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ONNIA TRIQUETRA (PERS.) IMAZEKI, A PINE ASSOCIATED POLYPORE SPECIES REPORTED FOR THE FIRST TIME FROM HUNGARY

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Abstract: *Onnia triquetra*, a *Pinus* specialist polypore species in Europe, is reported for the first time in Hungary. Historical and recent collections of almost 60 years were examined. The macro- and micromorphological characteristics are given, along with ecological inferences of the species and its hosts in Hungary.

Keywords: Hymenochaetaceae, Europe, native, new record

INTRODUCTION

Hungarian forests are composed mainly of deciduous tree species, covering 89.5% of the forest area. The most common species are oaks, poplars, beech and hornbeam, among aliens the black locust. Conifers represent only 10.5% of the forests, with a significant decline in their actual area in the last two decades (from 243 500 hectares in 2000 to 195 000 hectares in 2016). The most widespread conifer species are Scots pine (*Pinus sylvestris* L.) and Austrian pine (*Pinus nigra* J.F.Arnold), covering an area of 6.2% and 3.2% respectively (Komarek 2018). Scots pine (*Pinus sylvestris* L.) is considered to be native, while Austrian pine (*P. nigra* J.F.Arnold) was introduced to the Pannonian basin, with its first plantations established in the 19th century (Borhidi 2003; Tamás 2003; Bölöni *et al.* 2008).

The effects of such forest plantations on local biodiversity depend on the sensibility and ecological specificity of the site (e.g. the surrounding landscape), in which they are found. Thus, planted

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forests – both native and exotic – may have positive, as well as negative effects on biodiversity at the population, stand or landscape level (Humphrey *et al.* 2000; Mack *et al.* 2000; Carnus *et al.* 2006; Cseresnyés and Tamás 2014). Due to the wide ecological tolerance of Scots pine, it is hard to describe the effects of its semi-natural stands on local biodiversity. In this regard, indicator species for these semi-natural stands should be recognized on the local level (Kelly and Conolly 2000). In case of Austrian pine, it is widely accepted that its plantations had detrimental effects on the Hungarian sites where they were planted in the past. Many local species disappeared from the native flora and fauna of such plantations (Török and Tóth 1996; Bartha *et al.* 2004; Cseresnyés and Tamás 2014).

On the other hand, vast diversity of fungi can be seen in plantations of exotic conifers (Newton and Haigh 1998; Humphrey *et al.* 2000). These planted stands could serve as potential substrata for native lignicolous fungal assemblages, which could include rare and threatened species (Humphrey *et al.* 2000; Ryvarden and Melo 2014).

The *Onnia* P. Karst. genus (Hymenochetaceae) contains nine white rot polypore species, from which seven are growing on gymnosperms. *Onnia tomentosa* (Fr.) P. Karst. and *O. leporina* (Fr.) H. Jahn grow mainly on *Picea*, but also can be found on *Pinus*, *Abies* and *Larix*, while *O. triquetra* (Pers.) Imazeki, *O. subtriquetra* Vlasák & Y.C. Dai, *O. microspora* Y.C. Dai & L.W. Zhou, *O. kesiya* Zhou & F.Wu and *O. tibetica* Y.C. Dai & S.H. He occurs mainly on *Pinus* (Dai 2010, 2012; Ryvarden and Melo 2014; Ji *et al.* 2017). These fungi are characterized by annual, sessile or stipitate basidiocarps; pileal surface from yellowish brown to dark brown and velutinate to rough; pore surface from yellowish brown to dark brown; duplex context. Main microscopic characteristics are: monomitic hyphal system with generative hypha bearing simple septa; presence of mostly hooked hymenial setae; and hyaline, thin-walled, smooth, nonamyloid, nondextrinoid, and acyanophilous basidiospores (Dai 2010; Ji *et al.* 2017). The genus is widespread; its distribution extends from boreal to subtropical climates, being present throughout the Northern Hemisphere (Dai 2012; Ryvarden and Melo 2014; Lockman and Kearns 2016; Ji *et al.* 2017).

In Europe, *Onnia tomentosa*, *O. leporina* and *O. triquetra* are considered to be native. In contrast to the first two circumboreal species, *O. triquetra* is geographically restricted to Europe, growing mainly on *Pinus* (Ryvarden and Gilbertson 1993; Dai 2012; Ji *et al.* 2017). The possible occurrence of *O. triquetra* in Hungary was implied first by Zoltán Igmándy in the 1980's (Igmándy 1989), but since then it was never found.

In Igmándy's own collection, among deposited unidentified specimens, we have found a sample collected from a *P. sylvestris* trunk near Szilvágy (Zala County, Western Hungary) from 1959, which we identified as *O. triquetra*. Almost 60 years later, a recently collected specimen from *P. nigra* in the Búbánat-völgy (Komárom-Esztergom County, North Hungary) was identified to be the same species.

MATERIALS AND METHODS

The historical specimen (Z. Igmándy 1131) collected by L. Haracsi is available at the Institute of Silviculture and Forest Protection, University of Sopron (Sopron, Hungary); the new specimen (Borsicki 100916) is deposited at the personal fungarium of the last author (PV). Macromorphological descriptions are based on field notes. The micromorphological data were obtained using a light microscope following the methods by Papp and Dima (2018). Microscopic characters, measurements and drawings were made from slide preparations stained with Melzer's reagent. The sections were studied at 1000× magnification using a Zeiss Axio Imager A2 light microscope (Zeiss, Göttingen, Germany) attached with an AxioCam HRc camera (Zeiss, Göttingen, Gemany). Drawings of the micromorphological characteristics of the basidiocarps were made using a drawing tube. Spores were measured from sections cut from the tubes. For the measurements, we used the Axio Vison Release 4.8. software. The following abbreviations were used in the description of the basidiospores: IKI = Melzer's reagent, IKI– = both inamyloid and indextrinoid, L = mean spore length, W = mean spore width, Q = variation in the L/W ratios, n = number of spores measured.

TAXONOMY

Onnia triquetra (Pers.) Imazeki [as 'triqueter'], Mycol. Fl. Japan, Basidiomycetes 2(4): 386 (1955) – (*Figure 1* and *2*)
Basionym: *Boletus triqueter* Pers., Observ. mycol. (Lipsiae) 1: 86 (1796)
Synonyms: *Polyporus triqueter* (Pers.) Pers., Mycol. eur. (Erlanga) 2: 57 (1825); *Inoderma triquetrum* (Pers.) P. Karst. [as 'triqvetrum'], Meddn Soc. Fauna Flora fenn. 5: 39 (1879); *Ochroporus triqueter* (Pers.) J. Schröt., in Cohn, Krypt.-Fl. Schlesien (Breslau) 3.1(25–32): 485 (1888) [1889]; *Mucronoporus tomentosus* var. *triqueter* (Pers.) Domański, Orloś & Skirg., Flora Polska. Grzyby, II: 321 (1967); *Mucronoporus circinatus* var. *triqueter* (Pers.) Domański, Orloś & Skirg., Fungi, Polyporaceae 2, Mucronoporaceae 2, Revised transl. Ed. (Warsaw): 289 (1973)

Specimens examined: Hungary, Zala County, Szilvágy, on *Pinus sylvestris* trunk, 22 Jan 1959, leg. L. Haracsi, herb. Z. Igmándy 1131. Komárom-Esztergom County, Esztergom, Búbánat-völgy, on *Pinus nigra* trunk, 10 Sept 2016, leg. I. Borsicki, herb. Borsicki 100916.

Basidiocarps annual, sessile or laterally stipitate/substipitate, soft corky or corky. Pileus dimidiate, with 3–4 cm diameter and 2–3 cm thickness at centre. Pileal surface golden brown to rust-brown, tomentose to velutinate, concentric zones indistinct; margin sharp to blunt. Pore surface yellowish brown to rusty brown; sterile margin pale yellowish; pores angular, 3–4 per mm, later more angular to semi labyrinthine and up to 1–2 mm wide in places; dissepiments thin, slightly lacerate. Context duplex; upper layer rust-brown, spongy; lower layer umber-brown, corky, demarcation zone indistinct between the two layers; entire context up to 1 cm thick. Tubes pale umber-brown, slightly paler than context and pore surface, hard corky, up to 5 mm long. Stipe rust-brown, hirsute to velutinate; 1–2 cm long, 0.5–1 mm in diameter; pores decurrent on stipe.

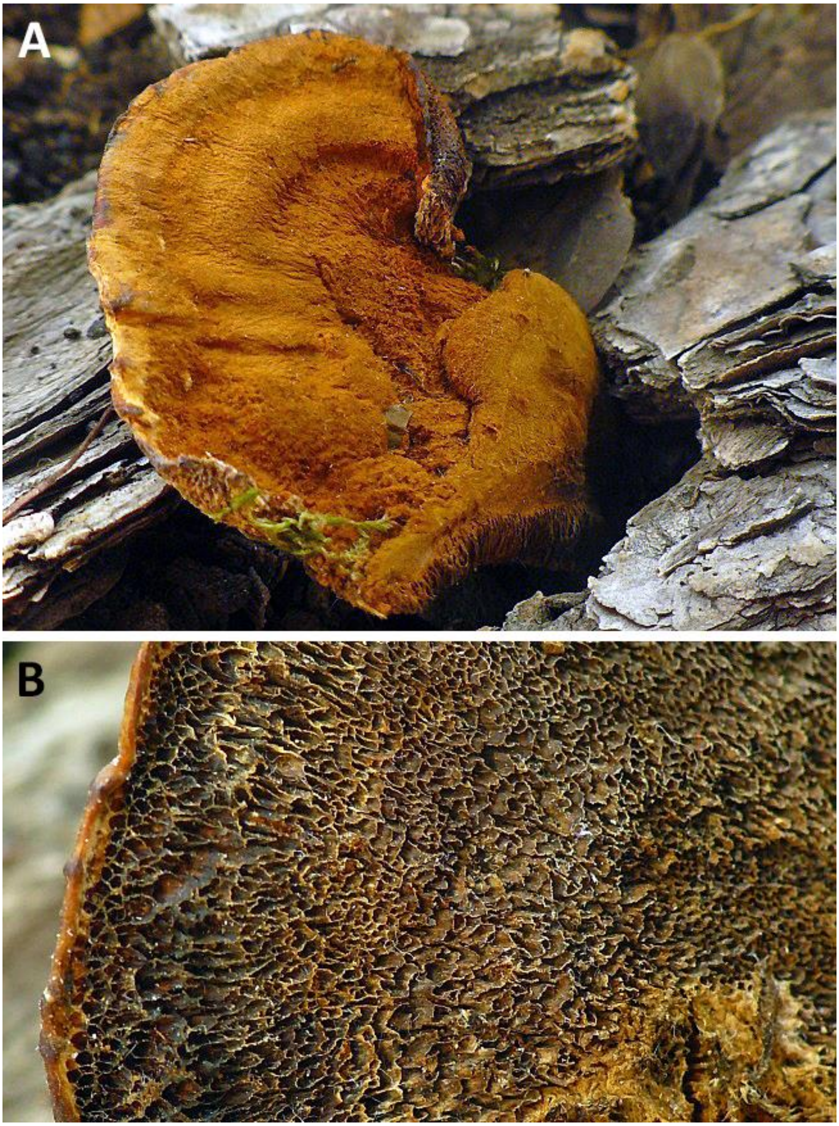

Figure 1. *Onnia triquetra* basidiocarp in the habitat (Búbánat-völgy, Komárom-Esztergom County, Hungary) **A.** pileal surface **B.** pore surface. Photographs by I. Borsicki.

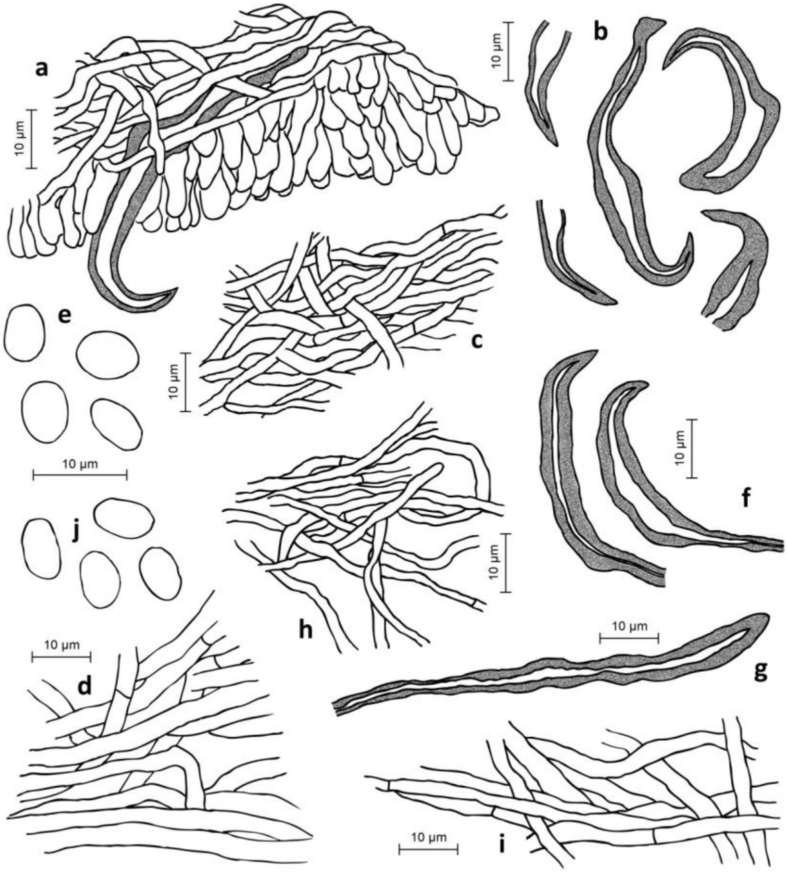

Figure 2. Micromorphological structures of *Onnia triquetra*, collected from *Pinus sylvestis* (a-e) and *Pinus nigra* (f-j) **a.** section of trama **b.** setae **c.** hyphae from trama **d.** hyphae from context **e.** basidiospore **f.** setae **g.** narrow setae **h.** hyphae from trama **i.** hyphae from context **j.** basidiospores.

Hyphal system monomitic; generative hyphae simple septate; tissue darkening but otherwise unchanged in KOH. Tramal hyphae hyaline to pale yellowish, thin- to slightly thick-walled, occasionally branched and septate, agglutinated, 2.5–6 µm in diam. Contextual hyphae yellowish to golden brown, thin- to slightly thick-walled, rarely branched, with frequent simple septa, regularly arranged, agglutinated, 5–8 µm in diameter. Contextual hyphae at upper spongy layer pale yellowish, thin-walled, unbranched or rarely branched, with frequent simple septa, interwoven, 3–6 μm in diam; hyphae of lower solid layer pale yellowish, septate, rarely branched, 3–5 μm in diameter. Hyphae from stipe similar to those in context. Setae abundant, mostly hooked, sometimes narrow, sharp-pointed, dark brown, thick-walled, deep-rooting, 28–68 × 8–13 μm. Basidia clavate, with four sterigmata, simple septate at the base, 9–17 × 4.8–6 μm. Basidiospores cylindric-ellipsoid, hyaline, thin-walled, smooth, mostly glued together in tetrads, IKI–, (5.84–)6.15–6.61(–7.03) × (4.12–)4.24–4.68(–5.02) μm, L=6.4 μm, W= 4.5 μm, Q=1.35–1.50, Q_{av}=1.43 (n=50).

DISCUSSION

The concept of whether a planted and/or non-native forest is beneficial or detrimental for local biodiversity has been much debated. It is often assumed, that tree plantations impoverish local flora and fauna; however, proper forest management can improve the balance between sustainable biodiversity and timber production (Hartley 2002). In case of non-indigenous gymnosperm plantations, both negative (Török and Tóth 1996; Mack *et al.* 2000; Magura *et al.* 2000; Brockerhoff *et al.* 2003; Cseresnyés and Tamás 2014) and positive (Fisher and Goldney 1998; Brockerhoff *et al.* 2003) impacts on natural biodiversity have been observed, related to different ecological and management qualities of the stands.

Plantations of native and non-native gymnosperms have considerable impact on fungal biodiversity. Exotic *Pinus radiata* plantations were found to be less rich in lignicolous saprotrophs and ectomycorrhizal fungi, compared to native oak forests in the Basque Country (Sarrionandia *et al.* 2015). Although the study recorded numerous host specific fungi within the *P. radiata* stands, the overall fungal community consisted mainly of generalist species (i.e. non habitat specialists), presumably because the stands did not reach maturity due to local forest management practices. The authors concluded that exotic plantations in their older, mature stages, with patches of native trees are more capable of contributing to a higher macrofungal diversity. Humphrey *et al.* (2000) came to a similar conclusion in terms of exotic *Picea sitchensis* and native *Pinus sylvestris* plantations in Great Britain. They have met unexpectedly high incidences of rare and threatened fungi species in stands near to the extant native pinewoods (acting as sources of inoculum). They also emphasized the importance of understory diversity and the volume of fallen deadwood, as well as maintaining the over-mature growth stage of the stands through some form of continuous cover management system. Dejene *et al.* (2017) also confirmed the role of older stands of alien gymnosperms in shaping fungal diversity in case of *Pinus patula* in Ethiopia. Johnston (2010) pointed out, that though introduced *Pinus* species in New Zealand could serve as hosts for indigenous non-lichenised fungi, exotic plants are usually associated with exotic fungi. A similar observation was made by Campi *et al.* (2015) in case of *P. taeda*. Functional composition of wood-decaying assemblages may also differ amongst native and non-native conifers: white rotting or brown rotting fungi could be more or less dominant on the non-indigenous substrata, depending on host species and geographical region (Edman and Fällström 2013).

In Europe, the main distribution area of Scots pine is Central and Northern Europe, while more to the south it is usually restricted to higher elevations (Boratyński 1991). Due to its wide tolerance to climatic and edaphic conditions, this species sustains on many different habitat types (Kelly and Conolly 2000; Köbölkuti *et al.* 2017). In Hungary, Scots pine occurs mainly in the westernmost part of the country (Vendvidék, Őrség, Kemeneshát) in acidophilus coniferous forests. Small stands are also present in the xerophilous forest communities in Central- and Western Transdanubia, on calcareous, sandy substrates, like the habitat in Fenyőfő (Kelly and Conolly 2000; Borhidi 2003; Bölöni *et al.* 2008; Köbölkuti 2018). It has been stated that original Scots pine stands in Hungary are of small size, they do not cover large territories, some being considered relict stands. However, Scots pine forests are preserved by land use that has a crucial role in their survival. Populations in the present are mostly considered to be of planted origin (Völgyi 1955; Mason and Alía 2000; Bölöni *et al.* 2008).

Another important species in Hungary from the *Pinus* genera is Austrian pine. Being an Alpine-Mediterranean tree, Austrian pine is alien to the Pannonian Basin. It was first introduced to Hungary in the 19th century for soil preservation and landscape protection purposes. Trees were planted on hillsides, dolomite slopes and on sandy substrates in the lowlands (Tamás 2003). Today, larger plantations are found mainly in the Great Hungarian Plain, but there are also plantations in the Transdanubian- and in the Northern Hungarian Mountains (Cseresnyés and Tamás 2014). The establishment of these plantations had a harmful effect on the native vegetation of dolomite slopes, warm tolerant oak forests and sandy grasslands. The above mentioned habitats contain numerous endemic species; the monodominant structure of the plantations resulted in closed canopies, impoverished understory and reduced diversity of the local plant and animal communities (Török and Tóth 1996; Bartha *et al.* 2004; Bíró 2008; Cseresnyés and Tamás 2014). Moreover, the accumulating litter under the canopy of Austrian pine plantations contributed to elevated fire risks. In this regard, both needles, cones and fallen branches could serve as focal points for forest fires due to the relatively slow decomposition rate (Cseresnyés *et al.* 2006).

Both Scots pine and Austrian pine are serving as substrata for numerous native polypore fungi in Europe. Many of these species are found in East- and Central Europe, including Hungary (Ryvarden and Gilbertson 1993, 1994). Conifer-dwelling macrofungi in Hungary were already being studied more than a half century ago. Throughout these decades, numerous poroid species were recorded on hosts from the *Pinus* genera (Igmándy 1954; Völgyi 1955; Pagony 1977). Amongst these, species inhabiting both gymnosperm and angiosperm trees are represented in the highest amount (e.g. *Bjerkandera adusta* (Willd.) P. Karst., *Fomitopsis pinicola* (Sw.) P. Karst., *Pappia fissilis* (Berk. & M.A. Curtis) Zmitr., etc.). The angiosperm hosts include species from natural forest communities, e.g. *Fagus, Quercus, Carpinus, Populus* (Szabó 2012; Siller *et al.* 2013). Thus, polypores inhabiting both native and non-native gymnosperms and angiosperms may be originally considered indigenous to Hungary, with a preference for a broad range of hosts.

A bit smaller amount of *Pinus*-inhabiting polypores in Hungary are restricted only to gymnosperms: e.g. *Neoantrodia serialis* (Fr.) Audet, *Climacocystis borealis* (Fr.) Kotl. & Pouzar, *Gloeophyllum sepiarium* (Wulfen) P. Karst., *Gloeoporus taxicola* (Pers.) Gilb. & Ryvarden, *Osmoporus odoratus* (Wulfen) Singer, *Skeletocutis amorpha* (Fr.) Kotl. & Pouzar. Some species are found on *Pinus* exclusively: e.g. *Antrodia ramentacea* (Berk. & Broome) Donk, *Dichomitus squalens* (P. Karst.) D.A. Reid, *Diplomitoporus flavescens*

(Bres.) Domański*, Porodaedalea pini* (Brot.) Murrill. According to Igmándy (1981), a small number of these species associated with Scots pine were also found on Austrian pine (e.g. *Climacocystis borealis*, *Postia fragilis* (Fr.) Jülich), while some other species were only present on the former host (e.g. *Dichomitus squalens, Fuscoporia viticola* (Schwein.) Murrill).

Taken these into consideration, it seems that naturalized and non-native *Pinus* plantations have an important role in conserving indigenous polypore diversity. Igmándy's collection of *Onnia triqetra* from 1959 shows, that even a wider spectrum of poroid species were most probably present since a long time ago in Hungarian semi-natural Scots pine forests. The ongoing shrinkage of these forests (KSH 2013; Komarek 2018) and the recent occurrence of *O. triquetra* on Austrian pine highlights the importance of planted, non-native stands of conifers in preserving fungal biodiversity. These stands could serve as possible surrogate habitats for indigenous fungi, as it was presented in many other cases (Humphrey *et al.* 2000; Johnston 2010; Edman and Fällström 2013; Sarrionandia *et al.* 2015; Dejene *et al.* 2017).

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