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Erysiphales of the Drawski Landscape Park (NW Poland)

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This paper continues the presentation of results of a 3-year investigation on the occurrence of fungi of the order *Erysiphales* in the Drawski Landscape Park (north-western Poland). The list of occurrence of members of *Erysiphales* presented includes 31 next species and 15 species found on plants not mentioned in the previous paper. Additionally, the occurrence of the powdery mildew fungi in 12 permanent plots with nine plant associations was presented and compared.

Key words: *Erysiphales*, Drawski Landscape Park, Poland.

INTRODUCTION

The aim of this paper is to continue the presentation of results of a 3-year investigation on the occurrence of fungi of the order *Erysiphales* in the Drawski Landscape Park (DLP; Czerniawska et al. 2000). The list of occurrence of members of *Erysiphales* presented includes 31 next species and 15 species found on plants not mentioned in the previous paper. The degree of damage of plants affected by the powdery mildew fungi identified was also showed. Additionally, the occurrence of these fungi in 12 permanent plots harbouring nine plant associations was presented and compared.

MATERIALS AND METHODS

The general data on the location, vegetation, climatic conditions of DLP, spatial distribution of the permanent plots selected, as well as those regarding the methods of identification of fungi, the determination of frequency of their occurrence, and the degree of damage of plants are as previously presented (Czerniawska et al. 2000). Briefly, DLP is situated in the south of the Westernpomerania Voivodeship of Poland. Its dominant plant communities

are pet bogs, beech woods and pine forests (F i j a ł k o w s k i et al. 1994). The 12 permanent plots selected harbored natural vegetation. The area of each plot was ca. 1 ha. The plant associations of the plots were determined using the B r a u n - B l a n q u e t method (1964) and classified according to M a t u s z k i e w i c z (1984). Nine plant associations were recognized, including *Luzulo pilosae-Fagetum, Stellario-Carpinetum, Querco roboris-Pinetum, Leucobryo-Pinetum, Ribo nigri-Alnetum, Circaeo-Alnetum, Vaccinio ulginosi-Pinetum, Chenopodietea*, and *Artemisietea*. Plant species were recognized after S z a f e r, K u l c z y ń s k i and P a w ł o w s k i (1969). Nomenclature of plants is that of M i r e k et al. (1995). The data on location and vegetational properties of each plot are as follows.

Plot 1. A site comprising the suburb and areas located ca. 3 km south of Połczyn Zdrój. It harboured the *Luzulo pilosae-Fagetum* plant association with highly dominating *Fagus sylvatica* and *Quercus petrea*. The shrub layer was dominated by *Sorbus aucuparia*. The dominants of the undergrowth were *Lycopodium annotinum, Veronica chamaedrys, V. officinalis*, and clumps of mosses.

Plots 2. and 11. Plot 2 was located ca. 2 km north of Stare Worowo, and plot 11 – ca. 0.5 km north of Warniłęg. Both sites were covered by the *Stellario-Carpinetum* plant association with dominating *Carpinus betulus, Fagus sylvatica, Quercus robur*, and *Q. petraea. Corylus avellana* dominated in the undergrowth.

Plot 3. A site located ca. 3 km west of Stare Kaleńsko with the *Querco roboris-Pinetum* plant association. The dominant plants were *Betula pendula, Pinus sylvestris*, and *Populus tremula. Convallaria majalis, Deschampsia flexuosa*, and *Vaccinium myrtillus* predominated in the undergrowth.

Plot 4. A site located ca. 3 km north of Złocieniec and ca. 1 km west of the Dłusko lake. It was covered by the *Leucobryo-Pinetum* plant association with a well developed undergrowth comprising *Calluna vulgaris, Deschampsia flexuosa, Vaccinum myrtillus*, and *V. vitis-idaea*.

Plots 5. and 7. Plot 5 was located ca. 2 km north-west of Kluczewo, and plot 7 – ca. 1.5 km from Kocury. Both sites hosted the *Ribo nigri-Alnetum* plant association. The dominant plants were *Alnus glutinosa* among trees, *Betula pubescens* subsp. *pubescens, Rhamnus frangula* and *Viburnum opulus* among shrubs, *Caltha palustris, Equisetum limosum, Iris* spp., and members of the family Cyperaceae in the undergrowth. The frequently occurring creeper was *Humulus lupulus*.

Plot 6. A site located ca. 1 km west of Rzepowo with the *Circaeo-Alnetum* plant association. Among trees, the dominants were *Alnus glutinosa* and *Fraxinus excelsior*. The brushwood and the undergrowth were rich in *Anthriscus sylvestris, Festuca gigantea, Galium aparine, G. palustre, Geum urbanum, Impatiens noli-tangere, Padus avium, Rhamnus frangula, Sambucus nigra*, and *Urtica dioica*.

Plots 8. and 9. Plot 8 was located ca. 3 km east of Czaplinek, and plot 9 – ca. 2 km south of Ostrowice. Their plant association was *Vaccinio ulginosi-Pinetum*, an inland variety. The dominant trees were *Betula pubescens* subsp. *pubescens* and *Pinus sylvestris*. The undergrowth was predominated by *Ledum palustre*, *Oxycoccus palustris*, and *Vaccinium ulginosum*.

Plot 10. A site located ca. 2 km north of Stare Drawsko and ca. 1 km of the Drawski lake. It harboured the *Chenopodietea* plant association consisting of weeds of cultivated fields and gardens, plant communities adjacent to roads, fences, homes, and plants forming lawns. The dominant plant species were *Chenopodium album*, *Polygonum aviculare*, and *Rumex accetosella*.

Plot 12. A site located ca. 1 km west of Łubowo and ca. 0.5 km south of Rakowo with the *Artemisietea* plant association. It was predominated by *Arctium minus*, *A. lappa*, *Artemisia vulgaris*, *Carduus crispus*, *Conium maculatum*, *Melilotus altissimus*, *Tanacetum vulgare*, and *Urtica dioica*. The plants grew at lake banks, along tracks, near forests, and on balks.

C l i m a t i c c o n d i t i o n s. Compared with the 1951 – 1980 mean temperature of DLP (Table 1), the mean annual temperatures of 1997 and 1998 were higher by 0.3 and 0.6°C, respectively, and that of 1996 was lower by 1.3°C. April of 1996 and 1998 was warmer by 0.8 and 2.6°C, respectively, and colder by 1.7°C in 1997. May of 1996 and 1998 was warmer by 0.1 and 2.0°C, but colder by 0.2°C in 1997. June of 1996 was colder by 0.4°C, and warmer by 0.2 and 0.3°C in 1997 and 1998, respectively. July of 1996 and 1998 was colder by 1.7 and 0.8°C, respectively, but warmer by 0.6°C in 1997. In 1996 and 1997, August was warmer by 1.3 and 2.8°C, respectively, and colder by 0.8°C in 1998. Compared with the temperature of the long-term period considered, the mean temperature of September of 1996 was lower by 2.8°C, higher by 0.3°C in 1997, and the same in 1998. In 1997 and 1998, October was colder by 1.3 and 0.6°C, respectively, and warmer by 0.5°C in 1996.

Compared with the years 1951 – 1980, the sums of rainfalls in the years 1996 – 1998 were higher by 10.7%, 13.4%, and 43.3%, respectively. According to the classification of R a d o m s k i (1987), the years 1996 and 1997 were humid, and 1998 was very humid. April of 1996 was very dry, and humid in 1997 and 1998. May of 1996 and 1997 was humid, but moderate in 1998. June was moderate in 1996, humid in 1997, and very humid in 1998. July of 1996 was very humid, moderate in 1997, and humid in 1998. August was especially humid in 1996, dry in 1997, and very humid in 1998. September of 1996 and 1998 was moderate, but very humid in 1997. October was moderate in 1996, very humid in 1997, and humid in 1998.

The data on climatic conditions of the other months are showed in Table 1.

Table 1

Air temperature and rainfalls in the Drawski Landscape Park in the years 1996–1998 compared with averages of these parameters of the years 1956–1980

Month	Temperature (°C)				Rainfalls (mm)			
	Monthly average of the years	Deviation from the average of the years 1951–1980			Monthly average of the sum of the years	Deviation from the average of the years 1951–1980		
	1951–1980	1996	1997	1998	1951–1980	1996	1997	1998
I	−2.5	−2.5	−1.8	+3.7	38	−34	−34	14
II	−2.2	−3.6	+4.0	+5.7	30	11	33	37
III	+1.1	−2.9	+1.8	+0.6	30	−15	15	40
IV	+6.2	+0.8	−1.7	+2.6	38	−21	10	17
V	+11.5	+0.1	−0.2	+2.0	51	18	14	−2
VI	+15.7	−0.4	+0.2	+0.3	63	7	20	40
VII	+16.8	−1.7	+0.6	−0.8	84	77	14	26
VIII	+16.2	+1.3	+2.8	−1.1	67	72	−21	38
IX	+12.5	−2.8	+0.3	0.0	53	−12	32	9
X	+7.9	+0.5	−1.3	−0.6	48	0	46	20
XI	+3.4	+0.8	−1.5	−4.5	47	−6	−32	−2
XII	−0.3	−4.6	+0.9	−1.7	47	−33	−17	21

Collections of samples and determination of damage of plants. In each year, samples of diseased plants were collected three times, i.e., in July, August and September. All plants affected by fungi of *Erysiphales* were collected within each plot. The damage of plants was determined according to a 9-degree graphic scale given by Püntener (1981): 9° – healthy plant, 8° – 1% of the plant area diseased, 7° – 2% of the plant area diseased, 6° – 5% of the plant area diseased, 5° – 10% of the plant area diseased, 4° – 15% of the plant area diseased, 3° – 20% of the plant area diseased, 2° – 30% of the plant area diseased, 1° – 50% of the plant area diseased.

Identification of fungi and determination of frequency of their occurrence. The powdery mildew fungi collected were identified according to Braun (1987) and Hanlin (1990). The main characteristics recognized were the species affiliation of the plant host of the fungus found and its diagnostic morphological properties. The morphological properties considered were those of appendages, cleistothecia, asci and ascospores, as well as the type of germination of conidia. They were examined using an Olympus SZX9 dissecting microscope and a Zeiss compound microscope equipped with differential interference contrast optics. The frequency of occurrence of powdery mildew fungi was assessed based on a 4-degree scale proposed by Durska (1974): + – sporadic (1 plant damaged), ++ – rare (single plants damaged), +++ – frequent (50% of plants damaged), ++++ – very frequent (> 50% of plants damaged).

RESULTS AND DISCUSSION

During the three years of investigations, a total of 1042 plant samples were collected from the 12 permanent plots with nine plant associations of DLP considered. They represented 157 species in 39 plant families. The plant families most frequently examined were *Asteraceae* (with 31 plant species), followed by the *Poaceae* (19) and *Rosaceae* (17). The plant species most frequently sampled were *Polygonum aviculare* and *Tanacetum vulgare*.

A total of 55 species in 9 genera of the order *Erysiphales* were found. Most species of *Erysiphales* were identified in 1998 (48); the number of species encountered in the other two years was the same (36). In 1998, the fungal species revealed were associated with 110 plant species, and 71 and 87 plant species hosted the fungi found in 1996 and 1997, respectively. Among the powdery mildew fungi recognized, the highest number of species came from the genus *Erysiphe* (21), followed by *Sphaerotheca* (11) and *Microsphaera* (14). The genera represented by the lowest number of species were *Uncinula* and *Phyllactinia* (one species each). Most species of the genus *Erysiphe* were revealed in the *Artemisietea* plant association (12), followed by *Ribo nigri-Alnetum* (8) and *Chenopodietea* (7). The lowest species diversity of fungi of this genus was found in *Vaccinio uliginosi-Pinetum* (2).

Members of the order *Erysiphales* found in the Drawski Landscape Park

The data presented in this section supplement those given by Czerniawska et al. (2000). The occurrence of 31 next species of Erysiphales and 15 species of these fungi found on plants not listed in the paper mentioned above is showed.

Blumeria graminis on *Agropyron repens*: Stare Drawsko 10(+++); *Agrostis capillaris*: Połczyn Zdrój 1(+); *Alopecurus pratensis*: Stare Drawsko 10(+); *Avena sativa*: Złocieniec 4(+++), Łubowo 12(++), Czaplinek 8(+); *Bromus erectus*: Stare Drawsko 10(++); *Bromus hordeaceus*: Stare Drawsko 10(++); *Dactylis glomerata* subsp. *glomerata*: Połczyn Zdrój 1(++), Złocieniec 4(+); *Festuca pratensis*: Czaplinek 8(+), Ostrowice 9(+); *Festuca rubra*: Złocieniec 4(+); *Hordeum vulgare*: Stare Drawsko 10(+++), Złocieniec 4(++), Warnilęg 11(++), Kocury 7(+++), Ostrowice 9(+++), Stare Worowo 2(++); *Lolium multiflorum*: Stare Kaleńsko 3(+); *L. perenne*: Stare Worowo 2(+); *Millium effusum*: Kluczewo 5(0), Rzepowo 6(0); *Poa annua*: Łubowo 12(+), Rakowo 13(+); *P. pratensis*: Kocury 7(+), Czaplinek 8(++), Ostrowice 9(++); *P. trivialis*: Rzepowo 6(++); *Secale cereale*: Złocieniec 4(+++), Łubowo 12(+++), Czaplinek 8(++), Ostrowice 9(++), Stare Drawsko 10(++), Rzepowo 6(+++); *Triticum aestivum*: Połczyn Zdrój 1(+++), Ostrowice 9(+++), Rzepowo 6(++), Złocieniec 4(+++), Kluczewo 5(+++), Stare Kaleńsko 3(++). This fungus was not earlier recorded on *B. erectus* growing in Poland. *Blumeria graminis* affected many members of the family Poaceae occurring

in Europe, Africa, Asia, Australia, as well as North and South America (B r a u n 1987; S a ł a t a 1985).

Erysiphe aquilegiae var. *ranunculi* on *Consolida ajacis*: Stare Drawsko 10(+); *Ranunculus repens*: Rzepowo 6(+).

Erysiphe artemisiae on *Artemisia vulgaris*: Łubowo 12(+ + +), Rakowo 13(+ + +).

Erysiphe betae on *Beta vulgaris*: Stare Drawsko 10(+), Stare Worowo 2(+ +).

Erysiphe buhrii on *Melandrium album*: Łubowo 12(+); *Silene gallica*: Rakowo 13(0). This is the first report of the occurrence of *E. buhrii* on *S. gallica* in Poland. This fungus was reported to be associated with many species of the family Cariophyllaceae growing in Europe, south-western and central Asia, and probably with those of North and South America (B r a u n 1987; S a ł a t a 1985).

Erysiphe cichoracearum var. *cichoracearum* on *Aster novi-belgii*: Stare Drawsko 10(+ + +), Złocieniec 4(+ +), Połczyn Zdrój 1(+ + +); *A. tradescantii*: Rakowo 13(+); *Centaurea jacea*: Stare Kaleńsko 3(0); *Cirsium oleraceum*: Kluczewo 5(0), Rzepowo 6(+); *Cirsium palustre*: Kluczewo 5(+), Kocury 7(+), Rzepowo 6(+); *Conyza canadensis*: Stare Kaleńsko 3(+ +); *Cucumis sativus*: Złocieniec 4(+ + +), Ostrowice 9(+ +); *Cucurbita pepo*: Złocieniec 4(+ +), Stare Worowo 2(+ +), Kluczewo 5(+ +), Łubowo 12(+ +), Czaplinek 8(+ + +); *Hieracium sabaudum:* Kluczewo 5(+); *Lactuca serriola*: Stare Kaleńsko 3(0); *Rudbeckia lanciniata*: Stare Drawsko 10(+ +); *Senecio jacobaea*: Kluczewo 5(+), Kocury 7(+); *Sonchus arvensis*: Łubowo 12(+), Rakowo 13(+); *S. oleraceus*: Łubowo 12(0); *Tanacetum vulgare*: Stare Kaleńsko 3(+), Stare Drawsko 10(+ +), Łubowo 12(+ + +), Rakowo 13(+ + +). *Aster trandescantii* is a plant host of this fungus previously not recorded in Poland. According to B r a u n (1987) and S a ł a t a (1985), this powdery mildew fungal species parasitized on different species of the family Asteraceae of Europe, south-western and central Asia, and probably on those of North and South America (Braun 1987; S a ł a t a 1985).

Erysiphe convolvuli var. *convolvuli* on *Convolvulus arvensis*: Kluczewo 5(+ +), Kocury 7(+ +), Stare Drawsko 10(+ + +).

Erysiphe cruciferarum on *Brassica napus* subsp. *napus*: Warniłęg 11(+), Kocury 7(+ +), Połczyn Zdrój 1(+ +); *Brassica rapa* subsp. *rapa*: Ostrowice 9(+); *Sisymbrium loeselii*: Łubowo 12(+); *Sisymbrium officinale*: Rakowo 13(+ +), Złocieniec 4(0). A fungus previously known only from Szczecin (S a ł a t a 1985). U b r i z s y and V ö r ö s (1966) encountered it in Hungary.

Erysiphe cynoglosii on *Borago officinalis*: Stare Drawsko 10(0); *Echium vulgare*: Stare Kaleńsko 3(0), Łubowo 12(+), Rakowo 13(+).

Erysiphe depressa on *Arctium lappa*: Łubowo 12(+ +), Rakowo 13(+ +); *Arctium tomentosum*: Kluczewo 5(+ + +).

Erysiphe echinopis on *Echinops sphaerocephallus*: Łubowo 12(0).

Erysiphe galeopsidis on *Ballota nigra* subsp. *nigra*: Złocieniec 4(+ +); *Galeopsis tetrahit*: Połczyn Zdrój 1(+ +), Stare Worowo 2(+); *Lamium purpureum*: Połczyn Zdrój 1(+ +), Rzepowo 6(+ +).

Erysiphe galii var. *galii* on *Galium aparine*: Rzepowo 6(+ + +).

Erysiphe heraclei on *Anthriscus sylvestris*: Połczyn Zdrój 1(0), Rzepowo 6(+); *Daucus carota*: Stare Kaleńsko 3(+ + +), Połczyn Zdrój 1(+ +); *Heracleum sphondylium*: Złocieniec 4(+ +), Kluczewo 5(+ +), Kocury 7(+ +); *Pastinaca sativa*: Stare Kaleńsko 3(0).

Erysiphe magnicellulata var. *magnicellulata* on *Phlox paniculata*: Stare Drawsko 10(+ +).

Erysiphe mayorii var. *mayorii* on *Cirsium arvense*: Złocieniec 4(+).

Erysiphe orontii on *Veronica chamaedrys*: Połczyn Zdrój 1(0); *Viola tricolor*: Warniłęg 11(0).

Erysiphe pisi var. *pisi* on *Lathyrus tuberosus*: Stare Drawsko 10(0); *Lupinus angustifolius*: Warniłęg 11(+ +), Stare Worowo 2(+ +); *L. luteus*: Ostrowice 9(+), Stare Drawsko 10(+ + +); *L. mutabilis*: Łubowo 12(+); *L. polyphyllus*: Łubowo 12(+ +), Rakowo 13(+ +); *Melilotus alba*: Łubowo 12(+), Rakowo 13(+). *Lupinus mutabilis* is a new plant host of this fungus in Poland. *Erysiphe pisi* var. *pisi* affected numerous species of the genus *Fagus* growing in Europe, northern and southern Africa, Asia, Australia, and North and South America (B r a u n 1987).

Erysiphe polygoni on *Polygonum aviculare*: Stare Drawsko 10(+ + +), Łubowo 12(+ + +), Rakowo 13(+ + +); *Rumex acetosella*: Stare Drawsko 10(+).

Erysiphe sordida on *Plantago maior*: Łubowo 12(+ + +), Rakowo 13(+ + +); *P. media* L.: Rakowo 13(0).

Erysiphe urticae on *Urtica dioica*: Połczyn Zdrój 1(+), Rzepowo 6(+), Rakowo 13(0).

Microsphaera alphitoides var. *alphitoides* on *Quercus robur*: Stare Worowo 2(+ + +), Warniłęg 11(+ + +), Stare Kaleńsko 3(+ +).

Microsphaera berberidis var. *berberidis* on *Mahonia aquifolium*: Złocieniec 4(0).

Microsphaera euonymi on *Euonymus europaeus*: Rzepowo 6(+).

Microsphaera friesii var. *friesii* on *Rhamnus catharticus*: Stare Worowo 2(+).

Microsphaera hypericacearum on *Hypericum perforatum*: Stare Kaleńsko 3(0).

Microsphaera lonicerae var. *lonicerae* on *Lonicera tatarica*: Warniłęg 11(+).

Microsphaera palczewskii on *Caragana arborescens*: Złocieniec 4(+ + +), Połczyn Zdrój 1(+ +), Czaplinek 8(+ +), Stare Drawsko 10(+ + +), Łubowo 12(+ +).

Microsphaera russellii on *Oxalis stricta*: Połczyn Zdrój 1(0).

Microsphaera symphoricarpi on *Symphoricarpos albus*: Złocieniec 4(+ +), Czaplinek 8(+ +), Stare Drawsko 10(+ +, Fig. 2).

Microsphaera tortilis on *Cornus sanguinea*: Stare Worowo 2(+).

Microsphaera trifolii var. *trifolii* on *Trifolium alpestre*: Stare Drawsko 10(+ +); *T. hybrydium* L. subsp. *hybrydium*: Stare Drawsko 10(+); *T. medium*: Rakowo 13(+ +); *T. pratense*: Złocieniec 4(+), Połczyn Zdrój 1(+ +),

Czaplinek 8(+ +); *T. repens* subsp. *repens*: Łubowo 12(+), Połczyn Zdrój 1(+ +).

Oidium chrysanthemi on *Chrysanthemum* sp.: Łubowo (0).

Phyllactinia guttata on *Fagus sylvatica*: Połczyn Zdrój 1(0).

Podosphaera leucotricha on *Malus domestica*: Połczyn Zdrój 1(+ +), Czaplinek 8(+ +), Stare Worowo 2(+), Złocieniec 4(+); *Malus sylvestris*: Rzepowo 6(+ +).

Podosphaera tridactyla var. *tridactyla* on *Padus avium*: Kluczewo 5(+), Kocury 7(+), Rzepowo 6(+ +); *Prunus domestica*: Kocury (0).

Sawadaea bicornis on *Acer negundo*: Stare Worowo 2(+), Warniłęg 11(+), Rzepowo 6(+ +).

Sawadaea tulasnei on *Acer platanoides*: Połczyn Zdrój 1(+), Stare Worowo 2(+ +), Warniłęg 11(+ +).

Sphaerotheca aphanis var. *aphanis* on *Potentilla heptaphylla*: Połczyn Zdrój 1(0); *P. reptans*: Kluczewo 5(+); *Rubus caesius*: Stare Kaleńsko 3(0), Ostrowice 9(0, Fig. 3).

Sphaerotheca balsaminae on *Impatiens noli-tangere*: Kluczewo 5(+ + +), Kocury 7(+ + +), Czaplinek 8(+ + +), Ostrowice 9(+ + +), Rzepowo 6(+).

Sphaerotheca euphorbiae on *Euphorbia peplus*: Łubowo 12(+).

Sphaerotheca fugax on *Geranium pratense*: Stare Kaleńsko 3(+).

Sphaerotheca fusca on *Bidens tripartita*: Stare Worowo 2(+); *Calendula officinalis*: Rzepowo 6(+), Stare Drawsko 10(+ +); *Clinopodium vulgare*: Łubowo 12(+); *Taraxacum officinale*: Złocieniec 4(+), Stare Drawsko 10(+ + +). In Poland, this fungus was not previously found associated with *C. vulgare*. *Sphaerotheca fusca* affected *C. vulgare* in other countries of Europe and in North America (B r a u n 1987).

Sphaerotheca lini on *Linum* sp. Połczyn Zdrój 1(+).

Sphaerotheca macularis on *Humulus lupulus*: Kluczewo 5(+ +), Kocury 7(+ +), Rzepowo 6(+ +).

Sphaerotheca pannosa on *Rosa agrestis*: Stare Drawsko 10(0); *Rosa canina* L.: Stare Kaleńsko 3(0), Rzepowo 6(0); *Rosa glauca*: Stare Kaleńsko 3(0); *Rosa multiflora*: Rzepowo 6(0), Czaplinek 8(0). A new plant host of this fungus in Poland. J u n e l l (1967) found *S. pannosa* on *R. agrostis* in Sweden.

The occurrence of fungi of the order *Erysiphales* in nine plant associations of the Drawski Landscape Park

Luzulo pilosae-Fagetum. In *Luzulo pilosae-Fagetum*, 13 powdery mildew fungal species associated with 17 plant species were found (Fig. 1). The dominants were members of the genus *Erysiphe*; six *Erysiphe* spp. were recognized. The species most numerously occurring were *E. gaelopsidis* (present on *Gaelopsis tetrahit* and *Lamium purpureum*) and *B. graminis* (*Dactylis glomerata* subsp. *glomerata*).

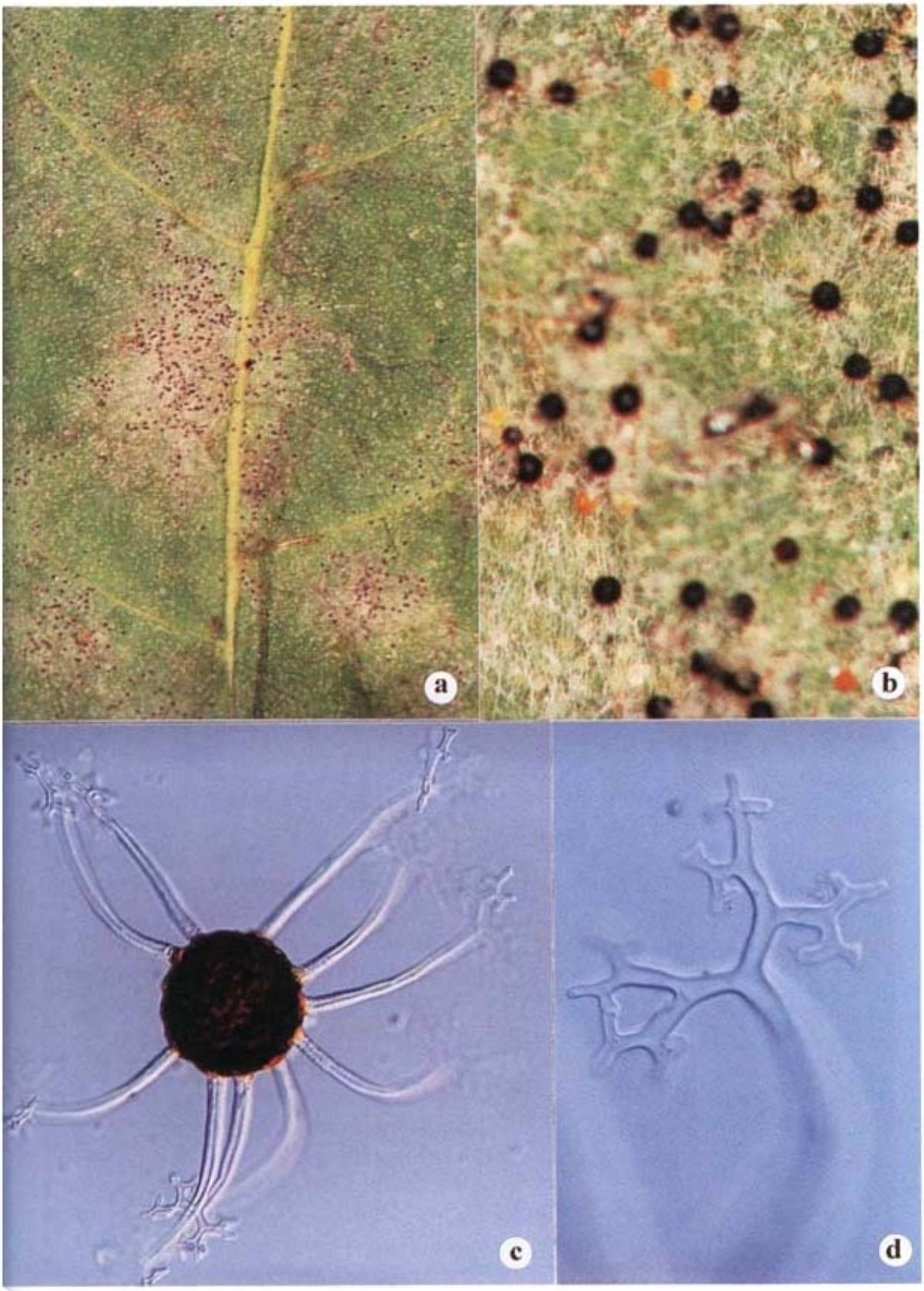

Fig. 2. *Microsphaera symphoricarpi*: **a** and **b** — cleistothecia on a leaf of *Symphoricarpos albus*, bright field microscopy, ×12.5 and ×62.5, respectively; **c** — cleistothecium with appendages, differential interference contrast (DIC), ×310; **d** — appendage, DIC, ×1200.

Fig. 3. *Sphaerotheca aphanis* var. *aphanis*: **a** — powdery mildew on leaves of *Alchemilla monticola*; **b** — crushed cleistothecium and ascus with ascospores, DIC, ×500.

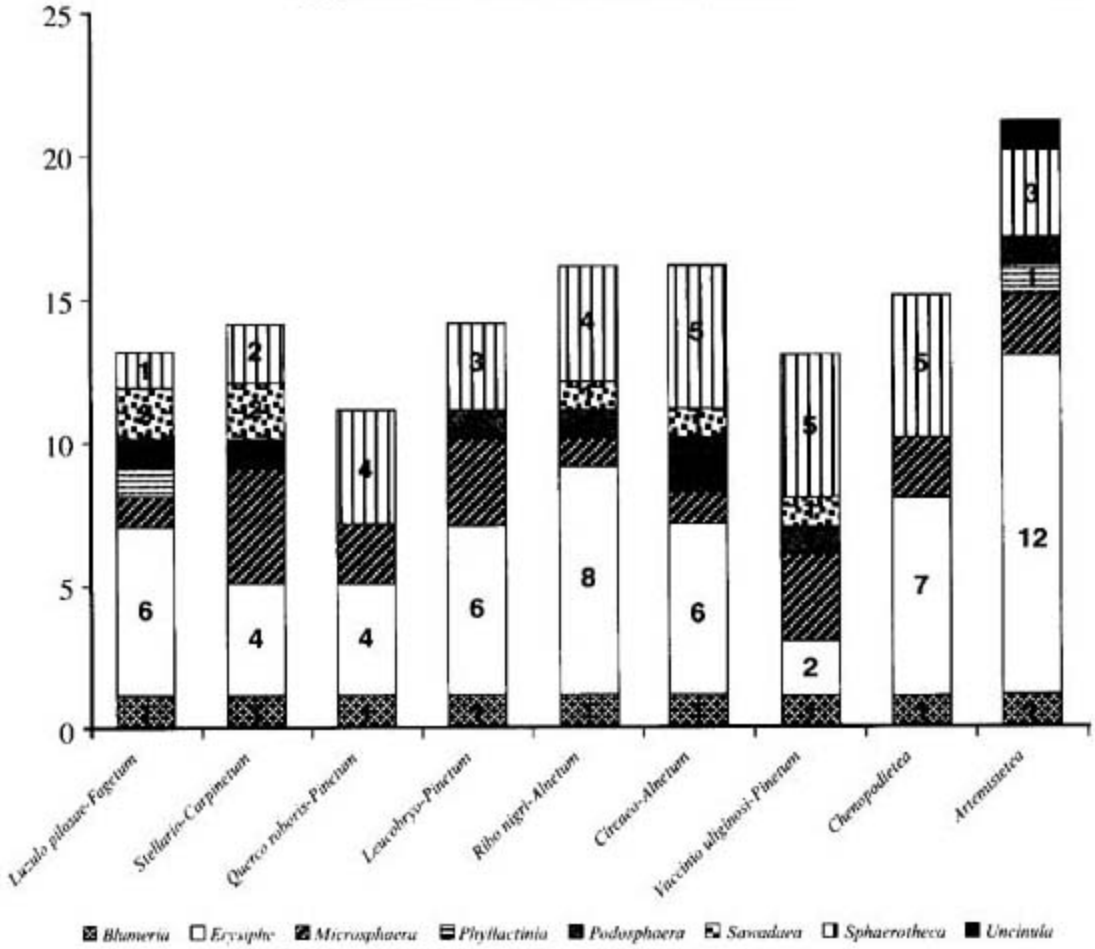

Fig. 1. Number of species of *Erysiphales* in nine plant associations of the Drawski Landscae Park

The specific species of this plant association, i.e., found only in one of the plant associations examined, were *M. russellii* (occurring on *Oxalis stricta*) and *P. guttata* (*Fagus sylvatica*).

As from the similarity coefficients result (Table 2), the species composition of the powdery mildews of *Luzulo pilosae-Fagetum* most resembled that of the *Stellario-carpinetum* and *Leucobryo-Pinetum* plant associations.

No literature data are on *Erysiphales* associated with plants of *Luzulo pilosae-Fagetum* growing in Poland.

Stellario-carpinetum. Fourteen species of *Erysiphales* occurring on 17 plant species were found in this association (Fig. 1). The species dominating were those of the genera *Erysiphe* and *Microsphaera* (each represented by four species).

The species most numerously present were *B. graminis* (on *Deschampsia caespitosa*), *M. alphitoides* var. *alphitoides* (*Quercus robur*, *Q. petraea*), and *Sa. tulasnei* (*Acer platanoides*).

The specific species included *M. friessi* var. *friessi* (on *Rhamnus catharticus*), *M. lonicerae* var. *lonicerae* (*Lonicera tatarica*), and *M. tortilis* (*Cornus sanquinea*).

The species composition of members of the order *Erysiphales* revealed in the *Querco roboris-Pinetum* plant association was most similar to that determined in *Luzulo pilosae-Fagetum* and *Vaccinio ulginosi-Pinetum* (Table 2).

No investigations of the occurrence of causal agents of powdery mildews in *Stellario-Carpinetum* were conducted in Poland to date.

Table 2

Similarity coefficients for powdery mildew fungal communities of nine plant associations of the Drawski Landscape Park

Plant association	*Lp-F**	*S-C*	*Qr-P*	*L-P*	*Rn-A*	*C-A*	*Vu-P*	*Ch*	*A*
Lp-F	100	35	20	35	25	26	18	8	17
S-C	35	100	19	26	24	25	35	25	16
Qr-P	20	19	100	25	25	16	41	40	14
L-P	35	26	25	100	28	20	26	20	24
Rn-A	25	24	26	28	100	37	25	32	22
C-A	26	25	16	20	37	100	32	23	15
Vu-P	18	35	41	26	25	32	100	32	21
Ch	8	25	40	20	32	23	32	100	41
A	17	16	14	24	22	15	21	41	100

Explanations: *Lp-F — Luzulo pilosae-Fagetum; S-C — Stellario-Carpinetum; Qr-P — Querco roboris-Pinetum; L-P — Leucobryo-Pinetum; Rn-A — Ribo nigri-Alnetum; C-A — Circaeo-Alnetum; Vu-P — Vaccinio ulginosi-Pinetum; Ch — Chenopodietea; A — Artemisietea.*

Querco roboris-Pinetum. Only 11 species of *Erysiphales* on 20 plant species were recognized in this site (Fig. 1). The dominants were members of *Erysiphe* and *Sphaerotheca* (each represented by four species).

The fungal species most numerously occurring were *E. cichoracearum* var. *cichoracearum* (on *Conyza canadensis*), *M. alphitoides* var. *alphitoides* (*Quercus robur, Quercus petraea*), and *S. aphanis* var. *aphanis* (*Alchemilla monticola*, Fig. 3).

The community of *Erysiphales* of *Querco roboris-Pinetum* was most closely related to that of *Vaccinio uliginosi-Pinetum* (Table 2).

No Polish literature data exist on *Erysiphales* of plants of *Querco roboris-Pinetum*. The *Querco roboris-Pinetum* plant association is a newly defined *Pino-Quercetum* plant association (M a t u s z k i e w i c z 1967, 1984), in which the occurrence of *Erysiphales* was earlier investigated. Plants of this association in the Białowieża National Park hosted five species of *Erysiphales* (M a j e w s k i 1971), in the Ojców National Park — six species (K u ć m i e r z 1973), and in the Chmielinne reserve — one species (D a n i l k i e w i c z 1982).

Leucobryo-Pinetum. In this site, 14 species of *Erysiphales* were found on 20 plant species (Fig. 1). The dominant fungi were those of the genus *Erysiphe*, which were represented by six species.

The species most numerously occurring were *E. galeopsidis* (on *Ballota nigra* subsp. *nigra*), *E. heraclei* (*Heracleum sphondylium*), *M. vanbruntiana* var. *sambuci-racemosae* (*Sambucus nigra*), and *S. aphanis* var. *aphanis* (*Alchemilla monticola*, Fig. 3).

The specific powdery mildew fungi of this site were *E. mayorii* var. *mayorii* (on *Cirsium arvense*) and *M. berberidis* var. *berberidis* (*Mahonia aquifolium*).

The species composition of *Erysiphales* revealed in *Leucobryo-Pinetum* was most reminiscent of that of *Luzulo pilosae-Fagetum* (Table 2).

The occurrence of *Erysiphales* in the *Leucobryo-Pinetum* plant association was not earlier investigated in Poland.

Ribo nigri-Alnetum. In *Ribo nigri-Alnetum*, 16 species of powdery mildew fungi affecting 24 plant species were recognized (Fig. 1). The dominants were members of the genus *Erysiphe*; they represented eight species.

The fungal species most numerously occurring included *E. cichoracearum* var. *cichoracearum* (on *Solidago canadensis*), *E. convolvuli* var. *convolvuli* (*Convolvulus arvensis*), *E. depressa* (*Arctium tomentosum*), *E. heraclei* (*Heracleum sphondylium*), *S. balsaminae* (*Impatiens noli-tangere*), *S. macularis* (*Humulus lupulus*), and *S. plantaginis* (*Plantago lanceolata*).

No specific fungus occupied plants of this site.

The powdery mildew fungal species composition of plants of *Ribo nigri-Alnetum* most fitted that of *Circaeo-Alnetum* and *Chenopodietea* (Table 2).

There is lack of literature information of the occurrence of causal agents of powdery mildews in *Ribo nigri-Alnetum*. However, the *Ribo nigri-Aletum* plant association of the newest classification (M a t u s z k i e w i c z 1984) was a part of the *Carici elongate-Alnetum* association in the former classification (M a t u s z k i e w i c z 1967). Therefore, the results of this study were compared with those of the older literature. Only plants of the Łęczyńsko-Włodawskie Lake District hosted more species of *Erysiphales* (26; M u ł e n k o 1988) than those of DLP. Six powdery mildew fungal species were identified in the Chmielinne reserve (D a n i l k i e w i c z 1982), eight in the Białowieża National Park (M a j e w s k i 1971), and 12 in the Bug middle valley (D a n i l k i e w i c z 1982).

Circaeo-Alnetum. Twenty-one plant species of this site harboured 16 species of *Erysiphales* (Fig. 1). The dominants were members of the genera *Erysiphe* (with 6 species) and *Sphaerotheca*.

The fungal species most numerously found were *B. graminis* (on *Poa trivialis*), *E. galeopsidis* (*Lamium purpureum*), *E. galii* var. *galii* (*Galium aparine*), *P. leucotricha* (*Malus sylvestris*), *P. tridactyla* var. *tridactyla* (*Padus avium*), *Sa. bicornis* (*Acer negundo*), *S. balsaminae* (*Impatiens noli-tangere*), and *S. macularis* (*Humulus lupulus*).

The fungi found only in this site included *E. aquilegiae* var. *ranunculi* (on *Ranunculus repens*), *E. galii* var. *galii* (*Galium aparine*), *M. euonymi* (*Euonymus europaeus*), and *P. leucotricha* (*Malus sylvestris*).

The powdery mildew fungal species composition of *Circaeo-Alnetum* most resembled that of *Ribo nigri-Alnetum* and *Vaccinio uliginosum-Pinetum* (Table 2).

Of the other sites with the *Circaeo-Alnetum* plant association earlier investigated in Poland, 16 species of *Erysiphales* were also found in the Białowieża National Park. The others hosted from one to seven species of these fungi (D a n i l k i e w i c z 1982, 1987; M a j e w s k i 1967).

Vaccinio uliginosi-Pinetum. In this site, 12 species of *Erysiphales* parasitizing on 15 plant species were revealed (Fig. 1). The fungal genus dominating was *Sphaerotheca*; it was represented by five species.

The powdery mildew fungi most numerously present were *B. graminis* (on *Poa pratensis*), *E. cynoglossi* (*Myosotis arvensis*), *M. alphitoides* var. *alphitoides* (*Quercus petraea*), and *P. clandestina* var. *clandestina* (*Crataegus monogyna*).

No specific fungal species was recognized in this site.

The species composition of the powdery mildew fungi found in *Vaccinio uliginosi-Pinetum* was most reminiscent of that of *Querco roboris-Pinetum*.

The *Vaccinio uliginosi-Pinetum* plant association of the Białowieża National Park hosted two species of *Erysiphales* (M a j e w s k i 1971) and 12 fungal species were found in the Łęczyńsko-Włodawskie Lake District (M u ł e n k o 1988).

Chenopodietea. In Chenopodietea, 16 species of *Erysiphales* on 27 plant species were identified (Fig. 1). The genera *Erysiphe* (with 7 species) and *Sphaerotheca* (5) dominated.

The fungi most numerously occurring were *B. graminis* (on *Agropyron repens, Bromus hordeaceus, Bromus erectus*), *E. cichoracearum* var. *cichoracearum* (*Cichorium intybus, Rudbeckia lanciniata, Solidago canadensis, Tanacetum vulgare, Tragopogon pratensis*), *E. convolvuli* var. *convolvuli* (*Convolvulus arvensis*), *E. magnicellulata* var. *magnicellulata* (*Phlox paniculata*), *E. polygoni* (*Polygonum aviculare*), *M. trifolii* var. *trifolii* (*Trifolium alpestre*), *S. aphanis* var. *aphanis* (*Alchemilla monticola*), *S. epilobii* (*Epilobium hirsutum*), *S. fusca* (*Calendula officinalis, Taraxacum officinale*), and *S. plantaginis* (*Plantago lanceolata*).

The specific fungus of this plant association was only *E. magnicellulata* var. *magnicellulata* affecting *Phlox paniculata*.

The powdery mildew fungal species community of *Chenopodietea* was highly related to that of *Artemisietea* (Table 2).

Artemisietea. In this site, 32 plant species were affected by 22 species of *Erysiphales* (Fig. 1). The dominant genus was *Erysiphe*, which was represented by 13 species.

The fungal species most numerously occurring were *E. artemisiae* (on *Artemisia vulgaris*), *E. cichoracearum* var. *cichoracearum* (*Tanacetum vulgare*), *E. cruciferarum* (*Sisymbrium officinalis*), *E. depressa* (*Arctium lappa*), *E. pisi* var. *pisi* (*Lupinus polyphyllus*), *E. polygoni* (*Polygonum aviculare*), *E. sordida* (*Plantago maior*), *M. trifolii* var. *trifolii* (*Trifolium medium*), and *P. clandestina* var. *aucupariae* (*Sorbus aucuparia*).

The fungal species found only in the *Artemisietea* plant association were *E. artemisiae* (on *Artemisia vulgaris*), *E. buhrii* (*Melandrium album, Silene gallica*), *E. echinopis* (*Echinops sphaerocephallus*), and *U. adunca* (*Salix aurita*).

The powdery mildew fungal species composition of *Artemisietea* was most similar to that of *Chenopodietea* (Table 2).

In summary, most genera of *Erysiphales* hosted plants of the *Luzulo pilosae-Fagetum* and *Artemisietea* plant associations (each 7), and least those of *Querco roboris-Pinetum* and *Chenopodietea* (each 4). Most species of *Erysiphales* were found in *Artemisietea* (22), followed by *Chenopodietea, Circo-Alnetum*, and *Ribo nigri-Alnetum* (each 16 species). The plant association harbouring the lowest number of powdery fungal species was *Querco roboris-Pinetum* (11).

Most specific fungal species contained the *Artemisietea* and *Circaeo-Alnetum* plant associations (each 4). No specific member of *Erysiphales* was found in *Ribo nigri-Alnetum* and *Vaccinio uliginosi-Pinetum.*

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Streszczenie

Autorka kontynuuje przedstawianie wyników 3-letnich badań nad występowaniem grzybów z rzędu *Erysiphales* w Drawskim Parku Krajobrazowym. Lista występowania przedstawicieli *Erysiphales* obejmuje 31 następnych gatunków i 15 gatunków stwierdzonych na roślinach nie wymienionych we wcześniejszej pracy. Ponadto przedstawiono i porównano występowanie tych grzybów w 12 stałych powierzchniach badawczych z dziewięcioma zbiorowiskami roślinnymi.