia svrcekiana* Réblová (PRM 830880).
a-mature ascospores, b-young ascospores, c-asci with ascospores, d-vertical section of ascoma, e-ascomata. Del.: M. Réblová

Capronia svrcekiana Réblová, sp. nov. Fig. 2 a–d.

Ascomata superficialia, solitaria vel gregaria, basi immersa, subglobosa, non collapsa, non papillata, fusca, 100–150 μm alta vel 90–150 μm lata, pariete 25–30 μm crassa, cellulis protrudentibus atque setis fuscis, flexuosis 19–60(140) × 5–6.8 μm praedita. Asci (56.7)59.3–64.5 × 13–14.6 μm, bitunicati, saccati. Filamenta interthecialia desunt. Ascosporae (14.6)15.5–19(20.6) × 6–6.8 μm, fuscae vel olivaceo-fuscae, fusoideae, septis (3)4–5 transversalibus, 1–2 longitudinalibus praeditae.

Holotypus: Bohemia meridionalis, montes Novohradské hory, in silva virginea Žofínský prales; ad truncum putridum iacentem *Fagi sylvaticae*, 27.V.1967, leg. M. Svrček et J. Kubička, det. M. Réblová (PRM 830880).

Ascomata superficial, scattered to gregarious, base immersed, subglobose, non-papillate, not collabent when dry, dark brown, 100–150 μm high and 90–150 μm wide; ascomatal wall 25–30 μm wide, composed of pseudoparenchymatous cells, its surface roughened by protruding thick-walled, darker brown cells in upper half, densely setose, setae 19–60(140) μm long and 5–6.8 μm at base, unbranched, slightly to hardly flexuous, septate, pointed, densely surrounded ostiolar region and scattered over surface. Asci (56.7)59.3–64.5 × 13–14.6 μm, octosporous, saccate, thick-walled, broadly rounded above. Interthecial filaments lacking. Ascospores (14.6)15.5–19(20.6) × 6–6.8 μm, 2–3-seriate, brown to olivaceous brown, fusiform with obtuse ends, with (3)4–5 transverse septa and a longitudinal septum in one or two middle cells, rarely into end cells, constricted at the septa, smooth.

Habitat: on very soft and rotten wood of *Fagus sylvatica* and *Tilia* sp., also associated with an effuse basidiocarp of primitive Aphyllophorales (*Galzinia* sp.).

Distribution: Czech Republic, Slovac Republic, Germany.

Additional specimens examined: Slovac Republic: Slovenské Rudohoří Mts., Muráňská planina, natural reserve "Poludnica" near Muráň; on rotten wood of branch of *Fagus sylvatica*, 22.IX.1995, leg. et det. M. Réblová (Herbarium M. Réblová 854/95); Germany: Freienfels between Coburg and Bayreuth, MTB 6063; on rotten wood of fallen branch of *Tilia* sp., 23.III.1990, leg. H. Engel, det. M. Réblová (Herbarium H. Engel 12723); idem., MTB 6063; on fallen decorticated branch of *Tilia* sp., 31.XII.1990, leg. H. Engel, det. M. Réblová (Herbarium H. Engel 13850).

C. svrcekiana is intermediate between *C. perpusilla* and *C. pilosella* (Karsten) E. Müll. et al. The latter species has ascospores 12–16 × 4–6 μm, constantly with 3 transverse septa and occasionally with one longitudinal septum in middle cells, ascomata with a conical papilla, surrounded by thick-walled, short erected hairs at the top. *C. coronata* Samuels resembles *C. svrcekiana* by the partially immersed

ascomata, slightly flexuous setae and comparable size of asci, but differs in size and septation of the ascospores. From North America, the similar *C. arctica* Barr was described (Barr 1991) from wood of *Salix reticulata*, which differs in possessing somewhat larger ascospore dimensiones (18–32(45) × 6.5–9 μm) with pointed ends and the longitudinal septum in the middle of most cells.

There are other two *Capronia* species, *C. parasitica* (Ellis et Everh.) E. Müll. et al. and *C. spinifera* (Ellis et Everh.) E. Müll. et al., growing on old resupinate basidiomycetous fungi. The former has 9–11 × 3.5–4 μm large ascospores with three transverse septa, the latter has ascospores (10)12–15.5 × 3.5–4.5 μm large, usually with three, occasionally with 4 to 5 transverse septa.

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New localities of Pilatoporus ibericus in Europe and Asia

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Vampola P. (1996): New localities of Pilatoporus ibericus in Europe and Asia.– Czech Mycol. 49: 85–90

The very rare polypore Pilatoporus ibericus (Melo et Ryv.) Kotl. et Pouz. is reported from the Czech Republic, Slovakia, Croatia and Iran for the first time. Study of the sexuality of pure cultures has shown that P. ibericus is heterothallic and bipolar.

The type species of the genus Pilatoporus, Polyporus palustris Berk. et Curt., was studied microscopically in detail. The presence of thick-walled and only rarely clamped sclerified generative hyphae in tissue of its basidiocarps is introduced as a new and for the genus Pilatoporus very important and characteristic feature. The new combination Pilatoporus spraguei (Berk. et Curt.) Vampola is proposed. The type specimen of the recently described polypore Pilatoporus maroccanus Kotl. et Pouz. was compared with the widely known species Trametes suaveolens Fr. Neither macroscopic nor microscopic study of its basidiocarps showed any marked distinguishing features, except for the slightly smaller spores of the former.

Key words: Pilatoporus, polypores, Aphyllophorales, sexuality, hyphal systems.

Vampola P. (1996): Nové lokality Pilatoporus ibericus v Evropě a Asii. – Czech Mycol. 49: 85–90

Velmi vzácný choroš bělotroudnatec iberijský — Pilatoporus ibericus (Melo et Ryv.) Kotl. et Pouz. je poprvé uváděn z České republiky, Slovenska, Chorvatska a Íránu. Studiem sexuality čistých kultur bylo zjištěno, že jde o druh heterothalický a bipolární.

Typový druh rodu Pilatoporus, a to Polyporus palustris Berk. et Curt., byl detailně mikroskopicky studován. Přítomnost tlustostěnných a pouze vzácně přezkatých sklerifikovaných generativních hyf v tkáni plodnic tohoto druhu je uváděna jako nový a pro rod Pilatoporus velmi důležitý charakteristický znak. Je navržena nová kombinace pro bělotroudnatce Sprague ova — Pilatoporus spraguei (Berk. et Curt.) Vampola. Typová položka nedávno popsaného choroše Pilatoporus maroccanus Kotl. et Pouz. (Kotlaba a Pouzar 1993) byla srovnávána s všeobecně známým druhem outkovkou vonnou — Trametes suaveolens Fr. Jak makroskopickým, tak mikroskopickým studiem plodnic nebyly, kromě nepatrně menších výtrusů P. maroccanus, zjištěny žádné zjevné rozdílné znaky.

The rare polypore *Pilatoporus ibericus* (Melo et Ryv.) Kotl. et Pouz. was described as a new species only seven years ago (Melo and Ryvarden 1989) and is so far know in Europe from Portugal, France, Italy and Austria (Ryvarden and Gilbertson 1993). The new localities proved the range of this thermophilous polypore to cover not only the Mediterranean area but also Central Europe north to the Czech Republic and Slovakia, and the Middle East into Iran. With the new records the number of known hosts has increased as well. *P. ibericus* is now known

	MJ 58/95 - 1	MJ 58/95 - 2	MJ 58/95 - 3	MJ 54/95 - 2	MJ 54/95 - 12	MJ 54/95 - 13	MJ 54/95 - 14	LISU 6414 - 1	LISU 6414 - 2	LISU 6414 - 3	LISU 6414 - 4
MJ 58/95 - 1	0	-	-	+	+	+	+	+	+	+	+
MJ 58/95 - 2	-	0	-	+	+	+	+	+	+	+	+
MJ 58/95 - 3	-	-	0	+	+	+	+	+	+	+	+
MJ 54/95 - 2	+	+	+	0	-	-	+	+	+	+	+
MJ 54/95 - 12	+	+	+	-	0	-	-	+	+	+	+
MJ 54/95 - 13	+	+	+	-	-	0	-	+	+	+	+
MJ 54/95 - 14	+	+	+	+	-	-	0	+	+	+	+
LISU 6414 - 1	+	+	+	+	+	+	+	0	-	-	-
LISU 6414 - 2	+	+	+	+	+	+	+	-	0	-	-
LISU 6414 - 3	+	+	+	+	+	+	+	-	-	0	-
LISU 6414 - 4	+	+	+	+	+	+	+	-	-	-	0

Fig. 1. Results of pairings of haploid mycelia of *Pilatoporus ibericus* (Melo et Ryv.) Kotl. et Pouz. from 3 carpophores collected on 3 different hosts in 2 countries (Portugal and Czech Republic); each (+) denotes the formation of hyphae with clamp-connections at the line where monosporic mycelia meet, each (-) a failure to form such hyphae with clamp-connections.

not only from species of the genera *Quercus* and *Pinus* but also from *Carpinus* and *Fraxinus*.

NEW LOCALITIES OF *P. ibericus*:

Europe:

Czech Republic, Moravia, Břeclav distr., Lanžhot, Ranšpurk Virgin Forest, alt. c. 150 m, on fallen trunk of *Fraxinus angustifolia* subsp. *danubialis*, 7. VII. 1990, leg. A. Černý, M. Jaquenoud, J. Kuthan, A. Vágner and P. Vampola, det. P. Vampola 1995 (MJ 427/90); ibid. 19. VI. 1993, 19. VI. 1995, leg. et det. P. Vampola (MJ 194/93, 54/95); ibid. on fallen trunk of *Carpinus betulus*, 19. VI. 1993, 19. VI. 1995, leg. et det. P. Vampola (MJ 160/93, 58/95 — Fig. 5).

Slovakia, Senica distr., Lakšárska Nová Ves, military rifle-range Mikulášov, on stump of ? *Pinus sylvestris*, 18. VI. 1994, leg. T. Kukulka, det. P. Vampola (MJ 250/94).

	MJ 54/95 - 1	MJ 54/95 - 2	MJ 54/95 - 4	MJ 54/95 - 5	MJ 54/95 - 6	MJ 54/95 - 7	MJ 54/95 - 9	MJ 54/95 - 10	MJ 54/95 - 12	MJ 54/95 - 13	MJ 54/95 - 3	MJ 54/95 - 8	MJ 54/95 - 11	MJ 54/95 - 14	MJ 54/95 - 15	MJ 54/95 - 16
MJ 54/95 - 1	0	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 2	-	0	-	-	-	-	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 4	-	-	0	-	-	-	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 5	-	-	-	0	-	-	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 6	-	-	-	-	0	-	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 7	-	-	-	-	-	0	-	-	-	-	+	+	+	+	+	+
MJ 54/95 - 9	-	-	-	-	-	-	0	-	-	-	+	+	+	+	+	+
MJ 54/95 - 10	-	-	-	-	-	-	-	0	-	-	+	+	+	+	+	+
MJ 54/95 - 12	-	-	-	-	-	-	-	-	0	-	+	+	+	+	+	+
MJ 54/95 - 13	-	-	-	-	-	-	-	-	-	0	+	+	+	+	+	+
MJ 54/95 - 3	+	+	+	+	+	+	+	+	+	+	0	-	-	-	-	-
MJ 54/95 - 8	+	+	+	+	+	+	+	+	+	+	-	0	-	-	-	-
MJ 54/95 - 11	+	+	+	+	+	+	+	+	+	+	-	-	0	-	-	-
MJ 54/95 - 14	+	+	+	+	+	+	+	+	+	+	-	-	-	0	-	-
MJ 54/95 - 15	+	+	+	+	+	+	+	+	+	+	-	-	-	-	0	-
MJ 54/95 - 16	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	0

Fig. 2. Results of pairings in 120 possible combinations of 16 monosporic mycelia of *Pilatoporus ibericus* (Melo et Ryv.) Kotl. et Pouz. (MJ 54/95); each (+) denotes the formation of hyphae with clamp-connections at septa at the line where monosporic mycelia of a given pair meet and each (-) a failure to form such hyphae.

Croatia, island Rab, on stump of *Pinus* sp., 23. IX. 1994, leg. L. Varjú, det. P. Vampola (MJ 483/94).

Asia:

Iran, Darab Kola Nagandaran, on *Carpinus betulus*, 9. V. 1971, leg. Steyaert, det. P. Vampola 1995 (IRAN 14, PRM 776860).

The identifications of *P. ibericus* were confirmed by comparing them with a specimen collected by I. Melo (author of the species) on *Pinus pinaster* in Portugal, 25. XI. 1994 (LISU 6414).

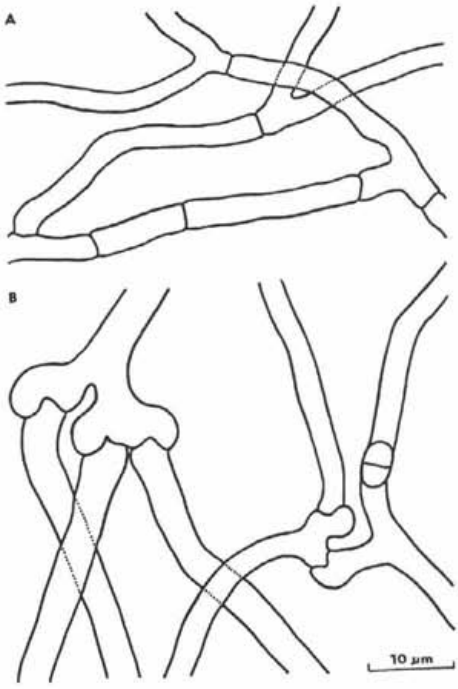

Fig. 3 *Pilatoporus ibericus* (Melo et Ryv.) Kotl. et Pouz. A) Monokaryotic mycelium (MJ 54/95 — 14), B) dikaryotic mycelium at the meeting line (MJ 54/95 — 14, LISU 6414 — 4).

Del. P. Vampola

Besides macroscopic and microscopic comparative studies of the basidiocarps, the pure cultures of this species were studied as well. Interfertility tests with monosporic cultures isolated from basidiocarps from Portugal (LISU 6414) and Moravia (MJ 54/95, 58/95) were positive and pairings occurred between cultures from both countries. These mutual pairings of monosporic cultures from two localities and three different hosts performed on 40 plates were positive in all cases (Fig. 1). The interfertility tests also confirmed that populations growing on hardwoods and populations from conifers are conspecific.

P. ibericus is heterothallic and bipolar. This was confirmed by the results of mutual pairings of 16 monosporic cultures isolated from the specimen MJ 54/95. In 120 possible combinations compatible matings occurred in 60 cases, i. e. 50 % (Fig. 2).

Pilatoporus ibericus was originally described in the genus *Fomitopsis* (Melo and Ryvarden 1989). Nevertheless, its classification within the recently described genus *Pilatoporus* (Kotlaba and Pouzar 1990) seems to be an acceptable solution

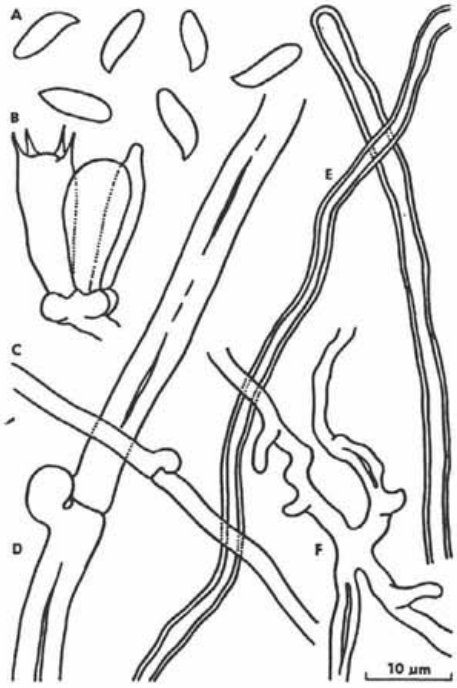

Fig. 4 *Pilatoporus ibericus* (Melo et Ryv.) Kotl. et Pouz. Microfeatures of basidiocarps (MJ 194/93). A) Spores, B) fragment of hymenium, C) thin-walled generative hypha, D) sklerified generative hypha, E) skeletal hyphae, F) binding hypha. Del. P. Vampola

(Kotlaba and Pouzar 1993). The genus *Fomitopsis* is rather heterogeneous and the exclusion of annual species with white context is certainly correct. Although the authors of the generic name *Pilatoporus* (Kotlaba and Pouzar 1990) in my opinion overestimate the slight difference in the thickness of the spore wall, this genus should be accepted. In addition to the fact that all species of *Pilatoporus* have exclusively annual basidiocarps, the whitish context and the absence of a crustaceous pileal surface are very good distinguishing features as well.

I had an opportunity to study ample herbarium material of the type species of *Pilatoporus*, *Polyporus palustris* Berk. et Curt., from different places in America. I would like to draw attention to another distinct and important feature: contrary to typical members of *Fomitopsis* s. s., special strikingly thick-walled and only rarely clamped generative hyphae can be found in the tissue of the basidiocarps of *Polyporus palustris*. These sclerified generative hyphae imitate so strongly the skeletal or binding hyphae, that their nature could easily be overlooked. The presence of rare clamps, however, reveals their identity. Besides the American *P. palustris*,

similar sclerified hyphae have been observed in all studied specimens of *Pilatoporus ibericus* (LISU 6414, HUBO 4937, PRM 776 860, MJ 427/90, 160/93, 194/93, 250/94, 483/94, 54/95, 58/95). Sclerified hyphae in the basidiocarps of *P. ibericus*, however, seem to be very rare and their observation can sometimes be rather difficult especially in badly dried specimens.

Pilatoporus spraguei (Berk. et Curt.) Vampola comb. nov. (basionymum *Polyporus spraguei* Berk. et Curt., Grevillea 1: 50, 1872) undoubtedly belongs to the same group — the sclerified generative hyphae in the tissue of its basidiocarps are well perceptible (HUBO 5047). Regarding this microscopical feature also the other species classified in *Pilatoporus* should in future be studied in detail. The presence of sclerified hyphae in the tissue of the basidiocarps also suggests that *Pilatoporus* is very closely related to *Tyromyces* s. l. and seems to pose a natural link between the genera *Fomitopsis* s. s. and *Tyromyces* s. l.

During the study of *Pilatoporus ibericus* the type specimen of the recently described *Pilatoporus maroccanus* Kotl. et Pouz. was revised as well. This species was described on the basis of only one find on a living trunk of *Cupressus sempervirens* in Morocco (Kotlaba and Pouzar 1993). The authors of the new species mentioned a brown rot of the wood in their description. However, no pieces of wood were found in the type specimen and this statement could not be confirmed. Correct identification of the type of rot can sometimes be very difficult in the field, especially when the host is furthermore attacked by another and not yet fruiting species. Unfortunately, in the case of *P. maroccanus*, no pure culture was isolated from fresh basidiocarps at the time and therefore oxidase reactions cannot be used for the determination of the type of rot. Both macroscopic and microscopic features of *P. maroccanus* seem to fit with the widely known species *Trametes suaveolens* Fr. Except the only slightly smaller spores of the former, no other significant distinguishing features were found in a comparison of both species. Although *T. suaveolens* grows almost exclusively on hardwoods, its exceptional occurrence on conifers (known from North America) could not be excluded. Further specimens from Morocco or other countries where *Cupressus sempervirens* occurs are badly needed to prove that *P. maroccanus* is really an independent species and not only a synonym of *Trametes suaveolens*.

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CZECH MYCOL. 49 (2), 1996

Growth and production of extracellular proteases by the fungus Aspergillus fumigatus on various media I. Media without proteins

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Kunert J. (1996): Growth and production of extracellular proteases by the fungus Aspergillus fumigatus on various media. I. Media without proteins. – Czech Mycol. 49: 91–106

A strain of Aspergillus fumigatus was grown on ten nutrient media containing glucose and various (organic and inorganic) sources of nitrogen. Growth of the mycelia, pH of the cultivation fluid, uptake of nutrients and proteolytic activity on haemoglobin at pH 3 and on azocasein at pH 7.5 were assessed. The aim of the study was to find the physiological conditions for the production of extracellular proteases. High activities of alkaline protease(s) were found only when the following three conditions were fulfilled: (a) exhaustion of glucose from the medium, (b) reaching of the maximum mycelium dry weight, (c) rise of the medium pH to at least 7. These three factors are causally related and coincide in time so that they can hardly be evaluated individually. A neutral to alkaline pH is certainly a necessary condition and a steep rise in pH may itself be a sufficient triggering factor for the synthesis of protease(s). The presence of proteins and/or peptides as inducers is probably not quite necessary but is nevertheless strongly stimulating. The activity of acid (aspartic) protease was small to negligible on all media and its production clearly depended only on the pH of the medium (optimum pH 4 to 6).

Key words: Aspergillus fumigatus, virulence, extracellular proteases, enzyme induction

Kunert J. (1996): Růst a tvorba extracelulárních proteáz houbou Aspergillus fumigatus na různých půdách. I. Půdy neobsahující bílkoviny. – Czech Mycol. 49: 91–106

Kmen Aspergillus fumigatus byl pěstován na deseti živných půdách s glukózou a různými (organickými i anorganickými) zdroji dusíku a sledován růst mycelia, pH kultivační tekutiny, využívání živin a proteolytická aktivita v pH 3 na hemoglobinu a pH 7,5 na azokaseinu. Hlavním cílem bylo nalézt fyziologické podmínky pro sekreci extracelulárních proteáz. Větší aktivity alkalické proteázy (proteáz) byly nalezeny jen při splnění tří podmínek: a) vyčerpání glukózy z média b) dosažení maximální sušiny mycelia c) vzestup pH média nad cca 7. Zmíněné faktory jsou při vývoji kultur příčinně spojeny a časově korelovány, takže je lze těžko posuzovat jednotlivě. Neutrální až alkalické pH je s určitostí podmínkou nutnou a sám prudký vzestup pH v médiu může být někdy pro tvorbu proteázy postačujícím signálem. Přítomnost peptidů a/nebo bílkovin jako induktorů není zřejmě zcela nutná, ale produkci proteázy silně stimuluje. Aktivita kyselé (aspartátové) proteázy byla u všech půd jen malá až nepatrná a její sekrece závisela zřetelně pouze na pH média (optimální pH 4 až 6).

Aspergillus fumigatus is an important opportunistic fungus and the main causative agent of aspergillosis in humans. Inhalation of airborne conidia by immunocompromised individuals may lead to invasive aspergillosis which is fatal in up to 90 % of the cases.

Among the putative factors of *Aspergillus* virulence an important role is ascribed to proteolytic enzymes ("elastases"). The latter have been studied intensively in the past few years, since advanced methods of biochemistry and molecular genetics have become available. The main alkaline serine protease of the subtilisine type was purified from various strains (Reichard et al. 1990, Monod et al. 1991, Frosco et al. 1992, Larcher et al. 1992, Kolattukudy et al. 1993), followed by a neutral metalloprotease (Monod et al. 1993, Markaryan et al. 1994) and an "acid" (aspartic) protease (Reichard et al. 1994, Lee and Kolattukudy 1995). Although the investigation of these three enzymes had already reached the molecular level of study, little attention was paid to physiology and regulation of their production under different circumstances.

In the seventies, these questions were addressed by Cohen (see e.g. Cohen 1973) in *A. nidulans*. He concluded on the basis of experiments with the transfer of growing mycelium into fresh media lacking some essential nutrients ("shift-down") that the presence of proteins was not a pre-requisite for the synthesis of extracellular proteases. Decisive was derepression caused by the absence of a suitable source of carbon, nitrogen or sulphur in the medium. Good sources of C, N and S (e.g. glucose, ammonium ions or methionine) repressed the synthesis; the repression by ammonium ions was especially strong. The same regulatory system was later found in 25 strains of 21 species of the genus *Aspergillus* (Cohen 1981), and some recent results (Katz et al. 1994) confirm its existence in *A. nidulans*. However, Srinivasan and Dhar (1990) could not achieve the production of proteases by simple derepression without the presence of proteins in their strain of *A. flavus*. The role of proteins as inducers of the synthesis of proteases has been shown in many fungi, e.g. in *Neurospora crassa* (Cohen and Drucker (1977) and *Candida albicans* (Lerner and Goldman 1993).

Because the data on the regulation of protease production in *A. fumigatus* are scattered and hard to generalize we thought it useful to study these questions systematically.

MATERIAL AND METHODS

The *Aspergillus fumigatus* strain Afu-1 isolated from the lung of a chicken with invasive aspergillosis was used throughout. It was kept on Sabouraud glucose (4 %) — peptone (1 %) agar at 26 °C. The conidia from 7 days old cultures on this medium were suspended in sterile distilled water by shaking with glass beads. The suspension was filtered through cotton wool, counted in a haemocytometer and diluted to about 10^6 spores per ml.

Ten media of the following composition (g/l) were used:
(1) glucose 9, bacto-peptone 1; (2) glucose 8, peptone 2; (3) glucose 6, peptone 4; (4) glucose 9, L-glutamine 1; (5) glucose 8, L-glutamine 2; (6) glucose 8, L-serine 2;

(7) glucose 6, L-glutamic acid, L-arginine, L-proline, L-serine and L-tyrosine 0.75 each; (8) glucose 9, ammonium tartrate 1; (9) glucose 8, ammonium tartrate 2; (10) glucose 8, sodium nitrate 2. The main nutrients were dissolved in a mineral solution containing 400 mg KH_2PO_4, 50 mg $MgSO_4.7\ H_2O$, 10 mg $CaCl_2.2\ H_2O$, 5 mg $FeCl_3$, 5 mg $ZnSO_4.7H_2O$ and 5 mg $MnCl_2.4\ H_2O$ per litre. The media were adjusted to pH 6.5 + 0.1 and sterilized by autoclaving. In media nrs. 5 and 6 glutamine was added as a concentrated solution sterilized by filtration.

Fifteen ml of the medium in 100 ml cotton wool-stoppered conical flasks were inoculated with 0.1 ml of spore suspension and the cultures incubated at 28 + 0.5 °C without shaking. At various time intervals three cultures were taken, filtered through pre-weighed paper filters and the dry weight of the mycelia measured after drying at 90 °C. In the cultivation fluid pH, concentration of the remaining nutrients and proteolytic activity at pH 3 and pH 7.5 were determined. The values presented are arithmetic means of three measurements in parallel cultures.

Glucose was assayed with glucose oxidase using a commercial set (Bio-La-Test, Lachema, Brno, Czech Republic) and peptide substances by the Lowry method, calibrated with bacto-peptone. The concentration of ammonium ions was determined colorimetrically by the Berthelot reaction (Bio-La-Test Oxochrom Urea) and that of nitrate by capillary isotachophoresis on the Agrophor apparatus (Development Laboratories of Palacký University, Olomouc, Czech Republic). As leading electrolyte 0.006 M HCl was used and 0.01 M n-caproic acid was the terminating electrolyte. The uptake of amino acids from the medium was followed semiquantitatively by thin layer chromatography on silica gel (Silufol^R plates, Cavalier Glassworks, Sázava, Czech Republic). For elution 70 % n-propanol was used and the substances detected with ninhydrin reagent containing cupric ions (Brenner and Niederwieser 1960).

For the assay of acid protease activity 2 ml 2 % acid –denatured bovine haemoglobin (Sigma, St. Louis, USA) in a 0.2 M citrate buffer (pH 3.0) and 1 ml cultivation fluid were mixed. After 1 hour at 40 °C 0.3 ml 40 % trichloracetic acid was added, left at 40 °C for 30 min., the precipitate centrifuged off and the concentration of peptides in the supernate determined by the Lowry method. To the blank trichloracetic acid was added before the sample. One arbitrary unit of enzyme activity corresponded to an increase in absorbance of 0.1 at 500 nm.

The activity of alkaline protease was assayed on azocasein synthesized according to Langner et al. (1973). To 2 ml 1 % azocasein in a 0.1 M tris-HCl buffer (pH 7.5) 0.2 to 1 ml of cultivation fluid was added and filled up to the volume of 3 ml with water. Incubation and substrate precipitation were as in the previous procedure. In the supernate, absorbance at 440 nm was measured against the blank. One arbitrary unit of activity corresponded to an increase in absorbance of 0.1. Because the dependence of final absorbance on the activity (estimated by serial dilution

of a highly active sample) was not sufficiently linear, the results were read from a calibration graph.

In the text the terms "acid protease" and "alkaline protease" are used. In fact, the activity measured was very likely the sum of the activities of several enzymes active at the respective pHs.

RESULTS

On medium nr. 1, glucose was present in excess so that the growth was terminated by the exhaustion of the nitrogen source (peptone) on about the 5th day of cultivation (Fig. 1B, 2B). Fast uptake of glucose was, however, terminated earlier (Fig. 2A). A long stationary phase was accompanied by a further — albeit much slower — utilization of glucose. Lowry-positive substances were present in the medium throughout the stationary phase (Fig. 2B). The dynamics of medium pH is shown in Fig. 1A. The activity of acid protease peaked in the mid-exponential phase and increased again in the stationary phase (Fig. 3B). The activity of alkaline protease was low (less than 3 U, Fig. 3A).

On medium nr. 2 the C/N ratio was better balanced, both glucose and peptone were exhausted at the same time (Fig. 2A,B) and the growth was faster. The autolytic phase began soon after cessation of the growth (Fig. 1B). The pH of the medium decreased to 4.2 in the exponential phase but later increased quickly to values above 6 (Fig. 1A). Lowry-positive substances were again present in the medium even after cessation of the growth (Fig. 2B). The activity of acid protease was the highest when the pH of the medium was the lowest and disappeared in the autolytic phase (Fig. 3B). The activity of alkaline protease did not exceed 3.5 U (Fig. 3A).

The relative content of the nitrogen source was further increased in medium nr. 3. This made the growth in the exponential phase faster but did not significantly increase the maximum dry weight (Fig. 1B). By the time the growth stopped (3rd day) glucose was nearly exhausted. The content of peptide substances, however, continued to decrease until the 5th day of cultivation (Fig. 2A,B). An intensive autolysis was accompanied by a steep increase in pH from about 5 up to 8.4 (Fig. 1A) and by an increase in the amount of Lowry-positive substances in the medium (Fig. 2B). Acid protease appeared by the time of minimal medium pH on the 3rd day but disappeared one day later (Fig. 3B). Simultaneously with the rapid increase in pH great amounts of alkaline protease were released (Fig. 2A). Later this activity decreased again.

On media nrs. 4 and 5 the source of nitrogen was 0.1 % and 0.2 % glutamine, respectively. The development of the cultures on both media was similar with respect to growth rate, maximum dry weight, medium acidification in the exponential phase (Fig. 4A,B) and glucose utilization (Fig. 5). Moreover, according to

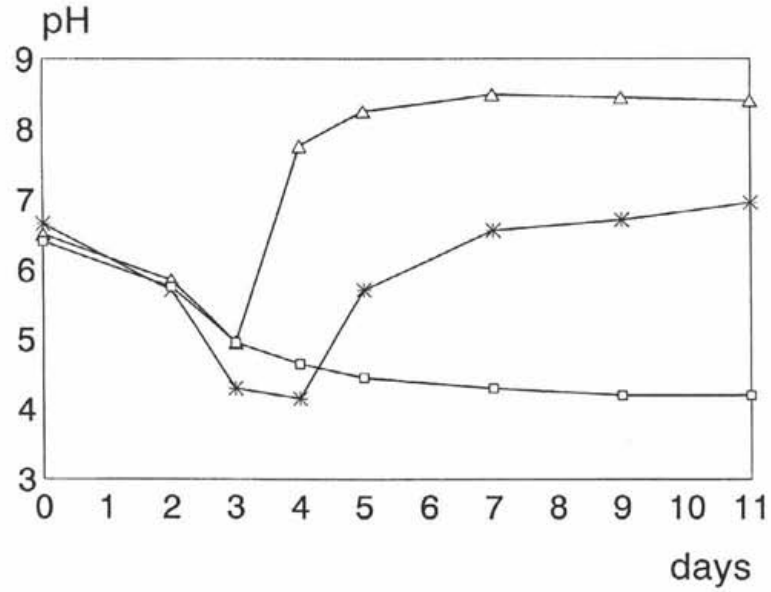

Fig. 1A. pH of the cultivation fluid during growth on glucose-peptone media.
X-axis: time, Y-axis: pH of the cultivation fluid. Squares, asterisks and triangles: medium nrs.1, 2 and 3, respectively.

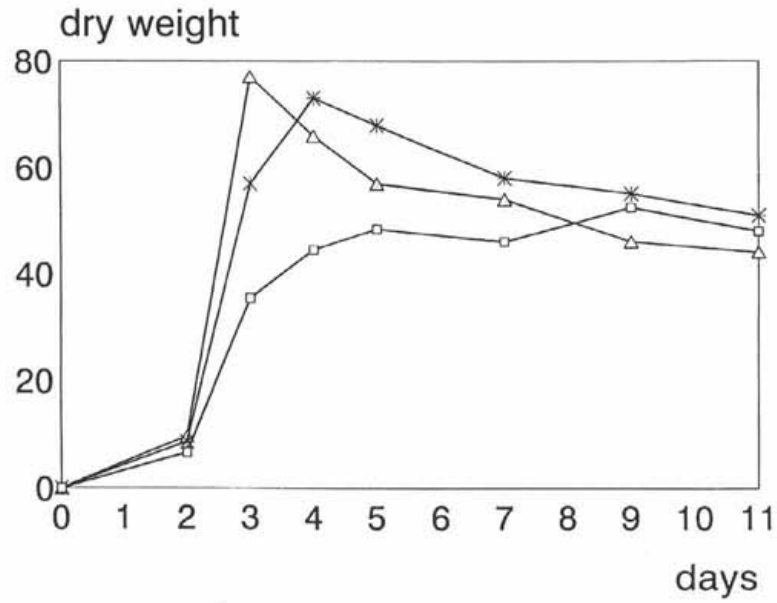

Fig. 1B. Growth of *Aspergillus fumigatus* on glucose-peptone media.
Y-axis: dry weight of the mycelium in milligrams per culture. For legend see Fig. 1A.

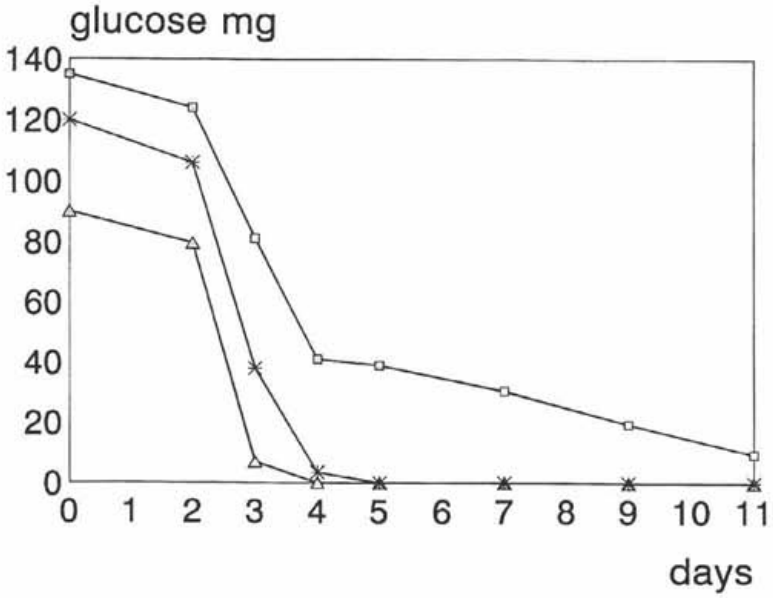

Fig. 2A. Utilization of glucose during growth on glucose-peptone media.
Y-axis: content of glucose in milligrams per culture. For legend see Fig. 1A.

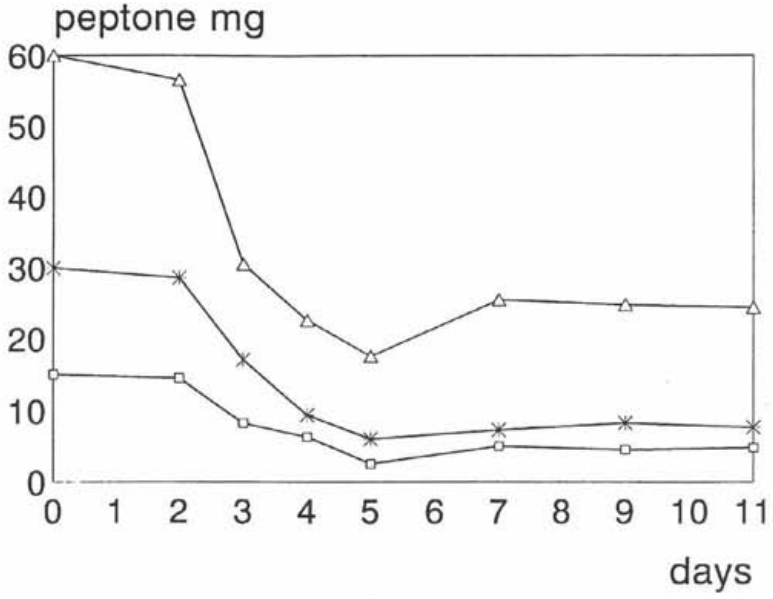

Fig. 2B. Utilization of peptone during growth on glucose-peptone media.
Y-axis: content of peptone (Lowry-positive substances) in milligrams per culture. For legend see Fig. 1A.

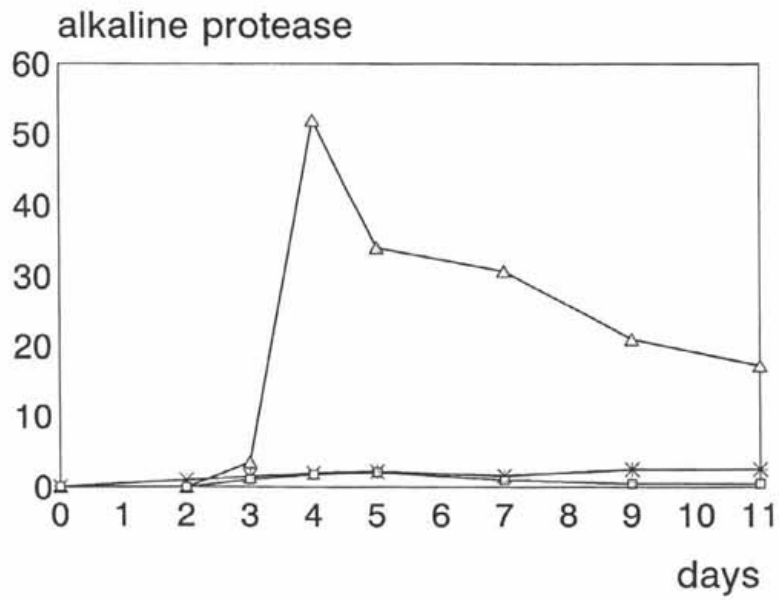

Fig. 3A. Activity of alkaline protease in the cultivation fluid.
Y-axis: activity of alkaline protease in arbitrary units. For legend see Fig. 1A.

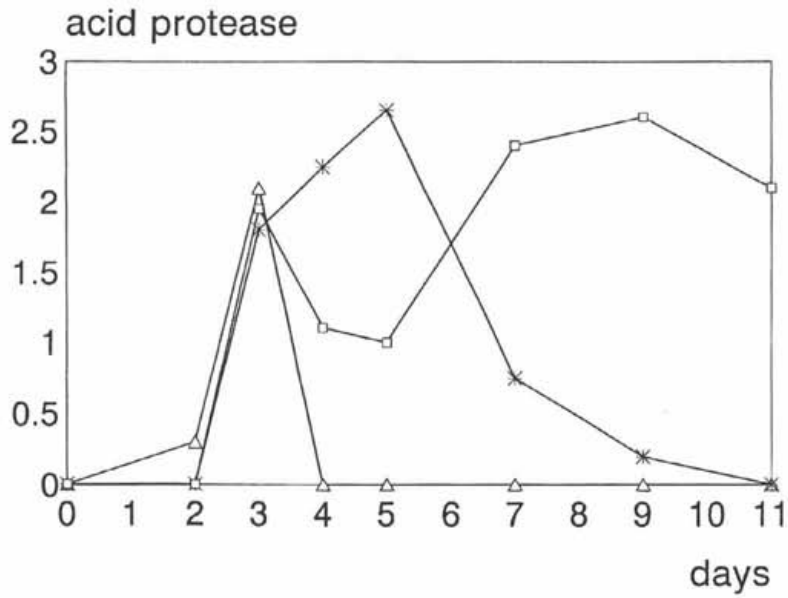

Fig. 3B. Activity of acid protease in the cultivation fluid.
Y-axis: activity of acid proteinase in arbitrary units. For legend see Fig. 1A.

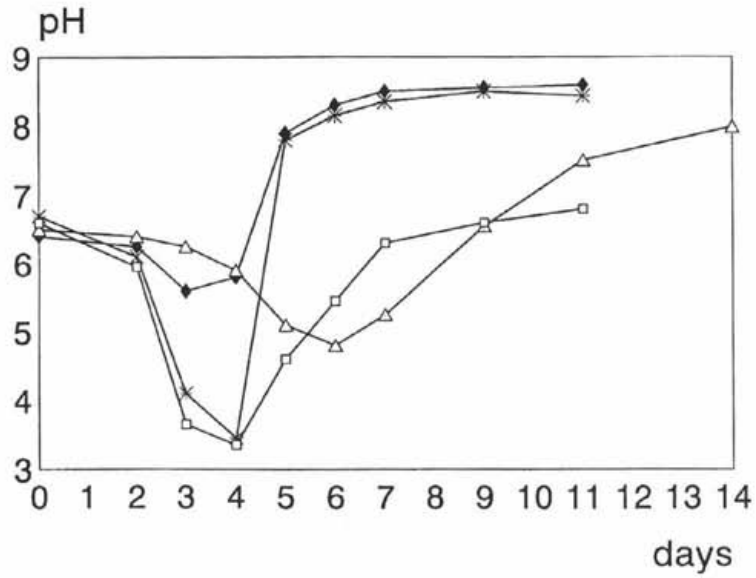

Fig. 4A. pH of the cultivation fluid during growth on media containing glucose and amino acids. X-axis: time, Y-axis: pH of the cultivation fluid. Squares, asterisks, triangles and diamonds: medium nrs. 4, 5, 6 and 7, respectively.

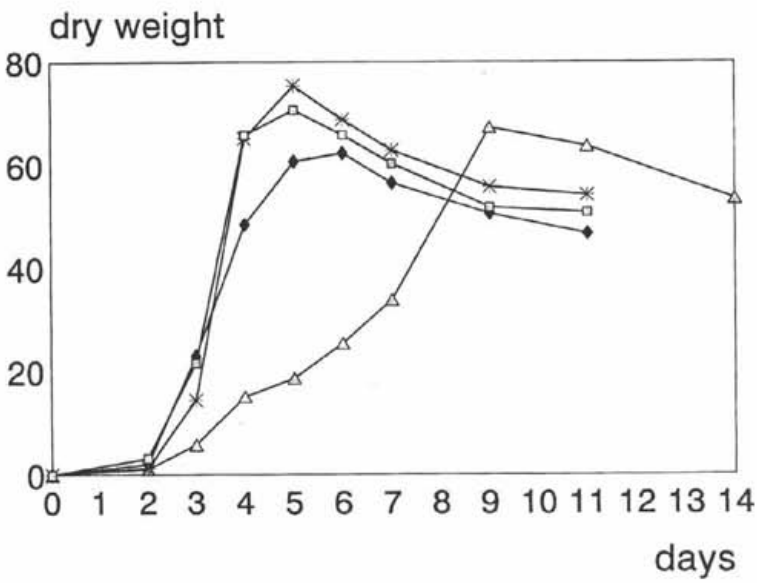

Fig. 4B. Growth of *Aspergillus fumigatus* on media containing glucose and amino acids. Y-axis: dry weight of the mycelium in milligrams per culture. For legend see Fig. 4A.

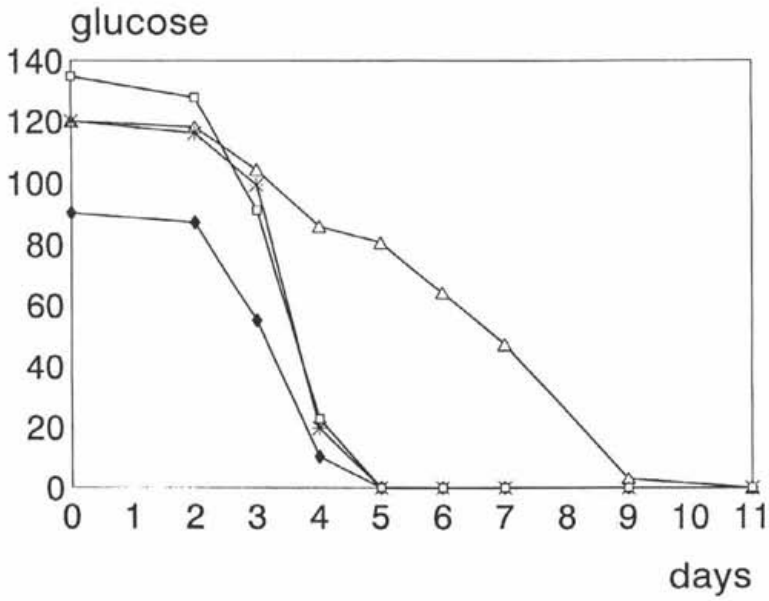

Fig. 5A. Utilization of glucose during growth on media containing glucose and amino acids. Y-axis: content of glucose in milligrams per culture. For legend see Fig. 4A.

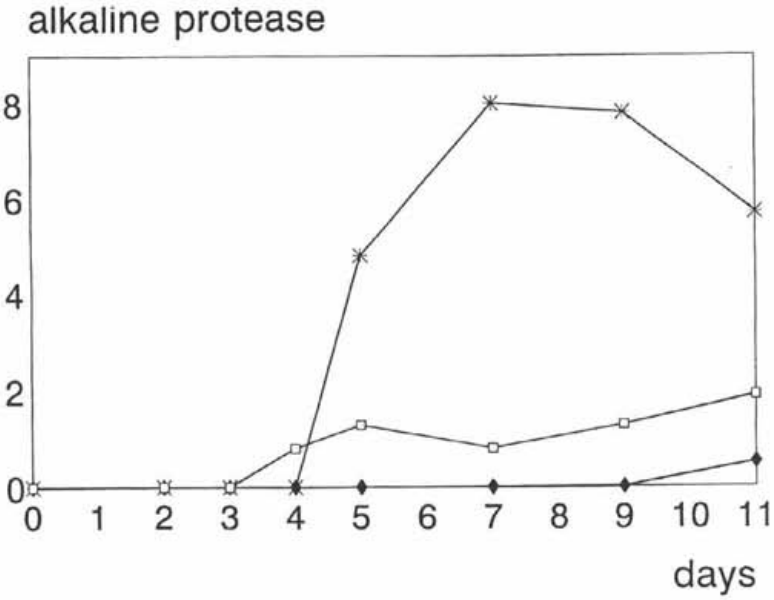

Fig. 6A. Activity of alkaline protease in the cultivation fluid.
Y-axis: activity of alkaline protease in arbitrary units. For legend see Fig. 4A.

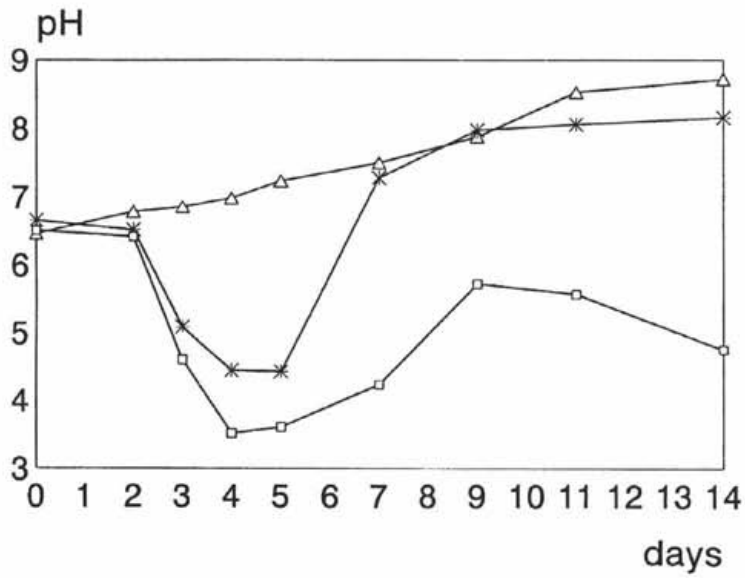

Fig. 7A. pH of the cultivation fluid during growth on media containing inorganic sources of nitrogen.
X-axis: time, Y-axis: pH of the cultivation fluid. Squares, asterisks and triangles: medium nrs. 8, 9 and 10, respectively.

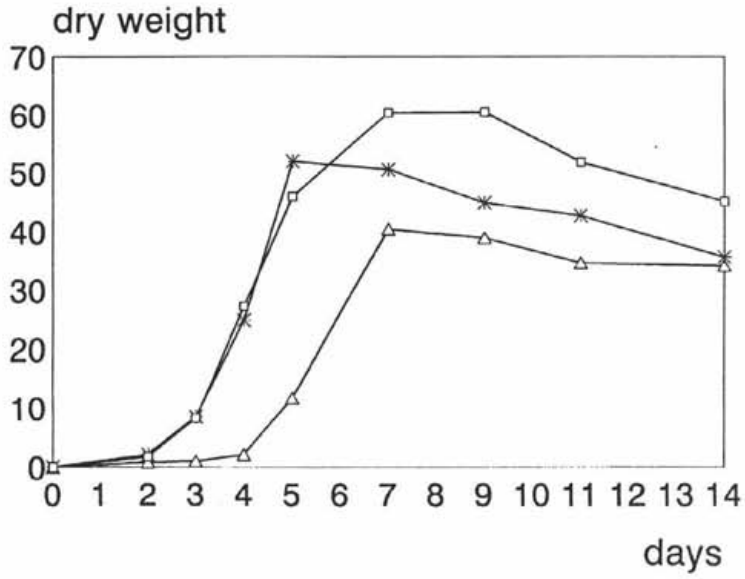

Fig. 7B. Growth of *Aspergillus fumigatus* on media containing inorganic sources of nitrogen.
Y-axis: dry weight of the mycelium in milligrams per culture. For legend see Fig. 7A.

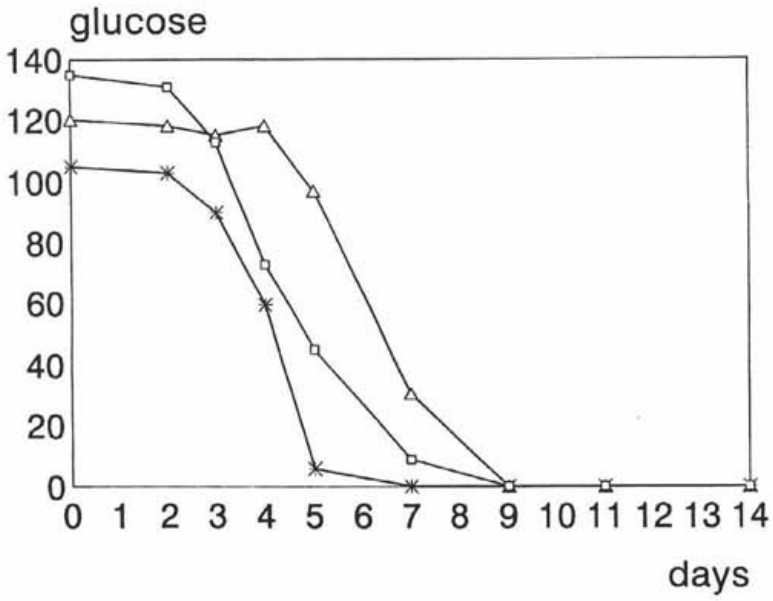

Fig. 8A. Utilization of glucose during growth on media containing inorganic sources of nitrogen. Y-axis: content of glucose in milligrams per culture. For legend see Fig. 7A.

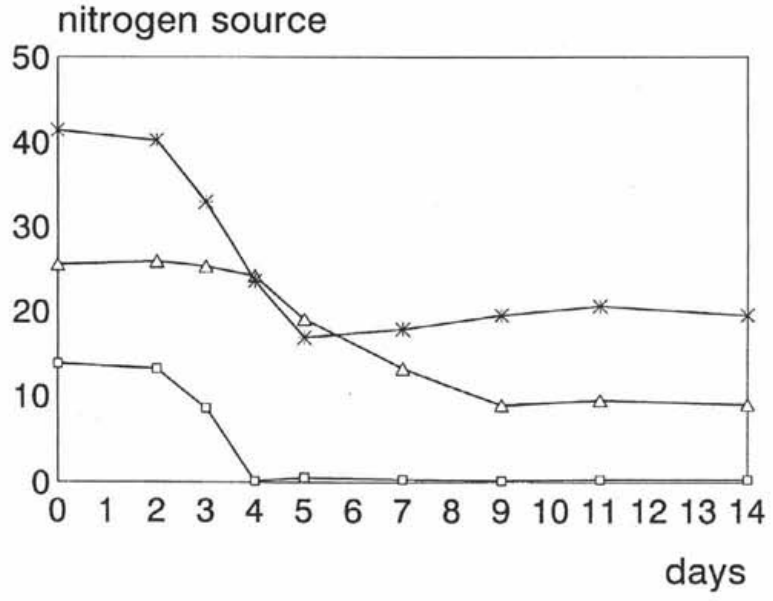

Fig. 8B. Utilization of the inorganic sources of nitrogen.
Y-axis: content of N-source in milligrams per culture. For legend see Fig. 7A.

the results of thin-layer chromatography, glutamine was consumed at the same time (4th to 5th day) from both media. The increase in pH in the autolytic phase was, however, much faster and higher in medium nr. 5 containing more glutamine. A well measurable activity of alkaline protease (up to 8 U, Fig. 6) also appeared on the latter medium only. The activity of acid protease was negligible.

On medium nr. 6 serine was used as the source of nitrogen. This amino acid supported only slow growth (Fig. 4B). Maximum dry weight was reached on the 9th day and by the same time glucose (Fig. 5) and also serine (according to the results of chromatography) were exhausted. The pH of the cultivation fluid decreased to below 5 during active growth but later increased to up to 8 (Fig. 4A). The proteolytic activities were mostly non-detectable, although a small activity of alkaline protease was present as late as in the autolytic phase (Fig. 6).

On medium nr. 7 a mixture of five amino acids (with a total nitrogen content comparable to 0.4 % peptone, cf. medium nr. 3) was used as nitrogen source. Compared to the glucose-peptone medium nr. 3 the growth was slower and the maximum dry weight about 16 % lower (Fig. 4B). Glucose and all amino acids were exhausted by the end of the exponential phase (5th day, Fig. 5). The dynamics of medium pH is shown in Fig. 4A. Proteolytic activities in the cultivation fluid were mostly non-measurable; a small activity of alkaline protease appeared at the end of the experiment (Fig. 6).

Ammonium tartrate (in concentrations of 0.1 and 0.2 %) was used as an inorganic source of nitrogen in media nrs. 8 and 9. In the presence of glucose it enabled medium growth with a maximum dry weight smaller than that on similar media with peptone (Fig. 7B). The cultures on medium nr. 9 with a higher ammonium tartrate content showed faster glucose utilization (Fig. 8A), a rather lower maximum dry weight and a smaller decrease in pH of the medium (Fig. 7A). Ammonium ions were not exhausted at the time of glucose consumption and their concentration increased again in the autolytic phase (Fig. 8B), simultaneously with the fast alkalinization of the cultivation fluid (Fig. 7A). On medium nr. 8 with only 0.1 % ammonium tartrate the development of the cultures was slower (Fig. 7B). Ammonium ions were completely consumed during the exponential phase of the growth and did not appear again in the autolysis (Fig. 8B). The increase in pH of the medium after the cessation of the growth was less pronounced (Fig. 7 A). A small activity (1.8 U at the maximum) of alkaline protease appeared as late as in the autolytic phase on medium nr. 9. There was no detectable activity of acid protease.

The other inorganic N source, sodium nitrate, proved to be a poor nutrient. The growth on medium nr. 10 was rather poor, with a long lag phase and a low maximum dry weight. The stationary phase was long and autolysis slow (Fig. 7B). Glucose was exhausted between the 7th and 9th day of growth, nitrate ions were taken up until the 9th day. About 40 % of nitrate remained in the medium until

the end of the experiment (Fig. 8A,B). The growth was in all phases accompanied by an alkalinization of the medium (Fig. 7A). No activity of the acid protease could be measured, a low (1-2 U) activity of alkaline protease was found in old cultures only.

DISCUSSION

The media used differed in their ability to support growth of the fungus. Best growth was attained on glucose-peptone media (nrs. 2,3) an on medium nr. 5 with glucose and glutamine. Poor media were those with an inorganic source of nitrogen and medium nr. 1 with a lowered content of peptone. The complex nitrogen source (peptone) was better than pure substances including amino acids used individually or in combination.

On five media the growth was terminated by simultaneous exhaustion of both the C and N sources, on media nrs. 3,9 and 10 by exhaustion of the C source (glucose) only. On media nrs. 1 and 8 the N source was consumed first. When glucose was still present in the stationary phase, it continued to be slowly utilized, probably for the growth of the surviving part of the mycelium. Here, substances released from the autolyzing part could have been used as the source of nitrogen. In this way all glucose was consumed during culture development on all media except nr. 1. When peptone was present in excess, it similarly continued to be taken up in the stationary phase after the exhaustion of glucose (medium nr. 3). It might have been utilized as a source of both carbon and nitrogen. A complete exhaustion of peptone from glucose-peptone media could not be determined with certainty because of the release of interfering Lowry-positive substances by the mycelium in the stationary and autolytic phases.

Active growth in the exponential phase was accompanied by an acidification of the medium. Its intensity depended on the C/N ratio, being highest when glucose was present in excess (media nrs. 1,2 and 8, pH as low as 3.5). Thus, acidification of the medium was probably due to the production of organic acids from the catabolism of glucose. Deamination of amino acids and peptides, leading to ammonia production, had an opposite effect. Exceptional was the course of pH on medium nr. 10, where uptake of nitrate ions from sodium nitrate led to the production of sodium hydroxide. The pH values always (with the exception of medium nr. 1 with excess glucose) rose during the stationary and autolytic phases. This was probably due to the release of ammonia during autolysis (cf. concentrations of ammonium ions measured in medium nr. 9, Fig. 8 B). An excess of nitrogen sources stimulated the pH increase. On glucose-peptone media nrs. 2 and 3 the start of medium alkalinization, glucose exhaustion and reaching the maximum dry weight coincided, on the remaining media the rise in pH had already begun in the late exponential phase.

The goal of the present study was to investigate the conditions for the production of extracellular proteolytic enzymes. In experiments with the transfer of growing mycelium to a fresh medium lacking C, N or S sources, this production in aspergilli is triggered by simple derepression (see Introduction). The situation during continuous growth on one medium is obviously different. In our experiments high activities (up to 50 U) of alkaline protease(s) were found only on medium nr. 3 containing substantial amounts of peptone. Medium activities (8 U at maximum) were present on medium nr. 5 containing 0.8 % glucose and 0.2 % glutamine. On both media the protease was induced in the late exponential phase and peaked early in the stationary phase. On the remaining media the activities were low (less than 3 U) and appeared later, often as late as in the autolytic phase.

In general it can be summarized that a high activity of alkaline protease in the media appeared only when (a) glucose had been consumed from the medium, (b) the maximum dry weight of mycelium had been reached, and (c) the pH of the cultivation fluid had risen to about 7 or higher. As stated above, these three conditions are causally related and usually coincide in time. It is thus difficult to analyze them separately. An exhaustion of glucose (the C source) was a necessary condition for the production of alkaline protease(s), in accordance with literature data on the absence of proteolytic activity on media rich in glucose (Klapper et al. 1973, Srinivasan and Dhar 1990, Monod et al. 1991, Jaton-Ogay et al. 1992, Bouchara et al. 1993, Katz et al. 1994, Tomee et al. 1994). In contrast, some authors found the production of proteases on media containing glucose (Reichard et al. 1990, Frosco et al. 1992, Larcher et al. 1992, Moutaouakil et al. 1993, Tronchin et al. 1993). However, these authors did not measure the concentration of glucose in the medium at the moment of protease induction. Consumption of glucose before or simultaneously with the N source did not always lead to the production of protease so that glucose exhaustion is not the only decisive factor.

Similarly, an exhaustion of the source of nitrogen before that of C source (on media nrs. 1 and 8) itself was not sufficient for the induction of protease. The role of peptone in the synthesis of extracellular proteases of *A. fumigatus* may be dual: it is stimulating in lower amounts and inhibiting in higher (0.5 to 1 %) concentrations (Monod et al. 1991, Jaton-Ogay et al. 1992, Larcher et al. 1992, Bouchara et al. 1993, Moutaouakil et al. 1993, Tronchin et al. 1993). The (poly)peptides present act probably as inducers, while ammonium ions are strong repressors (Bouchara et al. 1993).

The production of proteases in the stationary phase after cessation of the growth is a typical phenomenon in fungi. It is, however, hard to say if the main decisive factor is the derepression by the exhaustion of C and/or N sources or if other factors are involved. Increase in pH of the medium to 7 and more (where the alkaline protease of *A. fumigatus* has its optimum) is probably a necessary condition. According to our results, an early and sharp increase in pH is highly

inducing, whereas alkalinization that is slow or shifted to the autolytic phase is usually ineffective. A neutral to alkaline pH was found to be a condition for the production of alkaline proteases by Moutaouakil et al. (1993), too. The results published by Reichard et al. (1990) also point to the importance of the medium pH for the production of proteases.

Some of our results indicate that for the secretion of protease(s) the presence of at least some proteins and/or peptides in the medium is needed in addition to the above mentioned three factors. High protease activities were found only on medium nr. 3 containing well measurable amounts of peptide (Lowry-positive) compounds in the stationary phase while on the similar medium nr. 2 where these compounds were consumed the protease was not produced. In media nr. 7 (with amino acids) and 10 (with sodium nitrate) the three mentioned conditions were fulfilled but in the absence of proteins no proteases were secreted. However, the proteolytic activity was present on glucose-glutamine medium nr. 5 which contained no proteins either. An unusually fast increase in pH (from 3.5 to 7.8 in 24 hours) could be the triggering factor here. Concluding, the presence of proteins and peptides is at least stimulating for the production of proteases in our strain of *A. fumigatus*. The proteolytic activity on media containing proteins is the subject of a following paper (Kunert, in preparation).

The acid (aspartic) protease is an important enzyme in *A. fumigatus*, as shown by the experiments of Reichard et al. (1990, 1994) and Lee and Kolattukudy (1995). These experiments were, however, done on media containing proteins. In the present study acid protease could be found only on glucose-peptone media and its activity was in itself small. Its production was obviously pH-dependent: the activity was present in media with a pH in the acid range (4 to 6) and disappeared in neutral to alkaline cultivation fluid. Acidity of the medium was also postulated by Jarai and Buxton (1994) as the decisive factor. The production of acid protease only on media containing peptone may indicate the role of proteins and/or peptides as inducers.

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Occurrence of phytopathogenous micromycetes of the order Erysiphales in the national park Slovenský raj

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Paulech C. and Paulech P. (1996): Occurrence of phytopathogenous micromycetes of the order Erysiphales in the national park Slovenský raj. – Czech Mycol. 49: 107–118

Fifty five species of phytopathogenous micromycetes of the order Erysiphales from the following genera were detected on investigated territory: Sphaerotheca (12 species), Podosphaera (4), Erysiphe (22), Blumeria (1), Microsphaera (10), Sawadaea (1), Uncinula (2), Phyllactinia (2) and Oidium (1). For individual species the biometric variability of conidia dimensions, cleistothecial diameter, ascus and ascospore dimensions are given. The detected species were parasitizing on 129 host plant species.

Key words: Erysiphales, genera and species, host plants,

Paulech C. a Paulech P. (1996): Výskyt fytopatogénnych mikromycét radu Erysiphales v národnom parku Slovenský raj.– Czech Mycol. 49: 107–118

Na študovanom území bolo zistené 55 druhov fytopatogénnych mikromycét radu Erysiphales z rodov: Sphaerotheca (12 druhov), Podosphaera (4), Erysiphe (22), Blumeria (1), Microsphaera (10), Sawadaea (1), Uncinula (2), Phyllactinia (2) a Oidium (1). Pri jednotlivých druhoch sú uvedené biometrické variability rozmerov konídií, priemeru kleistotécií, rozmerov vreciek a askospór, Zistené druhy parazitovali na 129 druhoch hostiteľských rastlín.

INTRODUCTION

Last century Kalchbrenner contributed to the extension of knowledge of phytopathogenous micromycetes of the order *Erysiphales* on the territory of Spiš, including today's national park Slovak Paradise (Slovenský raj). His herbarium items which are currently deposited in the Slovak National Museum in Bratislava (BRA) document the occurrence of some species of the genera *Sphaerotheca*, *Erysiphe*, *Microsphaera*, *Uncinula* and *Phyllactinia* of the mentioned order. Since that time no study of this group of fungi has been performed on this territory. Recently we have studied the species spectrum, basic morphological characteristics and host plants range of the order Erysiphales on the territory of Slovak Paradise National park. This contribution presents a concise review of the results obtained in our study.

MATERIAL AND METHODS

We have studied the occurrence of the species of the order Erysiphales on the territory of Slovak Paradise National Park as well as herbarium items (BRA) from the investigated territory. The national park Slovak Paradise is situated in the area of eastern Slovakia, south-east ofthe High Tatra Mountains. Its flora belongs to the West-Carpathian flora (Carpaticum occidentale), part Praecarpaticum. The most significant component of vegetation in the area of Slovak Paradise are woods. The largest part of woody area is occupied by beechwood and relict limestone pinewood. Meadow and pasture plant communities belong to the *Cynosurion* alliance. Futák (Futák 1972) briefly and clearly characterize the flora of the Slovak Paradise. Flora and vegetation of this area were described in Pitoňák et al. 1978. Other data can be also found in Michalko et al. 1986. Taxonomical classification and nomenclature for the found species are according to Braun (Braun 1987), for host plants species according to Dostál and Červenka (Dostál and Červenka 1991, 1992). Biometric data of fungus organs were obtained from 50-100 measurements. For fungus organs the following abbreviations were used: C = conidia, length and width in μm, Cl = cleistothecial diameter in μm, A = length and width of ascus in μm, S = length and width of ascospores in μm. Kalchbrenner's species detected on the Spiš territory last century are marked with "+" after the scientific name of their host plants.

RESULTS

Genus **Sphaerotheca** Lév.

Cleistothecial appendages mycelioid, unbranched, basal. With single, mostly 4-8-spored, globose ascus per cleistothecium . Anamorphic stage belonging to the Euodium-type. Mainly parasites of herbaceous plants.

Sphaerotheca fugax Penz. et Sacc.

On *Geranium pratense* L., — Mlynky 22-9-1977, Čingov 10.9.1972, C = 27--36 × 15-19 μm, Cl = 78-98 μm, A = 70-91 × 59-75 μm, S = 18-24 × 12-16 μm.

On *Geranium robertianum* L., — Biele Vody 11-9-1986, sporadic occurrence.

Sphaerotheca euphorbiae (Castagne) E. S. Salmon

On *Euphorbia amygdaloides* L., — Veľký Sokol, Glac, Piecky, Letanovský mlyn, Ihrík, 9— and 10-9-1986, C = 21-33 × 11-16 μm, Cl = 80-108 μm, A = 76-103 × 50--82 μm, S = 18-29 × 11-17 μm.

Sphaerotheca pannosa (Wallr. : Fr.) Lév.

On *Rosa canina* L.$^{+}$, — Dedinky, Letanovský mlyn 10-9-1986, Čingov 13.10. 1972, C = 21-29 × 13-18 μm. No cleistothecia were found.

On *Rosa pimpinellifolia* L., — Ihrík 9-9-1986.

On *Rosa* sp. (cult.), — Čingov 13-10-1972.

Sphaerotheca spiraeae Sawada

On *Spiraea media* F. W. Schmidt^{+}, — Ihrík 9-9-1986, C = 23-35 × 13-21 μm, Cl = 75-105 μm, A = 65-95 × 50-74 μm, S = 18-26 × 12-17 μm.

Sphaerotheca ferruginea (Schlecht. : Fr.) L. Junell

On *Poterium sanguisorba* L., — Košiarny briežok 23-9-1977, C = 24-32 x 13--17 μm, Cl = 75-98 μm, A = 50-70 × 39-68 μm, S = 17-27 × 12-16 μm.

Sphaerotheca epilobii (Wallr.) Sacc.

On *Epilobium montanum* L., — Letanovský mlyn, Tomašovský výhľad 9-9- -1986, C = 20-30 × 12-18 μm, Cl = 78-93 μm, A = 68-81 × 50-64 μm, S = 16--24 × 12-16 μm.

Sphaerotheca aphanis (Wallr.) U. Braun

On *Agrimonia eupatoria* L., — Dedinky 22-9-1977.

On species of the genus *Alchemilla* L., — Mlynky, Dedinky, Geravy 22-9-1977, Vernár (meadows), Besník 11-9-1986, Kláštorisko 21-9-1977, Čingov 11-8-1972, C = 24-36 × 14-21 μm, Cl = 72-100 μm, A = 60-97 × 50-75 μm, S = 16-25 × 12--18 μm, common species in most of the area Slovak Paradise National Park.

Sphaerotheca fuliginea (Schlecht. : Fr.) Pollacci

On *Pseudolysimachion spicatum* (L.) Opiz, — Ihrík 9-9-1986,

On *Veronica officinalis* L., — Kláštorisko 21-9-1977, C = 22-36 × 12-19 μm, Cl = 69-95 μm, A = 60-80 × 50-64 μm, S = 20-26 × 12-18 μm.

Sphaerotheca delfinii (P. Karst.) S. Blumer

On *Trollius altissimus* Crantz , — Mlynky 1-9-1986, C = 24-33 × 12-17 μm, without cleistothecia.

Sphaerotheca thalictri (L.) Junell

On *Thalictrum aquilegiifolium* L.$^{+}$ (Spiš, Kalchbrenner).

Sphaerotheca fusca (Fr.) S. Blumer

On *Bidens cernua* L.$^{+}$, — Čingov 9-9-1986

On *Bidens tripartita* L., — Čingov 9-9-1986

On *Crepis biennis* L.,— Vernár (meadows) 11-9-1986, Tomašovský výhľad 9-9--1986

On *Crepis paludosa* (L.) Moench., — Čingov 9-9-1986. C = 27-33 × 15-18 μm, Cl = 65-95 μm, A = 50-80 × 30-65 μm,, S = 20-27 × 12-18 μm.

On *Euphrasia rostkoviana* Hayek, — Mlynky 11-9-1986, Čingov 13-8-1972.

On *Euphrasia salisburgensis* Funck ex Hoppe, — Ihrík, Tomášovský výhľad 9-9-1986, Čingov 13-8-1972.

On *Leontodon hispidus* L., — Kláštorisko 21-9-1977.

On *Melampyrum nemorosum* L., — Ihrík 9-9-1986.

On *Melampyrum sylvaticum* L., — Ihrík, Tomášovský výhľad 9-9-1986.

On *Melampyrum* sp., — national nature reserve Vernárska tiesňava 11-9-1986.

On *Rhinanthus serotinus* (Schönh.) Oborny, — Letanovský mlyn 10-9-1986.

On *Senecio nemorensis* L., — Biele Vody 11.9.1986, Čingov, Kláštorisko 21-9--1977, a very common species in the whole area of the national park.

On *Taraxacum officinale* Weber in F.H.Wigg.$^{+}$, — Biele Vody, Vernár 11-9--1986, Letanovský mlyn 10-9-1986, Čingov 13-8-1972, C = 24-35 × 14-20 μm, Cl = 70-92 μm, A = 56-86 × 45-68 μm, S = 14-22 × 12-17 μm.

Sphaerotheca balsaminae (Wallr.) Kari

On *Impatiens noli-tangere* L., — Biele Vody, Mlynky, Vernár 21-9-1977, Ihrík, Čingov, Sovia hora 24-9-1977, 9-8-1972, species with bad visual symptomatic, rather common in the whole area of national park, C = 26-37 × 15-18 μm, Cl = 85--100 μm, A = 65-85 × 50-65 μm, S = 15-21 × 12-16 μm.

On *Impatiens parviflora* DC., — Mlynky 21-9-1977.

Genus **Podosphaera** Kunze

Cleistothecial appendages non-mycelioid, their apex dichotomously branched (in *P.leucotricha* apex is mostly simple, occasionally 1-2 times dichotomously branched), equatorially arising or subfasciculate in the upper half of the cleistothecium. Single 8-spored globose ascus per cleistothecium. Anamorphic stages belonging to the Euoidium-type. Parasites of arboraceous plants (trees and shrubs).

Podosphaera clandestina (Wallr. : Fr.) Lév.

varieta *clandestina*

On *Crataegus monogyna* Jacq., — Dedinky 22-9-1977, Čingov 10.8.1972 C = 20-29 × 11-17 μm, Cl = 66-98 μm, A = 50-85 × 40-70 μm, S = 18-25 × 11--15 μm.

varieta *aucupariae* (Erikss.) U.Braun

On *Sorbus aucuparia* L., — Ihrík, Čingov 9-9-1986, rare occurrence.

Podosphaera myrtillina (F.Schub. ex Fr.) Kunze

varieta *myrtillina*

On *Vaccinium myrtillus* L., — Besník, national nature reserve Vernárska tiesňava 11-9-1986, C = 25-30 × 12-18 μm, Cl = 80-98 μm, A = 65-82 × 58--73 μm, S = 20-30 × 12-18 μm.

On *Vaccinium vitis-idaea* L., — national nature reserve Vernárska tiesňava 11-9-1986.

Podosphaera leucotricha (Ellis et Everh.) E.S.Salmon

On *Malus sylvestris* Mill., — Mlynky 22-9-1977, C = 20-27 × 13-19 μm, Cl = 70-92 μm, A = 60-78 × 45-58 μm, S = 21-26 × 12-16 μm.

Podosphaera tridactyla (Wallr.) de Bary

On *Prunus domestica* L., — Čingov 9-9-1986, C = 21-32 × 11-17 μm, Cl = 80--102 μm, A = 60-83 × 52-75 μm, S = 16-27 × 11-13 μm.

Genus **Erysiphe** DC.

Cleistothecial appendages mycelioid, simple, sometimes apex irregularly branched, mostly arising from basal half of cleistothecium. More than one elipsoid 2-8-spored ascus per cleistothecium. Anamorphic stages belonging to the Eu- or Pseudoidium-type. Parasites of herbaceous plants.

Erysiphe urticae (Wallr.) S.Blumer

On *Urtica dioica* L., — Čingov 9-9-1986, C = 25-30 × 11-20 μm, Cl = 95--130 μm, A = 55-80 × 32-43 μm, S = 19-24 × 11-14 μm, rare occurrence.

Erysiphe aquilegiae DC.

On *Aquilegia vulgaris* L., — national nature reserve Kocúrová 10-8-1972.

On *Caltha palustris* L., — Biele Vody, national nature reserve Vernárska tiesňava 11-9-1986, C = 30-40 × 14-20 μm, Cl = 75-120 μm, A = 45-70 × 30-44 μm, S = 18-25 × 10-14 μm.

Erysiphe ranunculi Grev.

On *Aconitum napellus* L.$^+$, — national nature reserve Prielom Hornádu 12-8--1972.

On *Aconitum* sp.$^+$, — Biele Vody 11-9-1986.

On *Clematis recta* L.$^+$, — Tomášovský výhľad 11-9-1986.

On *Clematis* sp.$^+$, — Stratená 27-9-1983.

On *Ranunculus acris* L., — Mlynky 11-9-1986, Letanovský mlyn 9-9-1986, Kláštorisko 21-9-1977, Čingov 3-10-1972.

On *Ranunculus repens* L., — Vernár 11-9-1986.

On *Ranunculus* sp.$^+$, — Dedinky, Besník, national nature reserve Vernárska tiesňava 11- and 12-9-1986, Veľký Sokol 10-9-1986, Letanovský mlyn, Čingov 9-9--1986, C = 30-41 × 15-20 μm, Cl = 78-120 μm, A = 50-75 × 29-45 μm, S = 18--26 × 10-14 μm.

Erysiphe cruciferarum Opiz ex L. Junell

On *Lunaria rediviva* L., — Biele Vody 11-9-1986, C = 29-42 × 12-18 μm, Cl = 90-125 μm, A = 50-75 × 11-15 μm, S = 16-23 × 11-15 μm.

Erysiphe lycopsidis R. Y. Zheng et Chen

On *Anchusa officinalis* L., — Čingov 12-8-1972, C = 25-32 × 12-16 μm, Cl = 90-115 μm, A = 50-65 × 39-41 μm, S = 17-20 × 10-15 μm.

Erysiphe pisi DC.

On *Medicago lupulina* L.$^+$, — Čingov 12-8-1972, C = 29-34 × 14-19 μm, Cl = 100-118 μm, A = 52-65 × 26-35 μm, S = 24-32 × 12-15 μm.

Erysiphe trifolii Grev.

On *Lathyrus vernus* (L.) Bernh., — Ihrík 9-9-1986, Kláštorisko (forest) 10-8--1972.

On *Lupinus polyphyllus* Lindl., — Čingov 8-9-1986.

On *Melilotus officinalis* (L.) Palla, — national nature reserve Prielom Hornádu 9-9-1986, Mlynky 22-9-1977, Čingov 13-10-1972, C = 29-40 × 19-20 μm, Cl = 98--125 μm, A = 50-75 × 28-44 μm, S = 18-26 × 11-15 μm.

On *Trifolium alpestre* L., — Stratená, Hradisko 27- and 28-9-1983.

On *Trifolium pratense* L.$^+$, — Dedinky, Mlynky, Besník, Vernár 11-9-1986, Čingov 9-8-1986.

On *Trifolium* sp., — Dedinky, Mlynky, Besník, Vernár 11-9-1986, Letanovský mlyn, Čingov 9-9-1986.

On *Vicia cracca* L., — Mlynky 11-9-1986.

Erysiphe convolvuli DC.

On *Convolvulus arvensis* L.$^+$,— Vernár 11-9-1986, C = 32-47 × 13-19 μm, Cl = 90-125 μm, A = 45-75 × 29-45 μm, S = 20-26 × 11-15 μm.

Erysiphe polygoni DC.

On *Polygonum aviculare* L.$^+$, — Vernár 11-9-1986, C = 25-35 × 12-17 μm, Cl = 95-125 μm, A = 62-74 × 31-40 μm, S = 22-29 × 11-15 μm.

Erysiphe heraclei DC.

On *Aegopodium podagraria* L., — Mlynky, Vernár 11-9-1986, national nature reserve Prielom Hornádu (Železné vráta), Letanovský mlyn 9-9-1986, Kláštorisko 9-8-1972, Čingov 9-9-1972. 9-9-1986.

On *Chaerophyllum hirsutum* L., — Biele Vody, national nature reserve Vernárska tiesňava 11-9-1986, Letanovský mlyn, Čingov 9-9-1986.

On *Heracleum sphondylium* L.$^+$, — Mlynky 11-9-1986, Píla, Veľký Sokol 10--9-1986, Ihrík, Čingov 9-9-1986, C = 30-43 × 12-18 μm, Cl = 90-120 μm, A = 50--75 × 30-45 μm, S = 20-27 × 12-15 μm.

On *Pastinaca sativa* L.$^+$, — Letanovský mlyn, Tomášovský výhľad, Čingov 9-9-1986.

Erysiphe hyperici (Wallr.) S.Blumer

On *Hypericum montanum* L.$^+$, — Ihrík 9-9-1986, C = 30-38 × 14-18 μm, Cl = 80-130 μm, A = 50-70 × 32-43 μm, S = 18-24 × 11-14 μm.

On *Hypericum* sp.$^+$, — Vernár (meadows) 11-9- -1986, Podlesok, Čingov 9-9--1986.

Erysiphe knautiae Duby

On *Knautia arvensis* (L.) Coulter$^+$, — Piecky, Veľký Sokol, Glac 10-9-1986, C = 27-36 × 15-18 μm, Cl = 85-110 μm, A = 50-70 × 30-45 μm, S = 19-24 × 13--16 μm.

On *Scabiosa lucida* Vill., — Vernár, Veľký Sokol 10- and 11-9-1986.

Erysiphe ulmariae Desm.

On *Filipendula ulmaria* (L.) Maxim., — Dedinky 11-9-1986, Čingov 9-9-1986, C = 26-36 × 13-16 μm, Cl = 80-140 μm, A = 52-75 × 28-43 μm, S = 16-22 × 10--15 μm.

Erysiphe galeopsidis DC.

On *Galeopsis speciosa* Mill.+, — Sovia hora 12-8-1972.

On *Galeopsis tetrahit* L., — Ihrík, Letanovský mlyn 9-9-1986, C = 25-40 × 10--18 μm, Cl = 100-160 μm, A = 50-80 × 24-40 μm, S = 20-25 × 14-16 μm, ascospores undifferentiated.

Erysiphe galii S. Blumer

On *Asperula tinctoria* L., — national nature reserve Prielom Hornádu (Hrdlo Hornádu) 9-9-1986.

On *Asperula* sp., — Čingov 9-9-1986.

On *Galium schultesii* Vest., — national nature reserve Vernárska tiesňava, Ihrík 9- and 11-9-1986, C = 25-31 × 13-17 μm, Cl = 93-140 μm, ascus undifferentiated.

On *Galium sylvaticum* L., — Ihrík 9-9-1986

Erysiphe depressa (Wallr.) Schlecht.

On *Arctium lappa* L.+, — Čingov 10-8-1972, C = 27-42 × 18-28 μm, Cl = 95--140 μm, A = 60-90 × 31-43 μm, S = 20-32 × 15-20 μm.

Erysiphe artemisiae Grev.

On *Artemisia vulgaris* L., — Dedinky 22-9-1977, C = 22-35 × 14-20 μm, Cl = 105-130 μm, A = 55-75 × 25-38 μm, S = 21-30 × 12-19 μm.

Erysiphe cichoracearum DC.

On *Carduus glaucinus* Holub, — Veľký Sokol, Glac 10-9-1986.

On *Carlina acaulis* L., — Veľký Sokol 10-9-1986.

On *Centaurea jacea* L., — Čingov 12-8-1972.

On *Centaurea phrygia* L., — national nature reserve Prielom Hornádu, Čingov 9-9-1986.

On *Centaurea* sp., — Besník 11-9-1986.

On *Cichorium intybus* L., — Mlynky 11-9-1986, Kozí chrbát 12-9-1986.

On *Cirsium eriophorum* (L.) Scop., — Mlynky 11-9-1986.

On *Cirsium erisithales* (Jacq.) Scop., — national nature reserve Prielom Hornádu, Čingov 9-9-1986.

On *Cirsium oleraceum* (L.) Scop., — Čingov 9-9-1986, 13-10-1972.

On *Cirsium rivulare* (Jacq.) All.+, — Dedinky 22-9-1977.

On *Hieracium bifidum* Kit. in Hornem., — Youth camp, Zelená hora 10-9-1986.

On *Hieracium murorum* L., — Letanovský mlyn 9-9-1986.

On *Hieracium* sp., — Ihrík 9-9-1986.

On *Leontodon autumnalis* L., — Vernár 11-9-1986.

On *Mycelis muralis* (L.) Dumort., — Podlesok 9-9-1986.

On *Prenanthes purpurea* L.+, — Čingov 9-9-1986.

On *Senecio nemorensis* L., — Biele Vody, Besník, Vernár 11-9-1986, Ihrík, Tomášovský výhľad 9-9-1986, C = 23-38 × 14-20 μm, Cl = 80-145 μm, A = 50--75 × 25-40 μm, S = 18-28 × 11-17 μm.

Erysiphe biocellata Ehrenb.

On *Mentha aquatica* L.$^+$, — Dedinky 22-9-1977.

On *Origanum vulgare* L., Dedinky 22-9-1977, C = 27-35 × 14-22 μm, Cl = 95--125 μm, A = 50-75 × 25-40 μm, S = 21-28 × 12-18 μm.

Erysiphe verbasci (Jacz.) S. Blumer

On *Verbascum densiflorum* Bertol., — Veľký Sokol, Glac 10-9-1986.

On *Verbascum* sp., — Biele Vody 11-9-1986, Čingov 9-9-1986, C = 28-38 × 15--26 μm, Cl = 95-140 μm, A = 50-80 × 28-40 μm, S = 19-28 × 12-18 μm.

Erysiphe cynoglossi (Wallr.) U. Braun

On *Buglossoides arvensis* L.$^+$, — Zelená hora 9-9-1986.

On *Cynoglossum officinale* L.$^+$, — Mlynky 11-9-1986.

On *Echium vulgare* L., — Mlynky 11-9-1986, Letanovský mlyn 9-9-1986, C = 25-40 × 14-21 μm, Cl = 87-140 μm, A = 50-75 × 25-45 μm, S = 18-28 × × 12-18 μm.

On *Pulmonaria officinalis* L.$^+$, — Čingov 13-8-1972.

On *Symphytum tuberosum* L., — Čingov, Sovia hora 12-8-1972.

Erysiphe sordida L. Junell

On *Plantago major* L., — Čingov, Letanovský mlyn 9-9-1986.

On *Plantago media* L., — Piecky 10-9-1986, Košiarny briežok 23-9-1977, C = 25-40 × 13-20 μm, Cl = 80-140 μm, A = 50-75 × 28-40 μm, S = 18-28 × × 11-17 μm.

Genus **Blumeria** V. P. Golovin ex Speer

Cleistothecial appendages mycelioid, short, sometimes rudimentary. Numerous 4-8-spored asci per cleistothecium. Basal cell of conidiophores with bulbous swellings. With digitate haustoria . Grass (*Poaceae*) parasites.

Blumeria graminis (DC.) Speer

On *Dactylis glomerata* L., — Dedinky 22-9-1977, Kláštorisko 8-8-1972, Čingov 10-8-1972.

On *Elytrigia repens* (L.) Desv., — Mlynky 23-9-1977, 11-9-1986, Kláštorisko 8-8-1972, Čingov 10-8-1972.

On *Milium effusum* L., — Letanovský mlyn, Tomášovský výhľad 9-9.1986.

On *Poa nemoralis* L., — Kláštorisko 8-8-1972.

On *Poa stiriaca* Fritsch et Hayek ex Dörfler, — Kláštorisko 8-8-1972.

On *Poa* sp., — Čingov 12-8-1972, C = 25-37 × 11-16 μm, Cl = 120-210 μm, A = 55-98 × 20-40 μm, S = 20-25 × 11-16 μm.

Genus **Microsphaera** Lév.

Cleistothecial appendages different from tubes of mycelium, apex usually branched. Numerous 2-8 spored asci per cleistothecium. Anamorphic stages belonging to the Pseudoidium-type. Mainly parasites of arboraceous plants (trees and shrubs).

Microsphaera tortilis (Wallr.: Fr.) Speer

On *Cornus sanguinea* L., — national nature reserve Prielom Hornádu (Železné vráta) 13-8-1972, Ihrík 9-9-1986, Čingov 10-8-1972, C = 26-38 × 14-19 μm, Cl = 75-110 μm, A = 45-68 × 30-45 μm, S = 17-25 × 10-15 μm.

Microsphaera astragali (DC.) Trevis.

On *Astragalus glycyphyllos* L., — Ihrík 9-9-1986, C = 28-42 × 12-20 μm, Cl = 90-125 μm, A = 55-83 × 26-45 μm, S = 18-28 × 10-15 μm.

Microsphaera baumleri Magnus

On *Vicia cracca* L.$^{+}$, — Biele Vody 23-9-1977, C = 26-43 × 10-18 μm, Cl = 92--140 μm, A = 55-85 × 30-43 μm, S = 18-30 × 10-16 μm.

Microsphaera euonymi (DC.) Sacc.

On *Euonymus europaeus* L., — Čingov 12-8-1972, 9-9-1986, C = 30-38 × 13--18 μm, Cl = 90-133 μm, A = 53-68 × 25-40 μm, S = 19-28 × 10-14 μm.

Microsphaera divaricata (Wallr.) Lév.

On *Frangula alnus* Mill., — Tomášovský výhľad 9-9-1986, Čingov 11-8-1972 and 9-9-1986, C = 27-40 × 12-18 μm, Cl = 80-135 μm, A = 40-65 /krat 25-40 μm, S = 17-22 × 10-12 μm.

Microsphaera alphitoides Griff. et Maubl.

On *Quercus petraea* (Mattusch.) Lieblein, — Geravy 22-9-1977, Tomašovský výhľad, Čingov 9-9-1986, C = 22-37 × 11-22 μm, Cl = 85-138 μm, A = 50-60 × × 30-45 μm, S = 17-26 × 9-15 μm.

Microsphaera magnusii S. Blumer

On *Lonicera xylosteum* L., — national nature reserve Prielom Hornádu (Železné vráta) 9-9-1986, C = 21-30 × 10-17 μm, Cl = 65-95 μm, A = 32-50 × 28-40 μm, S = 17-24 × 10-13 μm.

Microsphaera grossulariae (Wallr.) Lév.

On *Grossularia uva-crispa* (L.) Mill.,— Kláštorisko, Čingov 10-8-1972, Ihrík 9-9-1986, C = 22-33 × 10-18 μm, Cl = 80-120 μm, A = 42-65 × 30-40 μm, S = 18-26 × 10-15 μm.

On *Ribes petraeum* Wulf., — Biele Vody 11-9-1986.

Microsphaera berberidis (DC.) Lév.

On *Berberis vulgaris* L., — national nature reserve Prielom Hornádu (Železné vráta), Ihrík, Čingov 12-8-1972, C = 25-43 × 10-16 μm, Cl = 95-138 μm, A = 45--62 × 25-40 μm, S = 18-25 × 9-14 μm.

Microsphaera vanbruntiana W. R. Gérard

On *Sambucus racemosa* L., — Mlynky, Biele Vody 10-9-1986, Ihrík, Letanovský mlyn, Tomášovský výhľad, Čingov 9-9-1986, C = 25-38 × 11-16 μm, Cl = 95--138 μm, A = 45-75 × 25-40 μm, S = 18-30 × 10-16 μm.

Genus **Sawadaea** Miyabe

Cleistothecial appendages non-mycelioid, arising from upper half of cleistothecium, 1-2 times dichotomously branched, apex uncinate to spirally twisted . Numerous mainly 8-spored asci per cleistothecium. Anamorphic stages belonging to the Euoidium-type. Parasites of arboraceous plants.

Sawadaea bicornis (Wallr.: Fr.) Homma

On *Acer campestre* L.$^{+}$, — Dedinky 22-9-1977, C = 24-36 × 13-17 μm, Cl = 120-215 μm, A = 60-90 × 35-58 μm, S = 16-27 × 11-15 μm.

Genus **Uncinula** Lév.

Numerous cleistothecial appendages usually different from tubes of mycelium, simple, apex uncinate to spirally twisted. Numerous 2-8-spored asci per cleistothecium. Anamorphic stages belonging to the Pseudoidium-type. Parasites of arboraceous plants. (trees and shrubs).

Uncinula adunca (Wallr.: Fr.) Lév.

On *Salix purpurea* L., — Čingov 12-8-1972, C = 23-38 × 11-18 μm, Cl = 95--145 μm, A = 50-80 × 28-48 μm, S = 20-30 × 10-18 μm.

On *Salix silesiaca* Willd., — Čingov 12-8-1972.

Uncinula prunastri (DC.) Sacc.

On *Prunus spinosa* L., — Dedinky 11-9-1986, C = badly developed, Cl = 80--140 μm, A = 40-60 × 25-32 μm, S = 15-20 × 8-12 μm.

Genus **Phyllactinia** Lév.

Cleistothecial appendages non-mycelioid, simple, with bulbous swellings at the base, aw-shaped, equatorially arising. Numerous 2-3-spored asci per cleistothecium. Anamorphic stages belonging to *Ovulariopsis*. Parasites of arboraceous plants.

Phyllactinia fraxini (DC.) Fuss

On *Fraxinus excelsior* L., — Mlynky 6-10-1977, C = 45-80 × 13-24 μm, Cl = 180-254 μm, A = 65-90 × 30-40 μm, S = 30-44 × 17-25 μm.

Phyllactinia guttata (Wallr.: Fr.) Lév.

On *Corylus avellana* L.$^+$, — Čingov 4-10-1977, C = 45-85 × 13-26 μm, Cl = 160-250 μm, A = 60-98 × 25-41 μm, S = 26-45 × 14-26 μm.

On *Fagus sylvatica* L.$^+$, — national nature reserve Kocúrová 5-10-1977.

Genus Oidium Link.

Oidium chrysanthemi Rabenh.

On *Pyrethrum corymbosum* (L.) Scop., — Tomášovský výhľad 9-9-1986. C = 38-62 × 14-21 μm.

On *Chrysanthemum* sp. (cult.), — Mlynky 11-9-1986.

DISCUSSION

The species spectrum of the order *Erysiphales* in the national park Slovak Paradise is rather rich. We have established the occurrence of 55 species from 9 genera belonging to family *Erysiphaceae*, order *Erysiphales* there. Individual species are also known from other parts of the Slovakian territory (Paulech 1970, 1984, 1993, 1995, Paulech and Zlochová 1991, Paulech et al. 1991). Most species abundant are the genera *Erysiphe*, *Sphaerotheca* and *Microsphaera*. The so far known genera spread on our territory we have not established the occurrence of members of the genera *Arthrocladiella* Vassilkov and *Leveillula* G.Arnaud. The first ones have no host plants (species of the genus *Lycium* L.) on the territory of the national park and the second one probably has unsuitable conditions (Mediterranean genus) there.

The oldest herbarium items of the members of the order *Erysiphales* from the area of today's Slovakia are Kalchbrenner's collections from the area of Slovak Paradise. They do not a precise location and date of collection. For reason of unsufficient data and herbarium items on this group of micromycetes we revised Kalchbrenner's collections, which are indicated by sign "plus" after the scientific name of their host plants.

Biometric data of some fungus organs of found species of *Erysiphales* document the morphological variability of the investigated samples which is ranging between values quoted by many authors (Blumer 1967, Sałata 1985, Braun 1987, Paulech 1995).

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CZECH MYCOL. 49 (2), 1996

Seven little known species of the genus Alternaria

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Ondřej, M. 1996: Seven little known species of the genus Alternaria – Czech Mycol. 49: 119–127

The occurrence of seven little known Alternaria species (Fungi Imperfecti, Hyphomycetes, Dematiaciace) collected in the years 1969 to 1994 in the Czech Republic is reported and their morphological characteristics presented. They cover two species described by the author, A. calendulae (Ondřej 1974) and A. thalictrina (Ondřej 1974), a new combination: A. anthyllidis (Baudyš) Ondřej comb. nov. and three hitherto unknown species to the Czech Republic: (A. helianthinficiens Simmons, A. leucanthemi Nelen, and A. infectoria Simmons). A new species A. caricina Ondřej spec. nov., is described from leaves of Carex brizoides L. Additional taxonomical characters (size of conidial scars) are given for each species.

Key words: Alternaria spp., A. caricina spec. nov., Czech Republic, taxonomy

Ondřej, M. (1996): Málo známé druhy hub rodu Alternaria – Czech Mycol. 49: 119–127

Je uveden výskyt sedmi málo známých druhů hub rodu Alternaria Nees z území ČR (Fungi imperfecti, Hyphomycetes, Dematiaceae) sbíraných v letech 1969 — 1994. Jedná se o druhy popsané autorem (A. calendulae Ondřej 1974, A. thalictrina Ondřej 1974), o novou kombinaci A. anthyllidis (Baudyš) Ondřej comb. nov. a o druhy nové pro území ČR (A. helianthinficiens Simmons, A. leucanthemi Nelen, A. infectoria Simmons). Na listech Carex brizoides je popisován nový druh A. caricina Ondřej spec. nov. U jednotlivých druhů je uveden doplňující taxonomický znak (velikost basální konidiální jizvy).

The taxonomy of fungi from the genus *Alternaria* first reached a solid level after World War II thanks to Neergaard, who published a significant and fundamental study in 1945 including 18 species known at that time. The next step in the knowledge of the genus *Alternaria* was made by Joly in 1964, who mentioned 121 species. Further information enriching and deepening the insight into the taxonomy of the genus *Alternaria* was published by the following authors: Rao (1965, 1971, 1977) Joly (1969) and Simmons (1965, 1981, 1982, 1986). The recent extensive work on the genus *Alternaria* by Rotem (1994) does not deal with the taxonomy of the genus. In the Czech Republic a list of the collections of *Alternaria* species was published in 1974 by Ondřej, mentioning 16 species. As a result of further mycofloristic research the number of species known from the Czech Republic was extended to 31 (Ondřej 1990).

For the description and identification of *Alternaria* species formerly only differences in form and size of the conidia and in the number of septa were used.

Great significance was given to the association to a specific host or a group of hosts. So far however, no attention was paid to important taxonomical characters, such as the size of conidial scars and the dimension of basal conidial cells.

This paper aims at providing information on little and insufficiently known species of the genus *Alternaria* from the Czech Republic, and presenting additional taxonomical features of them.

Alternaria anthyllidis (Baudyš) Ondřej, comb. nov.

Basionym: *Helminthosporium anthyllidis* Baudyš, Lotos, 63:103, 1915.

Baudyš placed this species into the genus *Helminthosporium* as a consequence of the absence of longitudinal septa. According to the original diagnosis the conidiophores are 40-100 × 5-7 μm in size and the conidia possess 2-7 transverse septa and measure 35-80 × 11-15 μm. A study of my own collections (Fig. 1) revealed the occasional occurrence of transverse septa and the formation of conidia in chains. Conidiophores with 1-5 scars, 30-110 × 5-8 (10) μm. Conidia with 1-13 transverse and rarely with 1-2 longitudinal septa, formed individually or in short chains, 30-80 (90) × 8-13 (15) μm. Conidial scars 3,5-4,5 (5) μm, basal conidial cells 10-13 (18) × 8-10 μm, apical cells 8-13 (18) × 6-8 (9) μm.

Collections. Host: *Anthyllis vulneraria* L.

— Bohemia : Bohdánkov, July 1914 (Baudyš 1916), Kohoutovice, June 1915 (Baudyš 1916), Vrchovina u Libáně, Jičín, June 1915 (Baudyš 1916).

— Moravia : Pálava, 24 June 1959 (Ondřej PRC), Kralice n. Osl., 30 July 1970 (Ondřej BRA), Loučná n. Desnou, 9 Sep. 1981 (Ondřej, private herb.), Kralice n. Osl., 20 July 1985 (Ondřej, private herb.).

— Slovakia : Těrchová, Vrátna dolina, Janošíkovy diery, 7 July 1978 (Ondřej BRA).

Alternaria calendulae Ondřej, Acta Musei Silesiae, Opava, Ser. A, XXIII: 150, 1974.

Syn.: *Alternaria calendulae* Nirenberg, Phytopath. Z. 88:106-116, 1977

Species of the genus *Alternaria* parasitic on *Calendula officinalis* L. have long been known. Neergaard (1945) classified them under *Alternaria porri* (Ell.) Neerg. This opinion was accepted by Baker and Davis (1950), Joly (1964) and Pape (1964), though they mentioned morphological and physiological differences within the species. Nevertheless they did not designate a separate species. A probably identical taxon was described in Russia under the name of *Macrosporium calendulae* Nelen (Nelen and Vasiljeva, 1959), possessing the following conidium dimensions: 190-290 × 16-24 μm. The paper does however not contain a Latin

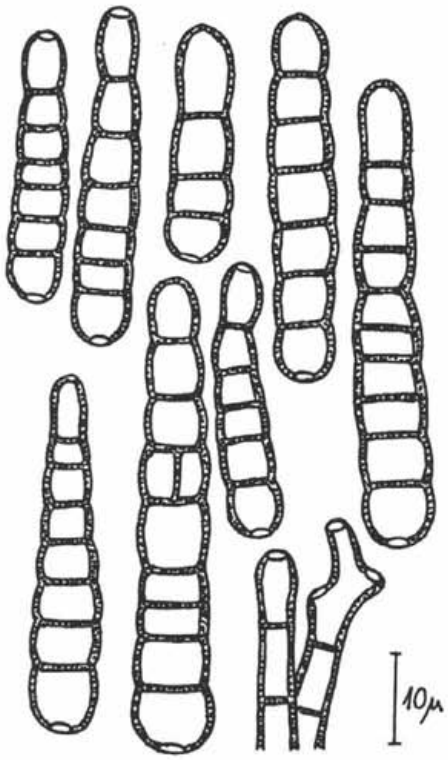

Fig. 1. *Alternaria anthyllidis* (Baudyš) Ondřej comb. nov.

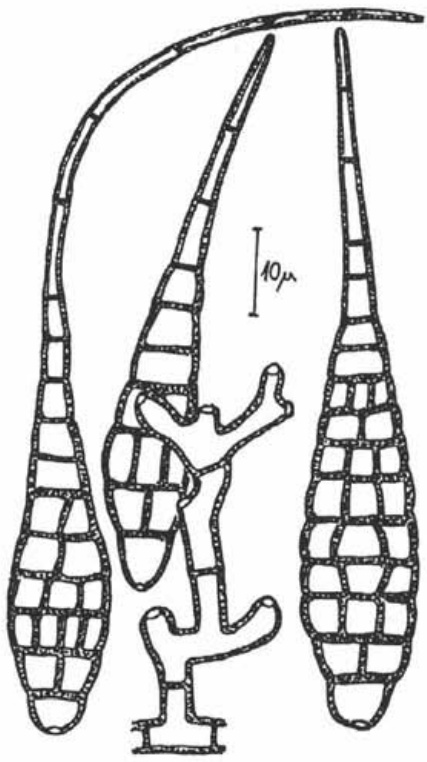

Fig. 2. *Alternaria calendulae* Ondřej

diagnosis nor information on the deposition of the type material, so that this name is invalid. Detailed research on the fungus was carried out in Germany (Nirenberg 1977), where it caused significant reduction in the germination as well as death of the plants in the course of their growth. In inoculation tests the pathogenicity of the species *A. porri* and *A. calendulae* infested on separate leaves was compared. The tests proved that they are two different species. Differences were also found on fertile agar substrates. *A. calendulae* differed in a tuft-like arrangement of the conidia on the conidiophores.

According to Nirenberg (1977) the conidiophores are coloured brown, lighter to top, often branched with 1-8 scars after the conidia have fallen off, and measure 7-90 × 5-8 µm. Conidia brown, reversely clavate with appendix, 60-141 × 15,5--42,0 µm (rostrum 58-206 × 2-6 µm), with 5-12 transverse septa.

According to my own collections (Fig.2) the fungus forms large brown-black spots on leaves, which later fuse and cause the leaves to die off. It spreads from

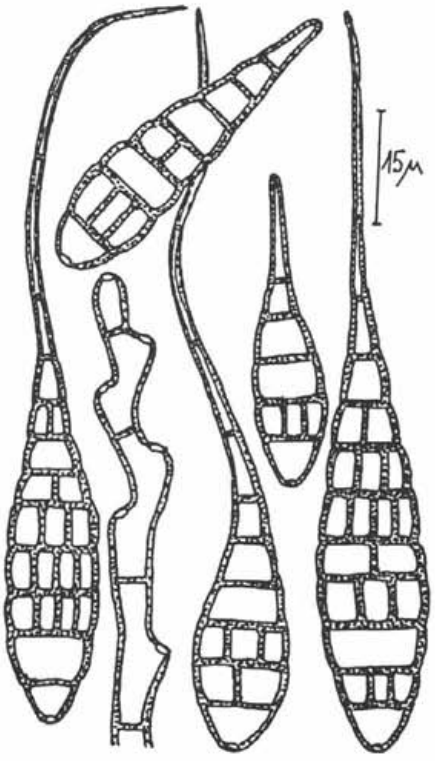

Fig. 3. *Alternaria helianthinficiens* Simmons, Walcz et Roberts

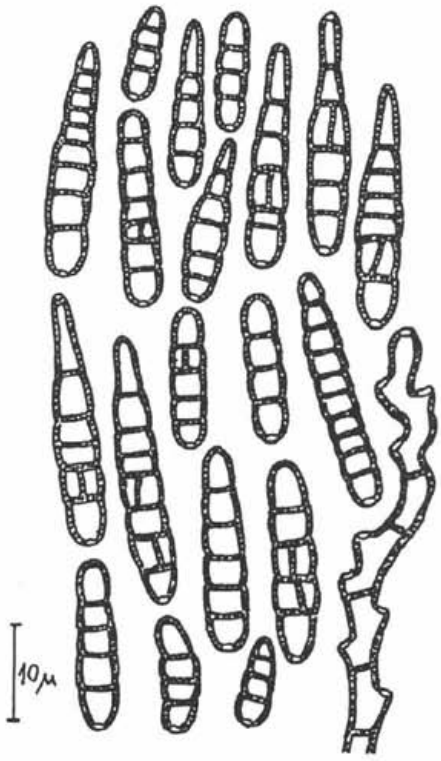

Fig. 4. *Alternaria infectoria* Simmons

the leaves onto the stalk. The septate conidiophores are brown-coloured, straight, unbranched or branched with branches measuring 20-50 (100) × 4-6 (8) µm. Conidia with long beaks, dark-coloured, not forming chains and measuring 80-250 (300) × 10-22 (30) µm. Number of transverse septa 8-15, number of longitudinal septa 2-13. Basal scars 2,5-3,5 µm large. The dimensions of the conidiophores and conidia are variable and dependent on habitat. Conidia from shadowed sites are longer and narrower.

Collections. Host: *Calendula officinalis* L.

— Moravia: Libina, Šumperk district, 22 Aug 1970 (Type), Vikýřovice, Šumperk district, 8 Sep 1980, 26 Aug 1985 (Ondřej, private herb.)

Remark: the species was also collected by the author in Russia: Železnogorsk, 29 July 1982, and in Belarus: Žodino, Minsk 17 Aug 1983 (both collections in private herb.).

Alternaria helianthinficiens Simmons, Walcz et Roberts, Mycotaxon 25: 204, 1986.

This species (Fig. 3) forms brown-black, irregularly shaped and later merging spots on leaves and cause the leaves to die off. It spreads from the leaves onto the stalks, where it forms brown oblong spots. During ripening they pass on to the seeds. The conidiophores are brown coloured, septate, 20-200 × 5-7 μm. Conidia brown-coloured, with long beaks, formed individually, 60-300 × 12-18 (22) μm in size, with 1-2 longitudinal septa. Basal scars 2,5-3,5 μm large.

This taxon was described by Simmons in 1986 based on a comparative study of collections from the USA, Canada and Hungary. So far four different *Alternaria* species have been described from sunflowers. The most common and wide-spread is *A. helianthi* (Hanf.) Tub. et Nishik., which was described as early as 1943 under the name *Helminthosporium helianthi* Hansford. The occurrence of this species in the Czech Republic is very likely. It is closely related to *A. leucanthemi* Nelen.

Collections. Host: *Helianthus annuus* L.

— Moravia: Vikýřovice, Šumperk district, 26 Aug 1985 (Ondřej, private herb.).

Alternaria infectoria Simmons, Mycotaxon 25:298, 1986.

As a half-parasite this species (Fig. 4) is partly responsible for the drying up of leaves of several grass species (*Agrostis, Lolium, Festuca, Poa*). It often occurs together with *Alternaria alternata*. The conidiophores are brown-coloured, septate, dented after the conidia haven fallen off, and 10-80 (100) × 2,5-4,5 μm large.

The brown coloured conidia are of different shapes (cylindrical, ovoid, reversely clavate), formed in branched chains, measure 15-30 (50) × 7-10 (11) μm and have 2-9 transverse and 0-3 longitudinal septa. The size of the basal scars is 2-3 μm.

This taxon was described in 1986 from several grasses by Simmons. He mentions the most frequent occurrence on *Triticum*, *Elymus*, *Lolium*, and *Festuca*. Its teleomorph *Lewia infectoria* (Fuckel) Barr et Simmons (syn. *Pleospora infectoria* Fuckel) was described as early as 1870 growing on *Hordeum* and *Triticum* (ascospores 12-25 × 7-9 μm). Fitt (1991) also mentions its occurence on flax (*Linum usitatissimum* L.).

Collections. Host: *Lolium perenne* L.

— Moravia: Vikýřovice, Šumperk district, 1 Sep 1985 (Ondřej, private herb.).

Alternaria leucanthemi Nelen, Bot. Mater, Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 15:148-150, 1962.

This fungus (Fig. 5) forms brown-black, later merging spots on leaves. Infected stalks die off soon. The conidiophores are brown, septate, scarred after the conidia haven fallen off, and 15-50 × 6-8 μm large. The conidia are cylindrical in shape, are formed individually, lack a beak and measure 20-120 × 10-20 (30) μm. They

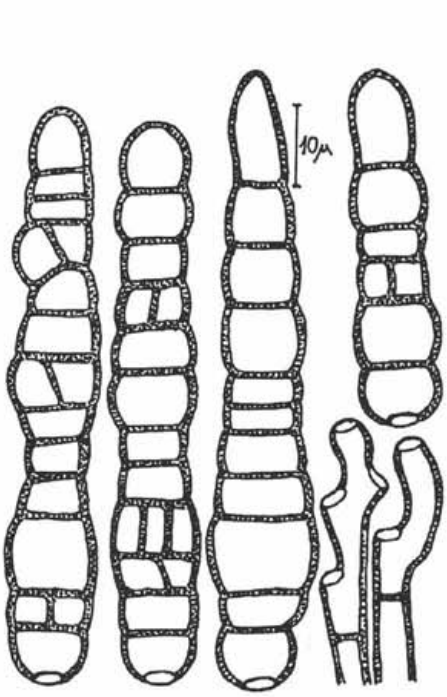

Fig. 5. *Alternaria leucanthemi* Nelen

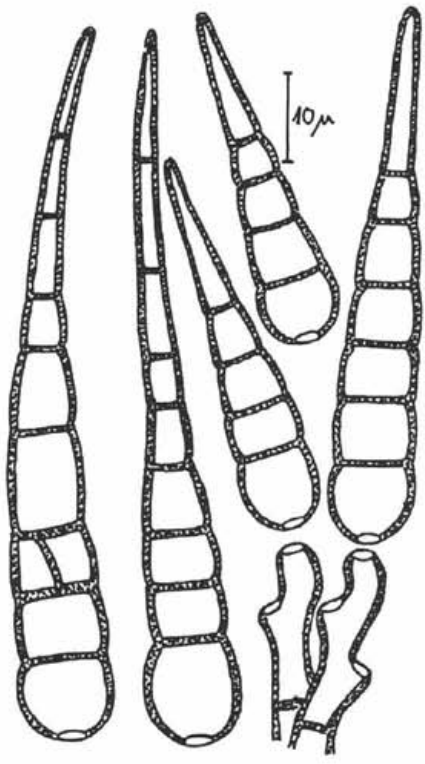

Fig. 6. *Alternaria thalictrina* Ondřej

count 10-20 transverse and 0-4 longitudinal septa. The basal scars are 4,5-5,5 μm large.

It was apparently described invalidly first in the year 1957 by Crosier and Heit (*A. chrysanthemi*) and again in 1958 by Schmidt (*A. leucanthemi*). In both cases no Latin diagnosis was provided and the type material was not identified.

Collections. Host: *Leucanthemum vulgare* Lam.

— Moravia: Šumperk, 10 Sep 1989, 3 Aug 1990 (Ondřej, private herb.).

Alternaria thalictrina Ondřej, Acta Musei Silesiae, Opava, Ser. A, XXIII:147, 1974

This species (Fig. 6) forms brown-black, later merging spots on leaves. It is very aggressive fungus and seriously damages the host plant. On the spots abundant brown-coloured septate conidiophores are formed, which are scared after the conidia have fallen off and 20-50 (100) × 4-6 (7) μm large. The conidia are light brown, reversely clavate, are formed individually, 40-90 (110) × 8-14 (16) μm

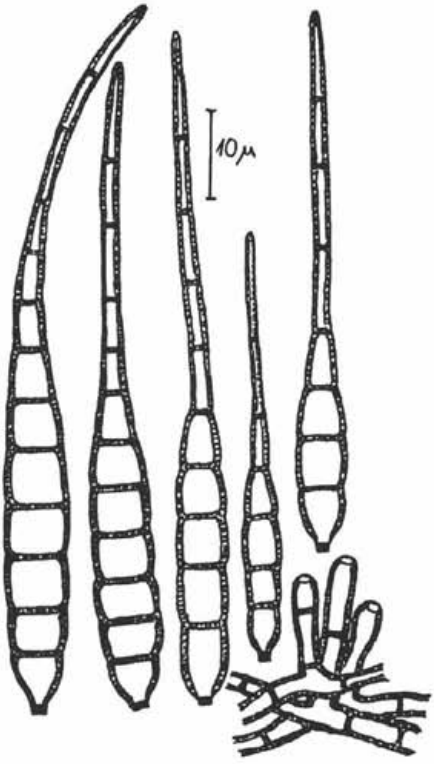

Fig. 7. *Alternaria caricina* Ondřej spec. nov.

in size, with 4-10 transverse septa and 0 or 1 longitudinal septum. Basal scars 4-6 μm.

It was first found by H. Zavřel in 1945 near Turovice. Picbauer, who identified Zavřeľs collections, erroneously identified the collection as *Alternaria tenuis* Ness.

Collections. Host: *Thalictrum aquilegifolium* L.

— Moravia: Bystřice pod Hostýnem, W of Turovice, 10 June 1945 (Zavřel BRA), Hrubý Jeseník, Podolský brook , 29 Aug 1969 (Ondřej BRA — Type).

— Slovakia: Nízké Tatry, Králova Hola, 1 July 1984 (Ondřej, private herb.), Černý Váh, 3 July 1984 (Ondřej, private herb.).

Alternaria caricina Ondřej spec. nov. (sect. *Noncatenatae* Neergaard)

This species (Fig.7) causes a browning and drying up of leaves of the sedge *Carex brizoides* L.

The conidiophores are brown coloured and formed on a mycelium that grows on the surface of died off leaf networks. Conidia arise individually on small

conidiophores 10-20 (25) × 4-6 μm in size. They are coloured light brown to brown, reversely clavate in shape, possess 4-15 (20) transverse septa, and are 60-190 × 8--10 (14) μm large. The occurrence of longitudinal septa was not established. The basal cell is remarkable by its prominent scar 2-2,5 μm large.

The species comes close to *Alternaria scirpicola* (Fuckel) Lucas et Webster (teleomorph *Pleospora scirpicola* (DC.) Karst.) which parasitizes on a group of hosts: *Scirpus*, *Eleocharis* and *Cyperus*. On *Carex* plants also a different species parasitizes, *Pleospora valesiaca* (Niessl) E. Müller, with a so far undescribed conidium stage of an *Alternaria* species (Sivanesan 1984).

Notice:

A similar species with larger conidia (without transverse septa and with short conidiophores) is known under the name *A. scirpicola* (Fuckel) Sivanesan (1984), (= *Sporidesmium scirpicola* (Fuckel) = *Clasterosporium scirpicolum* (Fuckel) Sacc. = *Cercospora scirpicola* (Fuckel) van Zinderen Bakker).

Alternaria caricina Ondřej spec. nov.

Descriptio: Conidiophora brunnea, laevia ex lateribus hypharum oriunda, singula, recta, 0-1(2) septata, 10-20(25) × 4-6 μm. Conidiis acrogenis, singulatim natis, obclavatis, pallidebrunneis vel fuscis, 60-190 × 8-10(14) μm , transverse 4-20 septatis. Cicatrice basali protuberante, 2-2,5 μm lata.

Habitatio: Parasitice in foliis vivis *Caricis brizoidis* L., Czech Republic, Moravia septentrionalis: Vikýřovice, pr. Šumperk 24.6.1984, Michal Ondřej legit. Typus in herbario Musei Nat. Praha (PRM) asservatur.

Collections. Host: *Carex brizoides* L.

— Moravia: Vikýřovice, Šumperk district, 24 June 1984 (Ondřej PRM — Type), 31 Sep 1985, 10 Oct 1989 (Ondřej, private herb.), Třemešek, Šumperk district, 16 Oct 1994 (Ondřej, private herb.).

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CZECH MYCOL. 49 (2), 1996

Polypores associated with native woody host plants in urban areas of Slovakia

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Gáper J. (1996): Polypores associated with native woody host plants in urban areas of Slovakia.– Czech Mycol. 49: 129–145

Sixty-three species of polypores (Polyporales s.l.) were identified on 38 taxa of native woody host plants out of 476 records in urban areas of Slovak towns and villages. The most common species (more than 20 finds) were Bjerkandera adusta, Daedaleopsis confragosa, Fomes fomentarius, Phellinus igniarius, Phellinus tuberculosus and Trametes versicolor. Twenty-eight species were recorded only once or twice.

Key words: Polypores, native woody plants, urban areas, Slovakia.

Gáper J. (1996): Trúdniky na autochtónnych drevinách v urbanizovanom prostredí Slovenska.– Czech Mycol. 49: 129–145

Štúdiom 476 nálezov sa identifikovalo 63 druhov trúdnikovitých húb, ktoré sa vyskytovali na 38 taxónoch autochtónnych hostiteľských drevín v slovenských sídlach. Medzi najčastejšie (viac ako 20 nálezov) patria Bjerkandera adusta, Daedaleopsis confragosa, Fomes fomentarius, Phellinus igniarius, Phellinus tuberculosus a Trametes versicolor. Pri 28 druhoch sa zaznamenal iba jeden alebo dva nálezy.

INTRODUCTION

Only few papers on polypores growing in urban areas have been published in Europe: Benkert (1977) from Germany, Erkkilä and Niemelä (1986) from Finland, Karlvall (1963) from Sweden, Kocsó (1981) from Hungary, Lawrynowicz (1982) from Poland, Seehann (1979) from Germany, Selik and Aksu (1967) from Turkey and Wolkinger (1973) from Austria. Numerous data on polypore distribution and ecology, including Slovak towns and villages were reported in Kotlaba's treatment (Kotlaba 1984).

The present paper is the first contribution to a synopsis of polypores reported on woody host plants in Slovak urban areas and is focused on species associated with native (autochtonous) hosts. The purpose of this paper is to enumerate the polypores (Polyporales s.l.) and to provide additional data concerning distribution, abundance and host relationships of these species. This contribution is part of a long-term project on the chorology and ecology of wood-inhabiting fungi in populated environments in Slovakia.

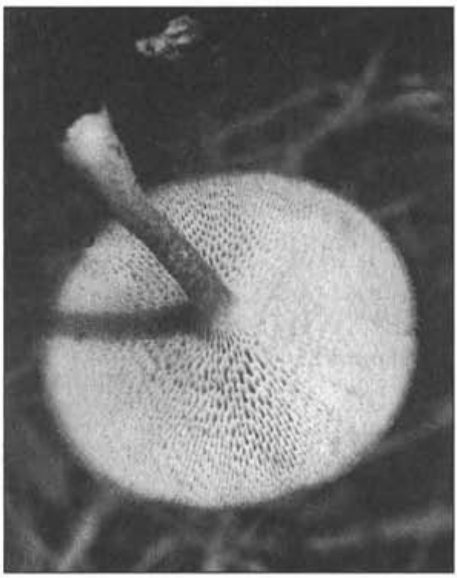

Fig. 1. *Polyporus arcularius* on lying branch of Carpinus betulus; "Hrabina" near Jelšava, 16. VIII. 1976 Photo F. Kotlaba

Fig. 2. *Trametes unicolor* on standing dead trunk of Carpinus betulus; "Kyšera" near Bardejov, 14. X. 1976. Photo F. Kotlaba

MATERIAL AND METHODS

The presented data are based on: (1) Field research by the author carried out from 1982 to 1989. Most records were collected during the summer and autumn months but extensive research covers the whole year. Voucher specimens are held at BRA. (2) Field notes and database (card-file) by František Kotlaba covering the period 1953-1989. (3) Field notes and collections (held at BRA and MJ, respectively) by Jan Kuthan and Petr Vampola.

The towns and villages to which these records refer are indicated on a map (Fig. 1). The names in the list of fungal species have been arranged alphabetically. The components of a record in this list are the following:

Distribution: Name of the town or village. These have been arranged alphabetically. Names in parentheses refer to the districts in which the town or village is located. For each locality the numbers of finds are given.

Hosts: Hosts determined at the species or lower level. From each of them the numbers of finds are given. Hosts are followed by the number of finds. If hosts have remained unidentified at the species level, the numbers of finds for each of them are given.

RESULTS

Out of 476 records 63 polypore species were identified growing on 38 taxa of trees and shrubs considered native to Slovakia.

LIST OF SPECIES

Abortiporus biennis (Bull.: Fr.) Singer

Distribution: Bratislava: 1, Dunajská Streda: 2.
Hosts: *Prunus* sp. (2), unknown (1).

Aurantioporus fissilis (Berk. et M. A. Curtis) H. Jahn

Distribution: single finds in Michalovce, Rožňava, Slatina (Levice), Slovenská Ľupča (Banská Bystrica), Tomášikovo (Galanta).
Hosts: *Malus sylvestris* var. *domestica* (4), *M. pumila* (1).

Bjerkandera adusta (Willd.: Fr.) P. Karst.

Distribution: Banská Bystrica: 1, Bardejov: 1, Bratislava: 5,
Čadca: 1, Fiľakovo (Lučenec): 1, Jasenové (Žilina): 1, Kamenica nad Hronom (Nové Zámky): 1, Košice: 3, Kúty (Senica): 1, Liptovský Hrádok (Liptovský Mikuláš): 1, Lučenec: 2, Nitra: 2, Osturňa (Poprad): 1, Porúbka (Žilina): 1, Prešov: 3, Rajec nad Rajčiankou (Žilina): 1, Rožňava: 1, Topoľčany: 1, Trebišov: 2, Trnava: 1, Vranov nad Topľou: 1, Zbýňov (Žilina): 1, Zvolen: 1, Žiar nad Hronom: 2, Žilina: 3.
Hosts: *Salix fragilis* (3), *Fraxinus excelsior* (2), *Tilia* × *euchlora* (2), single finds on *Acer campestre, A. pseudoplatanus, Carpinus betulus, Fagus sylvatica, Populus alba, P.* × *canadensis, Quercus robur, Salix alba* cv. *Tristis, Ulmus carpinifolia.*
Betula sp. (4), *Fraxinus* sp. (3), *Salix* sp. (3), *Acer* sp. (2), single finds on *Fagus* sp., *Populus* sp., *Tilia* sp., unknown (8).

Bjerkandera fumosa (Pers.: Fr.) P. Karst.

Distribution: single finds in Komárno, Kúty, (Senica), Lučenec.
Hosts: single finds on *Carpinus betulus, Salix alba cv. Tristis, S. fragilis.*

Ceriporia viridans (Berk. et Broome) Donk

Distribution: Prešov: 1.
Host: unknown (1).

Climacocystis borealis (Fr.) Kotlaba et Pouzar

Distribution: Liptovský Hrádok (Liptovský Mikuláš): 1.
Host: *Picea abies* (1).

Daedaleopsis confragosa (Bolton: Fr.) J. Schröt.

Distribution: Bardejov: 1, Červený Kláštor (Poprad): 2, Jasenové (Žilina): 4, Kamenná Poruba (Žilina): 1, Lietavská Lúčka (Žilina): 1, Nitra: 2, Porúbka (Žilina): 2, Považská Bystrica: 2, Prešov: 1, Rajec nad Rajčiankou (Žilina): 2, Rajecké Teplice (Žilina): 2, Rimavská Sobota: 2, Slepčany (Nitra): 1, Trebišov: 1, Zbýňov (Žilina): 1, Žilina: 1.

Hosts: *Salix alba* cv. *Tristis* (8), *S. fragili* (8), *S. alba* (2), *S. alba* cv. *Vitellina* (1).

Salix sp. (7).

Datronia mollis (Sommerf.: Fr.) Donk

Distribution: single finds in Prešov, Žiar nad Hronom.
Host: *Salix alba cv. Tristis* (1).
Betula sp. (1).

Fistulina hepatica (Schaeff.): Fr.

Distribution: single finds in Obyce (Nitra), Trenčianske Teplice (Trenčín).
Hosts: *Quercus robur* (1).
Quercus sp. (1).

Fomes fomentarius (L.: Fr.) Fr.

Distribution: Bratislava: 2, Dolný Kubín: 1, Gabčíkovo (Dunajská Streda): 1, Horné Semerovce (Levice): 1, Košice: 1, Martin: 1, Michalovce: 2, Nitra: 1, Rimavská Sobota: 1, Rožňava: 1, Slepčany (Nitra): 1, Šahy (Levice): 1, Tomášovce (Rimavská Sobota): 1, Topoľčany: 1, Trebišov: 1, Trnava: 1, Vranov nad Topľou: 1, Zlaté (Bardejov): 1, Zvolen: 1, Žiar nad Hronom: 1.

Hosts: *Populus alba* (4), *P.* × *canadensis* (2), *Tilia cordata* (2), *T. platyphyllos* (2), single finds on *Populus nigra* cv. *Italica, Salix fragilis, S. alba* cv. *Tristis.*

Fraxinus sp. (2), single finds on *Acer* sp.,? *A.* sp., *Populus* sp., *Tilia* sp., unknown (3).

Fomitopsis pinicola (Sw.: Fr.) P. Karst.

Distribution: Dolný Kubín: 2, Jasenie (Banská Bystrica): 2, Piešťany (Trnava): 1, Zvolen: 1.

Hosts: *Malus sylvestris var. domestica* (2).
Prunus sp. (1), unknown (3).

Ganoderma adspersum (Schulzer) Donk

Distribution: Banská Štiavnica (Žiar nad Hronom): 1, Bardejov: 1, Bratislava: 2, Čadca: 1, Červený Kláštor (Poprad): 1, Horné Semerovce (Levice): 1, Košice: 1, Levice: 1, Liptovský Mikuláš: 1, Lučenec: 1, Plaveč (Stará Ľubovňa: 2, Poprad: 1, Prešov: 1, Šahy (Levice): 2, Trebišov: 1, Trenčianske Teplice (Trenčín): 1.

Hosts: *Tilia cordata* (7), *Acer pseudoplatanus* (2), single finds on *Fagus sylvatica, Fraxinus excelsior, Populus alba, P. nigra, Quercus petraea, Sorbus aucuparia.*
Quercus sp. (1), *Tilia sp.* (1), unknown (2).

Ganoderma carnosum Pat.

Distribution: Bratislava: 2, Michalovce: 1.
Host: unknown (3).

Ganoderma lipsiense (Batsch) G. F. Atk.

Distribution: Bardejov: 1, Košice: 1, Liptovský Hrádok (Liptovský Mikuláš): 2, Michalovce: 1, Osturňa (Stará Ľubovňa): 1, Považská Bystrica: 1, Žiar nad Hronom: 1.

Hosts: single finds on *Fraxinus excelsior, Picea abies, Salix fragilis, Tilia cordata, T. platyphyllos.*
single finds on *Populus* sp., *Prunus* sp., unknown host.

Ganoderma resinaceum Boud. in Pat.

Distribution: Bratislava: 3, Trnava: 1.
Hosts: *Fraxinus excelsior* (2), *Quercus robur* (2).

Ganoderma sp.

Distribution: Bratislava: 1.
Host: *Tilia cordata* (1).

Gloeophyllum abietinum (Bull.: Fr.) P. Karst.

Distribution: Dolný Kubín: 1, Liptovský Hrádok (Liptovský Mikuláš): 1, Turčianske Teplice (Martin): 1.

Host: *Picea abies* (3).

Gloeophyllum sepiarium (Wulfen: Fr.) P. Karst.

Distribution: Košice: 1, Levoča (Spišská Nová Ves): 1, Piešťany (Trnava): 1.
Hosts: *Abies alba* (2).
unknown (1).

Heterobasidion annosus (Fr.) Bref.

Distribution: Liptovský Hrádok (Liptovský Mikuláš): 2, Michalovce: 1, Trenčianske Teplice (Trenčín): 2, Rajec nad Rajčiankou (Žilina): 1, Rajecké Teplice (Žilina): 1.
Hosts: *Corylus avellana* (2), *Picea abies* (2).
single finds on *Picea* sp., *Quercus* sp., unknown host.

Inonotus cuticularis (Bull.: Fr.) P. Karst.

Distribution: single finds in Breziny (Zvolen), Galanta, Topoľčany, Trebišov, Trnava.
Hosts: *Acer pseudoplatanus* (2), single finds on *A. campestre, Alnus glutinosa, Pyrus communis.*

Inonotus dryadeus (Pers.: Fr.) Murrill

Distribution: Trebišov: 1.
Host: *Quercus petraea* (1).

Inonotus hispidus (Bull.: Fr.) P. Karst.

Distribution: Banská Štiavnica (Žiar nad Hronom): 1, Bohunice (Žiar nad Hronom): 1, Bojnice (Prievidza): 1, Bratislava: 2, Michalovce: 3, Slepčany (Nitra): 1, Šahy (Levice): 1, Trenčianske Teplice (Trenčín): 1, Trenčín: 1, Žilina: 1.
Hosts: *Fraxinus excelsior* (5), *Malus sylvestris* var. *domestica* (3), single finds on *Pyrus communis, Sorbus aria, S. intermedia.*
Malus sp. (2).

Inonotus nidus-pici Pilát ex Pilát

Distribution: Liptovský Mikuláš: 1, Trebišov: 2, Zlaté Moravce (Nitra): 2, Zvolen: 1.
Hosts: *Fraxinus excelsior* (2), *Platanus* × *acerifolia* (2), *Acer pseudoplatanus* (1).
Fraxinus sp. (1).

Inonotus radiatus (Sowerby: Fr.) P. Karst.

Distribution: Tomášikovo (Galanta): 1.
Host: *Alnus glutinosa* (1).

Ischnoderma resinosum (Schrad.: Fr.) P. Karst.

Distribution: Liptovský Hrádok (Liptovský Mikuláš): 1.
Host: *Fagus* sp. (1).

Laetiporus sulphureus (Bull.: Fr.) Murrill

Distribution: Červený Kláštor (Poprad): 1, Hámor (Lučenec): 2, Nitra: 2, Tesárske Mlyňany (Nitra): 1, Trebišov: 1, Zvolen: 1.
Hosts: single finds on *Populus alba, Prunus domestica, Salix alba, S. alba* cv. *Tristis, S. fragilis.*
Prunus sp. (2), *Populus* sp. (1).

Lenzites betulina (L.: Fr.) Fr.

Distribution: Bratislava-Karlova Ves: 1, Porúbka (Žilina):1,
Žilina: 1.
Hosts: single finds on *Alnus glutinosa, Betula pendula.*
unknown (1).

Meripilus giganteus (Pers.: Fr.) P. Karst.

Distribution: Bratislava: 1, Kežmarok (Poprad): 1, Levice: 1, Trnava: 2, Žilina: 1.
Hosts: *Fagus sylvatica* (1).
Acer sp. (3), on the ground (1), unknown (1).

Osmoporus odoratus (Wulfen: Fr.) Singer

Distribution: Bratislava: 1, Jasenové (Žilina): 1, Liptovský Hrádok (Liptovský Mikuláš): 1, Michalovce: 1, Turčianske
Teplice (Martin): 1. Hosts: *Picea abies* (4).
unknown (1).

Pachykytospora tuberculosa (DC.: Fr.) Kotlaba et Pouzar

Distribution: Trebišov: 1, Trenčianske Teplice (Trenčín): 1.

Hosts: *Quercus petraea* (1).
Quercus sp. (1).

Perenniporia fraxinea (Bull.: Fr.) Ryvarden

Distribution: Bratislava: 1, Fiľakovo (Lučenec): 1. Host: *Acer pseudoplatanus* (2).

Perenniporia medulla-panis (Jacq.: Fr.) Donk

Distribution: Liptovský Mikuláš: 1.
Host: *Fraxinus excelsior* (1).

Perenniporia narymica (Pilát) Pouzar

Distribution: Biel (Trebišov): 1.
Host: *Salix alba* (1).

Perenniporia tenuis (Schwein.) Ryvarden

Distribution: Dolná Strehová (Veľký Krtíš): 1.
Host: *Quercus robur* (1).

Phaeolus schweinitzii (Fr.: Fr.) Pat.

Distribution: Bratislava: 1.
Host: apparently on the ground (1).

Phellinus contiguus (Pers.: Fr.) Pat.

Distribution: Solivar (Prešov): 1.
Host: on a fence (1).

Phellinus ferruginosus (Schrad.: Fr.) Pat.

Distribution: Bratislava-Karlova Ves: 1.
Host: unknown (1).

Phellinus igniarius (L.: Fr.) Quél.

Distribution: Andrejovka (Stará Ľubovňa): 1, Bratislava: 6, Cígeľka (Bardejov): 1, Čadca: 7, Červený Kláštor (Poprad): 3, Dlhoňa (Svidník): 1, Dravce (Spišská

Nová Ves): 1, Fiľakovo (Lučenec): 2, Hrušov (Vranov nad Topľou): 1, Jasenové (Žilina): 1, Komárno: 1, Košice: 7, Krupina (Zvolen): 3, Kružlov (Bardejov): 1, Kysucké Nové Mesto (Čadca): 1, Legnava (Stará Ľubovňa): 1, Liptovský Hrádok (Liptovský Mikuláš): 1, Lučenec: 1, Malá Poľana (Svidník): 1, Nitra: 10, Nižný Hrušov (Vranov nad Topľou): 1, Nižný Orlík (Svidník): 1, Nižný Slavkov (Prešov): 1, Oravské Veselé (Dolný Kubín): 1, Osturňa (Poprad): 2, Plaveč (Stará Ľubovňa): 2, Pohorelská Maša (Banská Bystrica): 1, Poprad: 2, Porúbka (Žilina): 1, Považská Bystrica: 3, Prievidza: 2, Rajec nad Rajčiankou (Žilina): 1, Rajecké Teplice (Žilina): 2, Rimavská Sobota: 1, Senica: 1, Slepčany (Nitra): 1, Stará Ľubovňa: 1, Trebišov: 1, Trenčianske Teplice (Trenčín): 1, Trenčín: 1, Zbýňov (Žilina): 1, Zlaté (Bardejov): 1, Zvolen: 2, Žiar nad Hronom: 1, Žilina: 6.

Hosts: *Salix alba cv. Tristis* (49), *S. fragilis* (29), *Sorbus aucuparia* (3), *Salix alba* (2), *Malus sylvestris var. domestica* (1).

Salix sp. (4), unknown (1).

Phellinus punctatus (P. Karst.) Pilát

Distribution: Čadca: 1, Dunajská Streda: 1, Považská Bystrica: 6, Rajecké Teplice (Žilina): 1, Topoľčany: 1.

Hosts: *Sorbus aucuparia* (2), *Taxus baccata* (1).

Prunus sp. (6), unknown (1).

Phellinus ribis (Schumach.: Fr.) P. Karst.

Distribution: Bratislava: 1.

Host: *Ribes* sp. (1).

Phellinus robustus (P. Karst.) Bourdot et Galzin

Distribution: Trebišov: 1, Vinné (Michalovce), 1.

Host: *Quercus petraea* (2).

Phellinus torulosus (Pers.) Bourdot et Galzin

Distribution: Trenčianske Teplice (Trenčín): 1.

Host: *Quercus* sp. (1).

Phellinus tuberculosus (Baumg.) Niemelä

Distribution: Andrejovka (Stará Ľubovňa): 1, Cígeľka (Bardejov): 1, Dravce (Spišská Nová Ves): 1, Hámor (Lučenec): 1, Jasenové (Žilina): 1, Košice: 2, Legnava

(Stará Ľubovňa): 1, Malá Poľana (Svidník): 1, Martin: 3, Medzilaborce (Humenné): 1, Michalovce: 1, Parchovany (Trebišov): 1, Považská Bystrica: 1, Sazdice (Levice): 1, Senica: 1, Slepčany (Nitra): 3, Slivník (Trebišov): 1, Smolenice (Trnava): 1, Spišská Nová Ves: 1, Šahy (Levice): 1,Trebišov: 1, Vlachovo (Rožňava): 1, Zborov (Bardejov):1.

Hosts: *Prunus domestica* (14), *P. avium* (1), *P. spinosa* (1).
Prunus sp. (11), unknown (1).

Piptoporus betulinus (Bull.: Fr.) P. Karst.

Distribution: Bratislava: 1, Jasov (Košice): 1, Piešťany (Trnava): 2.
Host: *Betula pendula* (2).
Betula sp. (2).

Polyporus arcularius (Batsch): Fr.

Distribution: Kamenica nad Hronom (Nové Zámky): 1.
Host: *Populus alba* (1).

Polyporus badius (Gray) Schwein.

Distribution: Košice: 1.
Host: *Tilia cordata* (1).

Polyporus lentus Berk.

Distribution: Trenčianske Teplice (Trenčín): 1.
Host: *Quercus* sp. (1).

Polyporus squamosus (Huds.) Fr.

Distribution: single finds in Bratislava, Čierna Voda (Galanta), Kamenica nad Hronom (Nové Zámky), Levice, Piešťany (Trnava), Šahy (Levice), Tomášikovo (Galanta), Trenčianske Teplice (Trenčín).

Hosts: *Acer pseudoplatanus* (3), *Populus alba* (2).
Fraxinus sp. (1), unknown (2).

Polyporus varius (Pers.): Fr.

Distribution: Dolný Kubín: 1, Trenčianske Teplice (Trenčín): 1.
Hosts: *Fagus* sp. (1), unknown (1).

Pycnoporus cinnabarinus (Jacq.: Fr.) P. Karst.

Distribution: Trenčianske Teplice (Trenčín): 1.
Host: *Tilia* sp. (1).

Rigidoporus corticola (Fr.) Pouzar

Distribution: Lučenec: 1.
Host: *Carpinus betulus* (1).

Rigidoporus obducens (Pers.) Pouzar

Distribution: Bardejov: 1, Čadca: 1, Dolný Kubín: 1, Košice: 3, Lučenec: 1, Šahy (Levice): 2, Poprad: 2, Trnava: 1, Trenčín: 1, Turčianske Teplice (Martin): 1, Vranov nad Topľou: 1, Žilina: 3.
Hosts: *Acer platanoides* (4), *A. pseudoplatanus* (4), *Tilia cordata* (3), *Acer campestre* (2) , *Sorbus aucuparia* (2).
Ulmus sp. (2), *Acer* sp. (1).

Rigidoporus populinus (Schumach.: Fr.) Pouzar

Distribution: Košice: 2, Stará Ľubovňa: 2, Žilina: 2, Šahy (Levice): 1, Žiar nad Hronom: 1, Trenčianske Teplice (Trenčín): 1.
Hosts: *Acer pseudoplatanus* (5), *Tilia cordata* (2), *Acer platanoides* (1).
Populus sp. (1).

Schizopora carneo-lutea (Rodway et Cleland) Kotlaba et Pouzar

Distributrion: Topoľčany: 2, Turčianske Teplice (Martin): 1. Hosts: *Acer platanoides* (1), *Tilia cordata* (1).
unknown (1).

Schizopora paradoxa (Schrad.: Fr.) Donk

Distribution: Bardejov: 1, Bratislava-Karlova Ves: 1, Červený Kláštor (Poprad): 1, Plaveč (Stará Ľubovňa): 1, Považská Bystrica: 1, Trebišov: 1. Hosts: single finds on *Quercus petraea, Salix alba cv. Tristis, S. fragilis, Tilia cordata.*
Prunus sp. (1), unknown (1).

Spongipellis spumeus (Sowerby: Fr.) Pat.

Distribution: single finds in Krupina (Zvolen), Zvolen.

Hosts: single finds on *Acer platanoides, A. pseudoplatanus.*

Trametes gallica (Fr.) Fr.

Distribution: Trebišov: 1.
Host: *Fraxinus* sp. (1).

Trametes gibbosa (Pers.: Fr.) Fr.

Distribution: single finds in Košice, Žiar nad Hronom.
Hosts: *Carpinus betulus* (1).
unknown (1).

Trametes hirsuta (Wulfen: Fr.) Pilát

Distribution: Červený Kláštor (Poprad): 1, Košice: ľ, Liptovský Hrádok (Liptovský Mikuláš): 1, Michalovce: 1, Nitra: 2 , Prešov: 1, Rajec nad Rajčiankou (Žilina): 1, Vranov nad Topľou: 1.

Hosts: *Sorbus aucuparia* (2), single finds on *Acer pseudoplatanus, Salix alba* cv. *Tristis, Tilia cordata.* single finds on *Crataegus* sp., *Fraxinus* sp., *Prunus* sp., unknown host.

Trametes suaveolens (Fr.) Fr.

Distribution: Andrejovka (Stará Ľubovňa): 1, Bardejov: 1, Dravce (Spišská Nová Ves): 1, Hurbanovo (Komárno): 1, Jasenové (Žilina): 5, Košice: 1, Košice-Čermeľ: 1,
Liptovský Hrádok (Liptovský Mikuláš): 1, Osturňa (Poprad):
1, Rajecké Teplice (Žilina): 4, Svidník: 1.
Hosts: *Salix fragilis* (5), *S. alba* cv. *Tristis* (1), *Tilia cordata* (1).
Salix sp. (8), *Populus* sp. (2), unknown (1).

Trametes trogii Berk. in Trog

Distribution: Bratislava: 1, Košice: 1, Nitra: 2, Slepčany (Nitra): 1.
Hosts: single finds on *Populus alba, P. nigra, Salix alba* cv. *Tristis.*
single finds on *Populus* sp., unknown host.

Trametes unicolor (Bull.: Fr.) Pilát

Distribution: Andrejovka (Stará Ľubovňa): 1, Kysucké Nové Mesto (Čadca): 1, Liptovský Hrádok (Liptovský Mikuláš): 1, Lučenec: 1, Osturňa (Poprad): 1, Trebišov: 1, Trenčianske Teplice (Trenčín): 1, Žilina: 6.

Hosts: *Acer pseudoplatanus* (5), *A. platanoides* (3), single finds on *Fraxinus excelsior, Platanus* × *acerifolia, Populus nigra.*

single finds on *Fagus* sp., unknown host.

Trametes versicolor (L.: Fr.) Pilát

Distribution: Bardejov: 1, Jasenové (Žilina): 3, Kamenica nad Hronom (Nové Zámky): 1, Kúty (Senica): 1, Liptovský Hrádok (Liptovský Mikuláš): 2, Liptovský Mikuláš: 1, Lučenec: 1, Michalovce: 2, Poluvsie (Žilina): 2, Porúbka (Žilina): 1, Rajecké Teplice (Žilina): 1, Rajec nad Rajčiankou (Žilina): 1, Tomášikovo (Galanta): 1, Trebišov: 1, Vranov nad Topľou: 1, Zbýňov (Žilina): 1.

Hosts: single finds on *Alnus glutinosa, Carpinus betulus, Malus sylvestris* var. *domestica, Populus alba, P.* × *canadensis, Picea abies.*

Salix sp. (7), single finds on *Alnus* sp., *Crataegus* sp.,

Fagus sp., *Fraxinus* sp., unknown (4).

Trichaptum fuscoviolaceum (Ehrenb: Fr.) Ryvarden

Distribution: Liptovský Hrádok (Liptovský Mikuláš): 1, Liptovský Mikuláš: 1.

Hosts: *Picea abies* (1).

Pinus sp. (1).

The most frequent species were *Phellinus igniarius* (89 records), *Bjerkandera adusta* (39 records), *Phellinus tuberculosus* (28 records), *Daedaleopsis confragosa* (26 records), *Fomes fomentarius* (22 records) and *Trametes versicolor* (21 records). Twenty-eight species were recorded only once or twice.

Where possible the host plant was identified to species (or even infraspecific) rank but for *Abortiporus biennis, Ceriporia viridans, Ganoderma carnosum, Ischnoderma resinosum, Phellinus ferruginosus, Phellinus ribis, Phellinus torulosus, Polyporus lentus, Polyporus varius, Pycnoporus cinnabarinus* and *Trametes gallica* only the generic name of the host plant was available. The hosts of *Phaeolus schweinitzii* and *Phellinus contiguus* are unkown, hence their association with a native host species is doubtful. *Populus* × *canadensis* is a hybrid of North American, European and North African origin but we consider the tree having become a member of the native dendroflora of Slovakia.

DISCUSSION

Species such as *Bjerkandera adusta, Daedaleopsis confragosa, Fomes fomentarius, Phellinus igniarius* and *Trametes versicolor* are always common

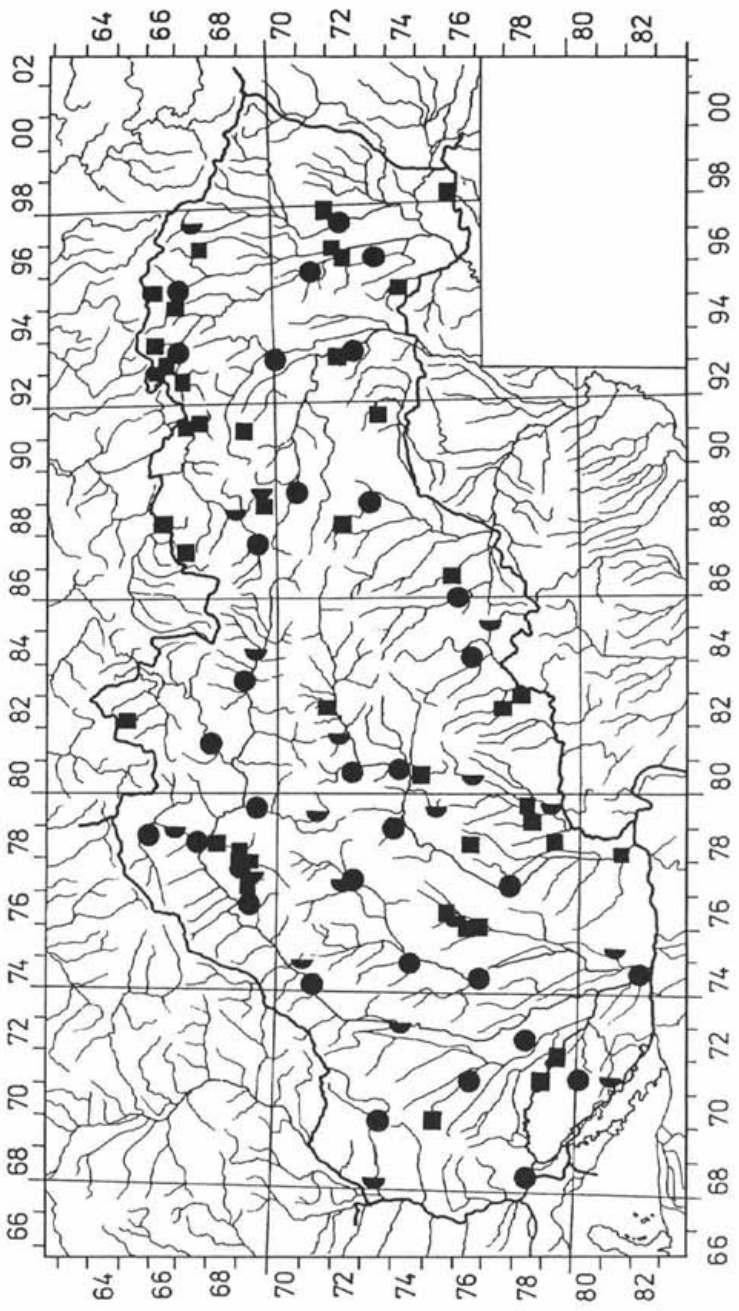

Fig. 3. Towns and villages where polypores were recorded (numerical codes represent squares of the Central European mapping net; circles — district capitals, semicircles — other towns, squares — villages)

in urban areas (with a few exceptions) if the appropriate host was present (Benkert 1977, Erkkilä and Niemelä 1986, Karlvall 1963, Kocsó 1981, Lawrynowicz 1982, Seehann 1979, Selik and Aksu 1967). *Daedaleopsis confragosa* and *Fomes fomentarius* were only locally abundant in Helsinki (Erkkilä and Niemelä 1986) but in Lódž *F. fomentarius* was missing even of the host trees were available (Lawrynowicz 1982). Species of *Betula* are quite common in the urban areas of Slovakia but abundance and density of *Lenzites betulina* and *Piptoporus betulinus* obligatory associates of birches, are extremely low. *Lenzites betulina*, a saproparasite (saprotrophe) may lack appropriate substrates, such as dead or dying trees, trunks and fallen branches due to the maintenance of parks, but there is no explanation for the low abundance of the parasite *Piptoporus betulinus*.

Species with a narrow host range show the great differences in abundance when their hosts are distributed unequally. For example, *Phellinus tuberculosus* is associated with species of *Prunus* which are not very common in public urban areas. Erkkilä and Niemelä (1986) pointed out that probably more data on this species would be gathered in Helsinki if private gardens could be searched more intensively.

Ganoderma lipsiense is a dominant species on native woody plants in natural environments of the Czech and Slovak Republics (Kotlaba 1984) but according to our research, it is not frequent in urban area. Erkkilä and Niemelä (1986) reported *G. lipsiense* as common at several Finnish locations but unfortunately, they did not distinguish this species from its look — a like *Ganoderma adspersum* (presented as a "park-inhabiting" variety of *G. lipsiense*). According to our data and data by other authors (Kotlaba 1984, Kotlaba and Pouzar 1971) *G. adspersum* has a clearly synanthropic distribution. There are 19 records of *G. adspersum* but only 8 collections of *G. lipsiense* on native hosts in populated areas of Slovakia. A. similar synantrophic distribution was recorded for *Abortiporus biennis*: Kotlaba (1984) reported 9 localities incl. the only one from a city and we are adding two more.

There are some differences in the occurrence and distribution of particular fungal species according to the size of a populated area. Fifty-one species were recorded in the largest cities (district capitals), 42 species in other towns and only 27 species in villages. This could be explained by smaller urban areas in towns and villages and thus a lower host-species range and fewer suitable trees and shrubs. This is evident when comparing town centres, cemeteries and resident areas with similar urban sites in villages. For example, *Ganoderma resinaceum* (associated with *Fraxinus excelsior* and *Quercus robur), Inonotus nidus-pici* (associated with *Fraxinus excelsior* and *Platanus* × *acerifolia*) and *Pachykytospora tuberculosa* (associated with *Quercus* spp.) were recorded only in towns and not in villages where their host trees are rare. Besides, old oaks and ash-trees are less frequent in villages than in towns. There are also differences in the maintenance of urban

areas. Trees in towns suffer from frequent injuries caused by improper pruning and other maintenance. For example, *Ganoderma resinaceum* and *Meripilus giganteus* were usually found to produce fruitbodies at the base of trunks which are often damaged by scythes when cutting lawns. Lawn mowers not only cause mechanical injuries (scratches) but their exhaust gases may damage cambial tissues and lower the resistance against fungal infection.

The results were also influenced by unequal investigation of the territory of Slovakia: some cities were visited several times but data from small towns and villages were recorded less frequently.

CONCLUSIONS

1. Sixty-three species of polypores were recorded on 38 taxa of autochtonous woody host plants from urban areas in Slovakia.

2. The distribution data of *Abortiporus biennis* and *Ganoderma adspersum* proved their synanthropic character.

3. The highest species diversity was recorded from cities (51 species) and middle-sized towns (42 species). Rural settlements showed a lower diversity (27 species). This is in accordance with the size of available urban areas and the availability of proper host plants there as well as with more intensive field research carried out in towns.

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Book review

F. L. Pfleger and R. G. Linderman ed.:

Mycorrhizae and plant health.

– (10)+344 p. APS Press, St. Paul, Minnesota, 1994. — The book is in the library of the Society.

This book is dedicated to the phenomenon of mycorrhiza, a symbiotic association common in the majority of vascular plant taxa, dealing with its effects on plant pathology, physiology and ecology. It presents excellent reviews of respected specialists in the field of mycorrhizal research, based on the contributions at a symposium entitled "A Reappraisal of Mycorrhizae in Plant Health", held in Portland, Oregon, in 1992.

There is widespread agreement among plant and soil scientists, that mycorrhizae can support plant growth and health due to the various mechanisms of action. This is reflected here in 14 thematically distinct chapters of the book.

The first two chapters describe the possibilities of the use of ecto— and endomycorrhizal fungi as agents active in the suppression of plant diseases. The use of inoculum of mycorrhizal fungi as a biologically active agent effective against certain plant diseases is highly desirable in agroecosystems because it provides a possibility to avoid the application of some conventional pesticides, which could accumulate in plant products and thus influence human health.

The role of mycorrhizas in the reclamation of sites disturbed by mining activities is discussed in the chapters 3 and 4. In this field, mycorrhizal symbiosis plays an essential role in the stabilization of newly formed plant cover in disturbed areas and probably increases the diversity in plant communities.

Arbuscular endomycorrhizal fungi are common inhabitants of arable soils, which make comprehensive information about mycorrhizae in agroecosystems necessary. The chapters 5 and 6 present information on the effect of cultural practices and pesticides on mycorrhizal fungi. Such research is still not sufficiently supported and developed, even though there is a potentially high practical impact of the data obtained in this field.

Chapter 7 displays the aspects of atmosphere-ecosystem relationships and their effects on mycorrhizae.

The role of mycorrhizae (of vesicular arbuscular and ecto— types) in biogeochemical cycles is mentioned in the Chapters 8 and 9. It is difficult to recognize the "checkpoints" in biogeochemical processes, so that our knowledge of the contribution of mycorrhiza in these processes is limited both conceptually and experimentally. External hyphae represent a relatively large carbon sink and mobilize some nutrients in the soil. In particular the stabilization of organic matter in soil, enhanced by mycorrhizal fungi due to their involvement in aggregation processes might be important. It can be stated that mycorrhizal symbiosis has a potential to alter soil chemistry and, consequently, the flux of matter in the biosphere.

There is an increasing interest in mycorrhizal associations (association of mycorrhizal fungus with a host plant) because these are capable, under certain conditions, to increase plant growth and yield significantly. The reasons for this effect are the enhancement of nutrients and water uptake and the increasing tolerance to various stresses. The questions of possible practical use of such beneficial effects through inoculations with mycorrhizal fungi and problems connected with inoculum production are discussed in chapters 10 and 11.

Chapter 12 is dedicated to the biosystematics of arbuscular mycorrhizal fungi, a difficult discipline limited by an unclear species concept in this group. This discipline studies the variability (e.g. morphological and functional) of different taxa and is therefore of practical importance.

Molecular and genetic tools (Chapter 13) are increasingly used to explore the mechanisms involved in the initialization and development of the colonization of a host root by a mycorrhizal fungus. Some mycorrhizal fungi are difficult to cultivate, even in association with a host, so that the use of such enhanced techniques are highly desired in order to obtain basic information on the studied objects.

Plant growth and health in all ecosystems depends on the maintenance of an optimum physical structure, and an optimum biological and chemical equilibrium. Soil is, at present, drastically disturbed by a human activities: cultivation, compaction, removal of organic residues, application of pesticides and fertilizers and changes in water regime. This often results in a decrease in ecosystem productivity and stability. At the same time, agricultural and forestry practices lower the potential for mycorrhizae to be effective due to population reduction, reduced biodiversity or shifts in species composition in soil.

In spite of our insufficient knowledge of the role of mycorrhizae in natural ecosystems and agro-ecosystems, we do however know that they represent the stabilizing factor influencing plant health and increasing plant population diversity. The belief that mycorrhizae greatly influence plant health has been supported by the many examples presented in the book. It may encourage the further research in the field of mycorrhiza biology. The use of the newly developed techniques will produce more important results needed for practical exploitation of mycorrhizae in a much wider range in future.

M. Gryndler

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Tommerup I. C., Kuek C., and Malajczuk N. (1987): Ectomycorrhizal inoculum production and utilization in Australia. – In: Sylvia D. M., Hung L. L., and Graham J. H. (eds.) Proceedings of the 7th North American Conference on Mycorrhizae, pp. 93–295, Gainesville.

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