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FUNGI ASSOCIATED WITH PLANTS OF CALAMUS (*ACORUS CALAMUS*)

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Abstract

The health status of calamus (*Acorus calamus*) in four growing seasons (2006 and 2008–2010) in 20 garden ponds was defined. Fungi inhabiting calamus phyllosphere, causing various spots and necrosis, which resulted in reduction of aesthetic values were determined. Out of 28 species of parasitic fungi, isolated from calamus leaves and stems, those constantly associated with plants were: *Alternaria alternata*, *Epicoccum purpurascens* and *Penicillium verrucosum* var. *cyclopium*. From the infected tissues most frequently isolated were: *A. alternata*, *Paecilomyces farinosus*, *E. purpurascens*, *Botrytis cinerea* and *Aspergillus niger*. *Ascochyta acori*, a monofagous species rarely quoted in Poland, was found in spots on calamus leaves.

Key words: calamus, fungi, phyllosphere, vegetation, garden pond

Introduction

The water gardens are planted with various species of aquatic plants, usually blooming beautifully, characterized by original colour and shape of shoots, leaves and flowers and intense aroma. The most common are, in addition to calamus: water lily, common cattails, common rushes, sedges, yellow iris, arrowhead and other species (Grabowska and Kubala 2006).

Calamus (drug sweet flag), *Acorus calamus*, is a perennial, expansive plant, reaching a height of 120 cm. It prefers a sunny position and marshy soil, or shallow, warm, fertile and not acidified water. Reddish flattened stem, lineal leaves and yellow-green cylindrical, later light brown butt are visible elements of the garden pond, and the intense smell lures insects (Polakowska 1992).

In the pond environment the threat from mycobiota is increased and results in reduction of aesthetic values. Chemical protection of plants is not practicable, be-

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cause the use of pesticides can lead to degradation of the local ecosystem (Małyszek et al. 2005).

The aim of the study was to evaluate the health status of calamus and to determine fungi occurring in phyllosphere during the growing season.

Materials and methods

The health condition of calamus was monitored for the years 2006 and 2008–2010, in 20 ponds located in house gardens on the Małopolska and Podkarpackie area. Each year, five observations were carried out from April to October.

For mycological analysis of tissues 600 pieces of calamus leaves and stems with spots symptoms and necroses were collected. Isolation and cultivation of fungi was carried out according to standard methods used in phytopathology, and the isolates were identified using mycological keys: Batko (1975), Domsch et al. (1980), Ellis and Ellis (1985).

Results and discussion

In the four growing seasons, in the majority of ponds mostly large spots (15–20 × 5–8 mm) were visible on calamus leaves. Yellowish spots in May and June were located in the upper parts of the leaves. During late summertime the spots were turning brown and located over the entire leaf surface. Tissue around the spots changed colour from yellow through reddish to light brown. In some ponds the spots formed narrow, fusiform, brown streaks. Spots visible along the veins were slightly smaller, measuring 5–8 × 4–6 mm. They appeared as yellowish discoloration of the brown spots with red and orange halo. Discoloured tissue underwent necrosis. The greatest necroses were noted in October.

Mycological analysis of infected tissues resulted in 565 isolates of the following fungi genera: *Alternaria, Ascochyta, Aspergillus, Botrytis, Chaetomium, Epicoccum, Fusarium, Humicola, Mortierella, Nigrospora, Nowakowskiella, Paecilomyces, Penicillium, Phialophora, Phoma, Rhizopus* and *Sordaria* (Table 1).

Calamus plants were inhabited by 28 species of parasitic fungi, but only the polyphagous ones: *Alternaria alternata, Epicoccum purpurascens* and *Penicillium verrucosum* var. *cyclopium* were associated with calamus and its tissue necrosis in all ponds during the four growing seasons. These fungi species, and *Paecilomyces farinosus,* were found dominant in calamus phyllosphere. Necrotic tissues were inhabited by *Chaetomium globosum, Ch. olivaceum, Nigrospora sphaerica, Rhizopus oryzae, R. stolonifer* and *Sordaria fimicola.* Fungi of the genera *Aspergillus* and *Penicillium*: *A. niger, P. expansum, P. verrucosum* var. *corymbiferum, P. verrucosum* var. *cyclopium, P. verrucosum* var. *verrucosum* inhabited mostly calamus leaves in September and October. From tissues with symptoms of spots *Fusarium culmorum, F. poae* and *F. sporotrichoides* (in May and June) and *Botrytis cinerea* (September and October) were

isolated. Occasionally at the beginning of the growing season *Mortierella alpina*, *M. isabellina*, *M. parvispora* and *Nowakowskiella elegans* were isolated.

Many of these fungi, including *A. alternata*, *A. niger*, *F. sporotrichoides*, *P. expansum*, *P. verrucosum* var. *verrucosum*, *P. verrucosum* var. *cyclopium* and *P. verrucosum* var. *corymbiferum*, belong to the toxin producing ones, and contribute significantly to the rapid destruction of plant tissues.

In a pond in Wieliczka, in 2006, *Ascochyta acori* was diagnosed as a calamus spot causing organism. This fungus, known as monofagous specialized pathogen, was

Table 1

Fungi isolated from affected tissues of calamus (*Acorus calamus*)

Fungus	Number in:					Percentage total
	2006	2008	2009	2010	total	
Alternaria alternata	47	96	63	71	277	49.03
Paecilomyces farinosus	3	35	–	–	38	7.00
Epicoccum purpurascens	11	7	6	9	33	5.84
Botrytis cinerea	13	–	–	10	23	4.07
Aspergillus niger	–	–	13	7	20	3.54
Penicillium expansum	12	–	5	2	19	3.36
Penicillium verrucosum var. *cyclopium*	1	1	11	3	16	2.83
Chaetomium olivaceum	–	–	10	5	15	2.65
Penicillium verrucosum var. *corymbiferum*	–	–	14	1	15	2.65
Penicillium verrucosum var. *verrucosum*	3	2	–	7	12	2.12
Mortierella alpina	–	1	7	3	11	1.95
Rhizopus oryzae	5	–	1	4	10	1.79
Fusarium culmorum	1	–	6	2	9	1.59
Fusarium sporotrichoides	–	–	5	4	9	1.59
Rhizopus stolonifer	1	1	3	4	9	1.59
Chaetomium globosum	3	1	–	4	8	1.42
Nigrospora sphaerica	–	8	–	–	8	1.42
Phoma medicaginis var. *pinodella*	–	7	–	–	7	1.24
Sordaria fimicola	–	–	–	5	5	0.88
Fusarium poae	–	–	–	4	4	0.71
Ascochyta acori	3	–	–	–	3	0.53
Humicola fuscoatra var. *fuscoatra*	1	2	–	–	3	0.53
Phialophora cyclaminis	–	–	2	1	3	0.53
Humicola grisea var. *grisea*	–	2	–	–	2	0.35
Mortierella parvispora	–	–	–	2	2	0.35
Mortierella isabellina	1	–	–	1	2	0.35
Nowakowskiella elegans	–	–	1	–	1	0.18
Phoma hedericola	–	–	1	–	1	0.18
Total	105	163	148	149	565	100.00

noted for the first time in Poland in 2005 in the rush communities in Drawieński National Park (Mazurkiewicz-Zapałowicz and Grajewski 2010). The occurrence of this monofagous fungus in calamus in the pond may be treated as evidence on its substantial expansion and proves its sporulation in the rush of wild plants and ornamental calamus.

Comparing the number of individual fungi isolates (from 105 to 163) and fungi species (from 12 to 20) obtained throughout the investigation years, it was found that most isolates were obtained in 2008, with the lowest number of species. In 2010 a comparable number of fungi colonies was isolated, with an attendance of 20 species.

Comparing fungi that lived in 2006 on the calamus in the ponds in Cracow (Kowalik and Krasny 2009) and Małopolska region it was found that the number of isolates in the calamus phyllosphere was twice lower (52 and 105), with comparable number of species (12 and 14), but only six species were common: *A. alternata*, *B. cinerea*, *E. purpurascens*, *P. farinosus*, *P. expansum* and *P. verrucosum* var. v*errucosum*.

In none of the 20 water ponds any signs of rust caused by *Uromyces sparganii* on calamus were found. Pathogens known to cause spots and calamus dieback, such as: *Athelia rolfsii*, *Ramularia aromatica*, *R. armoraciae*, *Cylindrosporium acori*, *Leptosphaeria acronella*, *Physoderma calami* and *Septocylindrium* sp. were not isolated (Ellis and Ellis 1985, Mazurkiewicz-Zapałowicz and Grajewski 2010).

Among the fungi inhabiting calamus phyllosphere there were polifagous species, inhabiting also plants of yellow iris, white lily, common cattail, common rush and other plants in the ponds. These were, among others*: A. alternata*, *A. niger*, *B. cinerea*, *Ch. globosum*, *E. purpurascens*, *P. farinosus*, *Penicillium expansum*, *P. verrucosum* var. *verrucosum*, *P. verrucosum* var. *cyclopium*, *Phialophora cyclaminis*, *Phoma medicaginis* and *S. fimicola* (Kowalik and Maik 2010, Kowalik 2011, Kowalik and Cwynar 2011).

From leaves and stems of calamus fungi from the genera *Cladosporium* and *Mucor*, inhabiting phyllosphere of many plants in ponds (Wagner 2000, Kowalik 2011, Kowalik and Cwynar 2011), were not isolated. For this fact, the content in calamus tissues of several active substances, such as essential oils, alkaloids, tannins and phytoncides (Hlava and Lánská 1983) could have accounted.

In the subject literature, an opinion exists that the majority of plants in garden ponds, especially the common calamus, show very low susceptibility to pests, and their phyllosphere is not much inhabited by mycobiota (Polakowska 1992, Małyszek et al. 2005, Mazurkiewicz-Zapałowicz and Grajewski 2010).

The health status of calamus in the ponds considered was very good or relatively good, which does not change the fact that plant pathogenic fungi associated with calamus plants in the growing season are a threat to other plants. Various spots and necroses on the leaves of plants does not improve the aesthetic qualities of the pond, on the contrary significantly reduce them.

Streszczenie

GRZYBY TOWARZYSZĄCE ROŚLINOM TATARAKU ZWYCZAJNEGO (*ACORUS CALAMUS*)

Celem badań była ocena stanu zdrowotnego tataraku zwyczajnego (*Acorus calamus*) oraz określenie grzybów występujących w jego fyllosferze. Badania przeprowadzono w ciągu czterech sezonów wegetacyjnych (2006 i 2008–2010) w 20 oczkach wodnych na terenie województw małopolskiego i podkarpackiego. Grzyby towarzyszące wegetacji tataraku zwyczajnego wywoływały różnorakie plamistości i nekrozy, co skutkowało pogorszeniem walorów estetycznych roślin. Spośród 28 gatunków grzybów pasożytniczych wyodrębnionych z liści i łodyg tataraku w okresie wegetacji stale towarzyszyły roślinom *Alternaria alternata*, *Epicoccum purpurascens* i *Penicillium verrucosum* var. *cyclopium*. Z porażonych tkanek tataraku najczęściej izolowano: *A. alternata*, *Paecilomyces farinosus*, *E. purpurascens*, *Botrytis cinerea* i *Aspergillus niger*. Zdiagnozowano plamistości powodowane przez monofaga *Ascochyta acori*, rzadko notowanego na terenie Polski.

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