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Pathogenicity of *Monilia* spp. to hazel (*Corylus*)

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As a result of inoculating generative organs of hazel (fruitlets, unripe and ripe nuts) by the fungi *Monilia coryli*, *M. fructigena* and *M. laxa* it was found that each of the species could infect these organs but *M. coryli* appeared to be most pathogenic. Macroconidia of *M. coryli* originating from 14-day-old PDA cultures were found to be larger than those of *M. fructigena* and *M. laxa*. Hence a conclusion that *Monilia coryli* in the first place should be regarded as the principal cause of the brown rot of hazel.

Key words: *Monilia*, hazel, pathogenicity.

INTRODUCTION

Within the genus *Monilia* about 30 species of fungi have been known to attack various organs of many plant species and to cause diseases known as the brown rot (Wormald 1954; Byrde and Willetts 1977). The generic name established by Persoon in 1801 derives from the Latin "monile", a necklace, is still used to denominate the conidial stage of the fungi producing pale sporodochia on diseased fruits (Honey 1928, according to quoted literature). The generic name *Monilinia* for the perfect stage of the fungi causing brown rot diseases and producing "monilia-shaped" conidia and pseudosclerotia was proposed by Honey (1928). Few cases of *Monilinia* spp. were recorded to occur in some natural habitats in North America, Australia and Europe (Wormald 1954; Byrde and Willetts 1977), whereas in Japan 9 *Monilinia* spp. were found on plants of the *Ericaceae* (Batra 1983).

Many authors mention hazel as a host plant of several *Monilia species*: *Monilia coryli* Schellenb. (Kotte 1958), *Monilia fructigena* (Pers.: Pers.)

Pers. ex Steudel (Moore 1947; Lovisolo 1951; Tzavella-Klonari 1985) and even *Monila laxa* (Ehrenb. ex Pers.) Sacc. et Vogl. (Lovisolo 1951; Glits 1960). In the region of Lublin the brown rot was frequently found to occur on various cultivars of hazel, especially intensively on low-lying grounds, adjacent to orchards and wet meadows (Machowicz-Stefaniak and Zalewska 2000).

The aim of research reported in the present contribution was to determine species of the fungi causing brown rot of hazel in the region of Lublin, to examine morphological characteristics of their macroconidia and to test the pathogenicity of the fungi.

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MATERIAL AND METHODS

The material to be tested comprised: 1 – generative organs of hazel taken from the cultivar Kataloński, namely fruitlets and unripe (of soft pericarp) and ripe (of hard pericarp) nuts, and 2 – isolates of the following species of fungi, *Monilia coryli* strains L 628, L 657 and L 702, obtained from diseased organs of hazel; *M. fructigena* strains J 3, J 5 and J 6, obtained from mummified apples and *M. laxa* strains W 1, W 2 and W 7 obtained from mummified cherries (Machowicz-Stefaniak and Zalewska 2000). The plant material was disinfected superficially in ethanol (50%), the fruitlets for 30 sec. and the nuts for 60 sec. and thereafter disinfected in a solution of $HgCl_2$ (0.1%), for this same time. Then the material was washed in sterile distilled water three times, for 3 min. each time. The plant material prepared this way was placed, in groups of four, in sterile moist chambers. The fungal material used for inoculations comprised circlets 3 mm in diameter originating from 5-day-old sporulating cultures of fungi grown on PDA medium. The inoculum was inserted into an incision made in the pericarp of fruitlets and full-shaped hazel-nuts. The organs, tested in groups of 48 (three strains per 16 organs each), were inoculated with each of the above-mentioned species of fungi. The fruitlets and full-shaped nuts in control tests were treated only with PDA medium. Then the material was incubated at 24°C for 12 days and surveyed after 3, 5, 7, 9 and 12 days. Next, reisolations after Koch were made. All the numerical data were statistically transformed using the analysis of variance and Tukey's HSD test (Oktaba 1987).

Macroconidia of *Monilia* spp. were measured to compare the species according to specific sizes of their conidia. Samples of conidia amounted to 300 specimens of each species (three strains per 100 conidia). The spores were taken from 14-day-old PDA cultures and directly from sporodochia developed on mummified fruits.

RESULTS AND DISCUSION

First symptoms of necrosis on the fruitlets of hazel were observed just after 3 days since they had been inoculated with *Monilia* spp. After successive 5 days the necrosis extended over 50% of the surface of fruitlets and after 12 days the necrosis was total. On necrotic tissues single sporodochia, typical for *Monilia* spp. appeared. The sporodochia were most often produced on the fruitlets inoculated with *M. coryli*. First symptoms of necrosis on unripe nuts were observed after 5 days following the inoculation whereas on ripe nuts they appeared after 7 days. After next 8–12 days most hazel nuts turned brown and sporodochia appeared most often on the nuts inoculated with *M. coryli*.

The reisolation of *Monilia* spp. from diseased organs of hazel showed that each of the three species did infect the organs. *Monilia coryli* was reisolated from most of the organs examined: 45.83% of fruitlets, 93.75% of unripe nuts and 37.50% of ripe nuts. The values were essentially higher in comparison with those obtained for *M. fructigena* and *M. laxa* (Tab. 1). Macroscopic and microscopic characteristics of reisolated cultures of *M. coryli*, *M. fructigena* and *M. laxa* were in accordance with those of the strains used for infections. *Monilia* spp. was also associated with other fungi in reisolated tests, namely with those belonging to the genera: *Alternaria*, *Epicoccum*, *Penicillium* and *Trichoderma* (Table 1).

Table 1

The effect of inoculation of different organs of hazel the Kataloński cultivar by *Monilia* spp. (data for 3 strains)

Species of fungi	Organs inoculated	Number of inoculated organs	Number (%) of organs from which *Monilia* spp. were reisolated	Other fungi isolated
Monilia coryli Schellenb.	Fruitlets	48	22 (45.83) g	*Alternaria alternata* *Epicoccum purpurascens* *Penicillium* spp. *Trichoderma* spp.
	Unripe fruit[1]	48	45 (93.75) h	
	Ripe fruit[2]	48	18 (37.50) f	
Monilia fructigena (Pers. ex Pers.) Pers. ex Steudel	Fruitlets	48	12 (25.00) e	
	Unripe fruit[1]	48	24 (50.00) g	
	Ripe fruit[2]	48	8 (16.67) d	
Monilia laxa (Ehrenb. ex Pers.) Sacc. et Vogl.	Fruitlets	48	4 (8.33) bc	
	Unripe fruit[1]	48	18 (37.50) f	
	Ripe fruit[2]	48	6 (12.50) cd	
Control	Fruitlets	48	2 (4.17) ab	
	Unripe fruit[1]	48	5 (10.42) bcd	
	Ripe fruit[2]	48	0 (0.00) a	

Explanations: means differ significantly ($P \leq 0.05$), if they are not marked with the same letter, $SLD_{0,05} = 3.0774$; 1 – fruit with soft pericarp; 2 – fruit with hard pericarp

Table 2
The size of macroconidia of *Monilia* spp.

Species of fungi	Measurements (μ)	Authors
Monilia coryli Schellenb.	11.4–36.3 × 7.6–19.1 (PDA) 16.6–24.0 × 7.4–18.5 (hazel nut) 12.0–34.0 × 9.0–15.0	Own data Own data Borecki (1990)
Monilia fructigena (Pers. ex Pers.) Pers. ex Steudel	11.4–30.5 × 5.7–17.1 (PDA) 14.8–22.2 × 9.2–18.5 (apple) 12.0–34.0 × 9.0–15.0 18.0 × 11.4	Own data Own data Wormald (1954) Byrde and Willetts (1977 acc. to quoted literature)
Monilia laxa (Ehrenb. ex Pers.) Sacc. et Vogl.	8.5–21.9 × 5.7–15.2 (PDA) 11.1–18.5 × 7.4–11.1 (cherry) 5.0–23.0 × 4.0–16.0 14.5 × 11.0	Own data Own data Wormald (1954) Byrde and Willetts (1977)

The result of length- and width-measurements of macroconidia of *Monilia* spp. are shown in Table 2. Macroconidia of *Monilia coryli* taken from 14-day-old PDA cultures were much larger than those of *M. fructigena* and *M. laxa* taken also from PDA cultures. Macroconidia of *Monilia coryli* taken directly from sporodochia formed on hazel nuts were smaller than those taken from PDA cultures. Macroconidia of *M. fructigena* and *M. laxa* taken directly from sporodochia formed on apples and cherries were larger than those taken from PDA cultures.

Basing on the above-conclusions we recognise the fungus *Monilia coryli* as the principal cause of brown rot of hazel, being of one mind with Kotte (1958) in this respect, because the specific name itself emphasises the close relationship between this pathogen and its host plant. It seems that macroconidia of a species should be of constant size but there was found that macroconidia of *M. coryli* taken from PDA cultures differed in size from those formed on a natural substratum. Maybe that this difference resulted from a better utilisation of nutrients by the fungus, especially of sugars present in the culture medium, which is a phenomenon well know as regards the fungi (Byrde and Willetts 1977). High amounts of simple sugars present in a substratum may strongly support the growth of *Monilia* spp., especially that of the mycelium and spores.

In 1886, *Monilia fructigena* and *M. laxa* were separated as good species owing to their specific affinities for definite host plants (Honey 1928). The former species was regarded to be specific for seedy fruits, the latter one was regarded to be specific for stone fruits. Recently however, both species were recorded to infect cherries (Siegfried et al. 1990). On the other hand Boeswinkel and Corbin (1970), found that peaches and apples might be infected with *Monilia* strains obtained from

grape-vine. Infection tests reported in the present study indicate that brown rot of hazel may be attributed chiefly to *Monilia coryli*. However, it is not unlikely that also *M. fructigena* and *M. laxa* can infect hazel-nuts as recorded by Glits (1960). Hence it appears that hazel plantations should be established in a breezy area, apart from orchards.

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Chorobotwórczość *Monilia* spp. dla leszczyny (*Corylus*)

Streszczenie

Celem pracy było przebadanie morfologii makrokonidiów *Monilia coryli* Schellenb., *M. fructigena* (Pers.: Pers.) Pers. ex Steudel i *M. laxa* (Ehrenb. ex Pers.) Sacc. et Vogl. oraz określenie powinowactwa chorobowego wymienionych gatunków grzybów dla różnych organów leszczyny. Zawiązki owocowe i owoce leszczyny o miękkiej oraz stwardniałej owocni odmiany Kataloński odkażano powierzchniowo i w nacięcia owocni umieszczano 3 mm krążki pochodzące z pięciodniowych, zarodnikujących na pożywce PDA kultur *M. coryli*, *M. fructigena* i *M. laxa*. Sztucznie zainfekowany i kontrolny materiał roślinny przetrzymywano przez 12 dni, w komorach wilgotnych, w temperaturze 24°C. Na podstawie reizolacji grzybów wykazano, że każdy z trzech

gatunków *Monilia* może zasiedlać badane organy leszczyny. Jednak procent zakażonych organów przez *M. coryli* był istotnie większy niż w kombinacji kontrolnej oraz w kombinacjach uwzględniających inokulację organów leszczyny przez *M. fructigena* i *M. laxa*. Długość i szerokość makrokonidiów *M. coryli* pochodzących z 14-dniowych kultur wzrastających na PDA była znacznie większa niż makrokonidiów *M. fructigena* i *M. laxa*.

Na podstawie wielkości makrokonidiów i dużego powinowactwa do porażania organów przyjęto dla grzyba powodującego brunatną zgniliznę leszczyny nazwę *Monilia coryli* podkreślającą związek patogena z tą właśnie rośliną.