Species of Taphrina on Alnus in Slovakia

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New data are presented on the occurrence of Taphrina Fr. [T. alni (Berk. et Br.) Gjaerum, Tepiphylla (Sadeb.) Sacc., T. tosquinetii (Westend.) Magn. and T. sadebeckii Johans.] on Alnus Mill. (A. incana (L.) Moench, A. glutinosa (L.) Gaertn.), till now unknown in Slovakia. Brief characteristics as to biology, ecology and distribution of the mentioned fungi as well as their host plants are given together with the ecological characteristics of the new localities.

Key words: Taphrina Fr., Alnus Mill., Slovakia, biology, ecology, distribution

Phytopathogenic micromycetes of the genus Taphrina Fr. are biotrophic pathogens of trees predominantly and shrubs. They cause characteristic changes on infected host plants. Mycofloristic research during the period 1987-1992 showed that Alnus species are frequently infected by fungi causing “leaf curl”, “witches’ broomes”, tongue-like outgrowths from female catkins or moderate-size yellow spots on leaves. From this point of view they have an unfavourable influence on the production of host biomass or on their aesthetic appeal. It is thought that they play an important role as indicators of environmental pollution. On the other hand, the results contribute to the knowledge of the mycoflora of Slovakia.

MATERIAL AND METHODS

Material of Taphrina species on Alnus was obtained from mycofloristic research in Slovakia and from existing herbarium items at the following institutes: Mycological Herbarium of the Slovak National Museum, Bratislava – BRA; Tatry National Park, Tatranská Lomnica – TNP; Moravian Museum, Brno – BRNM; Mycological
For identification of the genus *Taphrina* both visual symptoms of infected trees and anatomical-morphological characteristics of fungi were used. They were observed by taking thin cross and longitudinal sections from naturally infected *Alnus* leaves or twigs and applying a method used earlier (Bacigálová 1992). An evaluation was made by means of an Zeiss “Amplival” microscope with microphotographic equipment.

The species of the genus *Taphrina* were identified according to Mix (1949), Gjaerum (1964) and Salata (1974), and host plants according to Dostál et Červenka (1991). The localities of the fungi and their host plants are arranged in maps. A list of localities grouped according to their phytogeographical classification (Futák 1966) was compiled.

All collected specimens of *Taphrina* are deposited in the Herbarium of the Institute of Botany, Slovak Academy of Sciences – SAV.

Notes: R.– river, B.– brook, surr.– surroundings, Str.– street, M.– mountain

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**Symptoms.** The fungus causes rather large tongue-like outgrowths from the female catkins of *Alnus incana* (L.) Moench. Infected scales of catkins (Fig. 1) are enlarged, thickened, with 1.5 cm large tongue-like or 5–6 cm large tube-like outgrowths, empty inside, red or pale green and have a water-soaked tissues, and a swollen surface covered by asci as a white cover. The infected plant tissues turn brown, dry and remain on the catkins during winter.
Anatomical and morphological characteristics. Cells of the parasitic mycelium are thin, long and divided by layered septa. The mycelium follows vessels and branches in the spaces between cells of host parenchyma. In the region between epidermal cells and cuticle the mycelial cells become strongly thickened and desintegrated to shapeless cells, and thick-walled ascogenous cells are formed. During their further development the cuticle ruptures, the fungal cells increase in length and form asci (Fig. 2).

The asci are one-celled, at the top rounded, at the base broadened, attached to the host cells by a sheath (the rest of the outer layer of ascogenous cells) (Fig. 2). Asci 32–63 x 9–20 μm, most frequently 40–48 x 13–16 μm. According to Mix (1949) 26–53 x 10–23 μm, according to Gjaerum (1964) 34–81 x 9–18 μm, and most frequently 30–40 x 10–15 μm according to Salata (1974). The asci have 8 ascospores. These are oval or round, 5 x 4–6 μm, and are budding inside the ascus into blastospores of ovoid size 2–4 x 3–3.5 μm.

Localities of the fungus and their ecological characteristics. T. alni was collected on A. incana for the first in Slovakia by V. Greschik in 1892 in Vysoké Tatry Mts. (BRA) (Bacigálová 1988). New localities have been discovered on A. incana in lower submontane to montane belts up to elevations of 1000–1300 m in the Central Carpathians (Západné Tatry Mts., Vysoké Tatry Mts.). We could not find localities of T. alni on A. incana on sites as were found by Kmeť, Hruby, Picbauer and Cejp (Jeschková 1957). T. alni has not been recorded on A. glutinosa as is known from Norway (Gjaerum 1964, 1966) and Poland (Salata 1974).


The fungus is at least in Northern Europe montane-maritime (Palm 1917). According to Neger (1906) the fungus is common near the Baltic and has been often seen in Alps. In Norway it has been collected at sites only up to 650 m a.s.l. (Gjaerum 1966), but in our ecological conditions T. alni occurs in localities up to 1000 m a.s.l. T. alni occurs on A. incana in Central and Northern Europe (Salata 1974). We can state that the fungus occurs also in Slovakia only in north regions. According to Gjaerum (1964, 1966) and Neger (1906) from Norway the
fungus requires humid conditions, and the low humidity and winter temperatures are limiting factors. The mentioned data correspond with our records.

**Fig. 4** *T. epiphylla* causes “witches brooms” on *A. incana*

**Fig. 5** A) Ascogenous cells of *T. epiphylla* in the subcuticular layer of the leaves of *A. incana* B) Mature asci with ascospores

*Taprina epiphylla* (Sadeb.) Sacc., Syll. Fung. 8: 816, 1889.

**Symptoms.** The fungus causes “witches’ brooms” in crowns of *A. incana* (L.) Moench. Infected twigs - witches’ brooms - are long, thickened at the base, grow straight up (negative geotropism) and remain on the trees during the next vegetation seasons (Fig. 4). Leaves of witches’ brooms are sometimes enlarged, swollen, have a pale green colour, their tissues are thin, water-soaked, and the surface is covered by asci as a white cover. The infected leaves turn brown, dry out and fall off.
Anatomical and morphological characteristics. The mycelium penetrates all parts of young twigs, buds and leaves of *A. incana*. The cells of the intercellular and subcuticular hyphae are elongated and are divided or partitioned by layered septa which appear to be composed of several bands of cell wall material. The size of the cells change dependent on intercellular spaces of host parenchyma. In the region between epidermal cells and leaf cuticle, the mycelial cells become thickened and round, and thick-walled ascogenous cells are formed (Fig. 5a). During their further development the cuticle is ruptured and ascogenous cells increase in size and form asci.

Ascii amphigenous, broadly cylindrical, at the top rounded or widened to a flat head (Fig. 5b). They are 25–44 x 13–20 μm, stalked cells 5–18 x 15–41 μm, most frequently 33–40 x 14–16 μm and stalked cells 8–10 x 25–33 μm. The stalked cells are wider than long, at the base rounded. According to Salata (1974) they are 35–45 x 12.5–17 μm, stalked cells 8–21 x 10–30 μm; according to Gjaerum (1964) 25–52 x 11–23 μm. Ascospores oval or round, 4–5 x 4–7 μm, budding into blastospores inside the ascus.

Localities of the fungus and their ecological characteristics. *T. epiphylla* was collected for the first time in Slovakia by A. Kmeť in 1889, from the region of Sitno (Štiavnické Mts.) (BRA) and by V. Greschik in 1891, from Vysoké Tatry Mts. (Levoča) (BRA) on *A. incana*. The new localities are situated in communities of submontane and montane alder woods on steep alluvial slopes of valleys along the middle and upper regions of rivers. They were found in Central and Northern Slovakia at elevation of 500 to 1300 m, as well as in Čergovské Mts., Vihorlat Mts. and Nízké Beskydy Mts.

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*T. epiphylla* occurs on *A. incana* in colder valleys of higher mountains in the northern and eastern regions of Slovakia, as well as in Poland, in central and northern European countries and in the Caucasus (Salata, 1974). It is not known from America (Mix 1949). According to Gjaerum (1964), *T. epiphylla* is common on *A. glutinosa* only at a few sites in Norway. It was not found on that host in Slovakia up to now.

**Taphrina tosquinetii** (Westend.) Magn., Hedwigia, 29: 25, 1890.

**Symptoms.** The fungus causes leaf deformations (“leaf-curl” of a part or the whole blade) of *A. glutinosa* (L.) Gaertn. (Fig. 6). The leaf tissues are thin, water-soaked, and pale green. The surface is covered by asci as a white cover. The infected tissues of leaves turn brown and dry. The infections are systemic. The young shoots are most frequently infected, but true “witches’ brooms” are never formed.

**Anatomical and morphological characteristics.** The mycelium of *T. tosquinetii* penetrates buds of *A. glutinosa* in an early stage of their development and grows as an intercellular biotrophic pathogen. The mycelium follows the vessels of host leaf tissues and forms elongated, cylindrical cells divided by layered septa. Its size depends on intercellular spaces of host parenchyma. Between the epidermal cells and the leaf cuticle on the upper or lower leaf surface, the mycelial cells become strongly thickened, packed together, and thick-walled ascogenous cells are formed. During their further development the cuticle ruptures and asci are formed (Fig. 7).

Asci amphigenous, cylindrical, apically rounded, 23–37 x 8–15 µm, most frequently 25–33 x 10–11 µm. Stalked cells inserted between epidermal cells are 5–20 x 6–20 µm, but most frequently 8–10 x 10–16 µm. According to Mix (1949) they
are 17–40 x 7–13 μm, stalked cells 7–17 x 8–17 μm, and according to Salata (1974) most frequently 27–35 x 8–10.5 μm with stalked cells of 8–19 x 6–18 μm. The asci have 8 ascospores. They are globose, 3–5 x 3–5 μm; their budding into blastospores inside the ascus is not typical.

Localities of the fungus and their ecological characteristics. T. tosquinetii was collected in Slovakia for the first time by A. Kmeť in 1886, in Štiavnické Mts. on A. glutinosa (PRC) (Bacigálová, 1988). T. tosquinetii, being a cosmopolite is the most frequent species of the genus Taphrina in Slovakia. The localities are situated in floodplain woods in lowlands, submontane and montane vegetation regions.


*T. tosquinetii* is wide-spread on *A. glutinosa* in Poland (Salata 1974), Central and Northern Europe (Mix 1949, Gjaerum 1964), as well as in Bulgaria (Najdenov 1986) and in Georgia.


**Symptoms.** *T. sadebeckii* causes moderate-sized (up to 10 mm in diameter), yellow spots on the leaves of *A. glutinosa* and *A. incana*. Circular spots yellow or white-grey on the abaxial side of the leaf, pale green and a little convex on the adaxial side of the leaf. The spots are never joined together to cause a “leaf-curl” as in the case of *T. tosquinetii*. In the course of ascus development the spots turn brown and remain on the living leaves (Fig. 9).

**Anatomical and morphological characteristics.** Elongated cells of the mycelium follow the vessels of leaf tissues and branch off in intercellular spaces. In the region between epidermal cells and leaf cuticle mycelial cells become strongly thickened,
are packed together and form thick-walled ascogenous cells. Asci emerge from ascogenous cells by rupture of their cell walls (Fig. 10).

Asci hypophyllous, sometimes also epiphyllous, cylindrical, at the top often truncate, with yellowish epiplasm. They are 33–66 x 11–19 μm, most frequently 41–53 x 15–16.5 μm. Stalked cells are broad, 4–24 x 11–50 μm, most frequently 8–16 x 16–33 μm. According to Mix (1949) they are 17–65 x 10–21 μm, stalked cells 7–23 x 13–30 μm, according to Salata (1974) most frequently 40–55 x 15–17 μm, stalked cells 6–25 x 12–30 μm.

**Fig. 9** *T. sadebeckii* causes moderate sized yellow or white spots on leaves of *A. glutinosa*

**Fig. 10** Mature asci of *T. sadebeckii* with ascospores and blastospores

**Localities of the fungus and their ecological characteristics.** *T. sadebeckii* was recorded for the first time in Slovakia by A. Kmeť in 1877, in the region of the Štiavnické Mts. (PRC), and by V. Greschik in 1886, in Kežmarok (Vysoké Tatry Mts.) (BRA) on *A. glutinosa*. *T. sadebeckii* was recorded by V. Greschik on *A. incana* in 1889 from Levoča (BRA). New localities of this so far very rare fungus in Slovakia, were found in floodplain woods of Central, Northern and Southern Slovakia in different vegetation belts. The fungus is considered as the second-most common species of *Taphrina* (the most frequent is *T. tosquinetii*).

Localities of *T. sadebeckii* on *A. incana* (Fig. 11). 23a. Západné Tatry Mts.: Žiar surr. Smrečianka B., 1988; Zuberec surr. Studený potok B., 1988 (Bacigálová, SAV). 29. Spišské vrchy Mts.: Levoča (Greschik, 1889, BRA). On both these sites (Zuberec and Žiar) the host plants – *Alnus incana* – were planted after adjustment of a brook.

*T. sadebeckii* is wide spread in Northern and Western Europe, Georgia and Japan (Salata 1974). According to Gjaerum (1964), *T. sadebeckii* occurs in Norway as a summer form of *T. epiphylla*. In our ecological conditions *T. sadebeckii* was concluded to be a species occurring both on *A. glutinosa* and *A. incana*. We suppose that the fungus may also be distributed not only at two mentioned localities but also in some other areas of Slovakia. It is remarkable that also in Poland *T. sadebeckii* was found on *Alnus x pubescens* Tausch, only at two localities (Salata 1975).

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Fig. 3. Distribution map of *T. alni* - ▲ and *T. epiphylla* - ● on *A. incana* in Slovakia
Fig. 8. Distribution map of *T. tosquinettii* on *A. glutinosa* in Slovakia
Fig. 11. Distribution map of *T. sadebeckii* on *A. glutinosa* – ○ and *A. incana* – ▲ in Slovakia.