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MACROMYCETES IDENTIFIED ON THE CONSTRUCTION WOOD OF HISTORICAL MONUMENTS FROM MOLDAVIA AND CAUSES OF THEIR DEVELOPMENT

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Abstract: This paper presents a series of observations made at the historical monuments in Moldavia region, where they could show some cases which causes the appearance of macromycetes on wood. We maintained as significant a number of 13 species of macromycetes which were reported with greater frequency on construction wood, but also were included and species which are considered important agents of deterioration for wood: *Gloeophyllum sepiarium* (Wulfen) P. Karst., *Gloeophyllum abietinum* (Bull.) P. Karst., *Schizophyllum commune* Fr., *Trametes versicolor* (L.) Lloyd, *Coniophora puteana* (Schumach.) P. Karst., *Serpula lacrymans* (Wulfen) J. Schröt. etc. In the presence of a source of infection, it was found in some cases favorable conditions to the development of the sporiferous bodies. The number of attacks of macromycetes on historical monuments in Moldavia and the rate of the degradations on wood depend on a number of factors which were presented according to their importance in the overall process of preserving the timber used in construction. There were identified areas where the resistance of wood has been changed due to the destructive action of physical factors (improper humidity, temperature etc.) and especially because of the installation on this type of organic material of a considerable number of bodies from the various groups.

Key words: wood, macromycetes, biodeterioration, historical monuments

Introduction

Knowledge and understanding of the causes that promote the emergence and development of macromycetes on construction wood are of prime importance in determining eradication measures and preventive conservation programs. Specialty papers generally consider these causes, at all types of buildings, but to the historical monuments may have specific circumstances, especially if the constructions have value of outdoor museum exhibits or to a series of obsolete buildings which have specific conservation conditions [COJOCARIU & al., 2005].

Humidity is an important physical parameter, which is one of the main causes of degradation occurring in mobile and immobile heritage [BARBU & MARGINEANU, 1983]. For example, at old buildings, the construction materials used in the walls are generally porous and susceptible to moisture (bricks, porous limestone, lime mortar, wooden beams). Overall, at the historical monuments, wood is present in every building, being a material used in the past for its qualities but also because it is a material readily available in nature and is easy to process them as technology.

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Material and method

Our observations on the deterioration of wood produced by macromycetes, regard the building classify as historical monuments located in Moldavia - area less explored in this regard, as defined under the laws and criteria adopted by the Ministry of Culture by the National Institute of Historical Monuments (2004).

In order to achieve an interpretation on the macromycetes as degradation agents and causes that led to the emergence and development of their sporiferous bodies, were considered a number of 55 historical monuments included in different categories (conventionally labeled A to G). From the seven categories of monuments, have showed interest the wooden churches and monastic ensembles, because of the wood used as construction material, both fully and partially in the main building elements.

Methods for collecting, processing and determination of sporiferous bodies and also the required materials are different, depending on the group of macromycetes [BERNICCHIA & GORJÓN, 2010; BREITENBACH & KRÄNZLIN, 1986; ERIKSSON, 1958; JÜLICH, 1989; JÜLICH & STALPERS, 1980; SESAN & TANASE, 2006; TĂNASE & ŞESAN, 2006]. Worksheet was adapted to include information about the type of wood, local climatic conditions, all macroscopic characters observed in the ground etc.

Following these observations on historical monuments from the territory of Moldavia, we could reveal the causes that gave rise macromycetes on wood. Synthetic data were centralized and analyzed on the basis of tables and graphs drawn according to data recorded in the ground.

Results and discussions

We maintained as significant for our interpretations a number of 13 species of macromycetes which were reported with greater frequency on construction wood. We also take into consideration the species which are considered important agents for deterioration of construction wood. Thus, in order of frequency, the species considered are:

- *Gloeophyllum abietinum* (Bull.) P. Karst. – Photo 1
- *Gloeophyllum sepiarium* (Wulfen) P. Karst.
- *Hymenochaete rubiginosa* (Dicks.) Lév. – Photo 2
- *Dacrymyces stillatus* Nees – Photo 3
- *Schizophyllum commune* Fr.
- *Bjerkandera adusta* (Willd.) P. Karst.
- *Stereum hirsutum* (Willd.) Pers.
- *Daedalea quercina* (L.) Pers.
- *Trametes versicolor* (L.) Lloyd
- *Fibroporia vaillantii* (DC.) Parmasto
- *Coniophora puteana* (Schumach.) P. Karst. – Photo 4
- *Serpula lacrymans* (Wulfen) J. Schröt. – Photo 5
- *Peziza domiciliana* Cooke – Photo 6

Based on field observations, macromycetes have been identified as agents of degradation, which develops on building elements such as roofing (the wood shingle), wooden beams of the exterior walls, bottom beams - foot, beams and elements of wood used to build fences, floor, and annexes represented by stairs, porch, and fence. The frequency of macromycetes species related to category of building elements, indicating a

higher exposure to the attack of macromycetes for structural components located at the bottom, as exterior stairs, foot beams, and exterior walls.

There is a high frequency of occurrence of macromycetes on building elements as exterior walls and bottom beams, where we could see strong infiltration of water, either permanently from the ground, or only during some heavy rains, when water accumulates in areas near the building and the investigated elements are placed in contact with the ground. Sometimes, the stone foundation of the building is affected by the high humidity, the ceiling leaks and inadequate drainage of rain water being factors in the emergence of sporiferous bodies.

In the case of *Serpula lacrymans* species, the attacks mainly be installed within the floor construction and the notations on the type of construction and local conditions, confirm the literature data that this species grows in the presence of calcium sources [BUCSA & BUCSA, 2005]. Thus, in the case of the wooden church "Adormirea Maicii Domnului" from Cerviceşti, Botosani County, the source of calcium was identified in the foundation stone assembled with mortar, cement and lime. The same situation is observed and the Church "Pogorarea Sfantului Duh" from Agafton village, Botosani county.

A higher frequency of occurrence of species *Serpula lacrymans* was identified to the historical monuments that do not have heating systems, or if they exist, are poorly constructed, such as chimneys and such findings related to their poor insulation, allowing the infiltration of large quantities of water. We also observed attacks at the monuments with intermittent or no heating and in addition, there is a lack of ventilation, especially for those monuments out of religious service.

The number of attack of macromycetes at historical monuments in Moldova, and the rate of wood degradation depend on a number of factors as:

- maintaining the same position of exterior wood elements;
- maintaining humidity above 30%;
- infiltration of water from poorly maintained or damaged covers;
- lack of some construction foundation;
- microclimate conditions;
- vegetation in the area, the presence of forest and abandoned wood
- lack of heating in buildings and close them in winter
- arrangement of parts of the structures in direct contact with the ground
- periodic flooding of the lower parts of the building during heavy rains
- placement of leaves and plant debris on different elements of construction
- lack of suitable wood treatments

Moisture in the old building is unequal distributed and affect in different mode the parts of the building, is rarely stationary and often progressive time-related, and also irregular distributed in the masonry elements. Sources of origin of the moisture in walls may be multiple: moisture derived from rainfall that directly infiltrate, association of the wind with the rain, atmospheric moisture, surface or interstitial condensation, moisture in the ground by capillary rise, from surface water (pluvial or accidental leakage) or groundwater [NICOLESCU, 2001].

Moisture derived from rainfall is related to the leaks (roof deterioration, cracks), the failure of collecting devices (gutters, downspouts) and exposure to rain for the horizontal component of the walls. This phenomena is enhanced by maintaining the wet conditions, the lack of proper maintenance (Photo 6).

For the basic building annexes it can be observed a frequent occurrence of the sporiferous bodies. They belong in general to the species that are common in natural

ecosystems of forests on the felled timber, such as the example of species *Daedalea quercina*, *Trametes versicolor*, *Stereum hirsutum* and *Bjerkandera adusta*.

In areas affected by excessive moisture in historic buildings, could reveal a number of species of macromycete with sporiferous body attached on the substrate extending over large areas, which are the main agents of wood decay, such as species *Fibroporia vaillantii*, *Hyphodontia breviseta*, *Phellinus contiguus*, *Radulomyces confluence*.

Conclusions

In the case of species *Serpula lacrymans* (Wulfen) J. Schröt., the attacks are mainly installed on the floor, and we confirm the literature data regarding the development of this species in the presence of a source of calcium.

In some cases, in the presence of a source of infection, was found favorable conditions for sporiferous bodies such as making repairs or replacement during the cold season, use fresh wood, sufficiently dry, use untreated wood, adding filled with a high moisture content, use of paint for walls or floors, which affects ventilation, inadequate use of supplementary materials, as plastic film type by acting as isolator.

There is a high frequency of macromycetes occurrence on construction elements as outer walls and beams below, where is a higher humidity and where we could see the strong infiltration of water, either permanently from the ground, or only in abundant rainfall and water accumulates near the building, and the elements investigated are placed in contact with the ground.

To ensure adequate protection of wood is necessary to know first of all the forms of degradation and the agents involved in the biodegradation of wood to determine the measures of protection based on differential diagnosis and determination of degradation phase.

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Photo 1 – *Gloeophyllum abietinum* (Bull.) P. Karst.

Photo 2 – *Hymenochaete rubiginosa* (Dicks.) Lév.

Photo 3 – *Dacrymyces stillatus* Nees

Photo 4 – *Coniophora puteana* (Schumach.) P. Karst.

Photo 5 – *Serpula lacrymans* (Wulfen) J. Schröt.

Photo 6 – The rapid expansion of mycelium of *Peziza domiciliana* Cooke in the floor, historical house, Stefan cel Mare Street, 75, Targu Neamt