THE OCCURRENCE OF POWDERY MILDEW ON DECIDUOUS RHODODENDRON IN POLAND

M. Werner and Z. Karolewski

Abstract

The occurrence of powdery mildew symptoms on deciduous rhododendrons is described. In the material collected in various home gardens and botanical gardens cleistothecia were described and measured. Cleistothecia were very similar and corresponded to Microsphaera azaleae, which was identified on rhododendrons in North America.

Key words: Microsphaera azaleae, cleistothecia, rhododendron, deciduous azalea diseases

Introduction

Rhododendron powdery mildew in Europe has been causing serious damage on rhododendrons growing outdoors since 1981 (Brooks and Knights 1984, Evans et al. 1984). In Poland rhododendron powdery mildew was described by Łabanowski and Orlikowski (1997) and Czekalski and Aniśko (2004). It turned out to be difficult to determine the origin and to identify rhododendron powdery mildew, since only anamorphs of the fungus were observed on infected plants (Boesenwinkel 1981, Watling 1985). Teleomorphs of powdery mildew on Rhododendron found in other parts of the world are well investigated and described: Microsphaera azaleae (syn. M. alni, M. penicillata, M. rhododendrii, M. penicillata f. rhododendrii) in North America and South America (Braun 1982, 1984, Pitta et al. 1993) and probably in Asia (Braun 1982, Bunkina 1974, 1991), M. izuensis was described in Japan and the eastern part of the former USSR (Nomura 1984), while Erysiphe rhododendri was described in India (Kapoor 1965, Watling 1985, Braun 1987). Teleomorphs of powdery mildew on Rhododendron in Europe were recorded in Belgium on R. mekongense growing in a greenhouse. This rhododendron came from North America and cleistothecia matched M. azaleae (Helfer 1994, Basden and Helfer 1995).
Cleistothecia of *M. azaleae* were later observed in Germany (Braun 1997), England (Ing 2000), Switzerland (Inman et al. 2000) and the Czech Republic (Lebeda et al. 2007). In 2002 in Poland cleistothecia of *Microsphaera azaleae* (syn. *Erysiphe azaleae* (U. Braun), U. Braun & S. Takamatsu comb. Nov.) were found on *R. luteum* in the Botanical Garden in Cracow (Piątek 2003).

In 2003 in a home garden in Poznań cleistothecia-bearing powdery mildew was observed on garden shrubs of deciduous azalea. In the following years cleistothecia were observed on deciduous azaleas in different home gardens, young shrubs in nurseries and in the Dendrological Garden of The August Cieszkowski Agricultural University in Poznań (currently Poznań University of Life Sciences). These materials were used in this study. The occurrence and features of cleistothecia observed on different deciduous cultivars of azalea are described in this paper.

**Material and methods**

Powdery mildew symptoms, including cleistothecia, were observed on a deciduous azalea bush in a home garden in the district of Piątkowo in Poznań, Poland, in 2003. In the following years (2004, 2005 and 2006) cleistothecia were also found on deciduous azalea bushes in that one as well as other gardens, in the rhododendron collection of the Dendrological Garden of The August Cieszkowski Agricultural University in Poznań, and on young bushes for sale from different nurseries.

Leaves bearing cleistothecia were collected from July to the first decade of October. Specimens were examined under a light microscope and the observations concerned cleistothecia, cleistothecial appendages, asci and ascospores. A total of 50 observations and measurements were taken within each of the categories. Examinations were also conducted on cleistothecia, which were collected in September 2002 from deciduous azalea bushes, the latter material coming from the Botanical Garden – Centre for Biological Diversity Conservation of the Polish Academy of Sciences in Powsin near Warsaw.

**Results**

Powdery mildew infected deciduous rhododendron was observed for the first time in 2000 in a home garden in the city of Poznań. On leaves of this shrub, initially only the conidial stage of powdery mildew was found (Phot. 1). Mycelium, which was white at first, became light grey in time, while the leaves were yellowing, withering and falling. First cleistothecia were observed in 2003, while in the following years they were formed in abundance.

In the summer of 2006, which in that region was warm and dry, the bush was strongly infected by powdery mildew. Cleistothecia were observed as early as July, but they were immature as leaves dropped rapidly. Soon on shrubs new leaves were formed, on which after 14 days white mycelium of powdery mildew was ob-
served. Cleistothecia were also formed on those leaves. These cleistothecia were completely developed at the end of September and these were also described and measured.

In 2005 and 2006 cleistothecia were found on shrubs of different deciduous azalea cultivars in other gardens, on bushes from different nurseries as well as the rhododendron collection at the Dendrological Garden of The August Cieszkowski Agricultural University in Poznań. Powdery mildew was not detected on evergreen rhododendrons, although they were growing in the immediate vicinity of deciduous azaleas infected with powdery mildew. The incidence of rhododendron powdery mildew symptoms with or without cleistothecia on leaves is presented in Table 1.

At present cleistothecia are frequently formed on leaves and thus it is possible to describe their characteristics. Observations and measurements of cleistothecia were taken on all shrubs listed in Table 2. Cleistothecia were numerous, usually uniformly distributed on both sides of leaves, round, dark brown or brown-black with a diameter of 103.2–131.6 μm. Cleistothecial appendages were hyaline, usually straight, on ends four–six times dichotomically, regularly branched, in the terminal part of the branching lobed (Phot. 2). A total of 10–40 cleistothecial appendages were distributed radially, in the equatorial plane. They were 100–150 μm long. Asci were ellipsoid-ovoid with four–six, sometimes seven ascospores. Ascospores were ellipsoid or ellipsoid-ovoid, 18–26 × 10–15 μm in size. On all an-
alyzed leaves cleistothecia were similar in appearance and size to the description given for *M. azaleae* (Table 2).

### Discussion

First reports on the incidence of rhododendron powdery mildew in a greenhouse of the Royal Botanic Garden in Edinburgh come from 1950 and 1969 (Watling 1985). However, in 1973 only the imperfect stage of powdery mildew detected there was described. Two different powdery mildews were described, on *Rhododendron* section Vireya a chain-forming (euoidium) type, considered to be *Sphaerotheca pannosa* and the other non-chain-forming (pseudoidium) type, considered to be *Erysiphe cruciferarum*. The latter was found on *Rhododendron* and other *Ericaceae* (Boesewinkel 1981, Helfer 1994, Basden and Helfer 1995). Even earlier...
Table 2

Microscopic features of *Microsphaera azaleae* described by different authors and according to the authors’ observations

<table>
<thead>
<tr>
<th>Fungal elements</th>
<th>Braun (1982), USA</th>
<th>Ing (2000), Great Britain</th>
<th>Piątek (2003), Poland</th>
<th>Authors’ observations 2002, Powsin, Poland</th>
<th>Authors’ observations 2005, Poznań, Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleistothecia diameter (µm)</td>
<td>100–130</td>
<td>110–130</td>
<td>104–125</td>
<td>110.9–129</td>
<td>103.2–131.6</td>
</tr>
<tr>
<td>Appendages length (µm)</td>
<td>1–1.5 of cleistothecial diameter</td>
<td>1–1.5 of cleistothecial diameter</td>
<td>100–150</td>
<td>103–142</td>
<td>100–147</td>
</tr>
<tr>
<td>Apex</td>
<td>Equatorial, hyaline, aseptate, occasionally with a single septum near the bare; 4–6 regularly and closely branched, the tips recurved</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Asci size (µm)</td>
<td>35–60 × 30–50</td>
<td>35–60 × 30–50</td>
<td>40–60 × 30–45</td>
<td>56.8–61.9 × 33.5–38.7</td>
<td>51.6–59.3 × 31–46.4</td>
</tr>
<tr>
<td>Ascospores number</td>
<td>5–6(-7)</td>
<td>4–6</td>
<td>4–6(-7)</td>
<td>4–6</td>
<td>4–6</td>
</tr>
</tbody>
</table>

*Did not differ from those described by Braun (1982).
Oidium vides and O. ericinum were found and described on Calluna and Erica species (Blumer 1967, Braun 1987, 1995). At the same time Braun (1987, 1995) suggested including different pseudoidia described on Ericaceae in Europe into O. ericinum. The spread of rhododendron powdery mildew in England and other European countries and the appearance of this disease on garden rhododendrons indicated that M. azaleae was transferred to Europe from North America. These speculations were confirmed after cleistothecia were found on rhododendrons and described.

Inman et al. (2000) analyzed a large group of rhododendron leaves coming from different locations in Europe. Cleistothecia found in that material were compared with those described by Braun (1982) on rhododendrons in the USA. Braun (1982) considered this rhododendron powdery mildew a typical pathogen on that host plant. Inman et al. (2000), when analyzing material collected in Europe, showed that all the characteristics, i.e. cleistothecia, cleistothecial appendages, asci and ascospores, matched those described as M. azaleae (Braun 1982, 1984, 1987), syn. Erysiphe azaleae (Braun and Takamatsu 2000). Inman et al. (2000) did not exclude the possible incidence on rhododendrons and other Ericaceae plants of other powdery mildew species; however, M. azaleae has been most common.

As it was shown in the studies described in this paper, as well as in observations by Piątek (2003), in Poland cleistothecia-bearing powdery mildew on rhododendrons matched the description given for M. azaleae. Moreover, Inman et al. (2000) were of the opinion that there is little evidence which would support linking powdery mildew on Rhododendron with a native species of O. ericinum sensu stricto, which infests Erica and Calluna sp. Until the matter is satisfactorily clarified the im-

Phot. 2. Cleistothecium of Microsphaera azaleae; a – appendages (photo by M. Werner)
The occurrence of powdery mildew... 37

perfect stage on Rhododendron should be only referred to as Oidium subgen. Pseudoidium (Inman et al. 2000). It was also reported that the only one among all the analyzed, which differed markedly from the others, was powdery mildew coming from Belgium. Long, sinuous appendages were typical of this fungus. For this reason it could not be included into M. vaccini, M. izuensis or M. azaleae. This specimen, found on R. mekongense var. melinanthu in Belgium was described by Inman et al. (2000) as M. digitata sp. nov.

Rapid spread of M. azaleae as well as considerable damage caused by powdery mildew on rhododendrons are an incentive for the development of plant protection methods. Moreover, studies have been undertaken on the assessment of effectiveness of different fungicides in control of powdery mildew on rhododendrons (Kenyon et al. 1997).

Streszczenie
WYSTĘPOWANIE MĄCZNIAKA PRAWDZIWEGO NA RODODENDRONACH O LIŚCIACH OPADAJĄCYCH W POLSCE


Opisano i pomierzono otocznie, przyczepki, worki i askospory. Otocznie zebra- no z krzewów, które rosły w różnych ogrodach przydomowych oraz w kolekcji Ogrodu Dendrologicznego Akademii Rolniczej w Poznaniu (obecnie Uniwersytetu Przyrodniczego w Poznaniu). Zebrało również porażone liście z otoczmini z przygotowanych do posadzenia młodych krzewów azalii ośmiu odmian. Cechy otoczni, jak i pozostałych elementów, ze wszystkich zebranych materiałów, odpowiadają opisowi podanemu dla Microsphaera azaleae, a uzyskane wyniki wskazują, że gatunek ten jest czynnikiem sprawczym mączniaka prawdziwego na rododendronach.

Literature
Braun U., Takamatsu S., 2000: Phylogeny of Erysiphe, Microsphaera, Uncinula (Erysiphaceae) and Cystotheca, Podosphaera, Sphaerotheca (Cystothecaceae) inferred from rDNA ITS sequences – some taxonomic sequences. Schlechtendalia 4: 1–33.

Authors’ address:
Dr. hab. Maria Werner, Dr. Zbigniew Karolewski, Department of Phytopathology, Poznań University of Life Sciences, ul. Dąbrowskiego 159, 60-594 Poznań, Poland, e-mail: karolew@up.poznan.pl

Accepted for publication: 7.09.2010