Scab Disease of Firethorn at Selected Localities in Slovakia

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Abstract

Juhásová G., Ivanová H., Adamčíková K., Kobza M., Čerevková A. (2004): **Scab disease of firethorn at selected localities in Slovakia**. Plant Protect. Sci., **40**: 42–48.

The health state of firethorn, *Pyracantha coccinea,* was evaluated in different types of functional urban greenery at locations in Slovakia during 2001 (34 sites) and 2002 (18 sites). The occurrence of scab disease, caused by the fungus *Spilocaea pyracanthae,* was recorded. The degree of damage to firethorn fruits was evaluated; it ranged from 3.6% to 98.8% (2001) and from 9.1% to 38.5% (2002). Germination of conidia of the fungus ranged between 42 and 50% at 24–25°C after 24 h, and from 49% to 61% after 48 h. The germination of conidia collected on different parts of the plants from July to September was compared. Conidia taken from olive-green spots on fruits in September had the highest germination (53–89%).

Keywords: *Pyracantha coccinea*; *Spilocaea pyracanthae*; Slovakia

Firethorn, *Pyracantha coccinea* Roem., is one of the most beautiful ornamental plants. In central Europe, the ornamental effect of firethorn has suffered severely since the 1980-ies because of the spread of the fungal disease of pome (scab disease) caused by *Spilocaea pyracanthae* (Otth) Arx (syn. *Venturia pyracanthae* Desm.), anamorph *Fusicladium pyracanthae* (Otth) Rostr. (Větvička & Matoušová 1992).

MATERIALS AND METHODS

***Selection of localities to evaluate the health state of** Pyracantha coccinea.* The sites for this evaluation were chosen so as to include the different types of urban greenery (streets, parks, parts of the road and rail network, urban spaces, special-purpose plantings) in selected towns in Slovakia. Plants from Arborétum Mlyňany, Zvolen, Nitra, Bratislava, Zlaté Moravce, Topoľčany, Kováčová, Radošina, Sliač and Modra were evaluated in the year 2001 (10 localities with 34 sites). More plants from sites at Nitra and Bratislava were evaluated in 2002 (18 sites).

Taking of samples and evaluation of the level of damage to fruits of *P. coccinea.*

Samples were taken from March to October so that the first symptoms of the disease and each of its development stages could be recorded. At each site and according to an established time schedule, 100 fruits were collected from bottom, middle and top branches of a shrub and according to the cardinal points. The degree of damage to the fruit surface was classified by a five point scale:

0 – no visible damage on evaluated shrubs, fruits are healthy;
1 – sporadic spots on infected fruits, different in size and shape; number of spots between one and three;

Supported by the Grant Agency VEGA, Research project 2/4020/04.

2 – one third of the fruit surface covered with spots;
3 – half of the fruit surface covered with spots;
4 – spots covered nearly the entire surface of infected fruits.

The damage to the fruits in % was calculated according to the Towsend-Heuberger formula (Towsend & Heuberger 1943):

$$P = \frac{(0.n) + (1.n) + (2.n) + (3.n) + (4.n)}{5.N} \times 100$$

where: N – number of evaluated fruits
n – number of damaged fruits in each of the categories 0–4
P – stage of damage

Isolation and culture of the fungus. The fungus *Spilocaea pyracanthae* was isolated from infected firethorn fruits and cultured. Infected samples came from the sites Nitra, Botanical Garden (10. 10. 2002), Nitra, Novomeského Street (17. 10. 2002) and Bratislava, SAS Patrónka (13. 10. 2002). After surface sterilisation (0.15% NaClO, 20 min) the fruits were cut into small pieces (2–3 mm) and placed on the three solid media 3% maltose agar, 3% saccharose agar, and 3% potato dextrose agar in Petri dishes. These were incubated in the dark at 24–25°C and relative air humidity. The growth rate of the mycelium was measured every 24 h and was calculated from 10 repetitions.

Germination of conidia of the fungus. Fruits were colleted in July, August and September 2001 from the sites Nitra, Hornočermánska, Botanical Garden, Hviezdoslavova (27. 7., 10. 8., 26. 9., streets, park, urban spaces), Modra, Mariánske Square (27. 7., 31. 8., 25. 9., streets), Zvolen, Štúrova Street (12. 8., 10. 9., streets) and Zlaté Moravce, Bernolákova (28. 7. 10. 8., 13. 9., street). Conidia were taken from the olive-green and brown coatings on the fruit surface.

Dissolved 3% maltose agar was poured onto slides. After hardening of the medium, several drops of distilled water with fungal conidia were placed onto the medium. The slides were placed in desiccators kept at 24°C and the rate of germination determined after 24 and 48 h using a light microscope Carl-Zeiss Jena. Differences in the mean number of germinated conidia sampled from sites with different types of functional greenery (green and brown spots) were subjected to analyses of variation with two factors (functional type of greenery and month of sampling) with factors interaction. Post hoc tests were made by LSD test.

RESULTS

Occurrence and distribution of *Pyracantha coccinea* and *Spilocaea pyracanthae*

Scab disease occurred at all 10 localities and 52 sites.

Description of symptoms on leaves, branches and fruits of *P. coccinea*

The fungus *Spilocaea pyracanthae*, the cause of pyracantha scab, brought about severe damage to firethorn. The fungus is a commonly widespread pest not only in Slovakia, but also in some areas of southern Europe (Ubrizsy & Vörös 1968). Scab was manifested on fruits as a continual coating by a mycelium with conidiophores and conidia. Fruits were infected even on young shrubs that were fruiting for the first or second time. The degree of damage is higher on older shrubs.

Figure 1. Fruits of *Pyracantha coccinea* damaged by the fungus *Spilocaea pyracanthaea*. They become deformed in the place of infection (30. 8. 2001 in Arborétum Mlyňany)

Figure 2. Conidia of *Spilocaea pyracanthae* (bar = 25 μm)

A soft, later dark green mycelial layer is formed on fruits. Smooth, brown spots crack and turn into scabs at the end of May. The mycelium directly penetrates epidermal cells. The host defends itself against deeper penetration of the mycelium by suberisation of the fruit flesh. At the site of infection the fruit stops to grow and becomes deformed, whereas healthy parts keep growing and, therefore, infected fruits are wrinkled and deformed (Figure 1).

The conidia are formed on infected organs, and spread by rain and air during the whole season. In our case, the first wave of infection occurred from May to the end of June, the second was usually at the end of summer. There were no significant differences between the germination rates of conidia taken in the same month but from different sites. On the other hand, significant differences in germination of conidia were observed comparing the months July, August and September. The highest rate of conidia germination was found in September. Differences in germination were also recorded between conidia sampled on infected tissue with differently coloured spots. Germination of conidia taken from olive-green spots in September was the highest and ranged

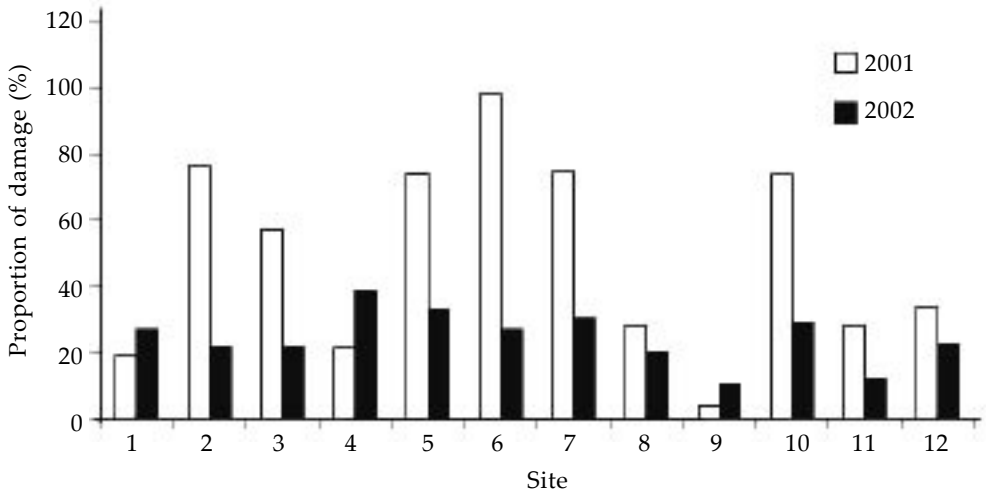

Figure 3. Degree of damage to *Pyracantha coccinea* fruits by the fungus *Spilocaea pyracanthae* at the same sites but in different years (2001 and 2002)

1 – Nitra, Botanical Garden 1; 2 – Nitra, Botanical Garden 2; 3 – Nitra, Priechodná Street; 4 – Nitra, Novomeského Street; 5 – Nitra, Hviezdoslavova Street 1; 6 – Nitra, Hviezdoslavova Street 2; 7 – Nitra, Hornočermánska Street; 8 – Bratislava, Trnavská Road; 9 – Bratislava, Radlinského Street; 10 – Bratislava, SAS Patrónka; 11 – Bratislava, Liberty Square; 12 – Bratislava, Kolár Square

Table 1. Growth rate of mycelium of *Spilocaea pyracanthaea* on different media within 96 hours

Medium	Minimum and maximum range of growth of mycelium (mm)			
	after 24 h	after 48 h	after 72 h	after 96 h
Maltose agar	9.0–11.3	15.8–17.8	24.2–25.6	35.2–38.4
Saccharose agar	11.9–14.9	19.8–23.3	28.8–32.8	37.0–42.6
Potato-dextrose agar	10.2–11.9	16.7–18.9	30.7–32.7	45.6–47.6

from 53 to 89%. Conidia taken from spots in July and those taken from brown spots had the lowest germination, at 18–38%.

The fungus is spread during the growing season by conidia that are formed on short conidiophores. The conidia are brown or olive-green, smooth, straight, in the lower part enlarged and with one compartment. Conidia isolated from leaves and fruits are 7–11 × 14–34 μm in size (Figure 2).

A brown or black stroma with pseudoperithecia is formed in the thick mycelial layer on fruits and leaves from the end of October to the beginning of November. The pseudoperithecia we observed were 90–140 μm in size, asci were 60–90 × 8–14 μm, and ascospores 8–14 × 3–7 μm. The scab fungus overwinters in pseudoperithecia in leaf litter. The fruiting bodies mature in spring, depending on optimal conditions of temperature and humidity. Ascospores are the primary source of infection; they are released in April and May, always after intensive rain.

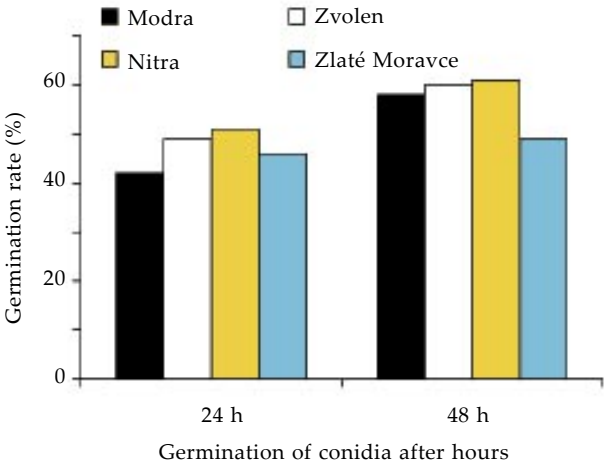

Figure 4. Germination rate on 3% maltose agar of conidia of *Spilocaea pyracanthae* from selected localities

Degree of damage to fruits

The results of the evaluation in 2001of the degree of damage to firethorn fruits in different types of urban greenery are shown in Figure 3. The fungus caused damage to fruits, leaves and branches. Degree of damage to fruits was evaluated by the Townsend-Heuberger method. Fruits were infected with scab at all evaluated sites. The proportion of damaged fruits ranged from 3.6% to 98.8%. Fruits at the site Bratislava, Radlinského Street, had the lowest damage. The highest degree of damage was recorded at Nitra, Hviezdoslavova Street 2.

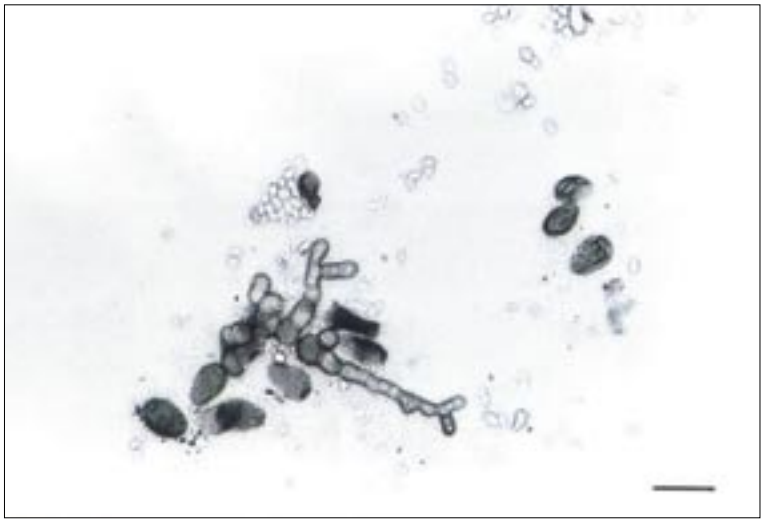

Figure 5. Beginning of germination of conidia of *Spilocaea pyracanthae* on 3% maltose agar at 24°C after 48 h of incubation (bar = 25 μm)

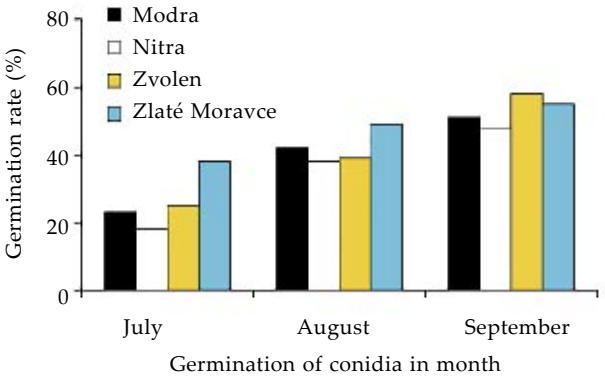

Figure 6. Germination rate on 3% maltose agar of conidia taken from brown spots on *Pyracantha coccinea* fruits collected at different sites from July to September 2001

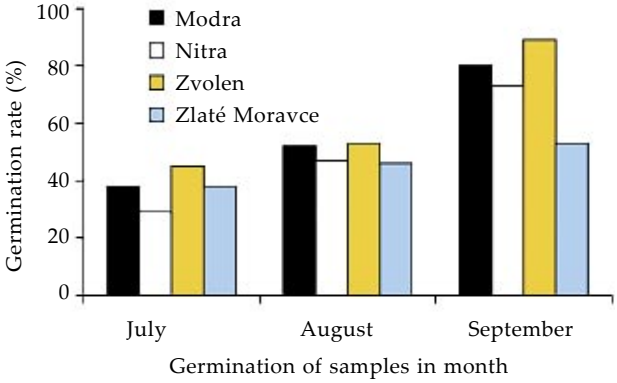

Figure 7. Germination rate on 3% maltose agar of conidia taken from olive-green spots on *Pyracantha coccinea* fruits collected at different sites from July to September 2001

Infection also occured in 2002, and the levels of damage to fruits at 18 sites of two localities (Bratislava and Nitra) ranged from 9.1% to 38.5%. The shrubs most severely damaged were at the site Nitra, Novomeského Street (38.5%), the lowest was found at site Nitra, Student Residence A. Bernolák (9.1%). The levels of damage by the disease on the same shrubs in 2001 and 2002 were compared and are shown in Figure 3.

Isolation and culture of *Spilocaea pyracanthae*

The fungus was successfully isolated on all three media. After 8–10 d of culture the fungus sporulated as yellow or orange powder covering the media surface. Sporulation was intense on 3% malt agar and 3% potato dextrose agar, while on 3% saccharose agar it was sparser.

There were only small differences between the media in growth rate of the mycelium. It was fastest on potato dextrose agar after 96 h, although at the beginning (up to 48 h) the growth rate was slow. A very slow but symmetric growth rate was found on maltose agar (Table 1). Fruiting bodies with conidia were formed on the surface of the media after 2 months of culture (Figure 8).

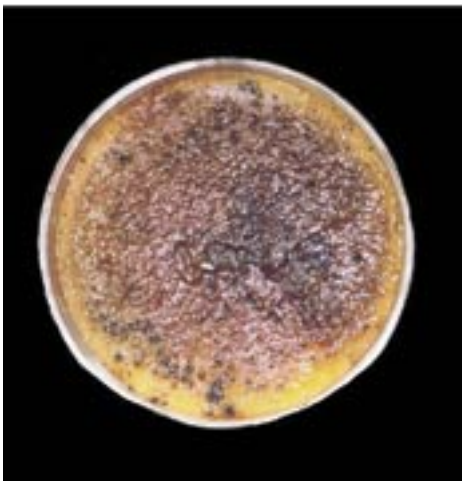

Figure 8. Two months old culture of *Spilocaea pyracanthae*

Germination of conidia

The germination rate of the conidia ranged between 42 and 50% at 24–25°C after 24 h. The number of germinating conidia increased after 48 h of incubation to 49–61%. There was no significant difference between the rates of germination of conidia from different sites (Figures 4 and 5). Statistical analyses of relevant data are shown in Table 2.

We compared the germination rate of conidia sampled from different sources from July to September. Conidia taken from brown scabs had higher germination rates in this period. The germination rate in July ranged from 18 to 38%, in August from 38 to 49% and in September from 48% to 58% (Figure 6, Table 2). The germination of conidia from brown spots was independent from the factor month of sampling [F (6.96) = 2.18; $P < 0.0517$]. Conidia taken from olive-green spots on fruits had a much higher germination; the rates ranged from 29 to 45% in July, from 46 to 53% in August and from 53 to 89%

Table 2. Statistical analysis of differences in conidial germination of *Spilocaea pyracanthae* from selected localities, of conidia taken from brown and olive-green spots on *Pyracantha* fruits

Univar. test	Interaction: localities (1) × hours (2)				
	Sum of squares	df	Mean square	*F*	*P*-level
Spilocaea pyracanthae from selected localities					
Effect	905.500	6	150.9167	3.549820	0.003225
Error	4081.333	96	42.5139		
Conidia taken from brown spots on *Pyracantha* fruits					
Effect	443.333	6	73.88889	2.177650	0.051686
Error	3257.333	96	33.93056		
Conidia taken from olive-green spots on *Pyracantha* fruits					
Effect	2813.315	6	468.8858	7.377842	0.000002
Error	6101.111	96	63.5532		

in September (Figure 7, Table 2). Germination of conidia from olive-green spots was dependent on both factors (month of sampling, types of functional greenery) [F (6.96) = 7.38; $P < 0.0000$].

DISCUSSION

The opinion of several authors (Ubrizsy 1952; Ubrizsy & Vörös 1968; Gorlenko 1969; Čača *et al*. 1981) that *S. pyracanthae* is a common and widespread pest not only in Slovakia, but also in the warmer parts of southern Europe has been confirmed. In both 2001 and 2002 we found the fungus at all 12 evaluated localities with 52 sites in Slovakia. The fungus had earlier been recorded over almost all of Slovakia, at 128 sites (Juhásová & Vokurková 1993).

The fruits got gradually covered with a continuous mycelium with conidiophores and conidia. Dark colored spots were formed on fruits. Unequal growth of healthy and attacked tissues caused fruit deformation and cracking. Brown, concave necrotic spots of different size and shape were scattered over the leaves. On branches, early infection was expressed through light spots and cracks of the branch epiderm, later it caused cankers.

A suitable medium for isolation and culture of the scab fungus is 3% maltose agar (Király *et al*. 1974). We isolated and grew the fungus on 3% maltose agar, 3% saccharose agar and 3% potato dextrose agar. Isolation was successful on these three media at 24–25°C. Sporulation was intense on 3% maltose agar and 3% potato dextrose agar.

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Received for publication February 24, 2004
Accepted after corrections May 24, 2004

Súhrn

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V rokoch 2001–2002 sme zhodnotili zdravotný stav dreviny *Pyracantha coccinea* v rôznych typoch funkčnej zeleni na Slovensku. Zaznamenali sme výskyt huby *Spilocaea pyracanthae*. Zhodnotili sme stupeň poškodenia plodov hlohyne šarlátovej. Stupeň poškodenia sa pohyboval od 9,1 % do 38,5 %. Klíčivosť konídií huby sa pohybovala v rozpätí 42–50 % pri teplote 24–25 °C po 24 hodinách a 49–61 % po 48 hodinách kultivácie. Porovnali sme klíčenie konídií zo zberov z rôznych typoch funkčnej zeleni sídiel v mesiacoch júl až september. Najvyššiu klíčivosť (53–89 %) mali konídie odobraté z olivovozelených škvŕn na plodoch v mesiaci august.

Klúčové slová: *Pyracantha coccinea*; *Spilocaea pyracanthae*; Slovensko

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