New and Unusual Report

First Report of Anthracnose of Common Snowberry Caused by *Sphaceloma symphoricarpi* in the Czech Republic

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Abstrakt

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During the first part of July, 2006, a severe outbreak of disease on common snowberry shrubs, *Symhoricarpos albus* var. *laevigata*, was observed in some city ornamental parks and small gardens in Prague and its environs. Based on disease symptoms and pathogen characteristics both on leaves, shoots, fruits and in culture, it can be concluded that the outbreak of anthracnose on common snowberry was caused by *Sphaceloma symphoricarpi* Barus & Horsfall 1928. This is probably the first record of *S. symphoricarpi* in the Czech Republic. Of the surveyed *Symphoricarpos* species and varieties, i.e. *S. albus* var. *albus*, *S. albus* var. *laevigata, S. orbiculatus*, *S. doorenbosii,* and *S.* × *chenaultii*, only *S. albus* var. *laevigata* was attacked by the pathogen. Common snowberry shrubs having semipendent branches appeared to be more susceptible than shrubs with upright ones. Disease symptoms and pathogen characteristics are described and illustrated. The analysis of meteorological data indicated that the outbreak of anthracnose of common snowberry might have been related with rainy and mild weather during May, and especially with a rainy period of 7 days at the end of May and beginning of June.

Keywords: *Symphoricarpos albus* var. *laevigata*; *Sphaceloma symphoricarpi*; anthracnose; occurrence in the Czech Republic

In the Czech Republic, some species, varieties and crosses of *Symphoricarpos*, namely *S. albus* var. *laevigata* (Fern.) Blake (common snowberry), *S. orbiculatus* Moench (coralberry) and *S. occidentalis* Hook. (western snowberry or wolfberry), are popular ornamental deciduous shrubs. The common snowberry is the most widespread variety of *Symphoricarpos* planted in gardens, town ornamental parks and roadsides for their decorative fruits which persist well into winter after the leaves have fallen. It is also the only variety of snowberry which became wild in the country. The variety *S. albus* var. *laevigata* is native to the Pacific coast of North America (from Alaska to California) from where it got distributed to many countries all over the world (Slavík & Štěpánková 2004). Tradition has it that there are no serious disease and pest problems with snowberry shrubs.

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In the Czech Republic an until then unreported disease, characterised by anthracnose lesions, occurred on leaves, shoots and fruits of common snowberry in 2006. This paper describes the symptoms of the disease, its causal agent and environmental conditions that probably contributed greatly to the outbreak of the disease. Preliminary results were presented earlier in form of an abstract (Kůdela & Krejzar 2006).

MATERIAL AND METHODS

In ornamental parks and small gardens in Prague and environs, samples were collected from common snowberry shrubs showing symptoms of anthracnose disease on leaves, succulent shoots and fruits during 2006. The pathogen was isolated from lesions on leaves and shoots, and especially from conidiomata situated in the centres of the leaf lesions. Following surface sterilisation with 70% ethanol, segments of the diseased tissues were taken or individual conidiomata were excised and placed on potato dextrose agar (PDA) or malt agar (MA) in Petri dishes and incubated in the dark at 26°C. The obtained pure isolates were maintained in Petri dishes on PDA.

To verify the pathogenicity of the four fungal isolates, detached succulent shoots of common snowberry from a healthy shrub were inoculated by spraying with a hand atomizer. The inoculum was obtained by suspending a mixture of the isolates in sterile distilled water and adjusting the concentration to ca. 2×10^5 conidia per 1 ml. Other detached shoots were sprayed with sterile distilled water and served as control. After inoculation, the shoots were kept at near 100% relative humidity for 3 days and afterwards between 50 and 75%. The plants were evaluated 7, 14 and 21 days after inoculation.

RESULTS

The symptoms of this year's disease outbreak on common snowberry shrubs, *Symhoricarpos albus* var. *laevigata*, look like one of the anthracnose diseases occurring worldwide on many diverse host plants. Yet of the surveyed *Symphoricarpos* species and varieties, i.e. *S. albus* var. *albus* (L.) Blake, *S. albus* var. *laevigata, S. orbiculatus, S. doorenbosii* Kruessm. and *S.* × *chenaultii* Rehd., only *S. albus* var. *laevigata* was attacked by the pathogen.

Figure 1. Incipient lesions of anthracnose on the upper surface of common snowberry leaf (Photo V. Krejzar)

Figure 2. Anthracnose-like lesions on common snowberry leaves. Note the lop-sidedness of some leaves when lesions on veins prevented normal development of leaf blades (Photo K. Veverka)

Figure 3. Greyish white centres on the anthracnose lesions on the upper surface of common snowberry leaves during production of conidiomata when the leaf cuticle within lesions is lifted and separated from the underlying tissues (Photo V. Krejzar)

Figure 4. Anthracnose lesions on the lower surface of the leaf pictured in Figure 3. Note that lesions are without greyish centres (Photo V. Krejzar)

Figure 5. An advanced stage of anthracnose symptoms development on common snowberry: dark brown conidiomata within lesion with greyish centre (Photo V. Krejzar)

Symptoms

The first symptoms included conspicuous spots on the leaf blade. They appeared as small, dark purple to black lesions of circular or irregular shape, 1 to 5 mm in diameter. Some necrotic le-

Figure 6. A leaf blade of common snowberry severely attacked by anthracnose (Photo V. Krejzar)

Figure 7. Anthracnose lesions on a shoot of common snowberry – enlarged 10× (Photo V. Krejzar)

sions were surrounded with diffuse chlorotic tissue (Figure 1). The distinctive feature of some spots was that they were bulged out from the upper leaf surface. The spots were quite numerous. They often enlarged slowly with time to large, irregular blotches with characteristic dark brown to black raised margins. Some spots remained isolated. If the veins were affected, especially on young leaves, the lesions prevented normal development, resulting in lopsided blades (Figure 2). Greyish white centres developed on the spots or blotches on the upper surface of leaves as the disease progressed (Figure 3); such greyish white centres were not noticeable on the lower surface (Figure 4). Large spots often had cracks in their centre. On leaf spots with the greyish white centres, minute sub-cuticular to sub-epidermal dark conidiomata were apparent on the upper leaf surface (Figure 5). Severely attacked leaves (Figure 6) fell off prematurely and often the disease destroyed the berries.

The tender shoots had small oblong and somewhat sunken lesions, about 3 mm long, with violet-brown raised margins (Figure 7). These lesions on the shoots were sometimes cracked.

The inflorescence showed minute lesions on unopened buds. Later infections of calyx ends resulted in small black lesions on the calyx end of fruits and in conspicuous black spots that were sharply delimited from healthy berry tissues (Figure 8).

Figure 8. Fruit cluster of common snowberry with symptoms of anthracnose in the form of large black lesions that resulted in fruit deformations, as seen on the bottom berries, or in necroses of the calyx-ends as present on the upper berries (Photo V. Krejzar)

Pathogen and pathogenicity test

Subcuticular pulvinate conidiomata observed in diseased leaf tissues of naturally infected common snowberry were 280 to 420 µm in diameter.

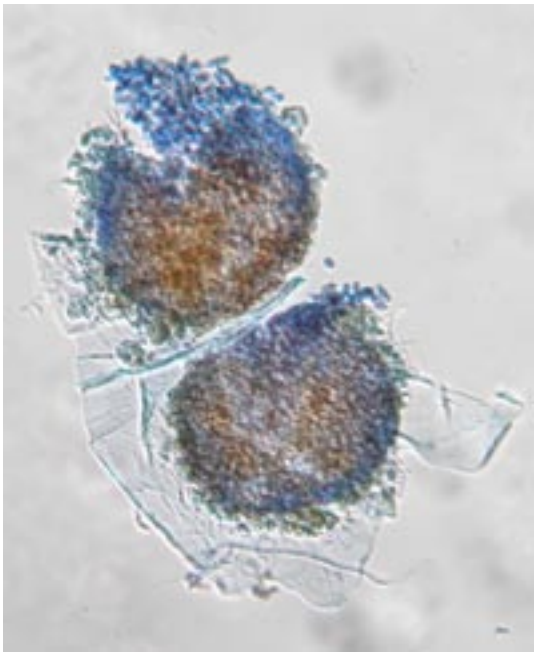

Figure 9. Photomicrograph of stromata, conidiophores and conidia of *Sphaceloma symphoricarpi* excised from anthracnose leaf lesion on common snowberry. Natural infection. Note transparent fragments of cuticle around conidiomata (Photo V. Krejzar)

Figure 10. Three weeks old culture of *Sphaceloma symphoricarpi* on potato dextrose agar with aerial mycelium (Photo V. Krejzar)

Figure 11. Five weeks old culture of *Sphaceloma symphoricarpi* on potato dextrose agar with submersed mycelium. Note a yellowish pigment diffusing from colonies into agar (Photo V. Krejzar)

Unbranched hyaline conidiophores, sharp-pointed and closely compacted, arose from the surface of conidiomata in a tuft. Conidiophores produced one- to two-celled, hyaline conidia which were ovoid to oblong, constricted at the septum, with dimensions of 8 × 4 µm (one-celled) or 17 × 3 µm (two-celled). The conidia were stuck together by a mucilaginous matrix (Figure 9).

The morphological characteristics of the fungal isolates, colony growth and colour, and presence

Figure 12. Symptoms on detached shoots of common snowberry after inoculation with *Sphaceloma symphoricarpi* (two shoots on the right) compared with an uninoculated shoot (on the left) (Photo V. Krejzar)

Figure 13. Anthracnose-like symptoms on coralberry leaf caused probably by *Gloeosporium* sp. natural infection (Photo V. Krejzar)

Table 1. Selected meteorological data for the locality Prague in the year 2006

Parameter	May		June		July	
	2006	normal	2006	normal	2006	normal
Monthly mean air temperature (°C)	13.5	12.7	17.7	15.9	22.4	17.7
Temperature as percentage of normal	106	–	111	–	128	–
Monthly precipitation (mm)	77.2	58.3	58.9	72.7	28.7	66.2
Precipitation as percentage of normal	125	–	81	–	43	–

Normal = longterm normal (1961–1990)
Source: Czech Hydrometeorological Institute, Prague, Czech Republic

or absence of aerial mycelium were evaluated. Colonies of all isolates grew slowly. A new colony began as a mucous mass that established itself on the nutrient medium. Growth of the colonies was irregular, and variable as to colony colour and presence or absence of aerial mycelium. The colour of a young colony was usually light brown. Areas of the colony changed colour and the yellow to brown pigment diffused from the mycelium into the nutrient medium as the colony matured (Figures 10 and 11). In colonies 4 weeks or older, the nutrient medium became a deep reddish brown, and cauhion-shaped bases of conidiomata, about 1 mm large, were produced. Hyphae consisting of a number rounded cells were observed in the culture.

To confirm the identity of the causal organism, the pathogen was isolated and detached tender shoots of common snowberry were inoculated with the obtained isolates. The first disease symptoms appeared on leaf blades 5 d after inoculation and the disease progressed relatively fast (Figure 12).

Based on disease symptoms and characteristics of the pathogen on leaves, shoots, fruits and in culture, it can be concluded that the outbreak of anthracnose on common snowberry in the Czech Republic in 2006 was caused by *Sphaceloma symphoricarpi* Barrus and Horsfall (1928). This is probably the first record of *S. symphoricarpi* in the Czech Republic.

Environmental conditions

The analysis of meteorological data (Table 1) indicated that the outbreak of anthracnose of common snowberry might have been related with rainy and mild weather during May, and especially with a period of rainy weather that lasted from May 26 to June 1. In May there were high daily temperatures that ranged from 12 to 18°C. In June and July, the warm temperatures continued but precipitation was below normal.

DISCUSSION

Symphoricarpos species belong to those plant species that have not been thoroughly dealt with from a phytopathological point of view. The *Sphaceloma* on snowberry appears to be fairly common and widespread in the USA. It was first described by Barrus and Horsfall (1928). They recorded the fungus from three counties in New York State and from one county each in Arkansas, Iowa and Wisconsin. Subsequently, the pathogen was recorded from Colorado, and another county in New York State (Jenkins 1930). Later, snowberry anthracnose, previously known only from North America, was reported from France and Denmark (Bitancourt & Jenkins 1948). Surprisingly, no other mention of the occurrence of *S. symphoricarpi* on common snowberry in European countries has been found, despite a thorough search in the Review of Applied Mycology, Review of Plant Pathology and other available literature.

There are more than 160 species of *Sphaceloma* (an anamorph genus belonging to the *Coelomycetes*; teleomorph *Elsinoë*). They are widespread and causing anthracnose or spot anthracnose and scab diseases on various host plants, e.g. on citrus (*S. fawcettii*), cassava (*S. manihoticola*), mango (*S. mangiferae*), avokado (*S. perseae*), bean (*Shaceloma* sp., teleomorph *Elsinoë dolichi*), grape (*S. ampelinum*), black raspberry and red raspberry (*S. necator*), rose (*S. rosarum*) and poinsettia (*S. poinsettiae*) (Anonymus 2006a). In the Czech Republic, *S. ampelinum* on grape and *S. necator*

on black raspberry and red raspberry are observed sporadically (Marvanová 1962; Ackermann personal communication). *Sphaceloma ampelinum* is a pathogen of European origin. Before the introduction of powdery mildew and downy mildew, anthracnose was the most damaging grape disease in Europe. After introduction of chemical preparations against downy mildew, both incidence and severity of anthracnose on European cultivars of *Vitis vinifera* were significantly reduced (Mirică 1988).

It has to be emphasised that temperature and moisture are the main environmental factors influencing the development of diseases caused by *Sphaceloma* spp. Anthracnoses or scab diseases are especially damaging in humid tropics and subtropics and in other areas during years of heavy rainfall and higher temperature. As to the outbreak of anthracnose on common snowberry in the CR in 2006, a correlation between high rainfall, humidity and temperature around the end of May and beginning of June seems obvious (Table 1).

In the Czech Republic the fungus *S. symphoricarpi*, causing spot on common snowberry, was identified by symptoms of the disease on the host plant, and by characteristics of the pathogen in culture. The disease symptoms on common snowberry were identical or similar with those described by Barrus and Horsfall (1928). On the other hand, there are some differences in the description of the pathogen. Of the characteristics of the pathogen that have not been described in the work of Barrus and Horsfall (1928), it is worth to mention our observation of both one-celled and two-celled conidia in diseased common snowberry tissues after natural infection. These discrepancies can be explained by the fact that Barrus and Horsfall (1928) based their description of the pathogen on features observed in culture. One- to two-celled conidia are common e.g. for *S. poinsettiae* (Anonymus 2006b). Barrus and Horsfall (1928) also did not mention hyphae of *S. symphoricarpi* that look like prayer beads as observed by us in submersed mycelium in nutrient agar medium. However, hyphae, usually hyaline or deep reddish brown and shown within or beneath the epidermis of diseased common snowberry leaves, were presented by Jenkins (1930) in her photomicrographs. Hyphae consisting of a number of rounded cells were also observed in culture of *S. symphocarpi* and photographed by Fisher (1933).

The question arose whether *S. symphoricarpi* can attack not only *S. albus* var. *laevigata* but also other species of the genus *Symphoricarpos*. In the ornamental parks of both the Research Institute of Crop Production in Prague-Ruzyně and at Průhonice situated near Prague, we inspected shrubs of *S. albus* var. *albus*, *S. orbiculatus*, *S. doorenbosii* and *S.* × *chenaultii* for symptoms of anthracnose, but did not find any. The writers have also received a specimen of *S. orbiculatus* from Kroměříž, south Moravia. Anthracnose-like symptoms occurred on coralberry leaves (Figure 13), but they were not identical with those observed on common snowberry. Acervular conidiomata in the centres of leaf spots were mostly disc-shaped and not pulvinate as on common snowberry. Therefore, the anthracnose-like symptoms on coralberry might have been caused by *Gloeosporium* sp. rather than *Sphaceloma* sp. In other words, the cause of anthracnose-like symptoms on the coralberry specimen from Kroměříž remains unsolved. Incidentally, the presence of fungal species of *Gloeosporium* and *Sphaceloma* on one plant and even on the same leaf blade is not at all extraordinary.

It is difficult to determine now when the fungus *S. symphoricarpi* might have been introduced in Europe and to Bohemia. The severe outbreak of anthracnose on common snowberry in the Czech Republic in 2006 on a relatively large area indicates that the disease may have been in this country much earlier but went unrecorded. The only known host plant of the pathogen of anthracnose is *S. albus* var. *laevigata*. Because this plant is native to North America (Slavík & Štěpánková 2004), it seems probable that the pathogen was introduced to European countries from the area of origin together with reproductive material of the host plant. It should be noted that *S. murrayae,* a pathogen new to Europe on *Salix* sp., has been reported recently (Butin & Kehr 2004). However, because of the worldwide distribution of *Salix*, it can never be ruled out that the *S. murrayae* occurring now in Europe, comes from another part of the world.

During our survey conducted in an area to determine the severity of snowberry anhracnose, we noticed marked differences in the reaction of various growth types of *S. albus* var. *laevigata* at the same locality. Common snowberry shrubs with semipendent branches appeared to be more susceptible than shrubs with upright ones.

Very little work has been done on the control of snowberry anthracnose. However, experiences with control of *Sphaceloma* sp. div. on economically important host plants, e.g. raspberry and blackberry, show that the fungicides captan, benomyl, dichlofluanid and ferbam should be effective (Travis & Rytter 1991) if the need arises. Like with *S. murrayae*, a pathogen new to Europe on *Salix* spp., *S. symphoricarpi* on common snowberry should be surveyed in the coming years.

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