ACTA SCIENTIARUM POLONORUM *Acta Sci. Pol., Hortorum Cultus 11(2) 2012, 167-172*

FUNGI AND CHROMISTAN FUNGI ASSOCIATED WITH PLANTS WHITE WATER LILY *Nymphaea alba* L. DURING THE VEGETATION SEASON

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Abstract. White water lily *Nymphaea alba* L. is very popular among enthusiasts for aquatic plants cultivation in ponds. The decorative values are provided by magnificent flowers and attractive floating leaves. The aim of the study was to determine the health status of white water lily, and identificate of mycobiota accompanying those plants in the growing season, and thus causing symptoms of disease. The studies were carried out in twenty ponds, in 2006, 2008–2010. It was found that spots and necrosis of leaves were caused by complex of fungi and chromistan fungi from genera: *Alternaria*, *Aspergillus*, *Cladosporium*, *Cylindrocarpon*, *Fusarium*, *Mortierella*, *Mucor*, *Paecilomyces*, *Penicillium*, *Phialophora*, *Phoma*, *Phytophthora*, *Pythium*, *Sordaria*, *Trichoderma* and others. White water lily plants often were colonized by *Alternaria alternata*, *Penicillium verrucosum* v. *verrucosum*, *P. expansum*, *Paecilomyces farinosus*, *Cylindrocarpon destructans*, *Sordaria fimicola*, *Mucor hiemalis* f. *hiemalis* and *Fusarium oxysporum*. Fungi colonized the most intensively white water lily in the autumn. It was also ascertained, that since pathogenic fungi and chromistan fungi infected white water lily, such complexes brought about a range of spotting symptoms up to leaves necrosis, on account of what has taken place sharp decrease of plants aesthetic value.

Key words: water plants, mycobiota, disease, garden pond

INTRODUCTION

White water lily (*Nymphaea alba* L.) is very popular among enthusiasts for aquatic plants cultivation in ponds. The decorative values are provided by magnificent flowers and attractive floating leaves. White water lily plant belongs vegetation of to the deep water zone. During the period of vegetation on the submerged and on floating organs exists mycobiota causing various infectious diseases [Westcott 1971, Batko 1975, Van der Aa 1978, Helberg 1998]. Symptoms of diseases visible as spots, necrosis, and dis-

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tortions on parts of plants floating on the water decrease aesthetics value of greenery in ponds, localized in both private and public gardens.

The aim of this study was to determine the health status of white water lily and identification of mycobiota accompanying cultivated plants during the growing season and causing symptoms of disease.

MATERIAL AND METHODS

The study was carried out on white water lily specimens growing in twenty ponds located in the gardens in the province of Malopolska and Podkarpackie, during the vegetation seasons: 2006 and 2008–2010. Health status was determined annually, in the five dates from April to October. 600 fragments of plants (leaves and petioles) with spots and necrosis symptoms were collected for laboratory analysis, which after decontamination were put on the PDA medium [Kowalik and Maik 2010]. Mycobiota were identyfied using mycological keys: Rifai [1969], Batko [1975], Domsch et al. [1980] and Ho [1981].

RESULTS

In every year of study chlorotic lesions were visible on leaves of white water lily in all monitored ponds. Symptoms of small and chlorotic leaf spots appeared in May. Symptoms gradually escalated, and at the end of the growing season brown spots surrounded by yellowish or reddish halo covered a significant part of the leaf surface. Necrotic tissue was covered with a delicate coating of concentrically zoned mycelium. Leaf tissue underwent local crumble away, which resulted in perforation of the leaf blade.

In three ponds, in 2008, symptoms of black rot of white lily rhizomes were ascertained. The infection of underwater plant vegetative organs resulted in chlorotic leaf bleaching, and in dark stripes radiating from the center to the edges of the leaf swchich were clearly separated from healthy tissue. The base of the leaf underwent maceration, and the rotten rhizome was given off an unpleasant odour.

In several ponds, in 2008–2009, on the leaves of inspected plants were observed signs of early spring physiological disorders. Leaves did not showed the typical coloring pattern for given cultivar, were red or maroon, deformed and wrinkled, especially in the place of leaf contact with water. Excessive plant density favoured the occurrence of such disorders.

The severity of symptoms of a white water lily in each year of study were rather diverse, generally the most distinguish symptoms of disease were observed in 2010.

As a result of mycological analysis of diseased leaves and petioles of white water lily with spots and necroses 558 fungal colonies were isolated, belonging to the kingdom of Fungi, 15 chromistan fungi colonies belonging to Chromista, and more than 160 isolates of bacteria (not covered by this study). Mycobiota belonged to 42 species within the genera: *Alternaria*, *Aspergillus*, *Botrytis*, *Chaetomium*, *Cladosporium*,

Table 1. Fungi and chromistan fungi isolated from affected tissues of white water lily *Nymphaea alba* L.

Tabela 1. Grzyby i grzyby chromistopodobne wyizolowane z porażonych tkanek grzybienia białego *Nymphaea alba* L.

Fungus Grzyb	Years of observation Lata obserwacji				Total Ogółem	Percentage Udział %
	2006	2008	2009	2010		
Alternaria alternata	20	30	33	21	104	18.15
Aspergillus niger		4		3	7	1.22
Aspergillus versicolor	7			1	8	1.40
Botrytis cinerea				2	2	0.35
Chaetomium globosum		3			3	0.52
Cladosporium cladosporioides	1			11	12	2.09
Cladosporium sphaerospermum	7	2			9	1.57
Coleophoma empetri	1	5			6	1.05
Cylindrocarpon destructans	17			11	28	4.89
Diplodia melaena			3		3	0.52
Epicoccum purpurascens	2	7	1	2	12	2.09
Fusarium oxysporum	13			4	17	2.97
Fusarium poae	2		3	2	7	1.22
Fusarium sporotrichoides	1			1	2	0.35
Fusarium tricinctum		1			1	0.17
Mortierella alpina	6	1		3	10	1.75
Mortierella isabellina	9			6	15	2.62
Mortierella nana	1		1	2	4	0.70
Mortierella parvispora	1				1	0.17
Mucor hiemalis f. *hiemalis*	8		7	7	22	3.84
Paecilomyces farinosus		41			41	7.16
Paecilomyces variotti			1		1	0.17
Penicillium expansum	9	7	5	11	32	5.58
Penicillium lanosum			8	4	12	2.09
Penicillium steckii	1			1	2	0.35
Penicillium verrucosum v. *verrucosum*	19	1	36	23	79	13.79
Penicillium verrucosum v. *corymbiferum*			11	4	15	2.62
Penicillium verrucosum v. *cyclopium*	1	3		4	8	1.40
Penicillium waksmanii	1	4	5	2	12	2.09
Pestalotia sydowiana		1			1	0.17
Phialophora cyclaminis	1			3	4	0.70
Phialophora richardsiae	3	1			4	0.70
Phoma chrysanthemicola		2			2	0.35
Phytophthora citricola				3	3	0.52
Pythium undulatum	7			5	12	2.09
Sordaria fimicola	8	1	7	8	24	4.19
Talaromyces wortmannii	3		4		7	1.22
Thielavia terricola		1			1	0.17
Trichoderma aureoviride			13	3	16	2.79
Trichoderma koningii			2		2	0.35
Trichoderma pseudokoningii		8		6	14	2.44
Trichoderma viride			2	6	8	1.40
Total – Ogółem	149	123	142	159	573	100.00

Coleophoma, *Cylindrocarpon*, *Diplodia*, *Epicoccum*, *Fusarium*, *Mortierella*, *Mucor*, *Paecilomyces*, *Penicillium*, *Phialophora*, *Phoma*, *Phytophthora*, *Pythium*, *Sordaria*, *Talaromyces*, *Thielavia* and *Trichoderma*.

Species with the largest number (dominant) were: *Alternaria alternata* constituting 18.15% of the total mycobiota community, *Penicillium verrucosum* v. *verrucosum* (13.79%), *Paecilomyces farinosus* (7.16%) and *Penicillium expansum* (5.58%). For the average numerous (influents) included: *Cylindrocarpon destructans*, *Sordaria fimicola*, *Mucor hiemalis* f. *hiemalis*, *Fusarium oxysporum*, *Trichoderma aureoviride*, *Mortierella isabellina*, *P. verrucosum* v. *corymbiferum*, *T. pseudokoningii*, *Cladosporium cladosporioides*, *Epicoccum purpurascens*, *P. lanosum*, *P. waksmanii*, *Pythium undulatum*, *M. alpina*, *C. sphaerospermum*, *Aspergillus versicolor*, *P. verrucosum* v. *cyclopium*, *T. viride*, *A. niger*, *F. poae*, and *Talaromyces wortmannii*, *Coleophoma empetri*, which is from 1 to 5% of the total mycobiota communities. The remaining 16 species, including from 0.17% to 0.7% of communities, fungi were classified as accessory (tab. 1).

Fungi: *A. alternata*, *E. purpurascens*, *P. expansum*, *P. verrucosum* v. *verrucosum*, *P. waksmanii* and *S. fimicola* accompanied white water lily plants in four growing seasons, with the fact that *A. alternata* and *E. purpurascens*, and *S. fimicola* brought about necroses of leaf tissue in most ponds, at the end of the growing season. Also at the end of vegetation season necroses were observed on the leaves and petioles caused by *Botrytis cinerea*, *Chaetomium globosum* and *M. hiemalis* f. *hiemalis*, *P. farinosus*, *T. aureoviride*, *T. pseudokoningii* and *T. viride*, and most colonies of these fungi were isolated in September and October.

In 2010, from infected petioles of white water lily, in the two ponds, chromistan fungi *Phytophthora citricola* and *Pythium undulatum* were isolated.

In all years of research, the greatest number of colonies and the species were isolated from infected organs of a white water lily in September, whereas the least in April. The greatest mycobiota species diversity was found in 2010, and the smallest in 2009.

DISCUSSION

The condition of white water lily health status in the vast majority of ponds was fairly good, despite the visible large spots on leaves and necroses caused by parasitic mycobiota. There were no dying white water lily in any of ponds during all years of research. Advanced symptoms of leaf spots (also known as brown spotted), visible until the end of the growing season, significantly decreased decorative value of plants and ponds.

Analysing the obtained results, and information on the occurrence on aboveground organs (parts) of white water lily of both infectious and uninfectious diseases [Pirone et al. 1960, Westcott 1971, Van der Aa 1978] it was established that there is a risk associated with the polyphagous accompanying permanent ponds components: yellow iris, common cattail, common rush and calamus [Kowalik and Krasny 2009, Kowalik and Maik 2010]. It was shown that the leaves and petioles of white water lily were inhabited by a complex of different species of mycobiota, including many belonging to the genus *Alternaria* and *Cladosporium*.

Fungi *A. alternata, C. cladosporioides* and *C. sphaerospermum* recognized as the perpetrators spots necroses and abnormalities in growth [Westcott 1971, Van der Aa

1978] were isolated from necrotic leaves at the end of the vegetation, in quantities of over one hundred colonies. However pathogens: *Burrillia decipens*, *Cercospora exotica*, *C. nymphaeacea*, *Helicoceras nympharum*, *Heliosporum nymphearum*, *Mycosphaerella pontederiae, Ovularia nymphaearum*, *Phyllosticta fatiscens*, *Ph. nympheacea* and *Entyloma nymphaeae* administered by Pirone et al. [1960] and Westcott [1971] from natural stands of white water lily were not isolated from garden ponds.

Among the colonies isolated from tissues of white water lily polyphagous fungi a known as hazard for many plants, not only in ponds were found [Kowalik and Krasny 2009, Kowalik and Maik 2010, Pląskowska 2010]. The intensity of occurrence of *A. alternata*, *B. cinerea*, *E. purpurascens*, *S. fimicola* and numerous species of *Fusarium*, *Penicillium* and *Aspergillus*, can increase in conditions of high temperature, and specific, sufficiently moist environment of the pond.

Black rot of rhizomes the most dangerous disease of white water lily disease is considered to be, occurring relatively rarely [Helberg 1998]. Among the perpetrators is mentioned *P. undulatum*, isolated in the two succesive years of research. The outgrowth of leaf mycelium by pathogens such as *C. destructans*, *F. oxysporum*, *F. poae*, *F. sporotrichoides* and *F. tricinctum* should be considered as a consequence of earlier water lily rhizomes. The course of disease may be enhanced, if dying organs will be not removed while routine nursing procedures.

In ponds special attention should be paid to the threat of *Phytophthora* and *Pythium*, as the chromistan fungi, belonging to these types, commonly colonize perennials, shrubs, coniferous and deciduous trees in their natural habitat, nursery-garden and ornamental plant nursery, causing symptoms of *Phytophthora*, and the water is a factor in spreading propagules [Orlikowski 2006].

Taxonomic mycobiota diversity associated with white water lily plants in the vegetation period, testify to rapid spread, and favorable conditions of development in the ponds – the sites with high species richness of plants.

CONCLUSIONS

1. Pathogenic fungi and chromistan fungi associated with period of white water lily growth were responsible for diverse discoloration and necrosis, which contributed to tissue destruction, and thus resulted in lovering of decorative plants qualities.

2. White water lily leaf symptoms spot were caused by mycobiota complex, which was dominated by: *A. alternata*, *P. verrucosum* v. *verrucosum*, *P. farinosus* and *P. expansum.*

3. Fungi colonized the most abundantly white water lily plants in the autumn. At this time greatly increased the necrotroph participation of: *A. alternata*, *E. purpurascens*, *P. farinosus* and *S. fimicola.*

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GRZYBY I GRZYBY CHROMISTOPODOBNE TOWARZYSZĄCE ROŚLINOM GRZYBIENIA BIAŁEGO *Nymphaea alba* L. W OKRESIE WEGETACJI

Streszczenie. Grzybień biały – lilia wodna – *Nymphaea alba* L. wśród miłośników oczek wodnych cieszy się wielką popularnością. O dekoracyjności roślin świadczą okazałe kwiaty oraz pływające liście. Celem badań było określenie stanu zdrowotnego grzybienia białego oraz identyfikacja mikobiota towarzyszących mu w okresie wegetacji i powodujących symptomy chorób. Badania prowadzono w dwudziestu oczkach wodnych na terenie województwa małopolskiego i podkarpackiego, w latach 2006, 2008–2010. Stwierdzono, że plamistość i nekrozy liści powodował kompleks grzybów i grzybów chromistopodobnych z rodzajów: *Alternaria*, *Aspergillus*, *Cladosporium*, *Cylindrocarpon*, *Fusarium*, *Mortierella*, *Mucor*, *Paecilomyces*, *Penicillium*, *Phialophora*, *Phoma*, *Phytophthora*, *Pythium*, *Sordaria*, *Trichoderma* i inne. Roślinom grzybienia białego najczęściej towarzyszyły: *A. alternata*, *P. verrucosum* v. *verrucosum*, *P. expansum*, *Paecilomyces farinosus*, *Cylindrocarpon destructans*, *Sordaria fimicola*, *Mucor hiemalis* f. *hiemalis* i *Fusarium oxysporum*. Grzyby najsilniej kolonizowały rośliny grzybienia w okresie jesiennym. Stwierdzono, że chorobotwórcze grzyby i grzyby chromistopodobne towarzyszące wegetacji grzybienia białego, powodując różnorakie przebarwienia i nekrozę, przyczyniały się do destrukcji tkanek, czego skutkiem było obniżenie walorów dekoracyjnych roślin.

Słowa kluczowe: rośliny wodne, mikobiota, choroba, oczko wodne

Accepted for print – Zaakceptowano do druku: 19.12.2011