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FUNGI PHYLUM *BASIDIOMYCOTA* ON WILLOWS IN THE AREA OF CENTRAL DANUBE BASIN

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Abstract

The results of three-year's research of fungi phylum *Basidiomycota* on *Salix* sp. in the area of Central Danube Basin (45°08′18″ and 45°42′50″ north latitude and 17°10′10″ and 17°58′50″ east longitude from Paris), are presented in this paper. During the research, the fruiting bodies were collected in the field and determined based on their reproductive organs. Twenty-eight species of macrofungi have been identified on the willows of which *Fomes fomentarius* (L.: Fr.) Fr., *Phellinus igniarius* (L.: Fr.) Quél. and *Trametes suavealens* (L.: Fr.) Fr. have the greatest pathogenic significance as wood rotting agents. Four of the above 28 species are used in human nutrition: *Pleurotus ostresus* (Jacquin: Fr.) Kumm., *Flammulina velutipes* P. Karst., *Auricularia auricula-judae* (Bull. :m Fr.) Wettst. and *Polyporus sulphureus* (Bull.) Fr.), and one is used in pharmacy (*Ganoderma lucidum* (Curt.: Fr.) P. Karst.). During this research, 17 species of macrofungi were first found on willow, which have not been so far identified from Serbia and Montenegro. Of 17 newly identified fungi, 7 species have never been identified from Serbia and Montenegro, and 10 have been identified, but on other hosts (e.g. poplars).

Key words: Basidiomycota, Central Danube Basin, *Salix* sp. pathogenic fungi, white rot, brown rot, medicine, edible fungi.

Introduction

Limited wood production in natural forests and rapid increment of industrial processing of lumber have resulted in wood deficit. This problem could be alleviated by production of fast growing trees in plantations (first of all poplars and willows).

In the Autonomous Province of Vojvodina, considerable areas of land are marked as unsuitable for agricultural production and establishment of plantations of economic important trees such as oak or poplar. This situation emphasizes the importance of willow plantations. Species of willows are recognized as pioneer plants on the lowest parts of the alluvial terraces along the rivers.

Opposite to poplar diseases, the diseases on willows did not attract attention until now. This problem became fully expressed by the establishment of

new willow plantations and made investigations like this necessary.

The aim of this study is to recognize the main willow wood destroyers, decay causers, and to determine the possibilities of the use of fungal sporophores in human nutrition and in medicine.

Materials and Methods

Field research and collecting of material have been done on several localities in the Middle Danube region, in natural willow populations and plantations in floodplain areas along the Danube River. The investigated area is situated between 45°08′18″ and 45°42′50″ north latitude, and 17°10′10″ and 17°58′50″east longitude, elevated from 73 to 79 m above see level. This region has a moderate continental climate (Katić et al. 1979).

The sampled sporophores were preserved using standard methods, and determined according to appropriate keys in the laboratory.

Results and Discussion

A list of macrofungi (Phylum Basidio–mycota – Cl. Basidiomycetes) detected on willows is given in Table 1.

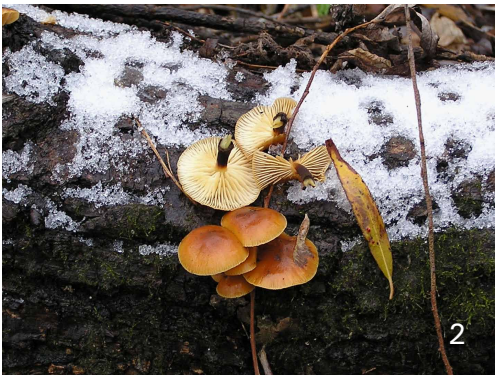
During the research, twenty-eight species of macrofungi have been de-

Table 1. A list of macrofungi detected on willows.

Fungus name	Family	Decay	Importance potential use *
Ordo Auriculariales			
Auricularia auricula-judae (Bull.) Quél. (photo 1)	Fam. Auriculariaceae Genus *Auricularia*	White	+ ●
Ordo Agaricales			
Flammulina velutipes P. Karst. (photo 2)	Fam. Tricholomataceae	White	+ ●
Mycena sp.		-	-
Panellus ringens (Fr.) Romagn.		White	+
Pluteus salicinus (Pers.:Fr.) Kummer	Fam. *Pluteaceae*	White	+ +
Pholiota adiposa (Batsch.:Fr.) Kumm.	Fam. Strophariaceae	White mottled	+ +
Pholiota squarrosa (Pers. ex Fr.) Kumm.		White	+
Ordo Cortinariales			
Crepidotus variabilis (Pers. ex Fr.) Kummer	Fam. Crepidotaceae Genus *Crepidotus*	White	+ +
Ordo Ganodermatales			
Ganoderma adspersum (Schulz) Dank	Fam. Ganodermataceae	White	+ +
Ganoderma lucidum (Curt. ex Fr.) Karst (photo 5)		White	+ + ◘

Ordo Hericiales			
Creolophus cirrhatus (Pers. Ex Fr.) Karst	Fam. Hericiaceae	White	+
Ordo Hymenochaetales			
Phellinus contiguus (Fr.) Pat.	Fam. Hymenochaetaceae	White	+
Phellinus igniarius (L. ex Fr.) Quel. (photo 6)		White layered	+ + +
Ordo Poriales			
Daedaleopsis confragosa (Bolt.: Fr.) J. Schroet	Fam. Coriolaceae	White	+ +
Fomes fomentarius (L.: Fr.) Fr.		White mottled	+ + +
Trametes gibbosa (Pers. ex Fr.) Fr.		White	+
Trametes hirsuta (Wulf. ex Fr.) Pilat		White	+ +
Trametes suavealens (L.: Fr.) Fr.		White	+ + +
Trametes versicolor (L.ex Fr.) Pilat		White	+ +
Lentinus tigrinus (Bull.: Fr.) Fr.	Fam. Lentinaceae	White	+ +
Pleurotus ostreatus (Jacquin : Fr.) Kumm. (photo 3)		White	+ ●
Polyporus sulphureus (Bull.) Fr. (photo 4)	Fam. Polyporaceae	Brown prismatic	+ + ●
Ordo Stereales			
Cytidia salicina (Fr.) Burt.	Fam. Corticiaceae	White	+
Irpex lacteus (Fr.:Fr.) Fr.	Fam. Steccherinaceae	White	+
Phanerochaetae filamentosa (Berk. & Curt.) Burdsall	Fam. Meruliaceae	White	+
Stereum subtomentosum Pouzer	Fam. Stereaceae	White	+ +
Ordo Schizophyllales			
Schizophyllum commune Fr.: Fr.	Fam. Schizophyllaceae	White	+ +
Ordo Tremellales			
Exidiopsis calcea Wells	Fam. Exidiaceae	-	-

*+++ Appearance of fungus is abundant and causes serious damages on host plant
+ + Appearance of fungus is rare and causes slight damages on host plant
+ Appearance of fungus is rare and without practical significance
- Appearance of fungus is abundant without practical significance
● Edible fungus
◘ Medical fungus



Photos 1-6. Macrofungi on willows: 1. *Auricularia auricula-judae* (Bull. ex St-Amons) Wetts.; **2.** *Flammulina velutipes* P. Karst.; **3.** *Pleurotus ostresus* (Jacquin : Fr.) Kumm.; **4.** *Polyporus sulphureus* (Bull.) Fr.; **5.** *Ganoderma lucidum* (Curt. ex Fr.) Karst.; **6.** *Phellinus igniarius* (L. ex Fr.) Quel.

tected on willows, of which twenty-four fungi cause white, while one brown prismatic decay.

The first group expressing the highest impact (+ + +) encompasses the fungi which have the greatest patho-

genic influence as wood rotting agents. *Fomes fomentarius* (L.: Fr.) Fr., *Phellinus igniarius* (L. ex Fr.) Quél. and *Trametes suaveolens* (L.: Fr.) Fr. are recognized as the major pathogens, causing serious decay.

During this research, 17 species of macrofungi were first found on willow, which have not been so far identified from Serbia and Montenegro. Of 17 newly identified fungi, 7 species have never been identified from Serbia and Montenegro, and 10 have been identified, but on other hosts (e.g. poplars).

A list of macrofungi detected on willows is given in Table 2.

Fomes fomentarius (L. : Fr.) Fr.

This fungus appears as saprotrophe or parasite on broadleaved trees and causes white mottled decay. It grows on standing, living trees, and develops further on fallen trees, but only untill they are wet. It rarely develops its colonies on dried and processed wood.

Karadžić and Anđelić (2002) cite that the species can be found in Europe, Asia, Africa and Northern America. The infection is done through bark contu-

Table 2. A list of macrofungis first time detected in Serbia and Montenegro and on willows.

Name of fungus	The first time found in Serbia and Montenegro	The first time Found on willow
Flammulina velutipes P. Karst.	-	+
Panellus ringens (Fr.) Romagn.	+	+
Pluteus salicinus (Pers.:Fr.) Kummer	+	+
Pholiota adiposa (Batsch.:Fr.) Kumm.	-	+
Pholiota squarrosa (Pers.ex Fr.) Kumm.	-	+
Crepidotus variabilis (Pers. ex Fr.) Kummer	+	+
Ganoderma adspersum (Schulz) Dank	-	+
Ganoderma lucidum (Curt. ex Fr.) Karst	-	+
Creolophus cirrhatus (Pers. Ex Fr.) Karst	-	+
Phellinus contiguus (Fr.) Pat.	+	+
Daedaleopsis confragosa (Bolt.: Fr.) J. Schroet	-	+
Trametes gibbosa (Pers. ex Fr.) Fr.	-	+
Pleurotus ostreatus (Jacquin : Fr.) Kumm.	-	+
Cytidia salicina (Fr.) Burt.	+	+
Phanerochaetae filamentosa (Berk. & Curt.) Burdsall	+	+
Stereum subtomentosum Pouzer	-	+
Exidiopsis calcea Wells	+	+

sions, and the process of rotting is very quick. After the degradation of the core, the fungus progress into the sapwood, and it proceeds with the destruction.

According to Krstić (1962) the emission of the spores from one sporophore is 887 millions in one our, or 139 millions per 1 cm^2 in one day, so we can conclude that the potential for contamination is very high.

Phellinus igniarius (L. : Fr.) Quél.

Karadžić and Anđelić (2002) cite that this fungus occurs as a parasite on broadleaved trees, and it occurs specially often on alder, wild cherry, beech, sycamore, ash, hornbeam, poplars, birch, willows, elm and on *Sorbus* sp. It causes white layered decay which is localised in the hearthwood and rarely grows into the sapwood. The infection is done through contusions or dead branches, from where it spreads towards the core of the stem. The sporophores appear individually or 2–3 samples incorporated, and they can be found the whole year (photo 6).

According to Krstić (1962) this fungus destroys both the cellulose and the lignin. It is a great problem for the broadleaved tree species, and it continues its development on the trunks even after the felling of the trees.

Trametes suavealens (L.: Fr.) Fr.

This species is registered on standing willow trees and it causes white, soft decay of the core of willows and poplars.

It's widespread in Europe, Asia and Northern America on broadleaved tree species. Sporophores are annual, and they can be found during the whole year.

The sporophores are console like, broadly fixed to the substratum, from 2–12 (15) cm wide, and 1.5–4 cm (on the fixation with the wood 1.5–8 cm). The surface is flat or widely wave-like, piled, white or grey-white, with sharper edges. The hymenophore consists of pores which are round-coined or elongated, dimensions from 1–3 mm, white, ocher or brown.

The trama is white; when fresh it is soft with a cork like consistence, when dry it is hard, tough and light. The body has a strong smell of. The sporophores are single or, more often, grown together in series (Karadžić and Anđelić 2002).

The following fungi are used in human nutrition *Pleurotus ostreatus* (Jacquin : Fr.) Kumm., *Flammulina velutipes* (Curtis) Singer, *Auricularia auricula-judae* (Bull.) Quél and *Polyporus sulphureus* (Bull.) Fr.

Pleurotus ostreatus (Jacquin : Fr.) Kumm. syn. *P. columbinus* Quél.

It can be found in broadleaved forests and in mixed broadleaved-coniferous forests. It is especially often recorded on beech and on poplars, and it can also be found on older willow stems. It attacks all constituents of wood and therefore causes white decay. The sporophores often grow in groups (photo 3). The body is flesh like, white, it has nice smell and taste. The print of spores is pale grey-purple (Marković 2006b).

It can be found in Europe, Asia, Australia, Northern Africa and America.

Flammulina velutipes (Curtis) Singer

The fungus spreads in the hearthwood of several broadleaved tees, both in living trees and in dead fallen wood. It causes soft, hollowed, yellow-white decay of sapwood (Josifović 1952). It is especially often recorded in flatland

areas, where it appears during winter months, from October until March, rarely outside of this period.

Karadžić and Anđelić (2002) cite that this fungus appears on death wood material, rarely on healthy or injured living stems of broadleaved trees, especially on *Salix*, *Tilia*, *Fagus* and *Alnus*, but with the remark that Breitenbach and Kranzlin (1991) also noticed this fungus on some coniferous tree species (*Abies*).

It does not have great importance as wood destructor. The Mushrooms are edible, and its importance is enhanced because it apperas during tre winter months when other edible fungi cannot be found (photo 2).

Polyporus sulphureus (Bull.) Fr.

The fungus often grows on stems of living broadleaved trees. It spreads in the corewood, very rarely in the sapwood, and causes brown prismatic decay.

It is an edible fungus, and in Germany and America it is considered a delicacy.

Ganoderma lucidum (Curt. : Fr.) P. Karst.

According to Krstić (2002) this fungus appears on roots and on the bottom part of the stem on oaks, rarer on other broadleaf tree species. It causes white decay. The carpofores are formed during the whole year. It can be found in Europe, Asia, Australia and Northern America.

It appears very rarely on willows. The sporophores are shaped like a kidney, in the beginning the surface is bright-yellow, later dark blood-red to red-brown with a purplish tinti, polished, the edges are white or yellow, 10–25 cm in diameter and 3 cm broad with a typical, rather long, excentric, brownish or almost black, polished stem (photo 5).

It is considered to be a medical fungus, especially in Asia (China) where it is also grown (Karadžić and Anđelić 2002).

Conclusion

During the three-year's research of Basidiomycota on willows, 28 species of macrofungi have been detected (Marković 2006a). Twenty-four species cause white, while one brown prismatic decay (Karadžić and Anđelić 2002). The following fungi have the greatest pathogenic importance: *Fomes fomentarius*, *Phellinus igniarius* and *Trametes suavealens*.

Pleurotus ostreatus, *Flammulina velutipes*, *Auricularia auricula-judae* and *Polyporus sulphureus* are used for human nutrition (Keizer 1996).

During this research, 17 species of macrofungi were first found on willow, which have not been so far identified from Serbia and Montenegro. Of 17 newly identified fungi, 7 species have never been identified from Serbia and Montenegro, and 10 have been identified, but on other hosts (e.g. poplars).

Based on the comparison of the mycoflora occurring on willow trees in natural stands and that occurring in plantations on clonal material, it was concluded that, on the clonal material, the dominant parasitic fungi are those which infest the leaves and bark, while on the old trees in natural stands, the dominant fungi are the agents of wood decay. To protect the juvenile willows in plantations (primarily against the parasites on the foliage) it is necessary to apply the chemical measures of protection, i.e. to apply the fungicides during the critical period for parasite infection.

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