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An update on the occurrence of the *Sporormiaceae* (*Pleosporales*) in Ukraine

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The article provides an update on the dung-inhabiting members of the *Sporormiaceae* in Ukraine. Overall, 26 species of *Sporormia* and the *Preussia/Sporormiella* species complex have been recorded in the country to date. Based on examination of specimens collected in 2007–2020, we report one species of *Sporormia* (*S. fimetaria*), two of *Preussia* s. str. (*P. fleischhakii*, *P. funiculata*) and 11 of *Sporormiella* (*S. affinis*, *S. commutata*, *S. grandispora*, *S. heptamera*, *S. kansensis*, *S. leporina*, *S. longisporopsis*, *S. megalospora*, *S. muskokensis*, *S. octomera* and *S. pulchella*). Of these, the genus *Sporormia* and four species of the other genera (*P. fleischhakii*, *S. affinis*, *S. commutata* and *S. longisporopsis*) are newly recorded in Ukraine. For all fourteen species, their morphological characters are described, illustrated and discussed; occurrence records, habitat and distribution data are also provided. This study extends the distribution ranges of these fungi eastwards within Europe and contributes to their substrate list.

Key words: coprophilous fungi, distribution, morphology, *Preussia*, *Sporormia*, *Sporormiella*.

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Lytvynenko Yu.I., Hayova V.P., Akulov O.Yu., Dzhagan V.V., Romanova D.A. (2022): Aktuální poznatky o výskytu hub z čeledi *Sporormiaceae* (*Pleosporales*) na Ukrajině. – Czech Mycol. 74(2): 195–226.

Článek přináší současné údaje o výskytu koprofilních zástupců čeledi *Sporormiaceae* na území Ukrajiny. Celkem zde bylo dosud zaznamenáno 26 druhů z rodu *Sporormia* a komplexu *Preussia/Sporormiella*. Na základě studia sběrů z let 2007–2020 jsou podány souhrnné informace o jednom druhu z rodu *Sporormia* (*S. fimetaria*), dvou z rodu *Preussia* s. str. (*P. fleischhakii*, *P. funiculata*) a 11 z rodu *Sporormiella* (*S. affinis*, *S. commutata*, *S. grandispora*, *S. heptamera*, *S. kansensis*, *S. leporina*, *S. longisporopsis*, *S. megalospora*, *S. muskokensis*, *S. octomera* a *S. pulchella*). Z toho rod *Sporormia* a čtyři druhy z dalších rodů (*P. fleischhakii*, *S. affinis*, *S. commutata* a *S. longisporopsis*) jsou poprvé zaznamenány na území Ukrajiny. U všech čtrnácti zmíněných druhů jsou popsány,

ilustrovány a diskutovány morfologické znaky, jakož i podány údaje o jejich výskytu, ekologii a celkovém rozšíření. Studie rozšiřuje známé areály těchto hub směrem do východní Evropy a obohacuje seznam jejich substrátů.

INTRODUCTION

Members of the *Sporormiaceae* are widely distributed throughout the world. They occur mainly as saprobic fungi on various organic substrates, such as dung, soil, decaying plant debris, etc. There are also numerous reports on these fungi isolated from different plant species as endophytes (Arenal et al. 2007, Mapperson et al. 2014, Gonzalez-Menendez et al. 2017). The majority of the *Sporormiaceae* are, however, coprophilous [some authors prefer the term 'fimicolous' for fungi inhabiting dung only occasionally, see e.g. Calaça et al. (2020), nevertheless we maintain the term 'coprophilous' in the wide sense throughout this paper]. The abundance of fossil ascospores of these fungi in ancient sediments was used as a proxy indicator of megaherbivore existence and decline in the past (Davis et Shafer 2006, Johnson et al. 2015).

The *Sporormiaceae* are characterised by pseudothecia with fissitunicate asci (Kruys et Wedin 2009, Hyde et al. 2013). Ascospores are thick-walled, dark brown, usually 4- to multi-celled, constricted at septa and often separating into part-spores at maturity, frequently with germ slits, sometimes surrounded by a mucilaginous sheath (Barr 2000, Hyde et al. 2013).

The number of genera varies from 7 (Lumbsch et Huhndorf 2010) or 8 with ca 100 species (Barr 2000) to 10 genera and 143 species (Kirk et al. 2008) or 9 genera and 199 species (Wijayawardene et al. 2020). *Preussia* Fuckel and *Sporormiella* Ellis et Everh. are particularly species-rich genera. Having studied phylogenetic relationships within the *Sporormiaceae*, Kruys et Wedin (2009) proposed a phylogeny-based generic classification of the family. In particular, the authors argued for merging *Sporormiella* and *Sporormula* Arx et Aa into the genus *Preussia*. However, phylogenetic analysis showed *Preussia* and *Sporormiella* to form non-monophyletic groups, thus the *Preussia/Sporormiella* complex has remained unresolved. Based on morphology and molecular data, Zhang et al. (2012) also accepted *Preussia* s. l. (inclusive of *Sporormiella* and *Sporormula*) pending further research. The same generic concept was supported by Hyde et al. (2013), who considered within the family five genera, *Chaetopreussia* Locq.-Lin., *Pleophragmia* Fuckel, *Preussia*, *Sporormia* De Not. and *Westerdykella* Stolk. Further phylogenetic analyses have not demonstrated a distinction between *Preussia* and *Sporormiella* (Mapperson et al. 2014, Gonzalez-Menendez et al. 2017). They are, therefore, treated as synonyms in recent classifications (Wijayawardene et al. 2014, 2017, 2018, 2020). Consequently, the above five genera are placed in

the *Sporormiaceae*, but the family has gradually expanded from five (Wijayawardene et al. 2014) to six (Wijayawardene et al. 2018), seven (Wijayawardene et al. 2017) and finally nine genera (Wijayawardene et al. 2020).

Since *Sporormiella*, *Preussia* and *Sporormia* are morphologically very similar (Kruys et Wedin 2009, Doveri 2011, Zhang et al. 2012), they remain a subject of extensive debate, leading to confusion with regard to a distinction of the genera. There are currently two main concepts resulting from different interpretations of the original diagnoses.

The first concept considers *Preussia* and *Sporormiella* as distinct genera, based on morphological and ecological characters (Cain 1961, Ahmed et Cain 1972, Barrasa et Checa 1991, Doveri 2004, 2011, Bell 2005, Kirk et al. 2008, Lumbsch et Huhndorf 2010, Mungai et al. 2012, Doveri et Sarrocco 2013, Melo et al. 2017). In this case, *Sporormiella* is characterised by semi-immersed or immersed ostiolate pseudothecia, cylindrical to cylindrical-clavate asci, 4- to multicelled spores, and is preferably found on dung. These features are opposite to those observed in *Preussia* with superficial, globose, cleistothecioid pseudothecia, clavate to broadly clavate asci, 4-celled spores, and main occurrence on soil and plant debris, occasionally on dung.

Another viewpoint does not acknowledge the independence of *Sporormiella* and considers it as a later synonym of *Preussia* (Ahmad 1978, Valldosera et Guarro 1990, Guarro et al. 1997a, 1997b, Abdullah et al. 1999, Arenal et al. 2004, Chang et Wang 2009, Kruys et Wedin 2009, Asgari et Zare 2010, Mapperson et al. 2014, Kruys 2015, Gonzalez-Menendez et al. 2017). That opinion is based on rather vague distinctions between the two genera with respect to substrate preference (coprophilous vs. non-coprophilous) and morphological features of pseudothecia (ostiolate vs. non-ostiolate) and asci (cylindrical to cylindrical-clavate vs. clavate to broadly clavate).

The latter concept has been supported by extensive phylogenetic studies on the *Preussia*/*Sporormiella* complex (Arenal et al. 2005, 2007, Kruys et Wedin 2009, Asgari et Zare 2010, Mapperson et al. 2014, Gonzalez-Menendez et al. 2017), although these do not definitely resolve the question of synonymy. However, this approach has resulted in several recombinations of *Sporormiella* species into *Preussia* (Arx 1973, Ahmad 1978, Valldosera et Guarro 1990, Guarro et al. 1997a, 1997b, Abdullah et al. 1999, Arenal et al. 2004, Chang et Wang 2009, Kruys et Wedin 2009). Nevertheless, new species of *Sporormiella* have later been described (Doveri et Sarrocco 2013, Melo et al. 2017). Some publications reported both *Sporormiella* species and those transferred to *Preussia* (Kruys 2015, Gonzalez-Menendez 2017), which may lead to more confusion. In general, a large number of *Sporormiella* species have not been assigned to *Preussia* to date. Accordingly, Index Fungorum (http://www.indexfungorum.org/) and Mycobank

(https://www.mycobank.org/) online databases also lack clarity regarding the synonymy of *Preussia* and *Sporormiella*.

In this study, we follow a rather conservative generic classification accepting *Preussia* s. str. and *Sporormiella*, despite the latter not being conclusively a well-supported monophyletic group. Given that generic delimitation in the *Sporormiaceae* is still not thoroughly resolved, we treat the two genera here in the sense of Cain (1961), Ahmed et Cain (1972), Doveri (2004), Kirk et al. (2008) and Mungai et al. (2012).

Although species of *Sporormiaceae* have long attracted attention of many mycologists in various countries, little information regarding this group of fungi is available in Ukraine. The first significant inventory of coprophilous fungi in the country (Milovtsova 1937) reported 56 species, including two species of *Sporormiella*, *S. intermedia* (Auersw.) S.I. Ahmed et Cain ex Kobayasi and *S. lageniformis* (Fuckel) S.I. Ahmed et Cain. *Sporormiella minima* (Auersw.) S.I. Ahmed et Cain was subsequently added by Morochkovskyi et al. (1969). *Sporormiella tomilinii* O.V. Korol. was described as a new species from Ukraine (Korolyova 2000). In 2000–2010, we studied the species diversity of the coprophilous *Sporormiaceae* in the country. As a result, we reported eight species of *Sporormiella* for Ukraine in 2008–2014: *S. australis* (Speg.) S.I. Ahmed et Cain, *S. minimoides* S.I. Ahmed et Cain, *S. vexans* (Auersw.) S.I. Ahmed et Cain (Golubtsova 2008), *S. dubia* S.I. Ahmed et Cain (Golubtsova et al. 2010), *S. corynespora* (Niessl) S.I. Ahmed et Cain (Akulov et Ordynets 2011), *S. megalospora* (Auersw.) S.I. Ahmed et Cain (Akulov et Ordynets 2011, Lytvynenko et Stepanovska 2014), *S. inaequalis* S.I. Ahmed et Asad (Lytvynenko et Kravtsov 2012) and *S. grandispora* S.I. Ahmed et Cain ex J.C. Krug (Lytvynenko et Stepanovska 2014). Ten of the above species are also listed in a summarising publication on the genus *Sporormiella* in Ukraine (Korolyova 2015). After that, another nine species of the *Sporormiaceae* have been recorded; out of these, seven species from the north-east of the country (Sumy Region) – *Preussia funiculata* (Preuss) Fuckel, *Sporormiella heptamera* (Auersw.) S.I. Ahmed et Cain, *S. kansensis* (Griffiths) S.I. Ahmed et Cain, *S. leporina* (Niessl) S.I. Ahmed et Cain, *S. muskokensis* (Cain) S.I. Ahmed et Cain, *S. octomera* (Auersw.) S.I. Ahmed et Cain and *S. pulchella* (E.C. Hansen) S.I. Ahmed et Cain (Lytvynenko et al. 2016, Mironets et Lytvynenko 2017), one species from the Carpathian Mountains, i.e. *Sporormiella subtilis* S.I. Ahmed et Cain (Lytvynenko et al. 2018), and one more species from Oleshkivski Pisky National Nature Park, i.e. *Sporormiella tetramera* S.I. Ahmed et Cain (Lytvynenko et al. 2021).

In this paper, we provide updated information on the occurrence of coprophilous species of the *Sporormiaceae* in Ukraine, including new records for the country, as well as their descriptions, current distribution data and original illustrations.

MATERIAL AND METHODS

Dung samples were collected during 2007–2020 at 12 locations in five regions in Ukraine (Fig. 1).

The moist-chamber method of incubation was used to detect and obtain ascomata in the dung samples. The samples were placed in a Petri dish on filter paper and moistened with distilled water. More water was added when necessary to maintain sufficient moisture of the substrate. The incubation was carried out at room temperature (18–22 °C) under natural light for 30–45 days, depending on the period of ascomata development. The samples were examined at intervals of 1–2 days using a stereomicroscope.

Microcharacters were examined on fresh material. MBS-10 (JSC 'LZOS', Lytkarino, Moscow Region, Russia) and SM-6630 ZOOM (MICROmed, China) stereomicroscopes were used to examine the surface of the excrements and to study the morphology of the ascomata. Microstructures were examined with MB-302 40x-1600x LED Trino (Sigeta, Kyiv, Ukraine) and XSM-40 (Ningbo Sunni Instruments Co., Yuyao, Zhejiang, China) compound microscopes. Dimensions of microstructures were measured using the Tsview7 modular software, and photomicrographs were taken with a 3.0mp Digital Microscope Camera (both produced by Fuzhou Tucsen Imaging Technology Co., Fujian, China).

Microstructures mounted in distilled water were examined at magnifications of up to 600×. Aqueous cotton blue was used for staining the hyaline gelatinous sheaths or appendages. Since ascomata and ascospores of the studied fungi are dark coloured (blackish or dark brown and olivaceous brown to dark brown, respectively), no colour charts were used for the descriptions. At least 20–30 mature spores and 10–20 more or less mature asci per specimen were measured. The quotient Q represents the length/width ratio of spores or cells. The mean values of spore dimensions and quotient are provided in square brackets.

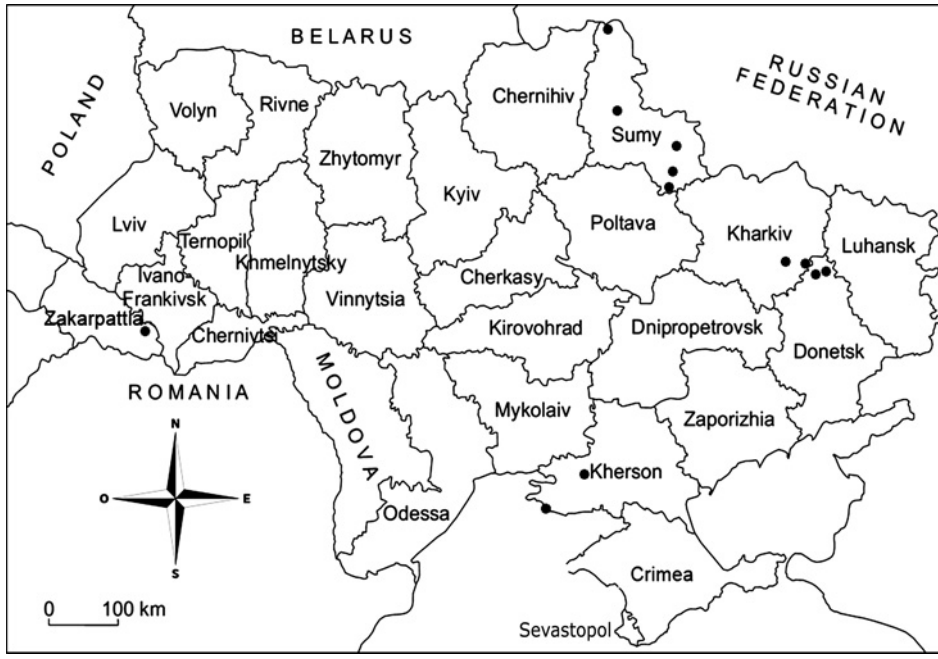


Fig. 1. Map of sampling locations (black dots) in Ukraine.

Analysis of general distribution is based on data from numerous bibliographic sources listed in the References and on critically revised open internet resources. Also the Global Biodiversity Information Facility (GBIF, www.gbif.org) was consulted for records.

The specimens are deposited at the Fungarium of the M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv (KW-M) and Mycological Herbarium (Fungarium) of the V.N. Karazin Kharkiv National University (CWU-MYC).

RESULTS

As a result of our research, the species diversity of the *Sporormiaceae* in Ukraine has increased to 26 species of the *Sporormia* and *Preussia/Sporormiella* species complex: one species of *Sporormia*, two of *Preussia* s. str., and 23 of *Sporormiella*. The *Sporormia* species was recorded for the first time in the country. Five of the currently distinguished species (*Preussia fleischhakii*, *Sporormia fimetaria*, *Sporormiella affinis*, *S. commutata* and *S. longisporopsis*) were new records for Ukraine. This study, therefore, extends the distribution ranges of these species within Europe, now including Ukraine as one more country in Eastern Europe. For some species, their substrate list has been extended.

Below we provide descriptions, photomicrographs, habitats, distribution data and taxonomic notes for 14 species of *Sporormiaceae* in Ukraine, five of them new to Ukraine, and nine listed in previous publications without any additional data.

Preussia fleischhakii (Auersw.) Cain, Can. J. Bot. 39: 1640, 1961 Figs 2A–C

Basionym: *Sporormia fleischhakii* Auersw. in Rabenhorst, Fungi Europaei exsiccati, Klotzschii herbarii vivi mycologici continuatio. Editio nova, Series secunda, Cent. 10: no. 921, 1866
≡ *Gnomonia fleischhakii* (Auersw.) Auersw., Mycologia europaea. Abbildungen sämmtlicher Schwämme Europas 5–6: 26, 1869
≡ *Perisporium fleischhakii* (Auersw.) Auersw. in Rabenhorst, Fungi Europaei exsiccati, Klotzschii herbarii vivi mycologici continuatio. Editio nova, Series secunda, Cent. 14: no. 1338, 1870
≡ *Diaporthe fleischhakii* (Auersw.) M. Monod, Beihefte zur Sydowia 9: 219, 1983
= *Fleischhakia laevis* Auersw., Hedwigia 8: 2, 1869
= *Perisporium laeve* (Auersw.) Auersw., Hedwigia 8: 179, 1869

Description. Pseudothecia scattered, semi-immersed, subglobose, glabrous, blackish, non-ostiolate, 132–175 µm diam. Peridium layered, pseudoparenchymatous, consisting of angular cells 5–9 µm diam. Asci 8-spored, broadly clavate to saccate, short stipitate, 51–60 × 20–26 µm (spore-bearing part 40–49 × 20–26 µm), broadly rounded at the apex, narrowing from the broadest part near the middle into a short, lobate stipe, 11–13 µm long. Ascospores crowded and fasciculate inside the asci, arranged parallel to the longitudinal axis and forming cylindrical bundles 40–55 µm long (sometimes one or two lower mature spores may enter the upper part of the stipe, hence the size of the bundle exceeds that of the spore-bearing part of the ascus), 4-celled, 26.4–[27.7]–28.7 × 5.2–[5.9]–6.6 µm,

Q = 4.15–[4.75]–5.41, cylindrical, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa broad and deep, segments easily separable; end cells slightly narrower and longer, 7.5–9.2 × 5.2–5.6 µm, ovoid to conical, with a roundish apex, mid-cells cylindrical to subglobose, 7.3–7.6 × 5.2–6.6 µm; germ slits oblique; gelatinous sheath not observed. Pseudoparaphyses numerous, filiform, septate, slightly exceeding the asci, 3–5 µm diam.

Distribution. Europe: Belgium, Cyprus, Czech Republic, Germany, Hungary, Italy, the Netherlands, Poland, Spain, Sweden, Ukraine, UK; Asia: Japan; Australasia: New Zealand; North America: Canada, USA (Cain 1961, Barrasa et Checa 1991, Doveri 2004, Kruys et Ericson 2008, Kruys et Wedin 2009, Asgari et Zare 2010, this study).

Habitat. On dung of donkey, hare, partridge, roe deer and sheep, isolated from soil, decaying wood and human nail (Cain 1961, Barrasa et Checa 1991, Doveri 2004, Kruys et Ericson 2008, Kruys et Wedin 2009, Asgari et Zare 2010).

Specimen examined

Ukraine. Sumy Region, Buryn' District, town of Buryn', private houses, 51°10'28.4" N, 33°51'09.1" E, rabbit dung, 24 Febr. 2019, leg. T. Khandiuk, det. Yu. Lytvynenko (KW-M71455).

Notes. This species is widespread in the world. Our record of *P. fleischhakii* is the first for Ukraine and rabbit dung represents a new substrate.

Preussia funiculata (Preuss) Fuckel, Fungi rhenani exsic. Suppl. Fasc. 3, No. 1750, 1866 Figs 2D–I

Basionym: *Perisporium funiculatum* Preuss, Linnaea 24: 143, 1851
= *Verrucaria pulposa* Leight., Lich.-Fl. Great Brit.: 427, 1871

Description. Pseudothecia scattered, semi-immersed, subglobose, glabrous, blackish, 325–455 × 295–425 µm; neck papilliform, bare, black. Peridium layered, pseudoparenchymatous, consisting of angular cells measuring 8–14 µm diam. Asci 8-spored, broadly-clavate, long stipitate, 95–128 × 14–18.5 µm (spore-bearing part 64–76 × 14–18.5 µm), narrowing from the broadest part above the middle into a very long, slender, nearly cylindrical stipe, 32–55 µm long. Ascospores crowded and fasciculate inside the asci, arranged parallel to the longitudinal axis and forming cylindrical bundles 60–66 µm long; 4-celled, young spores visible in asci measuring 24.7–[25.5]–26.6 × 6.3–[6.8]–7.7 µm, Q = 3.53–[3.76]–4.40, olivaceous brown; mature spores 26.4–[28.3]–29.7 × 5.3–[6.1]–7.3 µm, Q = 4.23–[4.51]–4.72, cylindrical, straight or slightly curved, dark brown; septa oblique, constrictions at septa broad and deep, segments easily separable; end cells slightly narrower and longer, 7.9–9.9 × 5.8–7.0 µm, more or less conical, with a roundish apex; mid-cells ovoid or barrel-shaped when young, 5.8–7.7 × 6.3–7.7 µm,

becoming cylindrical with age, 6.8–8.5 × 5.3–7.3 µm; germ slits oblique; gelatinous sheath not observed. Pseudoparaphyses numerous, filiform, septate, slightly exceeding the asci, 3–5 µm diam.

Distribution. Europe: Austria, Denmark, Estonia, France, Germany, Hungary, Lithuania, Norway, Russian Federation, Spain, Sweden, Switzerland, Ukraine, UK; Africa: Morocco, Senegal; Asia: Iran; Australasia: Australia; North America: Canada, USA (Munk 1957, Cain 1961, Valldosera et Guarro 1990, Treigienė 2004, Richardson 2004b, Bell 2005, Kruys et Ericson 2008, this study).

Habitat. On dung of dog, goat, horse, moose, porcupine, rabbit, roe deer, sheep and wild boar, on decaying wood of *Quercus* sp., on straw and rotting stems of *Brassica oleracea*, *Festuca* spp., *Poa* spp., on an old beehive, old wooden boards, rotten cloth, sacking, seeds (Munk 1957, Cain 1961, Doveri 2004, Richardson 2004b, Treigienė 2004, Kruys et Ericson 2008).

Specimens examined

Ukraine. Sumy Region, Buryn' District, town of Buryn', private houses, 51°10'28.4" N, 33°51'09.1" E, rabbit dung, 24 Febr. 2019, leg. T. Khandiuk, det. Yu. Lytvynenko (KW-M71455). – Sumy Region, Okhtyrka District, Hetmanskyi National Nature Park, village of Klymentove, Vorskla river bank, grassland, 50°23'12.3" N, 34°55'30.9" E, cattle dung, 25 May 2019, leg. et det. Yu. Lytvynenko (KW-M71464).

Notes. *Preussia funiculata* is facultatively coprophilous and is also reported to occur on other organic substrates, such as decaying textile or woody material, plant stems and seeds; it forms numerous fertile perithecia in vitro (Ahmed et Cain 1972).

This species is widespread throughout the world. In Ukraine, *P. funiculata* has been previously reported briefly from two localities, on dung of cow (Lytvynenko et al. 2016) and hare (Lytvynenko et al. 2022), both representing new substrates. Here we provide a description and original illustrations of its microstructures for the first time.

Sporormia fimetaria (De Not.) De Not., Mem. Reale Accad. Sci. Torino, ser. 2, 10: 342, 1849 Figs 2J–N

Basionym: *Hormospora fimetaria* De Not., G. Bot. Ital. 1, 2: 47, 1844 (nom. illeg.)
≡ *Sphaeria fimetaria* (De Not.) Rabenh., Herb. Mycol.: 1733, 1853
≡ *Brochospora fimetaria* (De Not.) Kirschst., Hedwigia 81: 204, 1944

Description. Pseudothecia scattered, immersed, globose, glabrous, dark brown, 100–130 × 95–125 µm, without neck. Peridium thin, pseudoparenchymatous, consisting of dark brown, thick-walled, angular cells measuring 9–13 µm diam. Asci 8-spored, cylindrical, short stipitate, 52–68 × 11–12.5 µm,

broadly rounded at the apex, contracted below into a very short, persistent, lobate stipe, measuring 5–6 µm in length. Ascospores crowded and fasciculate inside the asci, arranged parallel to the longitudinal axis and forming cylindrical bundles in the middle of the ascus, 37–48 µm long; 16-celled, 37.6–[40.9]–44.8 × 3.2–[3.4]–3.7 µm, Q = 11.1–[12.42]–13.9, olivaceous when young, turning dark brown with age; cylindrical, straight or slightly curved; septa transverse, constrictions at septa broad and deep, segments easily separable; end cells slightly narrower and longer, subconical, with a roundish apex; mid-cells cylindrical or barrel-shaped, wider than long; germ slits absent; gelatinous appendages observed at both spore ends. Pseudoparaphyses filiform, septate, slightly exceeding the asci, ephemeral, hardly observable.

Distribution. Europe: Austria, Belgium, Bulgaria, Denmark, France, Germany, Greece, Italy, the Netherlands, Sweden, Ukraine, UK; Africa: Ivory Coast, Morocco; Asia: Iraq, Pakistan, Sri Lanka, Taiwan, Turkey; Australasia: Australia, New Zealand; North America: Canada, Greenland, Mexico, Puerto Rico, USA; South America: Argentina, Brazil; Atlantic Ocean: St. Helena (Munk 1957, Fakirova 1968, Ahmed et al. 1971, Ahmed et Cain 1972, Ahmad 1978, Dissing 1992, Jahn et al. 2000, Doveri 2004, Richardson 1998, 2004b, Chang et Wang 2009, this study).

Habitat. On dung of cattle, deer, goat, ox, porcupine, rabbit and sheep (Ahmed et Cain 1972, Doveri 2004, Richardson 2004b, Chang et Wang 2009).

Specimen examined

Ukraine. Transcarpathian (Zakarpattia) Region, Rakhiv District, Carpathian Biosphere Reserve, Svydovets Mountain Range, near Dragobrat, mixed forest with dominant *Picea abies*, alt. 1250 m, 48°14'48.9" N, 24°14'59.5" E, roe deer dung, 23 Sept. 2016, leg. V. Dzhagan, det. Yu. Lytvynenko (KW-M71461).

Notes. This is a cosmopolitan but infrequently encountered species. This is the first report for Ukraine.

Sporormiella affinis (Sacc., E. Bommer et M. Rousseau) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 425, 1972 Figs 3A–E

Basionym: *Sporormia affinis* Sacc., E. Bommer et M. Rousseau, Bull. Soc. R. Bot. Belg. 25: 171, 1886
≡ *Preussia affinis* (Sacc., E. Bommer et M. Rousseau) Valldos. et Guarro, Bol. Soc. Micol. Madrid 14: 82, 1990

Description. Pseudothecia ostiolate, scattered, immersed, subglobose, smooth, dark brown, 530–650 µm diam.; neck small, papilliform, bare, black. Peridium thick, membranaceous, layered. Asci 8-spored, cylindrical-clavate, gradually tapered into a short stipe, 190–285 × 30–37 µm. Ascospores triseriate above, uni- or biseriate below, 8-celled, 82.9–[87.7]–94.3 × 13.1–[14.0]–14.9 µm,

Q = 5.97–[6.25]–6.59, fusiform-cylindrical, straight or slightly curved, olivaceous when young, turning dark brown with age; septa transverse, constrictions at septa broad and deep, segments easily separable; terminal cells ovoid-conical, rounded at the ends, longer than wide; mid-cells cylindrical or ellipsoidal, almost equal in length, wider than long, third cell from the upper end the broadest; germ slit diagonal; gelatinous sheath hyaline, broad, 9.8–11.1 µm wide. Pseudoparaphyses filiform, septate, equalling the asci.

Distribution. Europe: Austria, Belgium, Bulgaria, Denmark, Hungary, Italy, Luxemburg, Spain, Sweden, Switzerland, Ukraine; North America: Canada, Mexico, USA (Bommer et Rousseau 1886, Tóth 1963, Fakirova 1969, Ahmed et Cain 1972, Valldosera et Guarro 1990, Kruys et Wedin 2009, Doveri 2011, this study).

Habitat. On dung of hare and rabbit (Bommer et Rousseau 1886, Ahmed et Cain 1972).

Specimens examined

Ukraine. Donetsk Region, Kramatorsk District, Svyati Hory National Nature Park, near the village of Studenok, pine wood, 49°04'24.7'' N, 37°30'27.6'' E, hare dung, 29 Apr. 2008, leg. et det. O. Akulov (CWU2739). – Kherson Region, Hola Prystan District, Oleshkivski Pisky National Nature Park, near the village of Burkuty, close to Dovge Lake, sandy steppe, 46°24'21.3'' N, 32°48'58.6'' E, hare dung, 20 July 2020, leg. K. Orlova-Hudim, det. Yu. Lytvynenko (KW-M71462). – Kherson Region, Oleshkivskiy District, near the village of Radensk, sandy steppe, 46°32'02.4'' N, 32°58'29.0'' E, hare dung, 7 July 2020, leg. K. Orlova-Hudim, det. D. Romanova (KW-M71460).

Notes. The species is currently only known from the Northern Hemisphere, where it has been reported exclusively on lagomorph droppings. All Ukrainian specimens were recorded on hare dung. This record is the first for Ukraine.

Sporormiella commutata (Niessl) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 437, 1972 Figs 3F–J

Basionym: *Sporormia commutata* Niessl, Österr. Bot. Zeit. 28: 164, 1878

≡ *Preussia commutata* (Niessl) Abdullah et Guarro, in Abdullah, Al-Saadoon et Guarro, Nova Hedwigia 69(1–2): 214, 1999

Description. Pseudothecia scattered, immersed, subglobose, smooth, blackish, 255–273 × 235–248 µm diam.; neck small, papilliform, bare. Peridium thick, membranaceous, layered. Asci 8-spored, cylindrical-clavate, gradually tapered into a short stipe, 155–198 × 20.5–22.5 µm. Ascospores bi- or triseriate, usually 8-celled, occasionally 7- and 9-celled, 55.5–[61.1]–64.6 × 8.4–[9.9]–10.5 (11.5) µm, Q = 5.85–[6.42]–7.25, cylindrical-clavate, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa deep; segments easily separable, mid-cells broader than long, third cell from the upper end the broadest, terminal cells ovoid, longer than

broad; germ slits strongly oblique to diagonal; gelatinous sheath present, hyaline. Pseudoparaphyses filiform, septate, longer than the asci.

Distribution. Europe: Czech Republic, Germany, Iceland, Lithuania, Norway, Ukraine; Africa: Morocco; Asia: Iraq, Pakistan; North America: USA (Niessl 1878b, Ahmed et al. 1971, Ahmed et Cain 1972, Abdullah et al. 1999, Jahn et al. 2000, Richardson 2004a, Treigienė 2004, this study).

Habitat. On dung of cattle, donkey, hare, rabbit and sheep (Niessl 1878b, Ahmed et Cain 1972, Treigienė 2004).

Specimen examined

Ukraine. Kherson Region, Hola Prystan District, Chornomorsky Biosphere Reserve, Tendra Spit, near Austrian beacon, 46°13'38.4" N, 31°40'36.4" E, cattle dung, 23 May 2007, leg. V. Hayova, det. Yu. Lytvynenko (KW-M50626).

Notes. This is a rather uncommon and probably rare species globally. This record is the first for Ukraine.

Sporormiella grandispora (Speg.) S.I. Ahmed et Cain ex J.C. Krug, Trans. Bot. Soc. Edinb. 41(2): 198, 1971 Figs 4A–E

Basionym: *Sporormia intermedia* subsp. *grandispora* Speg., Michelia 2: 230, 1878
≡ *Sporormia grandispora* (Speg.) Speg., Syll. fung. (Abellini) 2: 128, 1883
≡ *Preussia grandispora* (Speg.) Barrasa et Arenal, in Arenal, Platas et Peláez, Mycotaxon 89(1): 139, 2004

Description. Pseudothecia scattered, immersed, becoming almost superficial, subglobose, smooth, dark brown to black, 310–330 µm diam.; neck small, bare, black. Peridium thin, membranaceous. Asci 8-spored, cylindrical-clavate, gradually narrowing from the broadest part near the apex into a short stipe, 154–187 × 22–27 µm. Ascospores bi- or triseriate, 4-celled, (44.2)46.4–[48.4]–50.7 × 10.9–[11.9]–12.6 µm, Q = 3.53–[3.89]–4.47, fusiform-cylindrical, yellowish brown when young, turning blackish brown with age; septa transverse, constrictions at septa broad and deep; segments not easily separable, cells about equal in length, terminal cells ovoid-conical; germ slits parallel; gelatinous sheath hyaline, broad. Pseudoparaphyses filiform, septate, longer than asci.

Distribution. Europe: Austria, Denmark, France, Germany, Hungary, Iceland, Italy, Lithuania, Spain, Sweden, Switzerland, Ukraine, UK; Africa: Morocco; Australasia: Australia; North America: Canada, USA; South America: Argentina, Falkland Islands (Tóth 1965, Ahmed et Cain 1972, Barrasa et Checa 1991, Doveri 2004, Richardson 2004a, 2004b, Treigienė 2004, Bell 2005, Welt et Heine 2007, Watling et Richardson 2010, this study).

Habitat. On dung of cattle, deer, elk, goat, hare, horse, pig, rabbit, sheep and wild boar; on leaves of *Phragmites australis* (Ahmed et Cain 1972, Barrasa et Checa 1991, Doveri 2004, Richardson 2004a, 2004b, Arenal et al. 2004, Treigienė 2004, Watling et Richardson 2010).

Specimens examined

Ukraine. Kharkiv Region, Izyum District, Izyumska Luka Regional Landscape Park, near the village of Spivakivka, mixed forest, 49°11'03.8'' N, 37°01'13.4'' E, deer dung, 7 May 2010, leg. et det. O. Akulov (CWU-MYC4052). – Kherson Region, Hola Prystan District, Oleshkivski Pisky National Nature Park, near the village of Burkuty, close to Dovge Lake, sandy steppe, 46°24'21.3'' N, 32°48'58.6'' E, hare dung, 20 July 2020, leg. K. Orlova-Hudim, det. Yu. Lytvynenko et D. Romanova (KW-M71463; Lytvynenko et al. 2021).

Notes. In Ukraine, apart from these specimens, *S. grandispora* is also known from two localities in the Bilopillya District, Sumy Region (Lytvynenko et Stepanovska 2014).

Sporormiella heptamera (Auersw.) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 442, 1972 Figs 3K–O

Basionym: *Sporormia heptamera* Auersw., Hedwigia 7: 71, 1868

≡ *Preussia heptamera* (Auersw.) Guarro, in Guarro, Al-Saadoon et Abdullah, Nova Hedwigia 64(1–2): 182, 1997

Description. Pseudothecia scattered, immersed, subglobose, smooth, dark brown, 420–490 × 385–460 µm; neck small, cylindrical, bare, black. Peridium layered, pseudoparenchymatous. Asci 8-spored, cylindrical-clavate, 266–348 × 43–50 µm, gradually tapered into a slender stipe, 18–28 µm long. Ascospores biseriate above, uniseriate below, 7-celled, (64.9)70.8–[75.3]–86.7 × (15.7)16.5–[17.8]–19.8 µm, Q = 3.63–[4.26]–5.10, cylindrical, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa deep, segments easily separable; five mid-cells wider than long, third cell from the upper end the broadest, terminal cells slightly longer than the mid-cells, ovoid-conical to almost hemispherical, the basal cell hardly longer than the apical one; germ slits oblique to transverse; gelatinous sheath hyaline, broad. Pseudoparaphyses numerous, filiform, septate, containing many hyaline vacuoles, slightly exceeding the asci.

Distribution. Europe: Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Iceland, Italy, Lithuania, Luxemburg, the Netherlands, Norway, Spain, Sweden, Switzerland, Ukraine; Asia: Japan; Australasia: New Zealand; North America: Canada, USA; South America: Argentina, Chile (Niessl 1878a, Munk 1957, Tóth 1963, Fakirova 1969, Ahmed et Cain 1972, Furuya et Udagawa 1972, Valldosera et Guarro 1990, Doveri 2004, Treigienė 2004, Kruys et Wedin 2009, Richardson 2011, this study).

Habitat. On dung of cattle, deer, hare, horse, moose, pig, rabbit and sheep (Ahmed et Cain 1972, Furuya et Udagawa 1972, Doveri 2004, Richardson 2011).

Specimen examined

Ukraine. Sumy Region, Seredyna-Buda District, Desniansko-Starohutsky National Nature Park, near the village of Vasylivka, pine forest, 52°18'43.8" N, 33°44'35.3" E, roe deer dung, 20 Sept. 2016, leg. A. Mironets, det. Yu. Lytvynenko (KW-M71457).

Notes. Despite its rather wide distribution range, *S. heptamera* is infrequent. Previously, it was reported as quite rare (Doveri et al. 1999) or apparently uncommon (Richardson 2011). In Ukraine, this is the second record of the species, after another one in the Sumy Region (Lytvynenko et al. 2016). The description and illustrations given here are of the latter collection.

Sporormiella kansensis (Griffiths) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 445, 1972 Figs 4F–J

Basionym: *Sporormia kansensis* Griffiths, Mem. Torrey Bot. Club 11(1): 113, 1901
≡ *Preussia kansensis* (Griffiths) Guarro, in Guarro, Al-Saadoon et Abdullah, Nova Hedwigia 64(1–2): 182, 1997

Description. Pseudothecia scattered, immersed, pyriform or subglobose, slightly tomentose, dark brown, 450–475 × 375–425 µm; neck subcylindrical, bare, black. Peridium layered, pseudoparenchymatous, consisting of subglobose to angular cells. Asci 8-spored, cylindrical-clavate, 225–342 × 31–34 µm, gradually narrowing from the broadest part above the middle into a stout, persistent stipe, 38–45 µm long. Ascospores triseriate above, uni- or biseriate below, 4-celled, (65.9)70.2–[71.8]–74.4 × 9.9–[11.5]–12.9(13.9) µm, Q = 5.33–[6.25]–6.69, cylindrical, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa broad and deep, segments easily separable; all cells about equal in length, end cells hardly narrower; mid-cells cylindrical, the terminal ones more or less conical, with a roundish apex; germ slits parallel, less slightly oblique in terminal cells; gelatinous sheath hyaline, broad. Pseudoparaphyses numerous, filiform, septate, slightly exceeding the asci.

Distribution. Europe: Hungary, Italy, Spain, Ukraine; Africa: Kenya; Asia: Pakistan, Taiwan; North America: USA (Tóth 1965, Ahmed et Cain 1972, Ahmad 1978, Khan et Cain 1979, Doveri 2004, Chang et Wang 2009, this study).

Habitat. On dung of antelope, cattle, deer, horse, rabbit and yellow ox (Tóth 1965, Ahmed et Cain 1972, Khan et Cain 1979, Doveri 2004, Chang et Wang 2009).

Specimen examined

Ukraine. Sumy Region, Okhtyrka District, Hetmanskyi National Nature Park, near the village of Huhra, Vorskla river bank, grassland, 50°21'31.9" N, 34°48'53.9" E, cattle dung, 20 Sept. 2015, leg. et det. Yu. Lytvynenko (KW-M71458).

Notes. *Sporormiella kansensis* is most probably a rare species known from single finds in several countries. In Ukraine, this is the second record of the species, after an earlier brief report of it on cow dung in the same Park (Lytvynenko et al. 2016).

Sporormiella leporina (Niessl) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 447, 1972
Figs 5A–E

Basionym: *Sporormia leporina* Niessl, Österr. Bot. Z. 28: 44, 1878
≡ *Preussia leporina* (Niessl) Arx, Proc. K. Ned. Akad. Wet., Ser. C, Biol. Med. Sci. 76(3): 294, 1973

Description. Pseudothecia scattered, immersed, becoming almost superficial, subglobose, smooth, dark brown, 210–280 µm diam.; neck short, papilliform, bare, black. Peridium thin, membranaceous. Asci 8-spored, cylindrical-clavate, broadest near the apex, gradually tapered into a stipe, 136–146 × 14.2–17.0 µm. Ascospores bi- or triseriate above, uni- or biseriate below, 4-celled, (34.0)34.8–[35.1]–35.5 × 5.8–[6.3]–6.5(7.0) µm, Q = 5.38–[5.62]–5.85, fusiform-cylindrical, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa deep, segments not easily separable; cells more or less equal in length, terminal cells ovoid-conical, mid-cells cylindrical, end cells sometimes slightly longer than the middle ones, and the second upper cell slightly wider than the others, barrel-shaped; germ slits nearly parallel to strongly oblique; gelatinous sheath hyaline, broad. Pseudoparaphyses filiform, septate, longer than the asci, 2.5–3.0 µm diam.

Distribution. Europe: Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Germany, Iceland, Italy, Lithuania, Luxemburg, Norway, Russian Federation, Spain, Sweden, Switzerland, Ukraine, UK; Africa: Kenya; Asia: Pakistan; Australasia: Australia; North America: Canada, Mexico, USA; South America: Argentina, Brazil, Falkland Islands (Niessl 1878a, Ahmed et Cain 1972, Ahmad 1978, Prokhorov et Armenskaya 2003, Doveri 2004, Treigienė 2004, Bell 2005, Welt et Heine 2007, Watling et Richardson 2010, Richardson 2011, Mungai et al. 2012, Melo et al. 2017, this study).

Habitat. On dung of cow, deer, donkey, fox, giraffe, hare, horse, llama, moose, mouse, partridge, porcupine, rabbit, sheep, wood grouse and unidentified carnivores (Ahmed et Cain 1972, Prokhorov et Armenskaya 2003, Doveri 2004, Mungai et al. 2012, Melo et al. 2017).

Specimens examined

Ukraine. Kharkiv Region, Izyum District, near the village of Studenok, Yaremovsky proposed botanic reserve, floodplain forest, 49°06'10.3'' N, 37°27'25.8'' E, hare dung, 9 May 2010, leg. et det. O. Akulov (CWU-MYC4231). – Sumy Region, Okhtyrka District, Hetmanskyi National Nature Park, near the village of Klymentove, Vorskla river bank, grassland, 50°23'21.0" N, 34°55'27.2" E, cattle dung, 25 May 2019, leg. et det. Yu. Lytvynenko.

Notes. *Sporormiella leporina* is widely distributed throughout the world. The epithet of this fungus refers to its preference for lagomorph excrements but it also occurs on excrements of many other herbivores and carnivores.

Sporormiella longisporopsis S.I. Ahmed et Cain, Can. J. Bot. 50(3): 448, 1972 Figs 4Q–W

≡ *Preussia longisporopsis* (S.I. Ahmed et Cain) Kruys et Wedin, Syst. Biodiv. 7(4): 476, 2009

Description. Pseudothecia scattered or aggregated, immersed, becoming almost superficial, subglobose, smooth, dark brown, 400–450 µm diam.; neck short, bare, black. Peridium thin, membranaceous. Asci 8-spored, cylindrical-clavate, gradually tapered into a stout, persistent stipe, 289–296 × 36–39 µm. Ascospores bi- or triseriate, 4-celled, 80.6–[84.7]–98.0 × 14.5–[16.7]–17.6 µm, Q = 4.64–[5.03]–5.88, cylindrical, straight or slightly curved, yellowish brown when young to dark brown when mature; septa transverse, constrictions at septa broad and deep; segments easily separable, all cells almost equal in length, roundish at the apex; germ slits parallel or oblique; gelatinous sheath hyaline, broad. Pseudoparaphyses filiform, septate, exceeding the asci.

Distribution. Europe: Austria, Hungary, Italy, Ukraine; Africa: Kenya; Asia: Japan; Australasia: Australia; North America: Mexico, USA; South America: Argentina (Ahmed et Cain 1972, Furuya et Udagawa 1972, Khan et Cain 1979, Doveri 2004, Bell 2005, Kruys et Wedin 2009, Mungai et al. 2012, this study).

Habitat. On dung of cow, deer, donkey, giraffe, goat, hare, rabbit, unidentified rodent, sheep and zebra (Ahmed et Cain 1972, Furuya et Udagawa 1972, Khan et Cain 1979, Doveri 2004, Mungai et al. 2012).

Specimens examined

Ukraine. Kherson Region, Hola Prystan District, Chornomorsky Biosphere Reserve, Tendra Spit, 46°17'35.0" N, 31°32'15.9" E, horse dung, 22 May 2007, leg. V. Hayova, det. Yu. Lytvynenko (KW-M50633); ibid., north of Tendra lighthouse, 46°21'09.6" N, 31°31'32.5" E, goat dung, 26 May 2007, leg. V. Hayova, det. Yu. Lytvynenko (KW-M50656).

Notes. *Sporormiella longisporopsis* is probably a rare fungus worldwide (Doveri 2004, Mungai et al. 2012). This is the first record for Ukraine and horse dung represents a new substrate.

Sporormiella megalospora (Auersw.) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 449, 1972 Figs 4K–P

Basionym: *Sporormia megalospora* Auersw., Hedwigia 7: 68, 1868

≡ *Preussia megalospora* (Auersw.) Valldos. et Guarro, Bol. Soc. Micol. Madrid 14: 87, 1990 [1989]

Description. Pseudothecia scattered or aggregated, immersed, becoming almost superficial, pyriform, smooth, dark brown, 487–555 × 325–366 µm; necks short, bare, black. Peridium thin, coriaceous. Asci 8-spored, cylindrical-clavate, gradually tapered into a stout, persistent short stipe, 194–217 × 28–35 µm. Ascospores bi- or triseriate, 4-celled, 62.6–[71.5]–77.5(81.2) × (13.7)14.8–[15.5]–17.4 µm, Q = 4.23–[4.78]–5.41, fusiform-cylindrical, straight or slightly curved, yellowish brown when young to dark brown when mature; septa transverse, constrictions at septa broad and deep; segments easily separable, terminal cells slightly longer than the mid-cells, ovoid; germ slits diagonal or oblique; gelatinous sheath hyaline, broad. Pseudoparaphyses filiform, septate, exceeding the asci.

Distribution. Europe: Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Greece, Hungary, Iceland, Italy, Lithuania, the Netherlands, Norway, Romania, Russian Federation, Spain, Sweden, Switzerland, Ukraine, UK; Africa: Kenya, Morocco; Asia: China; Australasia: Australia; North America: Canada, Mexico, USA; South America: Argentina, Brazil, Falkland Islands (Niessl 1878a, Munk 1957, Tóth 1963, 1965, Fakirova 1968, 1969, Ahmed et Cain 1972, Khan et Cain 1979, Valldosera et Guarro 1990, Prokhorov et Armenskaya 2003, Doveri 2004, Richardson 2004a, Treigienė 2004, Bell 2005, Kruys et Wedin 2009, Watling et Richardson 2010, Melo et al. 2017, this study).

Habitat. On dung of cattle, deer, hare, horse, moose, mouse, rabbit, rock hyrax, sheep and unidentified carnivore (Ahmed et Cain 1972, Khan et Cain 1979, Prokhorov et Armenskaya 2003, Doveri 2004, Watling et Richardson 2010).

Specimens examined

Ukraine. Donetsk Region, Kramatorsk District, Svyati Hory National Nature Park, near the village of Studenok, pine wood, 49°04'24.7'' N, 37°30'27.6'' E, cattle dung, 28 Apr. 2008, with *S. coryne-spora*, leg. et det. O. Akulov (CWU-MYC2727). – Kharkiv Region, Izyum District, Izyums'ka Luka Regional Landscape Park, near the village of Spivakivka, mixed forest, 49°11'04.6'' N, 37°01'14.3'' E, roe deer dung, 7 May 2010, leg. et det. O. Akulov (CWU-MYC4045, CWU-MYC4051). – Kherson Region, Hola Prystan District, Chornomorsky Biosphere Reserve, Tendra Spit, near Austrian beacon, 46°13'38.4" N, 31°40'36.4" E, cattle dung, 23 May 2007, leg. V. Hayova, det. Yu. Lytvynenko (KW-M50629).

Notes. *Sporormiella megalospora* is one of the most common and widespread species preferably growing on dung of wild herbivores (Doveri 2004). In Ukraine, it has been previously listed in a few species inventories (Akulov et Ordynets 2011, Lytvynenko et Stepanovska 2014, Akulov et al. 2016, Lytvynenko et al. 2021). Here we provide descriptions and original micrographs of Ukrainian specimens for the first time.

Sporormiella muskokensis (Cain) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 451, 1972 Figs 5F–H

Basionym: *Sporormia muskokensis* Cain, Univ. Toronto Stud., Biol. Ser. No. 38: 96, 1934

Description. Pseudothecia scattered, immersed, subglobose, smooth, dark brown, 210–235 µm diam.; neck papilliform to cylindrical, bare, black. Peridium thin, membranaceous. Asci 8-spored, 144–175 × 14.0–16.5 µm, cylindrical-clavate, broadest near the apex, gradually tapered into a relatively long stipe, measuring about 24–32 µm. Ascospores bi- or triseriate, 4-celled, (24.5)27.5–[29.6]–32.4(35.7) × 5.3–[6.2]–6.7(7.2) µm, Q = 4.11–[4.63]–5.16, fusiform-cylindrical, straight or slightly curved, olivaceous brown and guttulate when young, turning dark brown with age; septa oblique, constrictions at septa broad and deep; segments separable, cells about equal in width, terminal cells narrowing toward the ends, conical, mid-cells oblong; germ slits oblique to diagonal; gelatinous sheath hyaline, narrow. Pseudoparaphyses filiform, septate, exceeding the asci.

Distribution. Europe: Austria, Estonia, France, Germany, Lithuania, Russian Federation, Sweden, Ukraine; Africa: Kenya; North America: Canada, USA (Ahmed et Cain 1972, Khan et Cain 1979, Prokhorov et Armenskaya 2003, Treigienė 2004, Welt et Heine 2007, this study).

Habitat. On dung of Daurian pika, deer, hare, moose, partridge, porcupine, rabbit and rock hyrax (Ahmed et Cain 1972, Khan et Cain 1979, Prokhorov et Armenskaya 2003, Mungai et al. 2012).

Specimens examined

Ukraine. Sumy Region, Seredyna-Buda District, Desniansko-Starohutsky National Nature Park, Quarter 92, near the village of Vasylivka, pine forest, 52°19'28.8" N, 33°43'48.9" E, roe deer dung, 20 Sept. 2016 (KW-M70965); ibid., Quarter 126, 52°19'01.0'' N, 33°43'51.6'' E, roe deer dung, 20 Sept. 2016 (KW-M70966), both leg. A. Mironets, det. Yu. Lytvynenko.

Notes. This fungus occurs on dung of predominantly wild herbivores (Ahmed et Cain 1972, Prokhorov et Armenskaya 2003, Mungai et al. 2012). In Ukraine, it has so far only been recorded on roe deer pellets. Previously, we reported *S. muskokensis* from two sites in the Sumy Region (Lytvynenko et al. 2016). In this article, we add two more locations, description and illustrations of the species.

Sporormiella octomera (Auersw.) S.I. Ahmed et Cain, in Kobayasi, Hiratsuka, Otani, Tubaki, Udagawa et Soneda, Bull. Natn. Sci. Mus., Tokyo 12: 340, 1969 Figs 3P–R

Basionym: *Sporormia octomera* Auersw., Hedwigia 7: 70, 1868

≡ *Sporormia octomera* var. *macrospora* Feltgen, Vorstud Pilzfl. Luxemb., Nachtr. II: 223, 1901

≡ *Preussia octomera* (Auersw.) Kruys, in Kruys et Wedin, Syst. Biodiv. 7(4): 476, 2009

Description. Pseudothecia scattered, immersed, pyriform, smooth, dark brown, 350–375 × 235–265 µm; neck small, papilliform, bare, black. Peridium thin, membranaceous. Asci 8-spored, clavate, 178–196 × 21–24 µm, gradually tapered into a long stipe, measuring 28–37 µm. Ascospores triseriate above, uni- or biseriate below, 8-celled, (35.5)38.4–[39.8]–46.9 × (5.4)6.4–[6.9]–8.3 µm, Q = 5.74–[5.92]–6.81, fusiform-cylindrical, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa deep; segments easily separable, third cell from the upper end the broadest, terminal cells slightly longer than the mid-cells, ovoid-conical; germ slits oblique to diagonal; gelatinous sheath hyaline, broad. Pseudoparaphyses filiform, septate, slightly exceeding the asci.

Distribution. Europe: Austria, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Iceland, Italy, Lithuania, Sweden, Switzerland, Ukraine; Asia: Japan; Australasia: Australia, New Zealand; North America: Canada, USA; South America: Argentina (Niessl 1878b, Munk 1957, Fakirova 1968, Ahmed et Cain 1972, Furuya et Udagawa 1972, Bell 1983, 2005, Doveri 2004, Richardson 2004a, 2011, Treigienė 2004, Welt et Heine 2007, Kruys et Ericson 2008, Kruys 2015, this study).

Habitat. On dung of deer, elk, fox, goat, grouse, hare, horse, moose, partridge, porcupine and rabbit (Ahmed et Cain 1972, Furuya et Udagawa 1972, Doveri 2004, Richardson 2004a, Treigienė 2004, Kruys et Ericson 2008, Kruys 2015).

Specimens examined

Ukraine. Kharkiv Region, Izyum District, Izyums'ka Luka Regional Landscape Park, near the village of Spivakivka, mixed forest, 49°10'52.0" N, 36°57'54.6" E, hare dung, 4 Nov. 2010, leg. et det. O. Akulov (CWU-MYC5761). – Sumy Region, Seredyna-Buda District, Desniansko-Starohutsky National Nature Park, Quarter 92, near the village of Vasylivka, pine forest, 52°19'27.7" N, 33°43'50.0" E, hare dung, 20 Sept. 2016, leg. A. Mironets, det. Yu. Lytvynenko (KW-M70962); ibid., 52°19'28.8" N, 33°43'48.9" E, hare dung, 20 Sept. 2016, leg. A. Mironets, det. Yu. Lytvynenko (KW-M70963).

Notes. Ahmed et Cain (1972) reported *S. octomera* on dung of various domestic and wild herbivores. In Europe, it appears to prefer lagomorph droppings (Doveri 2004). Our specimens were collected on hare dung.

Sporormiella pulchella (E.C. Hansen) S.I. Ahmed et Cain, Can. J. Bot. 50(3): 456, 1972 Figs 5I–N

Basionym: *Sporormia pulchella* E.C. Hansen, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 59: 114, 1877 [1876]

≡ *Preussia pulchella* (E.C. Hansen) S. Ahmad, Monogr. Biol. Soc. Pakistan 8: 51, 1979 [1978]

= *Sporormia microspora* Plowright, Trans. Br. Mycol. Soc. 1(2): 63, 1899 [1897–1898]

Description. Pseudothecia scattered, immersed, subglobose, smooth, dark brown, 200–280 µm in diameter; neck short, papilliform, bare, black. Peri-

dium thin, membranaceous. Asci 8-spored, cylindrical, broadest near the apex, gradually tapered into a short stipe, 127–145 × 9.5–10.5 µm. Ascospores uniseriate, 4-celled, 15.2–[18.7]–23.5(24.3) × 4.5–[5.5]–6.8 µm, Q = 2.90–[3.41]–3.88, fusiform, straight or slightly curved, olivaceous brown when young, turning dark brown with age; septa transverse, constrictions at septa broad and deep; segments separable, cells about equal in width, terminal cells longer than the mid-cells, conical, mid-cells oblong to oval; germ slits oblique; gelatinous sheath hyaline, narrow. Pseudoparaphyses filiform, septate, longer than the asci.

Distribution. Europe: Bulgaria, Denmark, France, Germany, Hungary, Iceland, Italy, Spain, Sweden, Ukraine, UK; Africa: Morocco, Tunisia; Asia: Iraq, Pakistan; Australasia: Australia; North America: Canada, Mexico, USA; Atlantic Ocean: St. Helena (Niessl 1878b, Munk 1957, Ahmed et al. 1971, Fakirova 1972, Ahmed et Cain 1972, Ahmad 1978, Valldosera et Guarro 1990, Doveri 2004, Richardson 2004a, 2004b, this study).

Habitat. On dung of cow, deer, goat, porcupine, rabbit and sheep (Ahmed et Cain 1972, Doveri 2004, Richardson 2004a).

Specimens examined

Ukraine. Kherson Region, Hola Prystan District, Chornomorsky Biosphere Reserve, Tendra Spit, near Austrian beacon, 46°13'38.4" N, 31°40'36.4" E, cattle dung, 23 May 2007, leg. V. Hayova, det. Yu. Lytvynenko (KW-M50628). – Sumy Region, Sumy District, settlement of Nyzy, Nyzy Forestry, mixed forest, clearing, 50°46'49.5'' N, 34°45'08.6'' E, roe deer dung, 3 Aug. 2015, leg. A. Butsyk, det. Yu. Lytvynenko (KW-M70968).

Notes. Prior to this study, we reported *S. pulchella* twice from the Sumy Region in Ukraine (Lytvynenko et al. 2016). Here it is described from two more locations and illustrated.

DISCUSSION

Despite rather wide geographical distribution ranges, most of the coprophilous species in the *Sporormiaceae* are encountered infrequently. In addition, the morphological traits of these fungi are often highly variable. For example, ascospores of many species greatly vary in shape and size. For the 14 Ukrainian species of *Sporormiaceae* reported here we compared ascospore morphology with that of other specimens from various geographical regions.

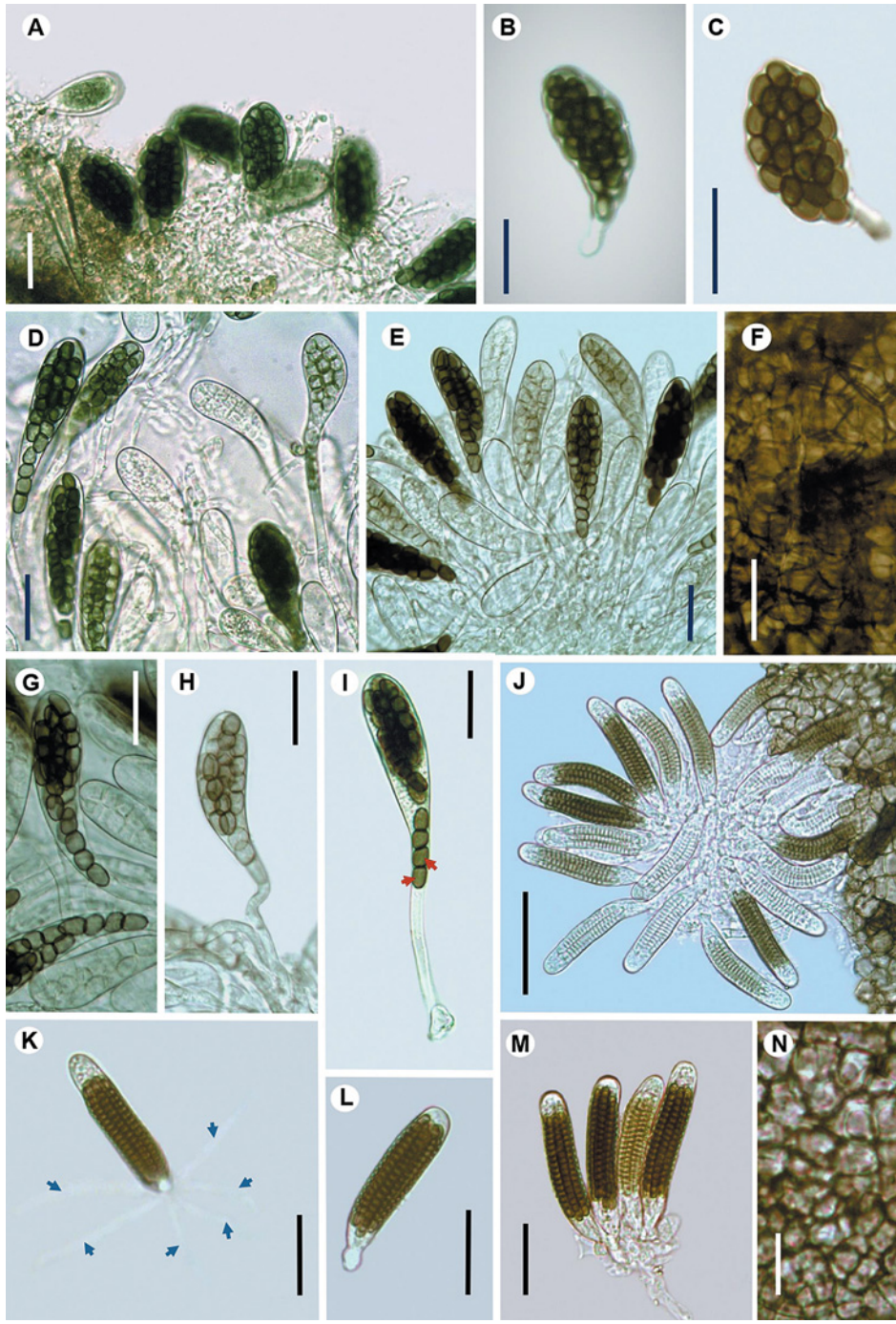
The only representative of *Sporormia* in Ukraine, *S. fimetaria* (Figs 2J–N), is the type species of the genus. One of its distinguishing morphological features is the presence of pointed gelatinous appendages at both spore ends, first described by Dissing (1992). In our observations, the appendages can be seen after

the ascospores are released from the asci (Fig. 2K arrows). The asci and ascospores of this species are highly variable in size. In New Zealand collections, ascospores measured 37–40 × 3.5–4.0 µm (Bell 1983). For European specimens, asci of *S. fimetaria* were reported to fall within the range of 50–70 × 10–13 µm (Dissing 1992) or 55–65 × 11–12 µm (Richardson 1998); ascospores are reported to be 40–55 × 3.0–3.5 µm (Dissing 1992) or 37–45 × 3.0 µm (Richardson 1998) in size. According to Ahmed et Cain (1972), North American collections demonstrated much larger asci (70–80 × 12–16 µm) and ascospores (50–57 × 3.5–4.5 µm). Richardson (1998) therefore concluded that "the European and New Zealand collections represent *S. fimetaria* sensu De Notaris, and that *S. fimetaria* sensu Ahmed et Cain, with markedly longer spores and asci, is a different species". However, Doveri (2004) reported an intermediate size of both asci (63–78 × 11.5–13 µm) and ascospores (47.2–53.6 × 4.0–4.5 µm) for Italian collections. In the Ukrainian specimens, the measurements correspond to those in *S. fimetaria* sensu Dissing (1992) and Richardson (1998), which is currently treated as *S. fimetaria* sensu De Notaris or *S. fimetaria* s. str.

Two species of *Preussia* s. str. are reported here from Ukraine. One of them, *P. funiculata* (Figs 2D–I), the type species of the genus, is the most similar to *P. typharum* (Sacc.) Cain, but differs in having oblique septa and narrower spores with cells more or less equal in size and shape. According to Cain (1961), an important diagnostic feature of *P. typharum* is that the middle ascospore cells are broader than long and distinctly shorter than the end-cells. In *P. funiculata*, the middle cells are cylindrical (Cain 1961). However, in the Ukrainian specimens, the middle cells of ascospores, when first visible in asci, are barrel-shaped as in KW-M71464 (Figs 2D, G), or ovoid as in KW-M71455 (Figs 2H, I); their length is almost equal to the width. The quotient for young middle cells equals 0.89 (KW-M71464) and 1.02 (KW-M71455), respectively. With age, ascospores become narrower and the central cells are extended to become cylindrical (Fig. 2I). The quotient for mature middle cells equals 1.25 (KW-M71464) and 1.18 (KW-M71455), respectively.

Another species, *P. fleischhakii* (Figs 2A–C), is easily recognisable by its uniloculate pseudothecia, transversely septate ascospores and clavate-sacciform

Fig. 2. *Preussia fleischhakii* (KW-M71455): **A** – detail of hymenium with mature and immature asci, **B, C** – mature asci with ascospores; *Preussia funiculata* (D, G: KW-M71464; E, F, H, I: KW-M71455): **D, E** – detail of hymenium with mature and immature asci, **F** – details of exoperidial wall, **G, H** – asci in different stages of maturity, **I** – mature ascus and ascospores with germ slits (red arrows); *Sporormia fimetaria* (KW-M71461): **J** – detail of peridium and hymenium with mature and immature asci, **K** – apical part of squashed ascus with ascospore cluster and gelatinous appendices (blue arrows), **L, M** – mature asci and ascospores, **N** – detail of exoperidial wall. Scale bars = 50 µm (J), 25 µm (A–I, K–M), 20 µm (F, N). Photos by Yu. Lytvynenko. ▶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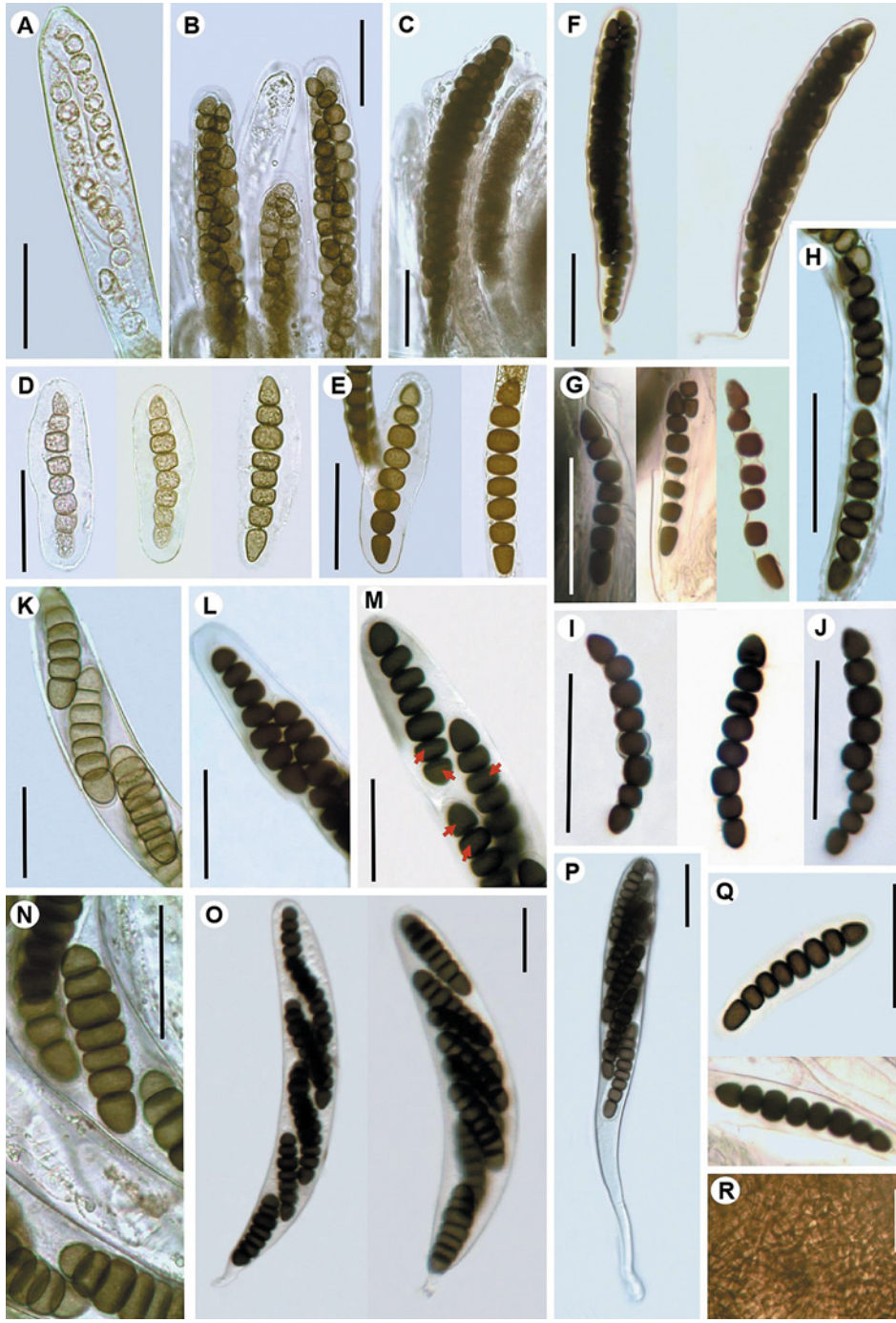
asci with very short stalks (Cain 1961). *Preussia terricola* Cain, resembling *P. fleischhakii* in spore shape and size, is distinguishable by its long stipitate asci and parallel rather than oblique germ slits.

The most species-rich genus in this study is *Sporormiella* with eleven species. *Sporormiella heptamera* (Figs 3K–O) is one of a group of species of the *Preussia/Sporormiella* complex characterised by 7-celled ascospores. Another member of this group, *S. vexans*, also occurs in Ukraine, but *S. heptamera* can be easily distinguished from the other 7-celled species by having the largest spores. In addition, the five central cells of its spores are wider than longer and the third one from the upper end is the largest. Ahmed et Cain (1972) described oblique to diagonal germ slits for this species. Doveri (2004) remarked that the germ slits are diagonal or almost transverse in the middle cells but oblique in the end cells. In our samples, germ slits are predominantly diagonal or almost transverse, with transverse septa occurring in the terminal cells as well (Fig. 3M, arrows).

Sporormiella affinis (Figs 3A–E) and *S. octomera* (Figs 3P–R) belong to a group of *Sporormiella* species with 8-celled spores, middle cells being unequal in width and the third cell being the broadest. Two more species of this group, *S. corynespora* and *S. tomilinii*, are also known from Ukraine. In our specimens of *S. affinis* (KW-M71460, KW-M71462), the spores are longer than those in collections from Spain (75–77 µm – Valldosera et Guarro 1990), Italy (70–75 µm – Doveri 2011) and North America (65–80 µm – Ahmed et Cain 1972), thus approaching the upper limit of its spore length (71–90 µm) as provided in the protologue (Bommer et Rousseau 1886).

At the same time, the Ukrainian material of *S. octomera* has ascospores measuring 35–47 × 6.4–8.3 µm (mean width is 6.9 µm, occasionally 5.4–5.8 µm in width), which is narrower than previously reported for this species: (37)40–48(50) × 7–8 µm (Ahmed et Cain 1972), 38–43.7(45.6) × 8–9 µm (Doveri 2004). Our measurements better fit those from Japanese collections of *S. octomera*, 35–40(45) × 6.5–7.5 µm (Furuya et Udagawa 1972), and comply with the protologue data, mentioning a size of 40 × 5–6 µm (Auerswald 1868).

Fig. 3. *Sporormiella affinis* (KW-M71460): **A** – immature ascospores in apical part of ascus, **B, C** – mature asci with ascospores, **D** – free immature ascospores, **E** – free mature ascospores; *S. commutata* (KW-M50626): **F** – mature asci with ascospores, **G** – free mature 7-celled ascospores, **H** – part of ascus with 7-celled (upper) and 8-celled (lower) ascospores, **I** – free mature 8-celled ascospores, **J** – free mature 9-celled ascospore; *S. heptamera* (KW-M71457): **K** – immature ascospores in apical part of ascus, **L, M** – mature ascospores in apical part of ascus (germ slits are marked by red arrows), **N** – part of ascus with immature ascospores, **O** – mature asci with ascospores; *S. octomera* (KW-M70962): **P** – mature ascus with ascospores, **Q** – free mature ascospores, **R** – detail of exoperidial wall. Scale bars = 50 µm (A–O), 25 µm (P, Q), 20 µm (R). Photos by D. Romanova (A–E), Yu. Lytvynenko (F–R). ▶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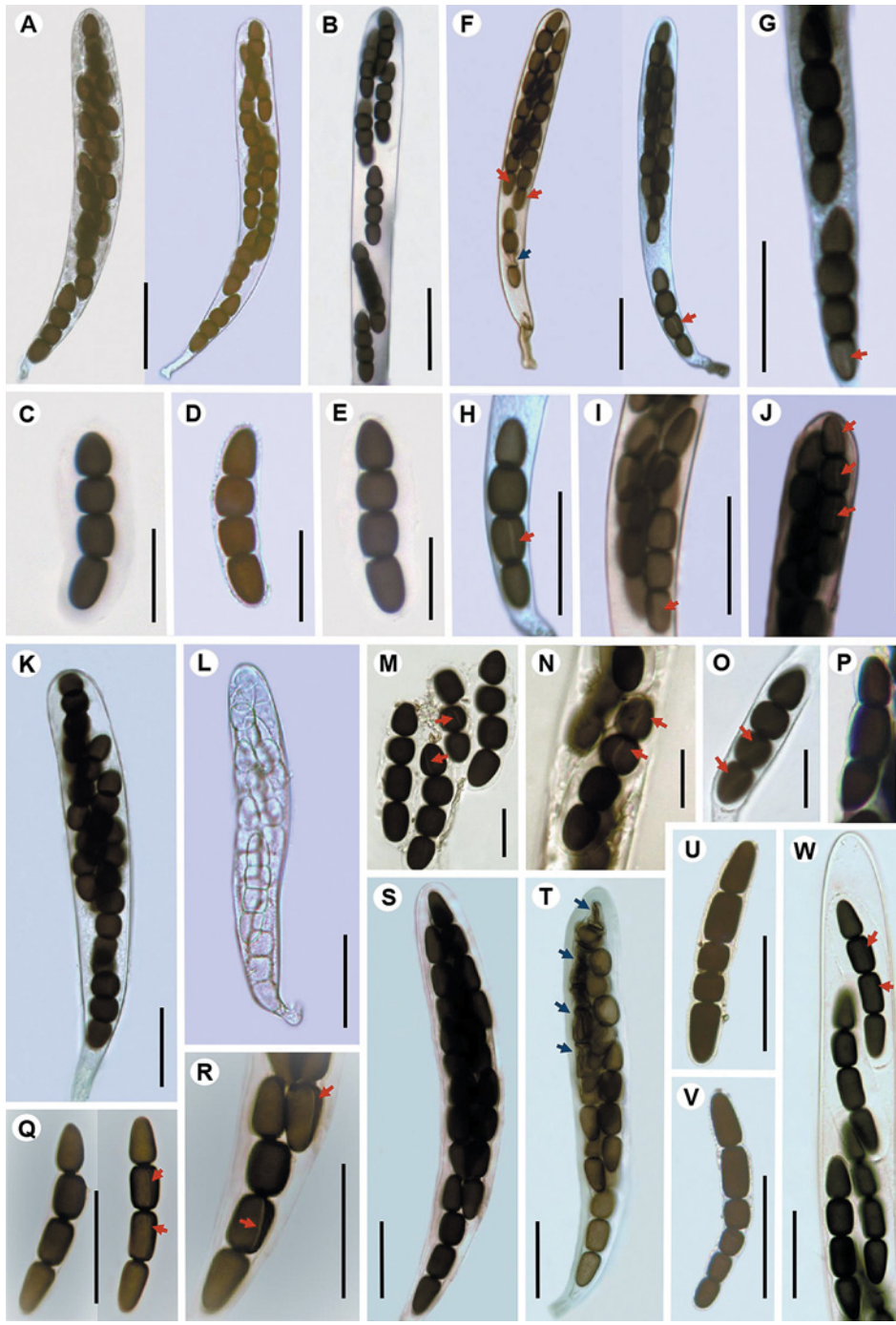
Sporormiella commutata (Figs 3F–J) is a member of a small group of species with a variable number of cells in the ascospores. According to the protologue (Niessl 1878b) and Ahmed et Cain (1972), the cell number in spores mostly equals 9, although 7- and 8-celled spores occur as well. In our specimens, ascospores are mostly 7- (Figs 3G, H) and 8-celled (Figs 3H, I), while 9-celled spores (Fig. 3J) are rarely observed.

The largest group within the genus *Sporormiella* is represented by species with 4-celled ascospores. In this group, *S. grandispora*, *S. megalospora*, *S. kansensis* and *S. longisporopsis* are relatively large-spored species. They form a morphological series of species with asci gradually narrowing in a stipe and ascospores usually not conspicuously tapered toward the ends.

Sporormiella grandispora (Figs 4A–E) is quite similar to *S. lageniformis* and *S. dubia*, both also recorded in Ukraine. These, however, differ from *S. grandispora* by their smaller ascospores and different septa. *Sporormiella lageniformis* has strongly oblique septa, whereas *S. dubia* has constantly transverse ones. As can be seen in Figs 4D and E, the spore septa in *S. grandispora* are mostly transverse, but occasionally slightly oblique septa are visible (Fig. 4C). Further, *S. grandispora* can be confused with another species reported in this article, *S. megalospora* (Figs 4K–P). Nonetheless, *S. megalospora* has larger asci and ascospores which are deeply constricted at the transverse septa, with diagonal (Fig. 4O, arrows) or oblique (Fig. 4M, arrows) rather than parallel (Fig. 4N, arrows) germ slits. Moreover, mature spores of *S. grandispora* do not easily separate into segments, while the segments in the other three species are easily separable. On the whole, the Ukrainian specimens of *S. grandispora* demonstrate considerable variation in spore size, as well as in septa and germ slit orientation, as observed by Richardson (2011).

In the group of species with 4-celled ascospores, *S. kansensis* and *S. megalospora* have ascospores which are often over 60 µm long. However, *S. kansensis* differs in having narrower spores (10–13 µm vs. 14–18 µm) and parallel germ slits

Fig. 4. *Sporormiella grandispora* (KW-M71463): **A, B** – mature asci with ascospores, **C–E** – free mature ascospores; *S. kansensis* (KW-M71458): **F** – mature asci with ascospores (red arrows: germ slits, blue arrow: underdeveloped cell), **G–J** – mature ascospores with germ slits (red arrows) in ascus; *S. megalospora* (KW-M50629): **K** – mature ascus with ascospores, **L** – immature ascus with ascospores, **M** – free mature ascospores with germ slits (red arrows), **N, O** – mature ascospores with germ slits (red arrows) in ascus, **P** – ascospore lacking one septum; *S. longisporopsis* (Q–T: KW-M50656; U–W: KW-M50633): **Q** – free mature ascospores with germ slits (red arrows), **R** – mature ascospores with germ slits (red arrows) in ascus, **S** – mature ascus with ascospores, **T** – immature ascus with underdeveloped ascospores (blue arrows), **U –** mature ascospore with one additional septum, **V** – mature ascospore with two additional septa, **W** – mature ascospores in apical part of ascus (germ slits are marked by red arrows). Scale bars = 50 µm (A, B, F–L, Q–W), 25 µm (C–E, M–P). Photos by Yu. Lytvynenko (A–T), D. Romanova (U–W). ▶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(Figs 4F–J, red arrows). Earlier ascospore measurements revealed some variability in American and Italian collections with ascospores, measuring (68)72–77 × 10–12 µm (Ahmed et Cain 1972) and 69–75(77) × 10.4–13.3 µm (Doveri 2004), respectively. In Taiwanese specimens, Chang et Wang (2009) recorded smaller ascospores, 57–69 × 9–12.5 µm. Our collections have somewhat broader ascospores, but otherwise agree well with the earlier data. An issue under discussion is the ascoma morphology of *S. kansensis*. According to Doveri (2004), "this species can be easily identified by pseudothecia with a long, cylindric neck and covered with wavy, hyphoid hairs". In the protologue (Griffiths 1901), ascomata are described as having long flexuous septate hairs and papilliform to cylindrical necks. Ahmed et Cain (1972), who examined Griffiths' slides of *S. kansensis*, but not Griffiths' collections, suggested that those slides were not in a very good condition and "evidently not the ones used by him in writing his description". Other authors (Khan et Cain 1979, Chang et Wang 2009) reported glabrous pseudothecia for *S. kansensis*. In our collection, the ascomata are slightly tomentose with bare cylindrical necks.

Another long-spored species, with ascospores of more than 70 µm long, is *S. longisporopsis* (Figs 4Q–W). This epithet refers to the resemblance to *S. longispora* (Cain) Ahmed et Cain, and the two species can be hardly distinguished apart from the different arrangement of the ascospores (Ahmed et Cain 1972). In *S. longisporopsis*, ascospores have a bi- or triseriate arrangement (Figs 4S, T), whereas in *S. longispora*, the uppermost four ascospores are arranged in a parallel manner, more or less at the same level in the ascus. In addition, septa in ascospores of *S. longisporopsis* are strictly transverse, while those of *S. longispora* may occasionally be almost oblique. Furthermore, *S. longisporopsis* has wider ascospores, 14–17 µm vs. 12–14 µm according to Ahmed et Cain (1972), and more rounded cells (vs. rectangular cells in *S. longispora*). Richardson (2011), however, remarked that due to the overlapping ascospore size and variable shape of ascospore cells, these two species may well be synonymous. In our specimens of *S. longisporopsis*, ascospores are slightly wider than in the collections from Australia (Bell 2005), Italy (Doveri 2004) and Kenya (Mungai et al. 2012) and better match those from Japan (Furuya et Udagawa 1972) as well as the protologue data (Ahmed et Cain 1972). The terminal cells of ascospores are slightly narrower and longer than the middle ones in the specimens of *S. longisporopsis* described by Ahmed et Cain (1972) and those reported by Furuya et Udagawa (1972) and Doveri (2004), while in the Ukrainian specimens, these cells are almost equal in size (Figs 4Q, R, V).

Two other species reported here, *S. muskokensis* and *S. leporina*, belong to a group with 4-celled ascospores of approx. 25–35 µm long with strongly oblique or occasionally oblique septa and asci gently narrowing towards the base. These morphological traits, in particular the cylindrical-claviform asci gradually

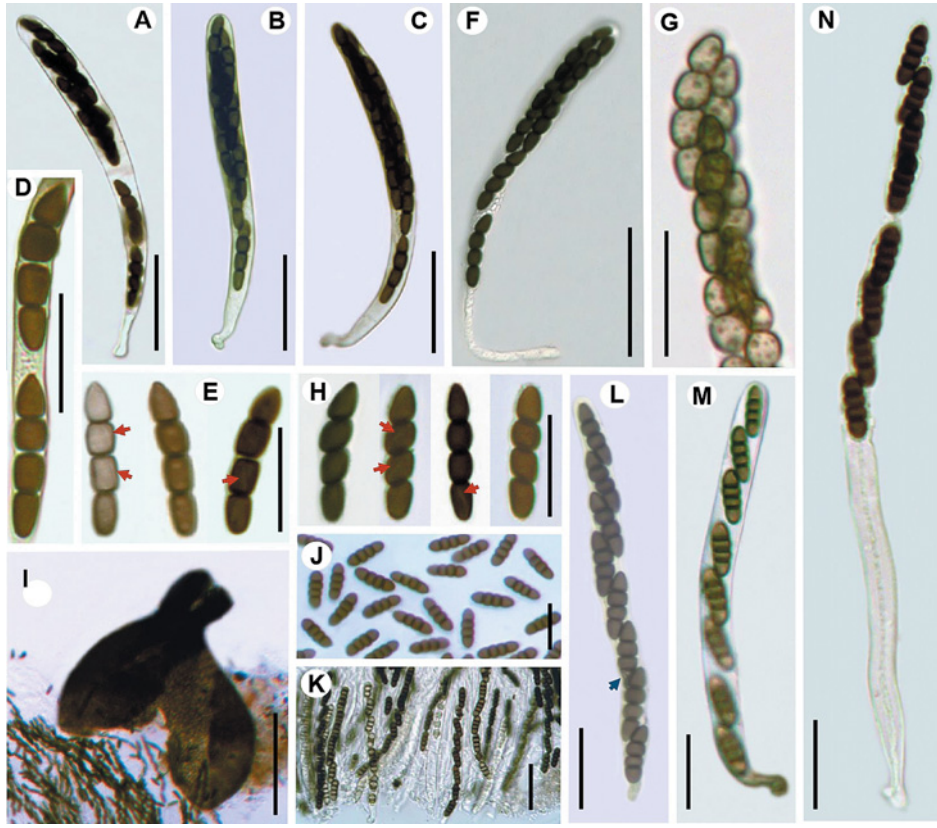

Fig. 5. *Sporormiella leporina*: **A–C** – mature asci with ascospores, **D** – mature ascospores in ascus, **E** – free ascospores with germ slits (red arrows); *S. muskokensis* (KW-M70965): **F** – mature ascus with ascospores, **G** – immature ascospores in apical part of ascus, **H** – free mature ascospores with germ slits (red arrows); *S. pulchella* (I, L: KW-M50628; J, K, M, N: KW-M70968): **I** – squashed ascoma, **J** – free mature ascospores, **K** – detail of hymenium with mature and immature asci, **L, M** – mature asci with ascospores (blue arrow: underdeveloped cell), **N** – ascospores released from ascus. Scale bars = 100 µm (I), 50 µm (A–C, F, K), 25 µm (D, E, G–H, J, L–N). Photos by Yu. Lytvynenko.

narrowed towards the base and spore cells nearly equal in length and with oblique septa, are demonstrated for *S. muskokensis* in Figs 5F–H. *Sporormiella lageniformis* and *S. leporina*, also recorded in Ukraine, are similar but the former differs from *S. muskokensis* in larger spores, 37–42 × 7.5–8.5 µm (Ahmed et Cain 1972) as well as unequal spore cells, i.e. terminal cells longer than middle cells. The latter species has somewhat longer spores, 30–35(37) µm (Ahmed et Cain 1972) and only occasionally oblique septa. The spore size ranges in the Ukrainian specimens of *S. muskokensis* fit those described for collections from North America (Ahmed et Cain 1972) and Lithuania (Treigienė 2004), but the

spores are much wider than reported for the European part of Russia (Prokhorov et Armenskaya 2003).

Sporormiella leporina (Figs 5A–E) also comes very close to *S. isomera* Ahmed et Cain. According to Mungai et al. (2012) and Doveri (2004) relying on Lundqvist's personal comments, these two species differ in the morphology of the germ slits and ascospore cells. In *S. leporina*, the upper cell is mostly conical, while the second cell is a little shorter, broader and rounder than the cylindrical third cell (Fig. 5D). The germ slits in *S. leporina* are mostly oblique (Fig. 5E, arrows) or subparallel, in contrast to parallel to oblique germ slits with a kink near the middle in *S. isomera* (Ahmed et Cain 1972). Mungai et al. (2012), Doveri (2004) and Melo et al. (2017) commented that ascospores of *S. leporina* in water are easily separable at any septum. Ahmed et Cain (1972) and Ahmad (1978), on the contrary, stated that the segments did not separate easily. In our specimens, ascospore cells do not easily separate from each other, except at the central septum (Fig. 5D).

Sporormiella pulchella (Figs 5I–N) is a rather exceptional species which can be easily recognised by its small 4-celled fusiform ascospores (Fig. 5J) arranged uniseriately in cylindrical asci (Figs 5K–N). Due to the small size of mature ascospores, germ slits are quite difficult to observe, as noted by Doveri (2004). In the Ukrainian specimens, we observed oblique to parallel germ slits in young, immature spores only. Other authors regarded them as oblique to diagonal (Ahmed et Cain 1972, Valldosera et Guarro 1990). In our examination, spore size varied between the specimens. The ascospores measuring 17.4–23.5(24.3) × 5.8–6.8 µm in KW-M50628 (Figs 5I, L) comply with the protologue data (Hansen 1877) and data given by other authors (Ahmed et al. 1971, Ahmad 1978, Valldosera et Guarro 1990, Doveri 2004), while the ascospores in KW-M70968 (Figs 5J, M, N) are slightly smaller (15.2–16.8 × 4.5–6.2 µm). In both specimens, the spores are at the lower end of the size range described by Ahmed et Cain (1972).

Finally, in addition to the morphological characteristics of the spores described, other anomalies have occasionally been recorded (Cain 1961, Doveri et al. 1999, Doveri 2004). Within the *Sporormiaceae*, spores with underdeveloped cells or spores devoid of one or more septa often occur. We have also observed anomalous ascospores with undeveloped cells in *S. kansensis* (Fig. 4F, blue arrow), *S. longisporopsis* (Fig. 4T, arrows) and *S. pulchella* (Fig. 5L, arrow). In *S. megalospora*, anomalous 3-celled spores were detected (Fig. 4P). In the spores of *S. longisporopsis* we noticed one or two additional septa (Figs 4U, V), which had not been reported before.

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