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КРАТКИЕ СООБЩЕНИЯ

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MICROMYCETES ROSSICAE: CHOROLOGICAL AND TAXONOMICAL NOTES. 1. *CHRYSOMYXA SUCCINEA* (*PUCCINIALES*, *BASIDIOMYCOTA*) – NEW FIND FOR SAINT PETERSBURG, EUROPEAN RUSSIA

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The present notice opens a paper series devoted to rare and interesting species of micromycetes causing rust and leaf spots found in various regions of Russia. In June 2019, an interesting species *Chrysomyxa succinea*, new to the European territory of Russia, was revealed at Peter the Great Botanical Garden of Komarov Botanical Institute (Saint Petersburg). The fungus colonized the leaves of *Rhododendron ledebourii*. Two infected plants were found at a certain distance from each other. The rust fungus *Chrysomyxa succinea* is common in Siberia, the Russian Far East, Japan, and China. Its aecidial stage develops almost exclusively on *Picea jezoensis*, whereas the uredinial stage develops on various *Rhododendron* species. In this notice, the uredinial/telial stages of *Chrysomyxa succinea* were characterized. The species in question differs from the closely related *Ch. rhododendri* in infesting a fresh leaves; certain differences in features of urediniospores ornamentation exist, too. The present notice also discusses a nature distribution range of the host plant, *Rhododendron ledebourii*, and the history of its introduction in Peter the Great Botanical Garden. It has been suggested that the infection occurred due to long-range propagules (urediniospores). Since the *Chrysomyxa succinea* is the macrocyclic rust, it can be assumed that its stages 0 and I can be found during careful examination of single *Picea jezoensis* representatives in Saint Petersburg arboreta.

Keywords: botanical gardens, distribution range, plant introduction, rare micromycetes species, rhododendrons, rust fungi

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The genus *Chrysomyxa* Unger (*Coleosporiaceae, Pucciniales*, *Pucciniomycetes*, *Basidiomycota*) is presented by more than 30 species of rust fungi, characterized by external basidia and warty urediniospores which develop in chains with intercalary cells. Most of species in the genus form a subepidermal spermogonia and aecia of *Peridermium*-type. Their uredinia of *Caeoma*-type with reduced or absent peridium; telia develop subepidermally, flat or casnion-shaped, sometimes with small stalk. The telispores one-celled, laid in chains (Kuprevich, Transhel, 1957; Arthur, 1962; Azbukina, 2015).

This genus includes both macrocyclic heteroecious species (the aecia and spermogonia develop mainly on *Picea*, whereas uredinia, telia, and wintering mycelium are associated with evergreen leaves of ericaceous plants), and microcyclic ones, whose life cycle is represented by telia and occasionally by spermogonia (Savile, 1950).

Some genus representatives are widely distributed over European Russia, as *Chrysomyxa cassandrae* (Peck et G.P. Clinton) Tranzschel, *Ch. empetri* (Pers.) J. Schröt. ex Cummins, *Ch. ledi* de Bary, *Ch. pirolata* (Koern.) G. Winter in Rabenh., *Ch. rhododendri* (DC.) de Bary, *Ch. woroninii* Tranzschel. Their aecidial stage is associated mainly with *Picea abies* or *P. obovata*, whereas the uredinial stage – with rhododendrons and boreal bogs ericaceous plants (Kuprevich, Transhel, 1957; Spaulding, 1961; Azbukina, 2015).

Since 2019, we have begun special studies of *Ericaceae* s.l. mycobiota, including *Rhododendron* spp. and boreal bogs ericaceous plants. This notice opens a series of papers devoted to rare and interesting species of micromycetes of various regions of Russia that cause rust and leaf spots.

The leaves of living plants were herbarized according to standard reccommendations (Geltman, 1995). Dried shoots were viewed using the MBS-3 binocular stereoscopic microscope. The micromorphological analysis of the basidiomata was carried out using an Axio Scope A1 light microscope at the Laboratory of Systematics and Geography of the Fungi (BIN RAS). Micro-preparations for general hyphal morphology study were prepared using a 5% KOH solution. Such media as Melzer's reagent, Congo Red, and 5% NH_4OH solution were used to testing of thickened wall structures (spore surface sculpture). The urediniо-

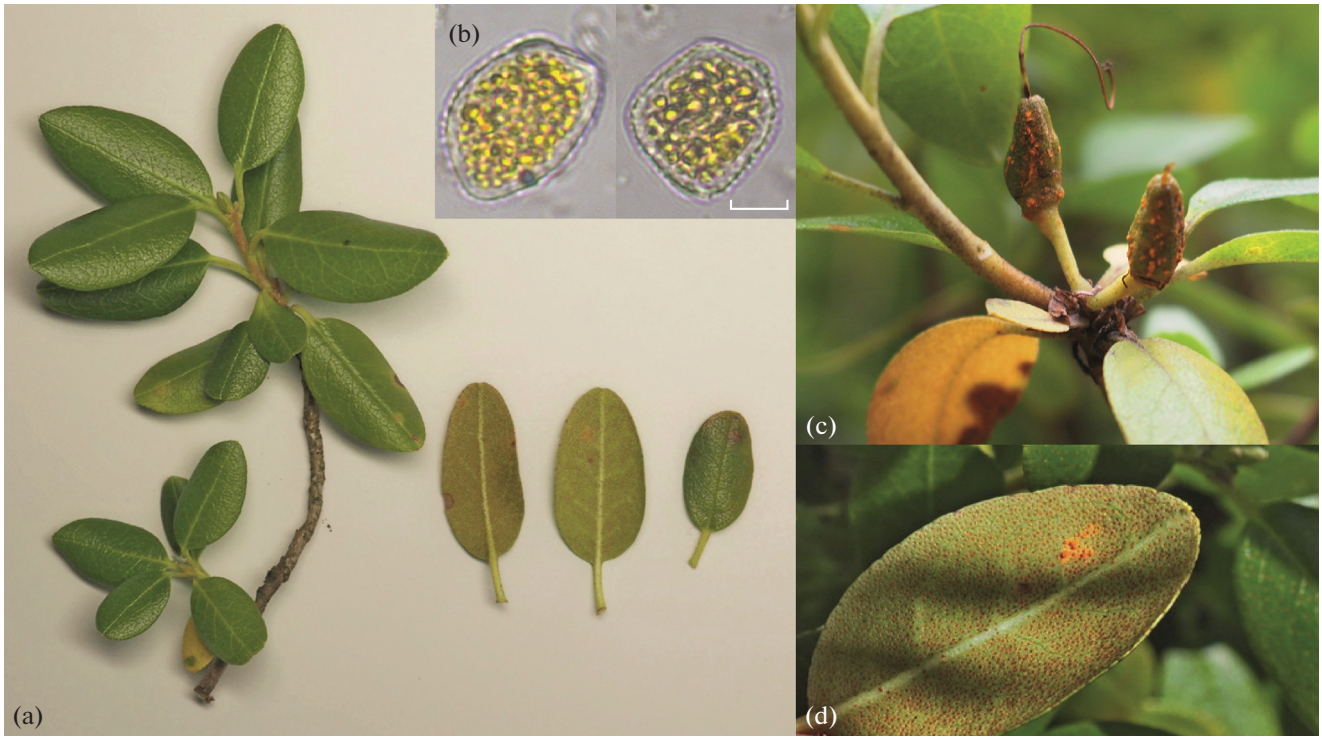

Fig. 1. *Chrysomyxa succinea* (LE 330109) on *Rhododendron ledebourii*, Saint Petersburg: a – general view of affected leaves with mild symptoms of dying; b – urediniospores with ornamented exosporium; c – young fruits are affected spots of uredinium stage of the fungus; d – underside of current leaf with small spots of uredinium stage of the fungus. Scale bar – 10 μm.

spores measurements were carried out into the distilled water. The material collected is loaned in the Mycological Herbarium of the BIN RAS (LE F).

In June 2019, on the territory of Peter the Great Botanical Garden of the Komarov Botanical Institute of the Russian Academy of Sciences, we have revealed the rust fungus *Ch. succinea* (Sacc.) Tranzschel. The fungus colonized the leaves and young fruits (Fig. 1, a–d) of *Rhododendron ledebourii* Pojark., whereas both infested plants were found that were 400 meters away from each other. The purpose of this notice is drawing attention to this interesting for European Russia rust species.

The species was described as hyphomycete *Gloeosporium succineum* based on Altai type specimen (Saccardo, 1880), then assigned to the rust genus *Chrysomyxa* by V.G. Tranzschel (Transhel, 1939). Taxonomically, this is rather stable species (Cummins, Hiratsuka, 2003; Cao et al., 2017). This rust fungus is common in Siberia, in the Russian Far East (Azbukina, 2015), Japan (Hiratsuka, Sato, 1969; Farr et al., 1996), and China (Ji et al., 2020). Its aecidial stage develops almost exclusively on *Picea jezoensis* (Siebold et Zucc.) Carriere, whereas the uredinial stage develops on various species of *Rhododendron*: *Rh. aureum* Georgi (locus classicus), *Rh. brachycarpum* D. Don ex G. Don, *Rh. dahuricum* L., *Rh. pseudochrysantum* Hayata. On *Rh. ledebourii*, as far as we can judge from the available literature, the fungus is noted here for the first time. Below follows a characterization of uredinial (II) and telial (III) stages of this species, based on original measurements.

Chrysomyxa succinea (Sacc.) Tranzschel, Conspectus Uredinalium URSS: 70, 314, 1939. – *Gloeosporium succineum* Sacc., Michelia 2 (6): 146, 1880; *Chrysomyxa expansa* Dietel, Bot. Jb. 28 (3): 287, 1900; *Ch. alpina* Hirats. f., Bot. Mag., Tokyo 46: 471, 1929. – Fig. 1.

Uredinia develop on the underside of living leaves (occasionally on petioles) on the wintering mycelium, slightly oblong with rapidly disappearing peridium, orange or orange-yellow, grainy under lens. Urediniospores 17.5–37.8 × 10.5–25.7 μm, in the main fraction subglobose, up to short ellisoid-cylindrical, with a thickened ornamented wall (ornament with regular columns, giving a surface warts up to 3 μm high), with 3–5 equatorial pores and granular golden-yellow contents Fig. 1, b).

Telia develop on the underside of living leaves or young fruits, spotted, cushion-shaped or almost capitate, orange-yellow, 0.3–1.5 mm in the largest dimension. Teliospores in chains up to 250 μm long, 14–28.5 × 6.5–12.5 μm, smooth, thick-walled, with golden-yellow contents.

Material examined: *Ch. succinea*. – Russia, Saint Petersburg, Peter the Great Botanical Garden of the Komarov Botanical Institute of the Russian Academy of Sciences, 59°58′08″N, 30°19′10″E, on *Rhododendron ledebourii*. Coll. 14.06.2019, det. 21.06.2019, V.A. Dudka and I.V. Zmitrovich (LE 330109).

Spermogonia (0) and aecia (I) of this species develop on spruce (the only *Picea jezoensis* was reported till now) and were not found by us. According to literature descriptions, the spermogonia are round, the aecia are oblong and develop on the underside of living needles; aeciospores 21–20 × 11–24 μm, ellipsoid to subglobose, thick-walled (Azbukina, 2015).

Another species, *Chrysomyxa rhododendri* also infests rhododendrons, but this species develops uredinia and telia on last year's leaves as well as dry petioles and even shoots; the urediniospores of this species in comparison with *Ch. succinea* are slightly smaller on average, and the columnar ornamentation of their wall is less pronounced.

An early synonymy of the species was studied by Crane (2005). The earlier name, *Ch. expansa*, was given on life cycle features [the rust on *Rhododendron brachycarpum* (*Chrysomyxa expansa*) had only telia, whereas the rust on *Rhododendron aureum* (*C. succinea*) had both uredinia and telia]. However, field studies and inoculation experiments (Hiratsuka, Sato 1969) showed that uredinia are produced on *Rhododendron brachycarpum* var. *roseum* and that the urediniial stages on both rhododendron hosts, and the aecial stages produced on *Picea jezoensis*, are identical. The production of uredinia and telia might be influenced with the host species and by environmental conditions in a particular location or from year to year.

Concerning the host plant, *Rhododendron ledebourii*, this species was segregated from *Rh. dauricum* relatively recently (Poyarkova, 1952), and its independent species status is rather controversial issue.

According to M.S. Alexandrova (1975), main part of *Rh. ledebourii* distribution range lies on Siberia: in Altai and in the southern part of the Sayan Mountains, along the Enisey mountains and on the Tanu-Ola ridge. This species is especially widely represented in Altai (near the Chiket-Aman pass, the Karagem river valley, the vicinity of the villages of Elekmonar, Chemal, Mount Uzyuk, the Katun river basin, Mount Sitokha, the surroundings of Lake Teletsk, the village of Ust-Muta, the lower reaches of the Chumat-man river, Maralda mountain, Anosu river) and in the Western Sayan (Turlygan taskyl, Buiba river valley, Kaimarsky Arshan mountain, Mondy village, Hulugayshi river, Khantepru river, Bingolchik river, Torgalyna village, Ha-Kem river, and Belbei river, valley Shiraita River, the upper reaches of the Usa River, Mount Rossypi, Tannu-Ola Ridge, Ungush River Valley, Ulengest and Uryanhai river basins). *Rh. ledebourii* is one of the most common shrubs of Tuva, where it grows everywhere within the forest belt. Outside of Russia, the range of this species extends to the northwestern part of Mongolia.

It would be interesting in this regard to understand a nature of rust specie expansion into alien region. *Rh. dauricum* s.l. was appeared in the collection of Peter the Great Botanical Garden even before 1816 (Svyazeva, 2005). Since 1910s, its evergreen forms were singled out in the collection catalogues of Peter the Great Botanical Garden. In 1952, these forms were segregated as independent species, *Rh. ledebourii*. The plant infested by *Chrysomyxa coccinea*, was entered to Peter the Great Botanical Garden in ~2010 from the Otradnoye tree nursery of the Komarov Botanical Institute as 10 years-old adult plants that were grown by Yu.A. Luks from seeds obtained from the Botanical Garden of the Riga University in 1985. The oldest cultivars of *Rhododendron ledebourii* in Peter the Great Botanical Garden represents by seed offspring from Altai obtained by E.G. Pobedimova in 1929.

Other botanical gardens which closest to the Peter the Great Botanical Garden, where *Rh. ledebourii* is cultivated, are located in Moscow (Russia), Tartu, and Tallinn (Estonia). This species has appeared in the Main Botanical Garden of Moscow only in the late 1940s. On all distance to the south from the Moscow and up to the northern limit of *Rh. ledebourii* nature distribution range, there are no tree nurseries would containing this species. Also, it should be noted that in Peter the Great Botanical Garden conditions, the *Rh. ledebourii* began to show certain signs of fungal diseases only during recent years. A seed origin of the main plantings of *Rhododendron* spp. of the Botanical Garden suggests that the rust infection can be occurred due to propagules of long-range transfer (Zmitrovich et al., 2003; Belomesyatseva, 2004). Since *Chrysomyxa succinea* is a macrocyclic species, it can be assumed that its stages 0 and I can be found, too, after careful examination of *Picea jezoensis*, which is available both from the collection of the Peter the Great Botanical Garden, and St. Petersburg State Forest Management University.

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Микромицеты России: географические и таксономические заметки. 1. *Chrysomyxa succinea* (*Pucciniales*, *Basidiomycota*) – новая находка в Санкт-Петербурге и Европейской России

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Настоящая заметка открывает серию статей, посвященных редким и интересным видам микромицетов, вызывающим ржавчину и листовые пятнистости, обнаруженным в различных регионах России. В июне 2019 г. в Ботаническом саду Петра Великого Ботанического института Российской академии наук был обнаружен новый для европейской территории России вид *Chrysomyxa succinea*. Гриб колонизировал листья интродуцента открытого грунта *Rhododendron ledebourii*, причем инфицированы были два растения, находящиеся в определенном отдалении друг от друга. Ржавчинный гриб *Chrysomyxa succinea* распространен в Сибири, на Российском Дальнем Востоке, в Японии, Китае. Его эцидиальная стадия развивается почти исключительно на *Picea jezoensis*, в то время как урединиальная – на различных видах *Rhododendron*. В заметке приводится характеристика урединиальной и телиостадий этого вида. От близкого вида *Chrysomyxa rhododendri* вид отличается тем, что колонизирует свежие листья; определенные различия имеются также в характере орнаментации урединиоспор. Также в заметке рассмотрены естественный ареал растения-хозяина (*Rhododendron ledebourii*) и история его интродукции в Ботаническом саду Петра Великого. Было выдвинуто предположение, что инфекция произошла за счет пропагул дальнего переноса гриба. Поскольку вид *Chrysomyxa succinea* является макроцикли-ческим, можно предположить нахождение его стадий 0 и I при внимательном обследовании посадок *Picea jezoensis* на территории Санкт-Петербурга.

Ключевые слова: ботанические сады, интродукция растений, микромицеты, распространение, редкие виды грибов, ржавчинные грибы, рододендроны