

Occurrence and Harmful Effects of *Gymnosporangium sabinae* (Dicks.) Winter in Slovak Republic

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Abstract

JUHÁSOVÁ G., PRASLIÈKA J. (2002): Occurrence and harmful effects of *Gymnosporangium sabinae* (Dicks.) Winter in Slovak Republic. *Plant Protect. Sci.*, 38: 89–93.

The fungus *Gymnosporangium sabinae* (Dicks.) Winter was found only at three locations during the years 1965 to 1990 in Slovakia, they were the Arboretum at Mlydany, Topoľčianky and Gbely (JUHÁSOVÁ 1973, 1975, 1998). We noticed a more frequent occurrence of this fungus during recent years. The life cycle, range of woody host plants and degree of damage on pear leaves at selected locations in Slovakia are described.

Keywords: *Gymnosporangium*; *Pyrus*; *Juniperus*; woody host plants

As part of the project “Biological-ecological bases for the creation and preservation of greenery in urban and production landscape” we evaluated the external factors that influence quality and quantity of greenery at selected locations in Slovakia. These included the important dendrological facilities (arboreta, botanical gardens and parks), public and private greenery in towns, gardening plots and private gardens. Part of the task was to determine the parasitic mycoflora on selected woody plant species, with members of the genus *Juniperus* amongst them.

According to a number of authors the heteroecious fungus *Gymnosporangium sabinae* parasitizes woody plants. It must unconditionally alternate hosts during its development. The spring (aecial) stage appears on pear (*Pyrus communis* L.), the winter spores (teliospores) are produced on *Juniperus sabina* L. The latter is considered in the literature as the main host plant, and the fungus was named after it.

The objective of this work was to obtain reliable data on whether *G. sabinae* occurs in Slovakia on *J. sabina* and on which woody host plants it produces the teliospores. At the same time we wanted to find out if urediospores are in fact missing from the life cycle of this fungus as mentioned in available literature.

Besides by *G. sabinae*, species of the genus *Juniperus* are also parasitized by the fungi *G. tremelloides* (A. Braun) Hartig, *G. clavariaeforme* (Jacqueuin) De Candolle (*J. communis* L.), *G. juniperi-virginiana* Schw. (*J. virginiana* L.), *G. sabinae* (*J. sabina*, *J. communis* and *J. virginiana*) (UBRIZSYI 1952; PŔÍHODA 1959; PARMELEE 1965; PADY *et al.* 1968, KUPREVIÈ & ULJANIŠÈEV 1975; BÀNHEGYI *et al.* 1985). Reviews of species of the genus *Gymnosporangium* have been prepared by PARMELEE (1965) and KERN (1973).

MATERIAL AND METHODS

Up to the present we evaluated the occurrence and distribution of the fungus *Gymnosporangium sabinae* at 136 locations in Slovakia such as botanical gardens, arboreta and towns greenery (BENÈA 1982). Various taxa of the genus *Juniperus* were represented, with most of them in the Arboretum Mlydany. TÁBOR and TOMAŠKO (1992) mentioned 42 taxa of *Juniperus* genus grown there in the collection of exotic woody plants. We paid special attention to the group of junipers, in which occurred *J. sabina*, *J. chinensis* Pfitzeriana Mast. and *J. communis*, on which we presupposed the occurrence of fungi of the genus *Gymnosporangium*.

We determined the developmental stages of this fungus at the Arboretum Mlyčany and Nitra. Samples were taken from branches of *J. chinensis* Pfitzeriana at intervals of 7 d (April to October) and 14 d (November to March) during the years 1994, 1995 and 2000. The presence of vegetative and reproductive organs of *G. sabinae* was evaluated visually and microscopically.

The presence of the fungus on leaves of pear, *Pyrus communis*, was determined during the phenological phases from budding to complete fall of leaves.

We evaluated the degree of damage on leaves of *P. communis* during the months July, August and September. Samples were taken at the Arboretum Mlyčany, Nitra and Modra Harmónia. The degree of damage on pear leaves was calculated by the formula by TOWNSEND and HEUBERGER (1948):

$$P = \frac{S(n \times v) \times 100}{5N}$$

where: P = degree of damage
n = number of leaves in each category (5)
v = numerical values of category
N = total number of evaluated leaves
S = sum

We evaluated 100 leaves from each locality. The affected leaves were evaluated according to the number of created aecial clusters and rated on a scale of 1 to 5.

1st degree from 1 to 5 aecial clusters
2nd degree from 6 to 10 aecial clusters
3rd degree from 11 to 15 aecial clusters
4th degree from 16 to 20 aecial clusters
5th degree from 21 to 25 and more



Fig. 1. *Gymnosporangium sabinae* on the branches of *Juniperus chinensis* Pfitzeriana. Black, horn-shaped formation of india-rubber hard consistence and 3–5 × 6–8 mm in size formed in winter. They were covered by a gelatinous substance of tongue-shaped form in spring, during optimal temperature and relative humidity (photographed at the Arboretum Mlyčany on 10th May, 1994)

We determined the fungi *G. sabinae* and *G. tremelloides* as mentioned by KUPREVIÈ and ULJANIŠÈEV (1975), BRANDENBURGER (1985) and BÁNHEGYI *et al.* (1985).

RESULTS AND DISCUSSION

We noticed *Gymnosporangium sabinae* at the Arboretum Mlyčany already for the first time in 1965. We evaluated specimens of 42 taxa of the species of the genus *Juniperus* at the Arboretum Mlyčany and a number of various taxa from 136 locations in Slovakia (botanic gardens, arboreta and town greenery). We found *G. sabinae* at 57 locations and only on branches of *J. chinensis* Pfitzeriana. It was not found on *J. sabina* which grew close to infected *J. chinensis* Pfitzeriana and *Pyrus communis*.

Likewise, we found *G. sabinae* neither on *J. sabina* nor in plantings where different species of the genera *Juniperus* and *Pyrus* were growing together and which we examined in Greece, France, Hungary, Poland, the Ukraine, Austria, Germany and North Korea during the years 1965–2001.

The symptoms of infection on *J. chinensis* Pfitzeriana match those on *J. sabina* described by a number of authors in our country and abroad (UBRIZSYI 1952; PEACE 1962; KUPREVIÈ & ULJANIŠÈEV 1975; PINTÉR 1997). The first symptoms of the disease occur on junipers at the end of the second year after the penetration of the parasite into the tissues of the host plant. The needles turn yellow, then brown and fall from the damaged branches, thinner branches die off. The infected branch swells in a spindle-like manner. On the swollen tumors lilac-red telial horns of 3–5 × 6–8 mm in size are formed.



Fig. 2. The size of individual tongue-shaped telia is 5–10 × 12–15 μm (photographed at the Arboretum Mlyčany on 10th May, 1994)



Fig. 3. Telia of the fungus *Gymnosporangium tremelloides* on branches of *Juniperus communis* at the location Prša – Modrý Kameň. Gelatinous swellings are more narrow, 2–3 × 4–7 mm in size, than those of the previous fungus (photographed on 4th May, 2000)

The spindle-like swollen tumor grows during the following years. The size of these swellings range from a few millimetres up to 70–80 cm. In the spring of the third year after infection, depending on optimum temperature and humidity conditions, the black horn-like formations are covered with a gelatinous substance in form of tongues. The size of individual columns of teliospores are 5–10 × 12–15 cm (Figs. 1 and 2). We found that teliospores formed in huge numbers at the end of April to the beginning of May. The gelatinous swollen protuberances were found most often from 5th to 15th May. The teliospores are thin at both ends, their size being 39–49 × 22–28 μm. They may have a thick or thin wall; the walls of thick-walled spores are dark brown, those of thin-walled ones are colourless (syn. *G. fuscum* de Candolle, *Tremella sabiniae* Dickson, *Aecidium cancellatum* Persoon).



Fig. 5. Small tumors are covered with protuberances in the shape of small thick bristles; under our conditions from 20th to 25th August to 10th–15th September. There is rosetelia formation typical for the genus *Gymnosporangium*



Fig. 4. Smooth, yellow, later on crimson red spots with marked orange red margin, concentrically arranged pycnidia, are formed on the upper surface of leaves

The spindle-shaped swellings and bare branches decrease the esthetical, horticultural as well as market value of *J. chinensis* Pfitzeriana.

Sporulation of *Gymnosporangium sabiniae* was noticed only on *Juniperus chinensis* Pfitzeriana at the Arboretum Mlydany since 1965. We did not find the fungus on other species of the genus *Juniperus*, not even at one of the locations in Slovakia. The similar results from abroad are mentioned by PEACE (1962), PARMELEE (1965), PADY *et al.* (1968), KUPREVIÈ and ULJANIŠÈEV (1975), BRANDENBURGER (1985) and others.

We also found teliospores of *G. tremelloides* on *J. communis*. This fungus creates 1–4 mm long, black horn-shaped formations on spindle-like swollen branches. The gelatinous swellings are narrower than with *G. sabiniae*, they reach the size 2–3 × 4–7 mm (Fig. 3).

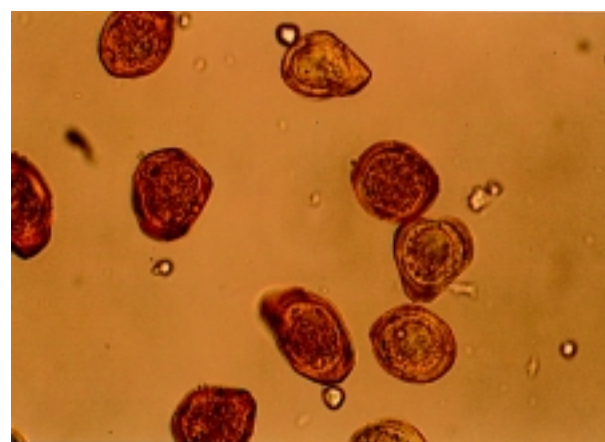


Fig. 6. Aeciospores of *Gymnosporangium sabiniae*

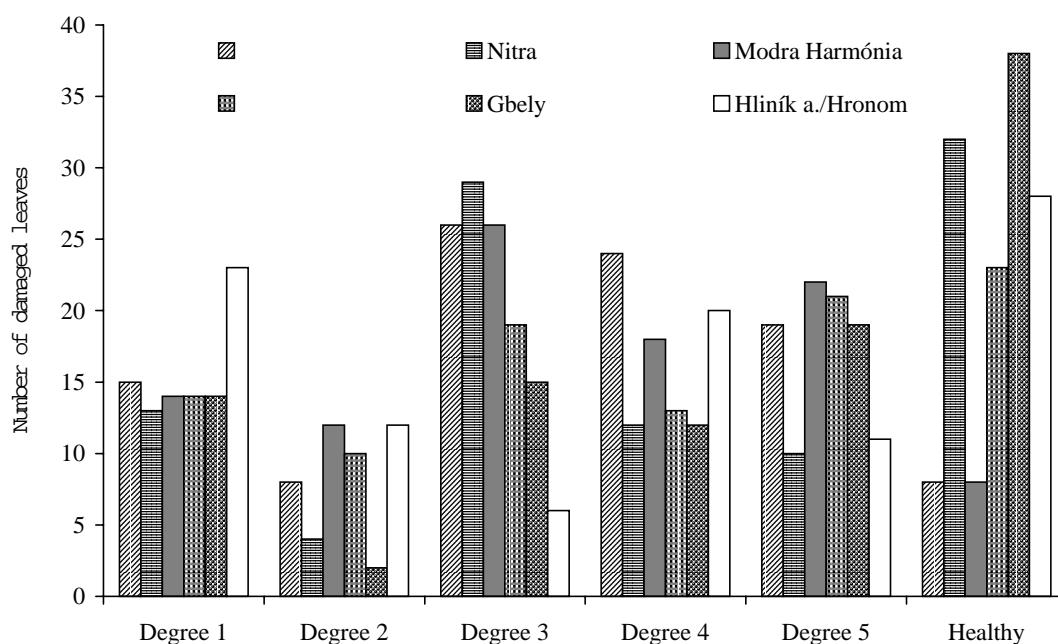


Fig. 7. Number of leaves of *Pyrus communis* damaged by *Gymnosporangium sabiniae* in degrees 1–6 at selected locations in Slovakia

On pear leaves, smooth and yellow, later up to crimson spots with marked orange-red margins began to appear in early June (Fig. 4). There are from 1 to 35 spots on one leaf. They are small at the beginning, later they grow and reach a size of 0.5–1 cm. The spots often fuse and then cover almost the whole leaf area. Tiny orange-red swellings – pycnid formations – form on the surface of the spots on the upper side of the leaves in 5–7 d. These swellings are arranged concentrically, being more sparse on the edge of the spots but denser towards the centre (Fig. 4).

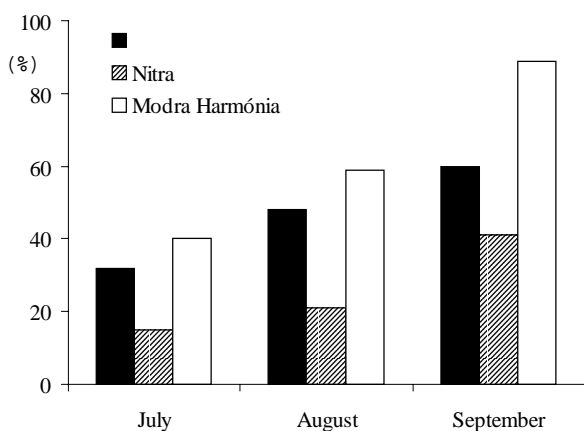


Fig 8. Degree of damage (in %) on *Pyrus communis* caused by *Gymnosporangium sabiniae* at selected locations in Slovakia

The spermogonium is hemisphere-shaped and 160–180 × 145–175 µm in size. The pycnidia become dark, almost black, 2–3 d after sporulation. The spots are light yellow on the lower side of the leaves. Around the end of July to beginning of August the fungus causes local growth of a spongy parenchyma, palisade parenchyma and of the epidermis. The surface of these small tumors is first smooth, then it cracks and becomes rough. The tumors are divided into several parts, with an aecium in each of them, just the peridium protruding out of the swelling (Fig. 5). The aeciospores are released after the peridium bursts; they are spherical or slightly angular and 27–31 × 19–27 µm in size (Fig. 6). The peridium of species of the genus *Gymnosporangium* is characterized by its form like a beaker or bell. The small tumors get covered by protuberances in the shape of small thick bristles, under our conditions from 20th–25th August to 10th–15th September. It is a roestelium formation (Fig. 5), typical for the genus *Gymnosporangium*.

The roestelia appear sporadically also on branches, then in the shape of 1–3 cm swellings, and on pear fruits. The leaves of the whole crown of a pear tree are affected. We did not notice premature fall of leaves, even on trees damaged to a high degree at the locations we evaluated. The level of damage to leaves at the locations where *G. sabiniae* occurs, varies from 10 to 98%; the most intensive damage was found at Modra and the Arboretum Mlyčáry (Figs. 7 and 8).

As part of this work we wanted to investigate the occurrence of urediospores in the developmental cycle of

G. sabiniae. After many years of observation we can confirm the findings of a number of authors that this fungus does not form urediospores in its developmental cycle.

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Received for publication May 22, 2002

Accepted after corrections September 12, 2002

Súhrn

JUHÁSOVÁ G., PRASLIĚKA J. (2002): Výskyt a škodlivosť huby *Gymnosporangium sabiniae* (Dicks.) Wirtz na Slovensku. *Plant Protect. Sci.*, 38: 89–93.

V rokoch 1965 a 1990 sme na Slovensku zaznamenali hubu *Gymnosporangium sabiniae* (Dicks.) Wirtz len na 3 lokalitách – Arboretum Mlyčany, Topoľčianky a Golej (JUHÁSOVÁ 1973, 1975, 1998). V posledných rokoch sme zistili zvýšený výskyt tejto huby. V príspevku uvádzame vývojové štádiá huby, okruh hostiteľských drevín a stupeň poškodenia listov hrušiek z vybraných lokalít Slovenska. Doteraz sme túto hubu zaznamenali na 57 lokalitách, vždy len na *Juniperus chinensis* Pfitzeriana. Vo vývojovom cykle tejto huby sme ani my nenašli urediospóry.

Kľúčové slová: *Gymnosporangium*; *Pyrus*; *Juniperus*; hostiteľské dreviny

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