

NEW FINDS OF PHYLLOTROPHIC PLANT PATHOGENIC MICROFUNGI IN EKATERINBURG CITY AND ITS SUBURBS

© 2021 г. Т. С. Bulgakov^{1,*} and A. G. Shiryaev^{2,**}

¹ Federal Research Centre the Subtropical Scientific Centre of the Russian Academy of Sciences, 354002 Sochi, Russia

² Institute of Plant and Animal Ecology of Ural Branch of the Russian Academy of Sciences, 620144 Ekaterinburg, Russia

*e-mail: ascomycologist@yandex.ru

**e-mail: anton.g.shiryaev@gmail.com

Received April 18, 2021; revised May 18, 2021; accepted May 22, 2021

According to the research results, 63 new species of plant pathogenic microfungi developing on leaves of vascular plants were recorded in Ekaterinburg city and its suburbs. Two species, *Alternaria obtusa* and *Ramularia bergeniae*, were firstly registered in Russia; 14 of 63 new recorded species (22.2%) could be considered as alien species for Sverdlovsk Region.

Keywords: alien species, biodiversity, invasions, Urals, urban ecology

DOI: 10.31857/S0026364821060064

INTRODUCTION

Sverdlovsk Region has long-term history of mycological researches, so the local mycobiota can be considered as the best studied of the Urals and one of the best studied in Russia (Demidova, 1960). However, the information on plant pathogenic microfungi in Ekaterinburg City and Sverdlovsk Region is very poor, because the mycological researches did not include this group of fungi, excluding some rusts (Tranzschel, 1939), powdery mildews (Karelina, 2017), and some most important fungal pathogens of wide-cultivated food plants (Zambin et al., 1962).

The objective of the work is to study the diversity of plant pathogenic microfungi in Ekaterinburg and its suburbs, primarily phyllotrophic species – developing on plant leaves and causing various plant diseases such as leaf spots, scabs, anthracnoses, rusts, powdery and downy mildews.

MATERIALS AND METHODS

Ekaterinburg City is located in the south boreal subzone, near the border of European and Asian parts of Russia. The average annual temperature over the past ten years has varied in the range of 2.8–3.6°C and the amount of precipitation consists 480–560 mm per year (Fick, Hijmans, 2017).

In the present work, we study plant pathogenic microfungi that develop only on live and dying leaves. The materials for the study were generative fungal structures on leaf specimens of affected wild-growing and cultivated plants. The majority of the specimens were collected by A.G. Shiryaev in Ekaterinburg and Sverd-

lovsk Region in 2020, and several specimens were collected by O.I. Shalunova in 2014–2017. The identification of the fungal species was carried out by light microscopy of temporary preparations according to standard methods (Kirai et al., 1974; Blagoveshchenskaya, 2015), a number of special keys, atlases and monographs were used to determinate the species belonging of the identified fungi (Kuprevich, Ulyanishchev, 1975; Ulyanishchev, 1978; Sutton, 1980; Novotelnova, Pystina, 1985; Butin, 1989; Karatygin, 2002; Khokhryakov et al., 2003; Braun, Cook, 2012; Blagoveshchenskaya, 2015), as well as some additional publications devoted to the study and taxonomical revision of the particular fungal taxa: *Erysiphaceae* (Braun et al., 2018, 2019; Bradshaw et al., 2020; Qiu et al., 2020; Schmidt, Braun, 2020; Darsaraei et al., 2021), *Mycosphaerellaceae* (Quaedvlieg et al., 2013; Verkley et al., 2013; Videira et al., 2017), and *Polystigmataceae* (Bundhun et al., 2019). The collected specimens were processed in the Institute of Plant and Animal Ecology of Ural Branch of the Russian Academy of Sciences (Ekaterinburg) and in the Department of Plant Protection of the Federal Research Center “Subtropical Scientific Center of the Russian Academy of Sciences” (Sochi).

The identification of plant species was carried out according to the “Key to vascular plants of the Middle Urals” (1994). The species belonging of introduced plants in the collections were determined according to the data of employees of the Botanical Garden of the Ural Branch of the Russian Academy of Sciences.

RESULTS

The following annotated list contains the names of fungal species given according to the Mycobank nomenclatural database (2021), whereas the plant names are given according to the "Catalogue of Life" nomenclatural database (Roskov et al., 2021). The fungal species are arranged in alphabetical order. The species new for Sverdlovsk Region are marked with asterisk.

The species annotation is given in the following sequence: currently accepted species name (most often used synonyms are given in parentheses); host plant name (with plant family name in parentheses); the locations of collections in the Ekaterinburg city: BG – The Botanical Garden of the Ural Branch of the Russian Academy of Sciences; GES – The gardens near the railway station "Ekaterinburg-Sortirovochnyy"; BUM – Botanichesky urban microdistrict; SFP – Shartashsky forest park; other locations outside of Ekaterinburg city are given without abbreviations; date of collection; collection number; collector (if not A.G. Shiryaev); native species (NS) or alien species (AS) for the Sverdlovsk Region (Desprez-Loustau, 2009; Farr, Rossman, 2021). All specimens are kept in the fungarium of the Institute of Plant and Animal Ecology, Ekaterinburg [SVER (F)].

Albugo candida (Pers. ex J.F. Gmel.) Roussel – *Armoracia rusticana* G. Gaertn., B. Mey. et Scherb. (*Brassicaceae*): GES, private vegetable garden, 27.09.2020, SVER (F) 96561. NS.

Alternaria alternata (Fr.) Keissl. (A) – *Dahlia* × *cultorum* Thorsrud et Reisaeter (*Asteraceae*): GES, private garden, flowerbed, 29.09.2020, SVER (F) 96591. NS.

**A. obtusa* B.W. Ferreira et R.W. Barreto [= *Acroconidiella tropaeoli* (T.E.T. Bond) J.C. Lindq. et Alippi, = *Heterosporium tropaeoli* T.E.T. Bond] (A) – *Tropeolum majus* L. (*Tropealaceae*): BG, flowerbed, 29.09.2020, SVER (F) 96592; GES, private garden, flowerbed, 23.09.2020, SVER (F) 96593. AS.

A. solani Sorauer (A) – *Capsicum annuum* L. (*Solanaceae*): GES, private vegetable garden, 18.09.2020, SVER (F) 96594; *Solanum lycopersicum* L. (*Solanaceae*): BUM, private vegetable garden, 30.09.2020, SVER (F) 96595. NS.

Asteroma padi DC. (A) – *Prunus padus* L. (*Rosaceae*): SFP, forest edge, 25.07.2020, SVER (F) 96672. NS.

Asteromella ovata Thüm. (A) – *Menispermum dauricum* DC. (*Menispermaceae*): BG, arboretum, 25.09.2020, SVER (F) 96597; *ibid.*, 14.10.2020, SVER (F) 96598. AS.

Aureobasidium nigricans (Atk. et Edgerton) W.B. Cooke [= *Kabatiella nigricans* (G.F. Atk. et Edgerton) Karak.] (A) – *Vicia cracca* L. (*Fabaceae*): BG, park, 17.09.2020, SVER (F) 96690; GES, ruderal vegetation, 29.09.2020, SVER (F) 96693; Sverdlovsk Region, Shalinsky district, near Chusovaya river, forest, meadow, 19.07.2020, SVER (F) 96567. NS.

Blumeriella jaapii (Rehm) Arx [= *Coccomyces hiemalis* B.B. Higgins] (A+) – *Prunus padus* L. (*Rosaceae*): SFP, forest edge, 25.07.2020, SVER (F) 96599. NS.

Botrytis paeoniae Oudem. (A) – *Paeonia lactiflora* Pall. (*Paeoniaceae*): BG, flowerbed, 27.09.2020, SVER (F) 96668. AS.

Cercospora hydrangeae Ellis et Everh. (A) – *Hydrangea paniculata* Siebold (*Hydrangeaceae*): BG, arboretum, 14.10.2020, SVER (F) 96569. AS.

Colletotrichum gloeosporioides (Penz.) Penz. et Sacc. (A) – *Dioscorea caucasica* Lipsky (*Dioscoreaceae*): BG, arboretum, 27.09.2020, SVER (F) 96675. NS.

Coniella diplodiella (Speg.) Petr. et Syd. (A) – *Vitis amurensis* Rupr. (*Vitaceae*): BG, arboretum, 10.09.2017, SVER (F) 96674, O.I. Shalunova. AS.

Cumminsia mirabilissima (Peck) Nannf. [= *C. sanguinea* (Peck) Arthur] (II) – *Berberis aquifolium* Pursh (≡ *Mahonia aquifolium* (Pursh) Nutt.) (*Berberidaceae*): BG, arboretum, 04.11.2020, SVER (F) 96683. AS.

Didymella viburnicola (Oudem.) Qian Chen et L. Cai [= *Phyllosticta opuli* Sacc.] (A) – *Viburnum opulus* L. (*Adoxaceae*): BG, arboretum, 04.10.2020, SVER (F) 96588. NS.

Diplocarpon mespili (Sorauer) B. Sutton (A+) – *Crataegus monogyna* Jacq. (*Rosaceae*): BUM, block park, 11.07.2020, SVER (F) 96600. NS.

Drepanopeziza ribis (Kleb.) Höhn. [= *Gloeosporidiella ribis* (Lib.) Petr.] (A+) – *Ribes uva-crispa* L. (= *R. grossularia* L.) (*Grossulariaceae*): GES, private garden, 04.10.2020, SVER (F) 96601. AS.

Erysiphe adunca (Wallr.) Fr. s. str. (H) – *Populus* × *sibirica* G.V. Krylov et G.V. Grig. ex A.K. Skvortsov (*Salicaceae*): BG, arboretum, 16.10.2020, SVER (F) 96602. NS.

E. aquilegiae var. *ranunculi* (Grev.) R.Y. Zheng et G.Q. Chen (A+) – *Clematis mandshurica* Rupr. (*Ranunculaceae*): BG, коллекции, 03.08.2020, SVER (F) 96605; *Acronitum lycocotum* L. (*Ranunculaceae*): BG, flowerbed, 06.07.2020, SVER (F) 96606; GES, private garden, flowerbed, 14.07.2020, SVER (F) 96607; *Clematis* sp. (*Ranunculaceae*): BG, arboretum (near greenhouse), 14.10.2020, SVER (F) 96608. NS.

E. baeumleri (Magnus) U. Braun et S. Takam. (A+) – *Vicia cracca* L. (*Fabaceae*): BG, meadow, 17.09.2020, SVER (F) 96609. NS.

E. convolvuli DC. var. *calystegiae* U. Braun (H) – *Calystegia sepium* (L.) R. Br. (*Convolvulaceae*): BG, ruderal vegetation, 17.09.2020, SVER (F) 96614; *ibid.*, 28.09.2020, SVER (F) 96615. NS.

E. cruchetiana S. Blumer (H) – *Lathyrus pratensis* L. (*Fabaceae*): Sverdlovsk Region, Shalinsky district, near Chusovaya river, meadow, 09.07.2020, SVER (F) 96618. NS.

E. ehrenbergii (Lév.) U. Braun, M. Bradshaw et S. Takam. [= *E. lonicerae* DC. var. *ehrenbergii* (Lév.) U. Braun et S. Takam.] (H) – *Lonicera caucasica* Pall. (*Caprifoliaceae*): BUM, block park, 22.07.2020, SVER (F) 96619. NS.

E. necator Schwein. (A+) – *Vitis vinifera* L. (*Vitaceae*): BG, arboretum, 10.09.2017, SVER (F) 96622, O.I. Shalunova. AS.

E. salicis DC. (H) – *Salix viminalis* L. (*Salicaceae*): BG, arboretum, 03.08.2020, SVER (F) 96623. NS.

E. trifolium (Wallr.) U. Braun (A+) – *Trifolium pratense* L. (*Fabaceae*): GES, private garden, 03.08.2020, SVER (F) 96624. NS.

E. viburni Duby (A+) – *Viburnum lantana* L. (*Adoxaceae*): GES, private garden, 30.09.2020, SVER (F) 96629. NS.

Golovinomyces asperifolium (Grev.) U. Braun et H.D. Shin (A+) – *Symphytum officinale* L. (*Boraginaceae*): BG, arboretum, 30.09.2020, SVER (F) 96630; *ibid.*, 20.10.2020, SVER (F) 96631. NS.

G. asterum var. *solidaginis* U. Braun (A+) – *Solidago gigantea* Aiton (*Asteraceae*): BUM, ruderal vegetation, 29.09.2020, SVER (F) 96634; *ibid.*, 01.10.2020, SVER (F)

- 96635; *S. canadensis* L. (*Asteraceae*): BG, flowerbed, 24.09.2020, SVER (F) 96636. AS.
- G. bolayi* S. Takam., Lebeda et M. Götz (A+) – *Lactuca scariola* L. (*Asteraceae*): GES, ruderal vegetation, 30.09.2020, SVER (F) 96637. NS.
- G. latisporus* (U. Braun) P.L. Qiu et S.Y. Liu (A+) – *Helianthus tuberosus* L. (*Asteraceae*): BG, flowerbed, 08.10.2020, SVER (F) 96640. AS.
- G. longipes* (Noordel. et Loer.) L. Kiss (A+) – *Petunia × hybrida* (Hook.) Vilm. (*Solanaceae*): BG, flowerbed, 28.09.2020, SVER (F) 96641. NS.
- G. montagnei* U. Braun (H) – *Centaurea* sp. (*Asteraceae*): BG, flowerbed, 08.08.2020, SVER (F) 96642; *Psephellus dealbatus* (Willd.) K. Koch (*Asteraceae*): BG, flowerbed, 05.10.2020, SVER (F) 96643; *Psephellus dealbatus* (Willd.) K. Koch (*Asteraceae*): BG, flowerbed, 28.09.2020, SVER (F) 96644. NS.
- Neoerysiphe galeopsidis* (DC.) U. Braun (H) – *Lamium album* L. (*Lamiaceae*): BG, park, 04.10.2020, SVER (F) 96647; *ibid.*, 20.10.2020, SVER (F) 96647. NS.
- Ophiognomonium intermedia* (Rehm) Sogonov [= *Gloeosporium betulae* Westend.] (A+) – *Betula pubescens* Ehrh. (*Betulaceae*): BG, arboretum, 04.11.2020, SVER (F) 96673. NS.
- Paracercosporidium microsorum* (Sacc.) U. Braun, C. Nakash., Videira et Crous [= *Cercospora microsora* Sacc.] (A) – *Tilia cordata* Mill. (*Malvaceae*): BUM, block park, 25.10.2020, SVER (F) 96570. NS.
- Phaeoseptoria longispora* (Bondartsev) Vasyag. [= *Septoria longispora* Bondartsev] (A) – *Convolvulus arvensis* L. (*Convolvulaceae*): GES, ruderal vegetation, 29.09.2020, SVER (F) 96590. NS.
- Phloeospora ulmi* (Fr.) Wallr. [= *Septoria ulmi* Fr.] (A+) – *Ulmus glabra* Huds. (*Ulmaceae*): BG, arboretum, 01.10.2020, 04.11.2020, SVER (F) 96571. NS.
- Phyllosticta ampellicida* (Engelm.) Aa (A+) – *Vitis amurensis* Rupr. (*Vitaceae*): BG, arboretum, 10.09.2017, SVER (F) 96566, O.I. Shalunova. AS.
- Plasmopara nivea* (Unger) J. Schröt. – *Aegopodium podagraria* L. (*Apiaceae*): Sverdlovsk Region, Shalinsky district, near Chusovaya river, forest, 19.07.2020, SVER (F) 96563. NS.
- P. obducens* (J. Schröt.) J. Schröt. – *Impatiens glandulifera* Royle. (*Balsaminaceae*): BUM, ruderal vegetation, 29.09.2020, SVER (F) 96564. NS.
- Podosphaera macularis* (Wallr.) U. Braun et S. Takam. (H) – *Humulus lupulus* L. (*Cannabaceae*): BG, park, 28.09.2020, SVER (F) 96650. NS.
- P. mors-uvae* (Schwein.) U. Braun et S. Takam. (H) – *Ribes uva-crispa* L. [= *R. grossularia* L.] (*Grossulariaceae*): BG, arboretum, 14.09.2020, SVER (F) 96652. AS.
- P. spiraeae* (Sawada) U. Braun et S. Takam. (A+) – *Spiraea chamaedryfolia* L. (*Rosaceae*): BG, arboretum, 20.10.2020, SVER (F) 96653; GES, private garden, 21.09.2020, SVER (F) 96654; *ibid.*, 28.09.2020, SVER (F) 96655; BUM, block park, 23.09.2020, SVER (F) 96656. NS.
- Polystigma fulvum* Pers. ex DC. (H) – *Prunus padus* L. (*Rosaceae*): SFP, forest edge, 25.07.2020, SVER (F) 96678. NS.
- Protomyces macrosporus* Unger (T) – *Aegopodium podagraria* L. (*Apiaceae*): GES, ruderal vegetation, 23.09.2020, SVER (F) 96679. NS.
- Pseudocercospora vitis* (Lév.) Speg. (A) – *Vitis amurensis* Rupr. (*Vitaceae*): BG, arboretum, 10.09.2017, SVER (F) 96572, O.I. Shalunova. AS.
- Pseudoperonospora humuli* (Miyabe et Takah.) G.W. Wilson – *Humulus lupulus* L. (*Cannabaceae*): BUM, ruderal vegetation, 25.09.2020, SVER (F) 96565. NS.
- Puccinia malvacearum* Bertero ex Mont. (III) – *Alcea rosea* L. (*Malvaceae*): BG, flowerbed, 04.10.2020, SVER (F) 96684; *Malva sylvestris* L. (*Malvaceae*): GES, block park, 18.10.2020, SVER (F) 96685. AS.
- **Ramularia bergeniae* Vasjagina (A) – *Bergenia crassifolia* (L.) Fritsch (*Crassulaceae*): BG, коллекции, 04.10.2020, SVER (F) 96573. NS.
- R. lamii* Fuckel (A) – *Lamium album* L. (*Lamiaceae*): GES, ruderal vegetation, 20.10.2020, SVER (F) 96574. NS.
- R. major* (Unger) U. Braun (A) – *Petasites japonicus* (Siebold et Zucc.) Maxim. (*Asteraceae*): BG, парк, 04.11.2020, SVER (F) 96575. NS.
- R. pratensis* Sacc. [= *R. rhei* Allesch.] (A) – *Rheum rhaponticum* L. (*Polygonaceae*): BG, flowerbed, 14.07.2020, 26.07.2020, SVER (F) 96576. NS.
- R. spiraeae* Peck (A) – *Spiraea crenata* L. (*Rosaceae*): BG, arboretum, 30.09.2020, SVER (F) 96577. NS.
- Sawadaea bicornis* (Wallr.) Homma (A+) – *Acer negundo* L. (*Sapindaceae*): BUM, block park, 22.07.2020, SVER (F) 96657; BG, arboretum, 14.10.2020, SVER (F) 96658. NS.
- Seimatosporium lichenicola* (Corda) Shoemaker et E. Müll. (A+) – *Crataegus monogyna* Jacq. (*Rosaceae*): BUM, block park, 22.07.2020, SVER (F) 96671. NS.
- Septoria convolvuli* Desm. (A) – *Calystegia pubescens* Lindl. (*Convolvulaceae*): BG, ruderal vegetation, 28.09.2020, SVER (F) 96695; *Convolvulus arvensis* L. (*Convolvulaceae*): BG, ruderal vegetation, 30.07.2016, SVER (F) 96578, O.I. Shalunova. NS.
- S. cucurbitacearum* Sacc. (A) – *Cucumis sativus* L. (*Cucurbitaceae*): BG, greenhouse, 04.08.2015, SVER (F) 96579, O.I. Shalunova; GES, private vegetable garden, 14.07.2020, SVER (F) 96691; *ibid.*, 27.09.2020, SVER (F) 96692.
- S. divergens* Bubák et Kabát (A) – *Humulus lupulus* L. (*Cannabaceae*): BG, block park, 10.07.2015, SVER (F) 96580, O.I. Shalunova. NS.
- S. dulcamarae* Desm. (A) – *Solanum dulcamara* L. (*Solanaceae*): BG, ruderal vegetation, 09.07.2014, SVER (F) 96581, O.I. Shalunova. NS.
- S. humuli* Westend. (A) – *Humulus lupulus* L. (*Cannabaceae*): BG, block park, 10.07.2016, SVER (F) 96582, O.I. Shalunova. NS.
- S. ribis* (Lib.) Desm. (A+) – *Ribes rubrum* L. (*Grossulariaceae*): GES, private garden, 23.09.2020, SVER (F) 96583. NS.
- Sphaerulina frondicola* (Fr.) Verkley, Quaedvlieg et Crous [= *Septoria populi* Desm.] (H) – *Populus × sibirica* G.V. Krylov et G.V. Grig. ex A.K. Skvortsov (*Salicaceae*): BUM, block park, 16.10.2020, SVER (F) 96584. NS.
- S. neoaceris* Crous et Bulgakov (A) – *Acer negundo* L. (*Sapindaceae*): BG, arboretum, 25.09.2020, SVER (F) 96585; *ibid.*, 04.11.2020, SVER (F) 96586. AS.
- S. westendorpii* Verkley, Quaedvl. et Crous [= *Septoria rubi* Westend.] (A) – *Rubus caesius* L. (*Rosaceae*): BG, arboretum, 26.10.2020, SVER (F) 96587. NS.
- Venturia pyrina* Aderh. (H) – *Pyrus communis* L. (*Rosaceae*): GES, private garden, 29.09.2020, SVER (F) 96596. NS.
- Wilsonomyces carpophilus* (Lév.) Adask., J.M. Ogawa et E.E. Butler [= *Clasterosporium carpophilum* (Lév.) Aderh.] (A) – *Prunus cerasus* L. (*Rosaceae*): GES, private garden, 27.09.2020, SVER (F) 96589. NS.



Fig. 1. Leaf spots caused by *Ramularia bergeniae* on leaves of *Bergenia crassifolia*.

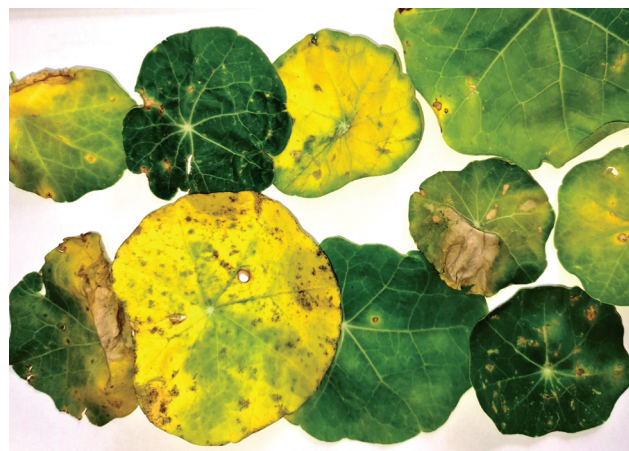


Fig. 2. Leaf spots caused by *Alternaria obtusa* on leaves of *Tropaeolum majus*.

There are 63 species and 3 varieties considered as new records for Sverdlovsk region. So a large number of firstly registered plant pathogenic microfungi can be explained by poor knowledge of this group in Sverdlovsk Region. Many firstly recorded species are widespread in other regions of Russia and other countries of Northern Hemisphere (Farr, Rossman, 2021). However, 14 of 63 new found species (22.2%) could be discussed as alien species for the Sverdlovsk Region, including several poor-known species, such as two ones that are new for Russia: *Alternaria obtusa* (Fig. 1) and *Ramularia bergeniae* (Fig. 2). *Alternaria obtusa* is known in many tropical countries as a pathogen of garden nasturtium (*Tropaeolum majus* L.), but it had not been recorded in Russia until now (Ferreira, Barreto, 2019). *Ramularia bergeniae* is a pathogen causing leaf spot of *Bergenia* spp. in its natural habitat in Kazakhstan (Braun, 1998); the finds of this species are quite expected in many regions of Russia due to wide culture of the host plant species as an ornamental plant.

The interesting fact is the discovery of *Sphaerulina neoaceris* in Ekaterinburg, which was recently described from the Rostov region of Russia (Crous et al., 2020) on live leaves of invasive plant – box elder maple (*Acer negundo*). Apparently, this obligate host plant-associated microfungus can be a quite widespread species in the invasive habitat of *Acer negundo* in Russia. In contrary, native *Plasmopara obducens*, previously known only on *Impatiens noli-tangere* (Novotelnova, Pystina, 1985), was firstly recorded on invasive plant *Impatiens glandulifera*. A similar change of host plants was noted in Moscow Region, where *Plasmopara obducens* have started to infect close-relative invasive plant *Impatiens parviflora* since 2010 (Blagoveshchenskaya, 2017).

The next well-known alien species *Puccinia malvacearum*, was found both on ornamental introduced species and on wild species of *Malvaceae*. This invasive plant pathogenic fungus was unintentionally introduced in Europe (and other continents) from South

America at the end of the 18th century (Desprez-Loustau, 2009); however, until the middle of the 20th century *P. malvacearum* was recorded only in the southern parts of the former USSR (Ukraine, Southern Russia, Caucasus, Central Asia), but not in the Ural macroregion (Tranzschel, 1939; Ulyanishchev, 1978). The second alien new-recorded rust fungus is *Cumminsia mirabilissima* introduced in the Europe at the beginning of the 20th century from North America (Desprez-Loustau, 2009); it was not registered in Russia until 1940s (Tranzschel et al., 1939), but later became a common species in the central part of European Russia (Kuprevich, Ulyanishchev, 1975). In addition, we note the record of native species *Polystigma fulvum*, which was revised by the specimens from Belarus (Bundhun et al., 2019), and the unclear origin species *Golovinomyces latisporus* – poor-known powdery mildew firstly found and confirmed in Rostov Region of Russia (Qui et al., 2020).

Several previously unknown in the region species – *Coniella diplodiella*, *Erysiphe necator*, *Phyllosticta ampellicida*, and *Pseudocercospora vitis* – were recorded on woody lianas, in particular, on the Amur grape (*Vitis amurensis*) introduced from the Russian Far East; these species are common in regions of vineyard culture (Khokhryakov et al., 2003; Braun, Cook, 2012; Farr, Rossman, 2021).

Authors thanks to O.I. Shalunova for help in the material collecting. Research of A.G. Shiryayev was carried out within the framework of the state assignment of the Institute of Plant and Animal Ecology, Ural Branch of the Russian Academy of Sciences.

REFERENCES

- Blagoveshchenskaya E. Yu. Invasive plant's fungal affection: the case of *Impatiens parviflora*. Bulletin of Moscow Society of Naturalists. Biology. 2017. V. 122 (2). P. 78–83.
- Blagoveshchenskaya E. Yu. Phytopathogenic micromycetes: educational keybook. Moscow, 2015 (in Russ.).

- Bradshaw M., Braun U., Götz M. et al. Taxonomy and phylogeny of the *Erysiphe lonicerae* complex (*Helotiales*, *Erysiphaceae*) on *Lonicera* spp. *Fungal Systematics and Evolution*. 2020. V. 7. P. 49–65.
<https://doi.org/10.3114/fuse.2021.07.03>
- Braun U. A monograph of *Cercospora*, *Ramularia* and allied genera (phytopathogenic Hyphomycetes). V. 2. Eching bei Munchen, IHW-Verlag, 1998.
- Braun U., Bradshaw M., Zhao T.-T. et al. Taxonomy of the *Golovinomyces cynoglossi* complex (*Erysiphales*, *Ascomycota*) disentangled by phylogenetic analyses and reassessments of morphological traits. *Mycobiology*. 2018. V. 46 (3). P. 192–204.
<https://doi.org/10.1080/12298093.2018.1509512>
- Braun U., Cook R.T.A. Taxonomic manual of the *Erysiphales* (powdery mildews). CBS Biodiversity series. V. 11. Utrecht, APS Press, 2012.
- Braun U., Mel'nik V.A. Cercosporoid fungi from Russia and adjacent countries. *Proceedings of the Komarov Botanical Institute*. V. 20. St. Petersburg, Russian Academy of Sciences, 2012.
- Braun U., Shin H., Takamatsu S. et al. Phylogeny and taxonomy of *Golovinomyces orontii* revisited. *Mycological Progress*. 2019. V. 18. P. 335–357.
<https://doi.org/10.1007/s11557-018-1453-y>
- Bundhun D., Jeewon R., Dayarathne M.C. et al. A morpho-molecular re-appraisal of *Polystigma fulvum* and *P. rubrum* (*Polystigma*, *Polystigmataceae*). *Phytotaxa*. 2019. V. 422 (3). P. 209–224.
<https://doi.org/10.11646/phytotaxa.422.3.1>
- Crous P.W., Wingfield M.J., Schumacher R.K. et al. New and interesting fungi. 3. *Fungal Systematics and Evolution*. 2020. V. 6. P. 157–231.
<https://doi.org/10.3114/fuse.2020.06.09>
- Darsaraei H., Khodaparast S.A., Takamatsu S. et al. Phylogeny and taxonomy of the *Erysiphe adunca* complex (*Erysiphaceae*, *Helotiales*) on poplars and willows // *Mycol. Progress*. 2021. V. 20. P. 517–537.
<https://doi.org/10.1007/s11557-021-01688-7>
- Demidova Z.A. A brief overview of research on mycology and phytopathology in the Urals. *Proc. Institute of Biol. UF AS USSR*. Vol. 15. Sverdlovsk, 1960, pp. 5–16 (in Russ.).
- Desprez-Loustau M.L. Alien fungi of Europe. *Handbook of alien species in Europe*. Springer, 2009. P. 15–28.
https://doi.org/10.1007/978-1-4020-8280-1_2
- Farr D.F., Rossman A.Y. *Fungal Databases*, U.S. National Fungus Collections, ARS, USDA.
<https://nt.ars-grin.gov/fungaldatabases>
- Ferreira B.W., Barreto R.W. Debunking *Acroconidiella*. *Mycological Progress*. 2019. V. 18 (11). P. 1303–1315.
<https://doi.org/10.1007/s11557-019-01525-y>
- Fick S.E., Hijmans R.J. WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas. *Int. J. Clim.* 2017. Vol. 37 (12). P. 4302–4315.
<https://doi.org/10.1002/joc.5086>
- Karatygin I.V. *Definitorium fungorum Rossiae*. The orders are *Taphrinaceae*, *Protomycetaceae*, *Exobasidiales*, *Microstromataceae*. Nauka, SPb., 2002 (in Russ.).
- Karelina E.D. The first report about powdery mildew in Ekaterinburg. *Bulletin of the Institute of Biology of the Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences*. 2017. V. 200 (2). P. 15–19 (in Russ.).
- Keys to vascular plants of the Middle Urals. Nauka, Moscow, 1994. 524 p. (in Russ.).
- Kirailiy Z., Klement Z., Solymosy F. et al. *Methods in plant pathology*. Moscow, Kolos, 1970 (in Russ.).
- Kuprevich V.F., Ulyanishchev V.I. *Keys to rust fungi of the USSR*. Part 1. Fam. *Melampsoraceae* and some *Pucciniaceae* species. Minsk, 1975 (in Russ.).
- Mycobank. International Mycological Association (IMA), 2021. <http://www.mycobank.org>
- Novotel'nova N.S., Pystina K.A. *Flora of spore plants of the USSR*. Vol. 11: Fungi (3). Order *Peronosporales*. Nauka, Leningrad, 1985 (in Russ.).
- Qiu P.-L., Liu S., Bradshaw M. et al. Multi-locus phylogeny and taxonomy of an unresolved, heterogeneous species complex within the genus *Golovinomyces* (*Ascomycota*, *Erysiphales*), including *G. ambrosiae*, *G. circumfusus* and *G. spadiceus*. *BMC Microbiology*. 2020. V. 20 (51).
<https://doi.org/10.1186/s12866-020-01731-9>
- Quaedvlieg W., Verkley G.J.M., Shin H.-D. et al. Sizing up *Septoria*. *Studies in Mycology*. 2013. V. 75. P. 307–390.
<https://doi.org/10.3114/sim0017>
- Roskov Y., Ower G., Orrell T. et al. 2021. *Species 2000 & ITIS Catalogue of Life*, 2021: Annual Checklist.
<http://www.catalogueoflife.org>
- Schmidt A., Braun U. Asexual morphs of powdery mildew species (*Erysiphaceae*) – new and supplementary morphological descriptions and illustrations. *Schlechtendalia*. 2020. V. 37. P. 30–79.
- Sutton B.C. *The Coelomycetes*. Fungi imperfecti with pycnidia, acervuli and stromata. Kew, C.M.I., 1980.
- Teterevnikova-Babayana D.N. *Fungi of the genus Septoria in the USSR*. Yerevan, Publishing House of the Academy of Sciences of the Armenian SSR, 1987 (in Russ.).
- Tranzschel V.G. *Review of rust fungi of the USSR*. Nauka, Moscow, Leningrad, 1939 (in Russ.).
- Verkley G.J.M., Quaedvlieg W., Shin H.-D. et al. A new approach to species delimitation in *Septoria*. *Stud. Mycol.* 2013. V. 75. P. 213–305.
<https://doi.org/10.3114/sim0018>
- Videira S.I.R., Groenewald J.Z., Nakashima C. et al. *Mycosphaerellaceae* – chaos or clarity? *Stud. Mycol.* 2017. V. 87. P. 257–421.
<https://doi.org/10.1016/j.simyco.2017.09.003>
- Zambin I.M., Turaev N.S., Shumilenko E.P. *Pests and diseases of crops*. Sverdlovsk Book Publishing House, Sverdlovsk, 1953 (in Russ.).
- Благовещенская Е.Ю. (Blagoveshchenskaya) Поражение инвазионных растений фитопатогенными грибами на примере недотроги мелкоцветковой // *Бюллетень Московского общества испытателей природы. Отдел биологический*. 2017. Т. 122. № 2. С. 78–83.
- Благовещенская Е.Ю. (Blagoveshchenskaya) Фитопатогенные микромицеты: учебный определитель. Москва: URSS, 2015. 232 с.
- Демидова З.А. (Demidova) Краткий обзор исследований по микологии и фитопатологии на Урале // *Тр. Ин-та биол. УФ АН СССР*. Вып. 15. Свердловск, 1960. С. 5–16.
- Замбин И.М., Тураев Н.С., Шумиленко Е.П. (Zambin et al.) Вредители и болезни сельскохозяйственных

- культур. Свердловск: Свердл. кн. изд-во, 1953. 207 с.
- Каратыгин И.В.* (Karatygin) Определитель грибов России. Порядки тафриновые, протомициевые, экзо-базидиальные, микростромациевые. СПб.: Наука, 2002. 135 с.
- Карелина Е.Д.* (Karelina) Первое сообщение о мучнисторосяных грибах города Екатеринбурга // Вестник института биологии Коми научного центра Уральского отделения РАН. 2017. Т. 200 (2). С. 15–19.
- Кирай З., Клемент З., Шоймоши Ф. и др.* (Kirai et al.) Методы фитопатологии. М.: Колос, 1974. 234 с.
- Купревич В.Ф., Ульянищев В.И.* (Kuprevich, Ulyanishchev) Определитель ржавчинных грибов СССР. Ч. 1. Сем. Melampsoraceae и некоторые виды Pucciniaceae. Минск: Наука и техника, 1975. 336 с.
- Новотельнова Н.С., Пыстина К.А.* (Novotelnova, Pystina) Флора споровых растений СССР. Т. 11: Грибы (3). Порядок Peronosporales. Л.: Наука, 1985. 363 с.
- Определитель сосудистых растений Среднего Урала (Key). М.: Наука, 1994. 524 с.
- Тетеревникова-Бабаян Д.Н.* (Teterevnikova-Babayan) Грибы рода *Septoria* в СССР. Ереван: Изд-во АН АрмССР, 1987. 479 с.
- Траншель В.Г.* (Tranzschel) Обзор ржавчинных грибов СССР. М.; Л.: Наука, 1939. 426 с.

Новые находки филлотрофных фитопатогенных микромицетов в г. Екатеринбурге и его пригородах

Т. С. Булгаков^{а, #}, А. Г. Ширяев^{б, ##}

^а Институт экологии растений и животных УрО РАН, Екатеринбург, Россия

^б Федеральный исследовательский центр “Субтропический научный центр Российской академии наук”, Сочи, Россия

[#] e-mail: ascmycologist@yandex.com

^{##} e-mail: anton.g.shiryayev@gmail.com

В ходе исследований видового состава филлотрофных фитопатогенных микромицетов, развивающихся на сосудистых растениях в г. Екатеринбурге и его пригородах было выявлено 63 новых для Свердловской области вида. Два вида – *Alternaria obtusa* and *Ramularia bergeniae* – впервые выявлены в России. 14 из 63 выявленных видов (22.2%) могут рассматриваться как чужеродные для Свердловской обл. виды.

Ключевые слова: биоразнообразие, инвазии, чужеродные виды, Урал, экология города