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Some taxonomic novelties for pyrenomycetous fungi from south-eastern Russia

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Abstract

One new species (*Nemania corylina*), one new genus (*Nummauxia*), and two new combinations (*Nummauxia succenturiata* and *Sarawakus bicolor*) are proposed in this paper. Being rather frequent in south-eastern Russia, two of these species display a biogeographic connection with Europe, and the third species is an example of the disjunction between north-eastern Asia and eastern North America.

Key words – Ascomycota – *Biscogniauxia* – *Nemania* – *Sarawakus* – taxonomy

Introduction

In recent series of papers (Vasilyeva & Stephenson 2010, 2011, 2014, Vasilyeva et al. 2012, 2013) we have emphasized the peculiar composition of the assemblages of species of pyrenomycetous fungi associated with different centers of fungal biodiversity. The most characteristic biogeographical features of this group of fungi in north-eastern Asia are (1) its connection with eastern North America and (2) the high level of endemism observed in species distributed around the Sea of Japan. However there are a number of pyrenomycetes described from Europe and also found in north-eastern Asia. Curiously, some of these species commonly occur in the latter area but are seemingly so rare in Europe that information about them is almost completely missing from European literature. Two examples of such species are considered in this paper.

Materials & methods

The specimens considered in this paper are deposited in the Herbarium of the Institute of Biology and Soil Science (VLA). Microscopic analyses were carried out using standard techniques. Photographs were taken using a Nikon D40x (with DG macro-objective SIGMA EX 105 mm F2.8) digital camera.

Taxonomy

Nemania corylina Lar.N. Vassiljeva & S.L. Stephenson, **sp. nov.**

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Etymology – Refers to the substrate associated with this fungus.

Fig. 1, 4A–B



Fig. 1 – Stromata of *Nemanja corylina*. Bar = 0,75 mm.

Stromata as small and thin crusts on the surface of the inner bark of twigs, 1.5–3 × 1–1.5 mm, often confluent and becoming slightly larger (up to 6 mm long), ellipsoid, rounded or irregular, black, studded with papillate ostioles, surrounded by a black line in the substrate. Perithecia subglobose, 200–250 µm diam. Asci cylindrical, 8-spored, paraphysate, short-stipitate, in the spore-bearing portion 90–115 × 10–12 µm, with an apical ring bluing in Melzer's reagent, ca. 4–4.5 × 4.5–5 µm. Ascospores uniseriate, one-celled, broadly-ellipsoid, brown, (13–)15–17.5 × (7–)8–10.5 µm.

Known distribution – Europe, north-eastern Asia.

Material examined – Russia, Amur region, Arkhara district, Kundur vicinity, on dead branches of *Corylus* sp., 23 Aug 1992, L. Vasilyeva, VLA P-2890 (holotype); Tarmanchukan vicinity, on dead branches of *Corylus* sp., 30 Aug 1992, L. Vasilyeva, VLA P-2892. Primorsky Territory, Sikhote-Alinsky Nature Reserve, on dead branches of *Corylus* sp., 19 Aug 1985, L. Vasilyeva, VLA P-2891.

Notes – This species should be widely distributed in north-eastern Asia but seemingly has been overlooked because it is so inconspicuous. The species is strongly associated with branches of *Corylus* spp. and develops in the inner portion of the bark, becoming visible only when the outer

layer of bark has been removed. There is some evidence that this species also occurs in Europe but has yet to be described there. On the web site <http://www.shroomery.org/forums/showflat.php/Number/16108293> (visited Oct 6, 2015) under the title “black fungus on *Corylus avellana*,” one can find a photograph (similar to those provided herein in Figure 1) and scanty information (such as “Slovenia, on very rotten wood, bark has long gone”) that appear likely to refer to the species described herein.

In Table 1, data relating to the variability of ascospore size in the genus *Nemania* are presented. The main body of evidence was taken from the monographs by Ju and Rogers (2002) and Granmo et al. (1999). The ranges of ascospore size provided by the different authors for a particular species are mostly similar, but there are several inconsistencies. For examples, *N. caries* (Schwein.) Y.M. Ju & J.D. Rogers and *N. serpens* (Pers.) Gray are considered by Ju and Rogers (2002) to have the same ranges in ascospore size (the second row in the Table 1), whereas Miller (1961) considers their width to be rather different (3-3.5 μm in *N. caries*, 5-7 μm in *N. serpens*). As such, they could be placed in different rows on the basis of ascospore width (in addition, Miller indicates a different ascospore length for the species in question: 9-12 μm in *N. caries*, 12-15 μm in *N. serpens*). Also, *N. effusa* (Nitschke) Pouzar as described by Ju and Rogers (2002) could be placed in the first row (ascospores 2.5–3.5 μm wide), but Miller (1961) described wider ascospores (3.5–5 μm) for this species (as a variety of *N. serpens* in his treatment). *Nemania gwyneddii* (Whalley et al.) Pouzar is listed as having ascospores 6–7.5 μm by Ju and Rogers’s (2002), but the species was described originally with ascospores 7–9.5 μm wide (Whalley et al. 1983) and even indicated as having 7–11 μm as the range of width (<http://pyrenomycetes.free.fr>, visited 6 Oct 2015). In other words, this species might be more appropriately placed in forth row of the Table 1).

As a general observation, the data presented in Table 1 shows a rather gradual increase in ascospore width in relation to length within the genus *Nemania*. In other words, the shape of ascospores is more or less the same for species in this genus. In this context, *N. corylina* is prominent for its widely ellipsoid ascospores.

Table 1 Arrangement of some *Nemania* species in accordance with average ascospore length (columns) and width (rows)

Width/length	6-10 μm	10-14 μm	15-19 μm	20-26 μm
3-4 μm	<i>N. albocincta</i> <i>N. beaumontii</i> <i>N. effusa</i>	<i>N. illita</i>		
4-6 μm	<i>N. chrysoconia</i> <i>N. macrocarpa</i>	<i>N. atropurpurea</i> <i>N. bipapillata</i> <i>N. carbonacea</i> <i>N. caries</i> <i>N. colliculosa</i> <i>N. diffusa</i> <i>N. immersidiscus</i> <i>N. maritima</i> <i>N. memorabilis</i> <i>N. minutula</i> <i>N. prava</i> <i>N. reticulosa</i> <i>N. serpens</i>		
6-7 μm		<i>N. ravenelii</i>	<i>N. aenea</i> <i>N. chestersii</i> <i>N. creoleuca</i> <i>N. latissima</i> <i>N. subaenea</i>	<i>N. gwyneddii</i> <i>N. maculosa</i>
8-12 μm		<i>N. corylina</i>	<i>N. confluens</i>	<i>N. angustata</i> <i>N. quadrata</i> <i>N. venezuelensis</i>

Nummauxia Lar.N. Vassiljeva & S.L. Stephenson, **gen. nov.**

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Etymology: the name is composed of the two names of genera (*Nummularia* and *Biscogniauxia*) where the type species was placed.

Stromata immersed-erumpent from the bark, diatrypelloid or lopadostomoid in appearance, wart-like, scattered, dark-brown or blackened. Perithecia elongated, arranged in a palisade layer in the upper portion of the stromata. Asci cylindrical, 8-spored, paraphysate, with an apical ring bluing in Melzer's reagent. Ascospores uniseriate, one-celled, ellipsoid, brown.

Type species: *Nummauxia succenturiata* (Tode) Lar.N. Vassilyeva & S.L. Stephenson.

This genus differs from *Biscogniauxia* in having wart-like–diatrypelloid or lopadostomoid–stromata.

Nummauxia succenturiata (Tode) Lar.N. Vassiljeva & S.L. Stephenson, **comb. nov.** Fig. 2, 4C

≡ *Sphaeria succenturiata* Tode, Fung. Mecklenb. 2: 37, 1791.

– *Hypoxylon succenturiatum* (Tode) Berk. & Broome, Ann. Mag. nat. Hist., Ser. 3(3): 363, 1859.

– *Nummularia succenturiata* (Tode) Nitschke, Pyrenomyc. Germ. 1: 58, 1867.

– *Biscogniauxia succenturiata* (Tode) Kuntze, Revis. gen. pl. 2: 398, 1891.

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Fig. 2 – Stromata of *Nummauxia succenturiata*. Bar = 1.4 mm

Stromata immersed-erumpent from the bark, diatrypelloid or lopadostomoid in appearance, wart-like, scattered, with coarsely papillate surface, dark-brown or blackened, 5–7(–10) × 2–4 mm. Perithecia elongated, arranged in a palisade layer in the upper portion of the stromata, with whitish tissues below, 700–900 × 400–500 µm. Asci cylindrical, 8-spored, paraphysate, short-stipitate, in the spore-bearing portion 65–75 × 4.5–5 µm, with an apical ring bluing in Melzer's reagent, ca. 3–3.5 × 2.5 µm. Ascospores uniseriate, one-celled, broadly-ellipsoid, brown, (9–)10–12.5 × (3.8–)4–4.5 µm.

Known distribution – Europe, north-eastern Asia.

Material examined – Russia, Primorsky Territory, Khasansky District, Ryazanovka vicinity, on dead branches of *Quercus mongolica* Fisch. ex Ledeb., 11 Aug 1991, L. Vasilyeva, VLA P-1124; Kedrovaya Pad Nature Reserve, on *Q. mongolica*, 17 Sep 1993, L. Vasilyeva, VLA P-1127; Troitsa Bay, on *Q. mongolica*, 1 Nov 1995, L. Vasilyeva, VLA P-1125; Vladivostok vicinity, on *Q. mongolica*, 10 Sep 1996, L. Vasilyeva, VLA-1122. – China, Heilongjiang Province, Xingkaihu Nature Reserve, on *Q. mongolica*, 1 Sep 2003, L. Vasilyeva, VLA P-1444.

Notes – The type specimen of *Biscogniauxia succenturiata* (“Germany: Sachsen, Leipzig, Kunze, G., corticated wood, as *Sphaeria succenturiata* [UPS 58312]”) is said to be *Lopadostoma gastrinum* (Fr. : Fr.) Traverso. “However, the descriptions given by Persoon (1801), Fries (1823), and Nitschke (1867) suggest a *Biscogniauxia* taxon” (Ju et al. 1998, p. 81). Indeed, the early stages of *B. succenturiata* remind one of the stromata of *L. gastrinum*, and they have similar ascospores. Only later in the life history the cross-sections of stromata of *B. succenturiata* show the typical layer of elongated perithecia in their upper portions (Fig. 2), a feature which is characteristic of *Biscogniauxia* and not *Lopadostoma*.

Nevertheless, despite the presence of the palisade layer of the perithecia, the stromata of *B. succenturiata* never show the widely discoid or effuse types characteristic of other species of *Biscogniauxia* [examples are *B. repanda* (Fr.) Kuntze and *B. nummularia* (Bull.) Kuntze] and remain irregularly wart-shaped. They are somewhat similar to the stromata of *Obolarina dryophila* (Tul. & C. Tul.) Pouzar, as this species is illustrated by Thomas Læssøe at www.mycoskey.com (visited 6 Oct, 2015). The latter species has also been placed in the genera *Nummularia* and *Biscogniauxia* (just as *B. succenturiata*) and even suggested to be properly treated as *Biscogniauxia dryophila* (Tul. & C. Tul.) Kuntze (Nordén 2014, p. 27) because it has affinities with *Biscogniauxia* as confirmed by molecular studies (Pažoutova et al. 2010).

The molecular studies brought together three genera in such a way that the conclusion was made that “With *Obolarina* and *Camillea* nested inside, the genus *Biscogniauxia* is paraphyletic” (Pažoutova et al. 2010, p. 506). However, with an inaccurate definition of the term “paraphyletic” (cf. Hörandl & Stuessy 2010, p. 1641), it is even more inaccurate to determine the taxonomic status of a group of species from molecular trees. They drew together the most similar forms considered for the analysis (which are often united on the similar parallel variation within closely related genera [cf. Vasilyeva & Stephenson 2010]), and it has been correctly noted that such molecular studies are based on numerical methods (Ebach et al. 2008) and not on phylogenetic ones. To construct a true hierarchical phylogeny of taxa, one should, first of all, estimate the differences that exist among the taxa created by the analysis (cf. Vasilyeva 1999).

The genus *Obolarina* could be taken into consideration as a possible genus for *Biscogniauxia succenturiata* on the basis of the stromatal similarity mentioned above, but other published illustrations (Nordén 2014, Fig. 4; Mirabolfathy et al. 2013, Fig. 2) show the typical, widely effused stromata of *Biscogniauxia* in *Obolarina dryophila* and *O. persica* Mirab. et al. Therefore, *B. succenturiata* stands apart in this respect.

The main differences that have been used for the segregation of *Obolarina* from *Biscogniauxia* were the presence of spiral germination slits on the rather large ascospores, shortly clavate (succuliform) asci with an irregularly two-seriate arrangement of ascospores, and the absence of an apical ring (Pouzar 1986). These features are well illustrated by Candoussau and Rogers (1990, Figs. 5–7) and Nordén and Sunhede (2001, Fig. 3). Moreover, the illustrations show

a stout fascicle of asci instead of the hymenial layer of asci typical for many members of the Xylariaceae. Neither of these distinguishing features of *Obolarina* are characteristic of *Biscogniauxia succenturiata*, so we segregate this species into its own genus.

Sarawakus bicolor (Ellis & Everh.) Lar.N. Vassiljeva & S.L. Stephenson, **comb. nov.** Fig. 3, 4D

≡ *Hypocrea bicolor* Ellis & Everh., J. Mycol. 4: 58, 1888.

– *Chromocreopsis bicolor* (Ellis & Everh.) Seaver, Mycologia 2: 64, 1910.

– *Thuemenella bicolor* (Ellis & Everh.) Boedijn, Persoonia, 3: 3, 1964.

– *Sarawakus frustulosa* sensu Lar.N. Vassiljeva, Nizshie Rasteniya, Griby i Mokhoobraznye Dalnego Vostoka Rossii, Griby. Tom 4. Pirenomitsety i Loculoaskomitsety: 157, 1998, pro parte.

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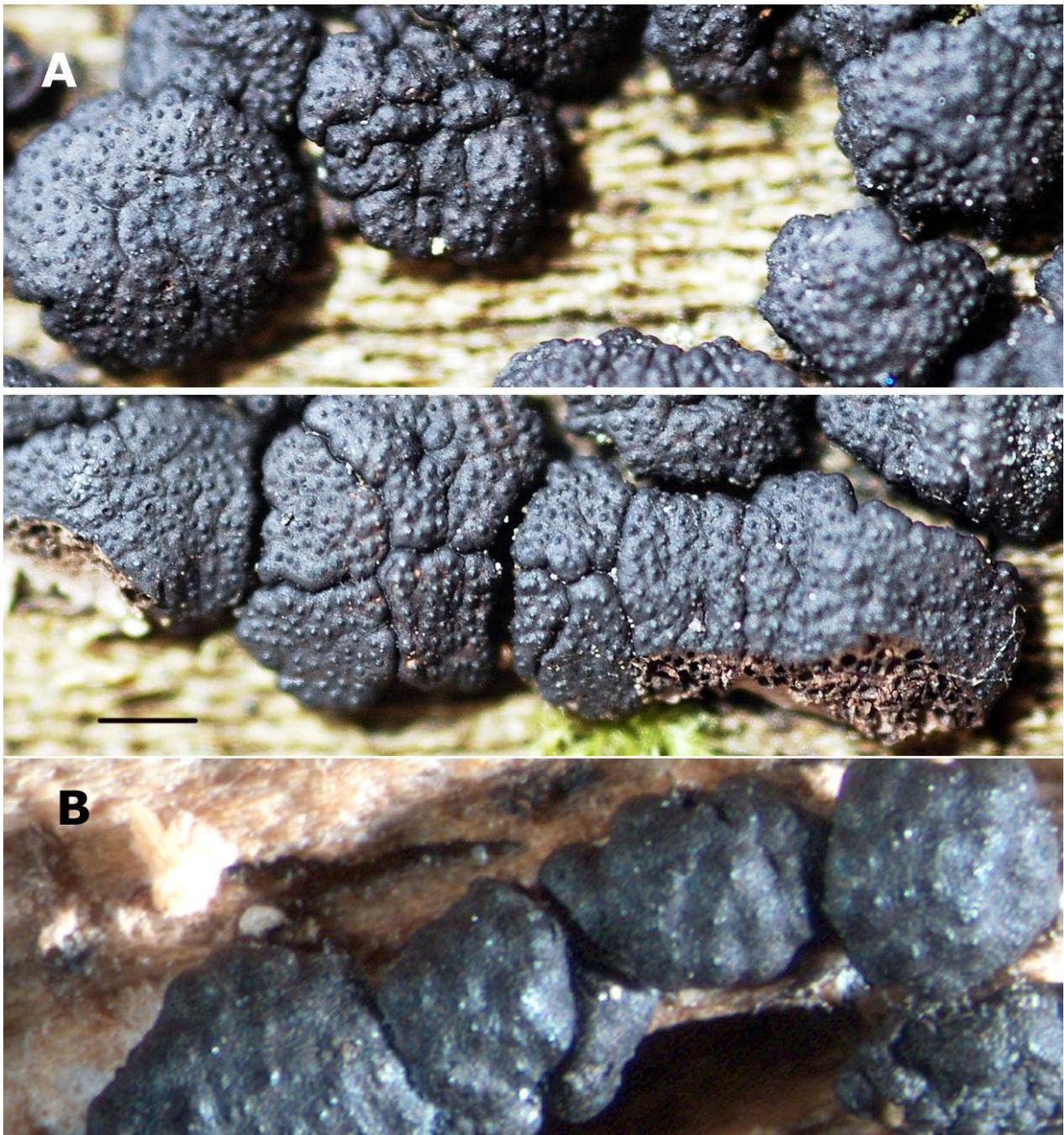


Fig. 3 – Stromata: **A**, *Sarawakus bicolor*. **B**, *Xylaria frustulosa*. Bar = 0.9 mm.

Stromata cushion-like, 1.5–3(–4) mm diam., broadly attached to the substrate, often confluent in large aggregates, at first reddish, later darkening to brown or almost black, whitish inside but also darkening with age to cream or brownish tinges, coarsely papillate and somewhat wrinkled at the surface. Perithecia globose, 150–200 µm diam., in the upper portion of a stroma. Asci cylindrical, 8-spored, in the spore-bearing portion 40–50 × 3–3.5 µm, stalks up to 40 µm long, with indistinct apical ring not bluing in Melzer’s reagent. Ascospores uniseriate, one-celled, narrow-ellipsoid, brownish, 5–7 × 2.5–2.8 µm.

Known distribution – eastern North America and north-eastern Asia (‘Asa-Grey disjunction).

Material examined – Russia, Primorsky Territory, Sikhote-Alin Nature Reserve, on wood, 24 Aug 1985, L. Vasilyeva, VLA P-1330; Lazo Nature Reserve, on wood, 9 Aug 1986, L. Vasilyeva, VLA P-1324; Reserve ‘Kedrovaya Pad’, on wood, 16 Oct 1987, L. Vasilyeva, VLA P-1329; Ussuriysk Nature Reserve, on wood, 14 Aug 1989, L. Vasilyeva, VLA P-819; Amur Region, Khingan Nature Reserve, on wood, 5 Jul 1988, L. Vasilyeva, VLA P-1327; Zeysky State Natural Reserve, on wood, 29 Jul 1988, L. Vasilyeva, VLA P-1322). – China, Heilongjiang Province, Xingkaihu Nature Reserve, on wood, 1 Sep 2003, L. Vasilyeva, VLA P-1726; Fuyuan vicinity, on wood, 5 Aug 2004, L. Vasilyeva, VLA P-1725; Jilin Province, Jiao-He vicinity, Ai-Lin forest farm, on wood, 30 Aug 2013, L. Vasilyeva, VLA P-2777.



Fig. 4 – A-B, *Nemania corylina*: A, Ascus with ascospores. B, Ascospore with visible germ slit. C, Part of the ascus and ascospore of *Nummauxia succenturiata*. D, Ascus and ascospores of *Sarawakus bicolor*. Bars: A = 16 µm; B = 5 µm; C = 10 µm; D = 8.5 µm.

Notes – This species is rather common in the southern portion of the Russian Far East and has been reported as '*Sarawakus frustulosus*' (Berk. & M.A. Curtis) Lar.N. Vassiljeva [as '*S. frustulosa*'] (Vasilyeva 1998). The erroneous combination '*Sarawakus frustulosus*' was based on the confusion of two species, namely *Xylaria frustulosa* (Berk. & M.A. Curtis) Cooke and *Thuemenella bicolor*, both of which have small and dark stromata and colored ascospores of the same size. The type collection of *T. bicolor* (Kansas: Manhattan, on a log of *Ulmus fulva* [NY, as *Hypocrea bicolor*]) was said to represent *Xylaria frustulosa* (Samuels & Rossman 1992). This is another good example of the high degree of parallel similarity observed in different pyrenomycetous families [the case of *Chromendothia citrina* Lar.N. Vassiljeva and *Camarops lutea* (Alb. & Schwein.) Shear was discussed previously by Vasilyeva et al. (2009)].

Despite the fact that *Thuemenella bicolor* is now treated as the member of the Xylariaceae (<http://www.speciesfungorum.org>, visited 6 Oct 2015), its hypocreaceous nature has been acknowledged by several different mycologists (Ellis & Everhart 1888; Seaver 1910; Boedijn 1964; Vasilyeva 1998). *T. bicolor* from south-eastern Russia and north-eastern China, as well as from eastern North America has a disjunctive area in moderate climate of the northern hemisphere, whereas *X. frustulosa* seems to have a subtropical and tropical distribution. The name of *T. bicolor* refers to the changing color of stromata, which are reddish at first and then darkening later. Such a feature is not observed in *X. frustulosa*.

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