Botanica SERBICA 40 (2): (2016) 261-264

Note

First record of the rust fungus *Endophyllum sempervivi* (Alb. & Schwein.) de Bary (Pucciniomycetes) in Serbia

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ABSTRACT: *Endophyllum sempervivi*, known to cause rust on *Sempervivum* and *Jovibarba* species, is here documented for the first time in Serbia, on *Jovibarba heuffelii* growing at two localities (in the gorge of Studenica River and on Mt. Treska). Aside from Serbia, an additional report of infected *J. heuffelii* plants is made for Romania (on Mt. Domogled). The pathogen's distribution presumably is wider than initially believed and requires further surveys.

Keywords: houseleek, pathogen, rust basidiomycete, Serbia

Received: 23 May 2016 Revision accepted: 14 September 2016

UDC: 582.28(497.11)
DOI: 10.5281/zenodo.162227

During field study of the highly variable *Jovibarba heuffelii* group in the central Balkan Peninsula and southern Carpathians in Romania, three populations with many individuals infected with rust fungus were recorded. After detailed investigation of symptoms and spore-producing structures (spermogonia and aecidioid telia), the rust fungus was identified as *Endophyllum sempervivi* (Alb. & Schwein.) de Bary (class Pucciniomycetes), an autoecious rust basidiomycete that develops its mycelium within the foliar tissue of *Sempervivum* spp. and *Jovibarba* spp. (family Crassulaceae).

Chorological data:

Specimen examined and pathogen identified:

Romania: Mt. Domogled, 44°52'41.70" N, 22°25'54.11"E, 1300 m, limestone (*Lakušić, D.,*13.4.2011. – host plant deposited in BEOU as voucher no. 16510).

Serbia: gorge of Studenica River, 43°29'20.56" N, 20°32'7.74" E, 486 m, serpentinite (*Lakušić, D.,*12.8.2004. – host plant deposited in BEOU as voucher no. 16461).

Symptoms observed in the field:

Serbia: Mt. Treska, Trešnjica, Lukovo, 43°11'40.07" N; 20°58'44.14" E, 1389 m, limestone (*Zlatković, B.,*18.04.2016., field observation).

Infected *Sempervivum* and *Jovibarba* plants showed a variety of symptoms similar to those described by Gołębniak (2004), such as deformation or withering of the rosette, slightly protruding pustules (sori) covered with epidermal cells, and elongation of leaves (Fig. 1a, b). Pilet (1952) demonstrated that the enormous size of infected leaves is due to increased intracellular concentration of the auxin IAA in infected plant tissue, which progressively leads to multiplication and overgrowth of plant cells.

Species of the genus *Endophyllum* are microcyclic (lacking pycniospores and aeciospores) and with an O, I life cycle, and two types of fruiting structures (sori) can develop on mycelium: spermagonia bearing spermatia (O) and aecidioid telia with aeciditeliospores (I) (Horst 2013). According to Hiratsuka & Hiratsuka (1980), the spermogonia of *E. sempervivi* belong to group V/ type 4, characterised by the presence of strongly concave hymenia with well developed periphyses, as also seen in this study (Fig. 2a). The spermatia are formed in spermogonia, usually by a budding process (Ashworth 1935). Spermogonia are subepidermal, occur mostly below stomata of infected plants, and only protrude from leaf tissue as small brown cones during late winter and early spring (Ashworth 1935). Primordia of aecidioid telia are composed of tightly packed wefts of uninucleate mycelium and form small whitish flecks beneath the

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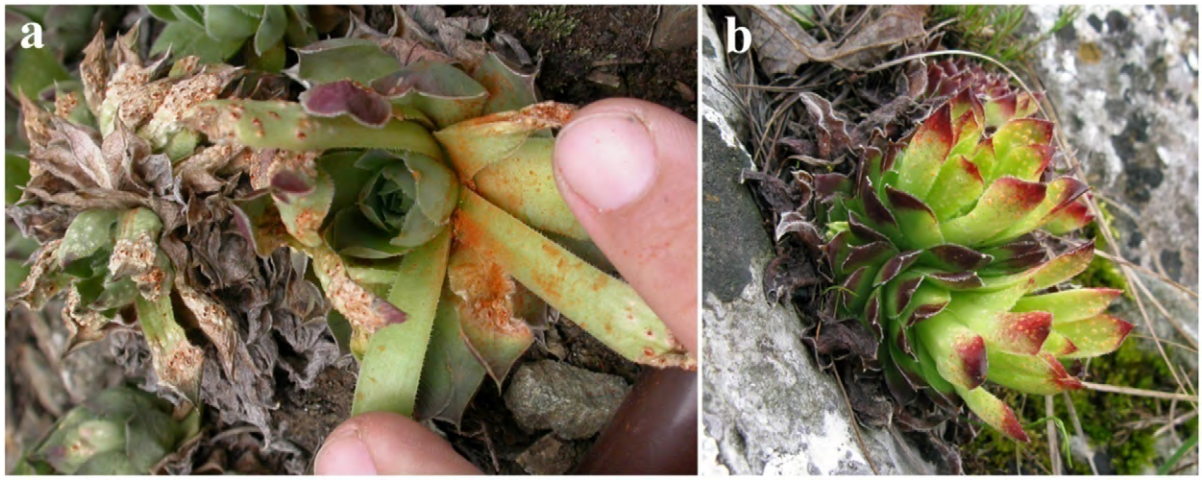

Figure 1. *Endophyllum sempervivi* rust symptoms on *Jovibarba heuffelii*: elongated leaves with slightly protruding pustules (orange sori) surrounding healthy rosette in central area. a) infected plant from Serbia, Studenica (photo: D. Lakušić, 7.5.2005); b) infected plant from Romania, Domogled (photo: D. Lakušić, 13.4.2011).

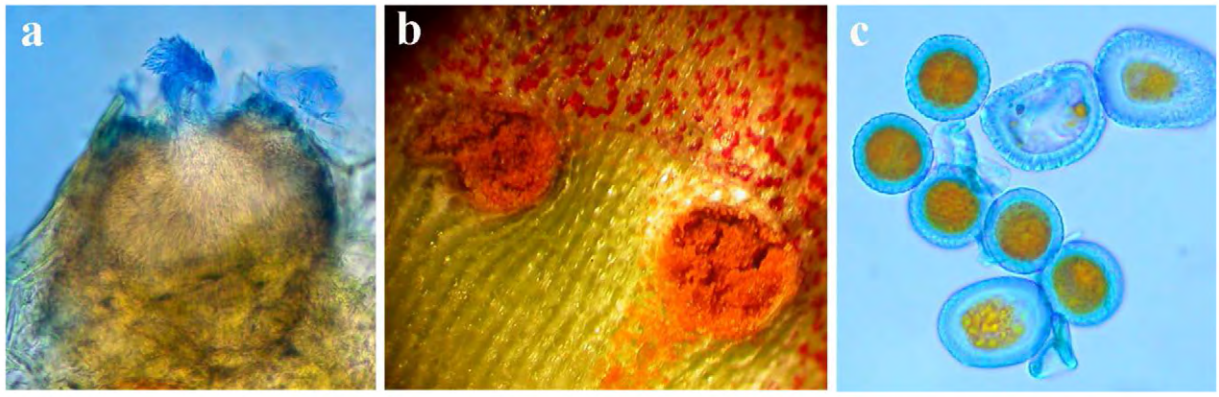

Figure 2. *Endophyllum sempervivi* on *Jovibarba heuffelii* from Serbia, Studenica: a) spermogonia in host tissue (magnification 630×); b) aecidioid telia on *Jovibarba heuffelii* phylloplane (magnification 51.2×); c) aeciditeliospores in mass (magnification 630×) (photo: M. Ljaljević Grbić, 24.4.2007).

host's epidermis. In early spring these primordia increase greatly in size and form cup shaped aecidioid telia (Fig. 2b). Aeciditeliospores (25 μm Ø), (Fig. 2c), although morphologically resembling aeciospores, behave like teleutospores, and upon germination form a metabasidium bearing basidiospores (Mendgen 1997), which is a unique feature of all members of the genus *Endophyllum*. Rarely, aeciditeliospores germinate into single long hyphae that are sometimes branched (Gołebniak 2004).

The host plant belongs to the endemic European genus *Jovibarba* Opiz (Crassulaceae), which is distributed in the Alps, the Carpathians and the Balkans (Jalas *et al.* 1999). This genus includes only two species: *J. globifera* (L.) J. Parnell and *J. heuffelii* (Schott) A. & D. Löve. Originally, both species were described as taxa within the genus *Sempervivum*. The results of recent molecular (Mort *et al.* 2002; Mort *et al.* 2010; Šinko *et al.* 2013) and phytochemical (Stevens *et al.* 1996) research have shown that *Jovibarba* and *Sempervivum* s. str. are monophyletic and phytochemically well differentiated groups. The main morphological characteristic that separates representatives of the genus *Jovibarba* from those of the genus *Sempervivum* is the possession of flowers with six (sometimes seven) petals typical in *Jovibarba* as opposed to 8–16 petals in *Sempervivum*.

The species *Jovibarba heuffelii* is distributed in the central part of the Balkan Peninsula and central and southern parts of the Carpathians (Jalas *et al.* 1999). This species usually inhabits open alpine and subalpine high mountain pastures (*Festuco–Seslerietea* Barbero et Bonim 1971), alpine heaths (*Juncetea trifidi* Hadač 1944), hilly rocky grounds (*Festuco- Brometea* Br. Bl. Et R. Tx. 1943) and rocky crevices (*Asplenietea trichomanis* Br.-Bl. 1934. corr. Oberd. 1977), at elevations between 500 and 2500 m on limestone, silicate and serpentinite substrates (Nikolić *et al.* 2015).

According to the Fungal Database (Farr & Rossman 2016) *E. sempervivi* has been documented on 12 *Sempervivum* species: *S. alpinum* Griseb. & Schenk (Germany), *S. arachnoideum* L. (Germany, UK), *S. calcareum* Jord. (UK), *S. fimbriatum* Klotzsch in Klotzsch & Garke (Germany), *S. globiferum* L. (Turkey, UK), *S. marmoreum* Griseb.(Bulgaria), *S. montanum* L. (Germany, Poland, Spain, UK), *S. schottii* Baker (Germany), *S. soboliferum* Sims (Poland), *S. tectorum* L. (Canada, Germany, Poland, Romania, Spain, UK, USA), *S. webbii* Schenck (UK) and *S. wulfenii* Hoppe ex Mert. & W.D.J.Koch (Germany); and on both *Jovibarba* species: *J. heuffelii* (Bulgaria) and *J. sobolifera* (Poland). It follows that our data represent the first record of *E. sempervivi* in Serbia and the second record of this rust fungus on the same host plant on the Balkan Peninsula. The first occurrence of *E. sempervivi* on *J. heuffelii* in the Balkans was reported by Denchev (1995) for Bulgaria. At the same time, our data represent the first record of *E. sempervivi* on *J. heuffelii* in Romania.

Acknowledgement — The Ministry of Education and Science of the Republic of Serbia supported this research (Grants 173030 and 173032). The authors would like to thank Dr. Bojan Zlatković, who kindly gave us information about the appearance of *Endophyllum sempervivi* rust symptoms on *Jovibarba heuffelii* from Mt. Treska.

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Botanica SERBICA

REZIME

Prvi nalaz *Endophyllum sempervivi* (Alb. & Schwein.) de Bary (Pucciniomycetes) na teritoriji Srbije

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Endophyllum sempervivi, poznati izazivač rđe vrsta rodova *Sempervivum* i *Jovibarba*, po prvi put je zabeležen u Srbiji. *Endophyllum sempervivi* je registrovan na vrsti *Jovibarba heuffelii* u kanjonu Studenice. Takođe, na istom domaćinu su registrovani simptomi ove rđe i na planini Treska iznad Lukova. Osim u Srbiji, dodatni nalaz zaraženih biljaka je dokumentovan na lokalitetu Domogled u Rumuniji. Vrlo je verovatno da je rasprostranjenje patogena mnogo šire i zahteva dalja istraživanja.

Ključne reči: čuvarkuća, patogen, rđe, Srbija.