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## Fungi on higher plants of the upper limit of alpine zone in Tian Shan

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**Abstract** — Fifty-two taxa of fungi were noted in upper limit of closed vegetation in Zailiyskiy Alatau Mts. (Tian Shan) in Kazakhstan. Of them only 30% were saprobic species. Six new species were described: *Cyathicula brunneospora*, *Microbotryum adenopetalae*, *Pirottaea atrofusca*, *Protoventuria juniperina*, *Trichometasphaeria barriae*, and *Veronaea thylacospermi*. A new combination, *Didymosphaerella spartii* with a possible *Sclerostagonospora* anamorph was proposed. There are some common species as well as rare ones: *Cistella tianschanica*, *Comoclathris planispora*, *Didymosphaerella spartii*, *Lagarobasidium detriticum*, *Mytilinidion acicola*, *Pleospora primulae*, *Scutellinia kerguelensis* var. *microspora*, *Wettsteinina oreophila*. The complete list is available on: <http://www.mycotaxon.com/resources/weblists.html>

**Key words** — parasites and saprotrophs, distribution, Kazakhstan

## Introduction

The current study aims to assess the diversity of fungi in upper alpine plant limit in Tian Shan. It is very difficult to describe all fungi linked with host plants. Neubert et al. (2006) investigated mycobiota of *Phragmites australis* and obtained 345 operational taxonomic units (OTU) using molecular methods. However in spite of the high diversity of obtained OTU, only some species of fungi dominated the plant organs. When we use traditional methods basing on morphological observations, we can find only a small part of the mycobiota linked with the host plant, but we expect that among the determined fungi will be present the dominant (important for the plant) fungal species. Mycorrhizal fungi (EM, AM) were not included because of their possible absence in the high mountain environments. Some information on fungi of the western part of Tian Shan is reported by Schwartzman (1962), Vasyagina (1977), Korbonskaya (1951, 1954), Raitvir (2004), Chlebicki (2002b, 2003, 2006, 2009), Chlebicki & Aime (2006), Chlebická & Chlebicki (2007) and Gaffyorov (2005). Miscellaneous data concerning fungi from Central Asia can be found in the many books and articles. Alpine fungi on wild grasses and sedges have been investigated by Eriksson (1967) and Scheuer (1988). Nogrsek & Matzer (1994) noted some species on *Carex firma* and *Sesleria varia*. Magnes & Hafellner (1991) reported some fungi on *Carex rostrata*. Chlebicki (2002a) investigated fungi on *Carex rupestris*, *Carex magellanica* subsp. *irrigua* and *Juncus trifidus*. Suková (2004) and Suková & Chlebicki (2004) reported the occurrence of 24 species of fungi on *Juncus trifidus*. In 2005, I investigated fungi from the upper limit of closed vegetation in Tian Shan. Some of them were new to science, *Cyathicula brunneospora*, *Pirottaea atrofusca* (Chlebická & Chlebicki 2007) and *Microbotryum adenopetalae* (Lutz et al. 2008). Another three species are described in the same volume, *Protoventuria juniperina*, *Trichometasphaeria barriae* and *Veronaea thylacospermi* and a new combination, *Didymosphaerella spartii* (Chlebicki 2009). The fungi from such genera as *Botrytis*, *Hymenella* and *Fusarium* were determined only to genus.

## Materials and Methods

**Study area:** The terminal glacier foreland of Issyk valley in Zailiyskiy Alatau Mts. (Tian Shan) in the vicinity of Almaty in southern Kazakhstan was investigated. The study was conducted 3 August 2005 in the slope of a marginal moraine (inactive ground ca 300 m before the ice margin) of the uppermost small basin in the front of the glacier. The full collection data is: KAZAKHSTAN, TIAN SHAN: Zailiyskiy Alatau Mts., , at 3436,5 m elev., N 43° 07' 52.5", E 77° 30' 25", 3440 m elev, 3 August 2005, coll.: A. Chlebicki – hereafter abbreviated to: KAZAKHSTAN, TIAN SHAN: permanent plots. A distinct limit of closed vegetation was present. The native habitats of all plants were composed of initial soil partially covered by granite rocks of various size (some cm to 1m diam). Material was collected from sixteen 2,5 × 2,5 m permanent plots forming a 10 m × 10 m square with a stream at this lower edge and the top of the moraine at its upper edge (see Fig. 1 for plot labelling). Plants growing at the altitudinal limit belong to various growth forms such as cushion plants (*Thylacospermum*, *Dryadanthe*), mat forming forbs (*Cerastium*), rosette perennial plants (*Draba*, *Oxyria*, *Primula*, *Saxifraga*, *Silene*, *Saussurea*, *Leontopodium*), tussock graminoids (*Anthoxanthum*, *Festuca*, *Carex*), prostrate dwarf shrubs (*Juniperus*, *Pentaphylloides*, *Salix*), and tiny bryophytes. There were present also two lichen species from the genera *Opegrapha* and *Caloplaca*.

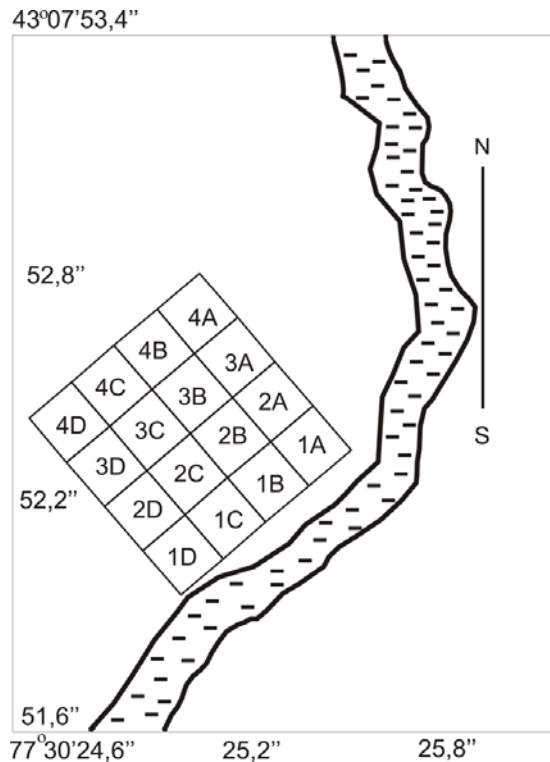


FIG. 1. Permanent plots composed of 16 plots, each 2,5 × 2,5 m which form square 10 m × 10 m

**Methods:** Dried material was examined under a zoom stereo microscope (Nikon SMZ 1500), and also with a light microscope Labophot 2 (Nikon) and Olympus BX-51, at magnifications of 1000× and 2000×, and in some cases using Nomarski contrast (DIC). Microscopical observations and measurements were made on material in water and in 3% KOH. Freehand-made longitudinal sections of ascocarps were observed in water or 3% KOH. Lugol's solution (IKI: 1% iodine, 3% KI in water), Melzer's reagent (MLZ) and 5% KOH were used to describe the reactions of apical rings and character of setae. Gelatinous sheaths of free ascospores were observed in India ink. Materials are deposited at the W. Szafer Institute of Botany of Polish Academy of Sciences in Kraków (Poland) and the National Museum in Prague (Czech Republic).

## Results

I found 46 fungus species and 6 taxa which were determined at the genus level. Ascomata and conidiomata of some fungi, in dead state, were not recognizable. Six species were described as new and a new combination is added. Tussock plants have the richest mycobiota (Tab. 1), especially two of them: sedge *Carex griffithii* and grass *Anthoxanthum alpinum*. However in one investigated square six new species (Chlebická & Chlebicki 2007, Lutz et al. 2008, and this article) were found: on *Anthoxanthum alpinum*, *Carex griffithii* and *Festuca coelestis* (2), *Silene adenopetala* (1), *Juniperus sibirica* (1), *Thylacospermum caespitosum* (1) and *Waldheimia trydactylites* (1). Strictly phytoparasitic species were a common component of the mycobiota (28% of all species). *Davidiella tassiana* colonized the highest number (9) of the host plants. 20 species of fungi (38%) were noted on senescent and dead plant organs, indicating their semiparasitic status. I found only 18 saprobic species which accounted approximately 34% of the total number of fungi. Leaves of the plants, i. e. *Cerastium cerastoides*, *Carex griffithii*, were partly covered by ascospores and conidia of various species of the genera *Pleospora* Rabenh. ex Ces. & De Not., *Phaeosphaeria* I. Miyake and others. Ecology and distribution patterns of the fungi in the investigated square will be presented in a separate article.

TABLE 1. Number of fungi noted on investigated plants

PLANT SPECIES	NO. OF FUNGI	PLANT SPECIES	NO. OF FUNGI
1. <i>Anthoxanthum alpinum</i> Á. Löve & D. Löve	22	12. <i>Oxyria digyna</i> (L.) Hill	2
2. <i>Carex griffithii</i> Boott	28	13. <i>Pentaphylloides fruticosa</i> (L.) O. Schwarz	0
3. <i>Cerastium cerastoides</i> (L.) Britton	5	14. <i>Primula nivalis</i> Pall.	4
4. <i>Doronicum oblongifolium</i> DC.	0	15. <i>Pyrethrum karelinii</i> Krasch.	0
5. <i>Draba incurvata</i> A.N. Vassiljeva & Golosk.	3	16. <i>Salix alata</i> Kar. & Kir. ex Stschehl.	3
6. <i>Draba oreades</i> Schrenk	5	17. <i>Saussurea</i> sp.	5
7. <i>Dryadanthe tetrandra</i> (Bunge) Juz.	0	18. <i>Saxifraga cernua</i> L.	5
8. <i>Erigeron</i> sp.	0	19. <i>Saxifraga oppositifolia</i> L.	0
9. <i>Festuca coelestis</i> (St.-Yves) V.I. Krecz. & Bobrov	18	20. <i>Silene adenopetala</i> Raikova	9
10. <i>Juniperus sibirica</i> Burgsd.	3	21. <i>Thylacospermum caespitosum</i> (Cambess.) Schischk.	11
11. <i>Leontopodium leontopodium</i> (DC.) Hand.-Mazz.	1	22. <i>Waldheimia tridactylites</i> Kar. & Kir.	7

***Alternaria alternata*** (Fr.) Keissl., Beih. Bot. Centralbl. 29: 433, 1912.

MYCELIUM pale grey, aerial, covered surface of leaves, HYPHAE olivaceous, 3–5 µm wide, septate, CONIDIOPHORES with apical cluster of branching chains of conidia, CONIDIA pale brown, finely verrucose 20–45 × 8–11 µm, with 3–5 transverse septa and some longitudinal septa.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on senescent leaves and stems of *Saxifraga cernua* L., Plot 2C.

***Alternaria tenuissima*** (Nees & T. Nees: Fr.) Wiltshire, Trans. Br. Mycol. Soc. 18: 157, 1933.

MYCELIUM pale grey, aerial, covered surface of single leaf, CONIDIA pale brown, finely verrucose 50–56 × 13–16 µm, with 5–7 transverse septa and some longitudinal septa.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on senescent leaves of *Silene adenopetala* Raikova, Plot 3A.

COMMENTS—*Alternaria tenuissima* is a very common fungus (Simmons 2007) mostly recognized as secondary pathogen or saprotroph.

***Barrmaelia oxyacanthae*** (Mont.) Rappaz, Mycol. Helv. 7: 137, 1995.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on decorticated twig of *Salix alata* Kar. & Kir. ex Stehgl. (only 10 perithecia), Plot 4A.

COMMENTS—The species was noted on dead branches of various hardwoods in Europe and North America (Rappaz 1995).

***Botrytis*** sp.

SCLEROTIA dark brown, slightly erect with flat or pulvinate surface 1000–1500 × 340–400 µm, CONIDIOPHORES unbranched or with 1 or some branches near the apex, 200–500 µm long, 18–22 µm wide, thin walled (1–1.2 µm thick), mostly 5 septate, slightly constricted at the septa, base cells brown, last upper cell swollen and distinctly paler to hyaline, conidial head up to 67 µm diam., CONIDIA (blastospores) hyaline to pale olivaceous, smooth, ovoid with pointed base 8–13 × 6–8 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead stems of *Draba oreades* Schrenk, Plot 3A.

COMMENTS—The fungus resembles *B. cinerea* Pers., but its mostly poorly branched conidiophores are an unusual character in the genus *Botrytis*.

***Cainia graminis*** (Niessl) Arx & E. Müll., Acta Bot. Neerl. 4: 112, 1955. FIGURE 2A

PERITHECIA scattered, 600–800 µm diam, partially immersed in plant tissue, ostioles distinct, ASCI cylindrical, 8-spored, 220–260 × 15–22 µm, p. sp. 180–190 × 15–22 µm, ASCOSPORES brown, 1-septate, slightly constricted at the septum, smooth with 5 striatae (FIG. 2A).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Carex griffithii* Boott, Plots 3C, 4C; on *Festuca coelestis* (St.-Yves) V.I.Krecz. & Bobrov, Plot 4D (only some ascocarps).

COMMENTS—Number of ridges on ascospores in different collections of *Cainia graminis* is quite variable. Wehmeyer (1975) noted that ascospores are octagonal, Eriksson (1967) stated that the spores are polygonal, mostly hexagonal, while Paraguey-Leduc & Chadefaud (1963) noted 5, 6 or 7 ridges on the ascospores. *Cainia graminis* is an arcto-alpine species reported on *Cyperaceae* and *Poaceae* (Eriksson 1967, Scheuer 1988, Nogrsek 1990).

***Calyptella campanula*** (Nees) W.B. Cooke, Beih. Sydowia 4: 32, 1962. FIGURE 2C

RECEPTACLE numerous, campanulate, creamy to light tan, 450–820 (900) µm diam., with slender stipe ca 400–500 µm long, HYMENIUM yellow to pale brown, BASIDIA 16.7–22.9 × 5.8–6.7 µm, 4 sterigmate, sterigmata 2.6–3.2 × 1.1–1.5 µm, BASIDIOSPORES hyaline 5.6–8.8 × 4.1–4.9 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on very old destroyed leaves and stems at the base of tussock of *Carex griffithii*, Plots 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B, 4A.

COMMENTS—A similar species, *C. capula* (Holmsk.) Quél. 1888, possesses pale yellow receptacles, funnel-shaped cups, slightly smaller basidiospores and distinctly longer stipae. *Calyptella campanula* was noted on herbaceous stems near the ground on different plants in Europe and North America (Cooke 1961). The fungus was also noted on living roots of potatoes (Clark et al. 1983).

***Cistella tianschanica*** Raitv., Scripta Mycol. 8: 153, 1978. FIGURE 2E

APOTHECIA superficial, scattered on stem surface, EXCIPULUM cistelloid, cells thin walled, pale, isodiametric to prismatic with surrounded corners, HAIRS in upper part of apothecium,

clavate, thin walled, apically finely spiny (FIG. 2E), smooth below  $17.1\text{--}30.1 \times 5.7\text{--}6.3 \mu\text{m}$ , 1–3 septate but mostly with a single septum. ASCI with croziers  $32.4\text{--}34.8 \times 5.4\text{--}6.0 \mu\text{m}$ , SPORES hyaline, one-celled  $7.3\text{--}9.1(10) \times 1.9\text{--}2.5 \mu\text{m}$ , PARAPHYSES hyaline, cylindric, exceeded the asci for  $4.4\text{--}5.7 \mu\text{m}$ ,  $1.7\text{--}2.5 \mu\text{m}$  wide, apex rounded.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Silene adenopetala*, Plot 4D.

COMMENTS—Raitviir (2004) suggested that it is an alpine species restricted to the Asia. Investigated apothecia were immature, and the size of its hairs and asci were smaller than in type collection. Hairs of Tian Shan specimens belong to *C. grevillei*-type, mentioned by Raitviir (2004). Those specimens noted on *Festuca coelestis* have apothecia covered by rhomboid crystals and hairs incrustated only in the top area by sparse stipitate warts, but a very scanty collection does not enable its precise description and is too sparse for a type collection.

***Cladosporium herbarum*** (Pers.) Link, Ges. Naturf. Freunde Berlin Mag. 7: 37, 1816.

Teleomorph: *Davidiella tassiana*

CONIDIA pale brown, verruculose, 0–1 septate,  $6\text{--}16 \times 4\text{--}5 \mu\text{m}$ .

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead stems of *Carex griffithii*, Plot 2A.

COMMENTS—It is a very common saprotroph growing on various substrata, see also *Davidiella tassiana*.

***Cladosporium macrocarpum*** Preuss, Deutschl. Fl., 3. Abt., 6: 27, 1848.

Teleomorph: *Davidiella macrocarpa* Crous et al.

CONIDIOPHORES pale brown, flexuous, geniculate and nodose  $80\text{--}100 \mu\text{m}$  long  $5\text{--}9 \mu\text{m}$  wide.

CONIDIA olivaceous, densely verrucose, 0–2 septate  $18\text{--}21(32) \times 8\text{--}10 \mu\text{m}$ .

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves of *Waldheimia tridactylites* Kar. & Kir., Plot 1B.

COMMENTS—saprotroph growing on dead plants, human and hypersaline water (Schubert et al. 2007).

***Comoclathris pentamera*** (P. Karst.) S. Ahmad, Monogr. Biol. Soc. Pak. 8: 68, 1979.

FIGURE 5A

ASCOMATA mostly scattered, subepidermal,  $230\text{--}250 \mu\text{m}$  diam., ASCI  $124\text{--}160 \times 26\text{--}29 \mu\text{m}$ , ASCOSPORES fusoid, straight, transversely 4-septate, with one longitudinal septum in mid cells, upper cell wider and pointed,  $36\text{--}39 \times 16\text{--}19 \times 7\text{--}9 \mu\text{m}$  (FIG. 5A), ascospores surrounded by gelatine sheath.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on sheaths of *Carex griffithii*, Plots 2A, 3C, 4A, 1B, 4C, 3B.

COMMENTS—The fungus was very often noted on sedge stems in the investigated area. It has an arctic and alpine distribution and was previously reported on *Poaceae* and *Cyperaceae*, rarely on *Asteraceae*, *Caryophyllaceae* and *Apiaceae* in Europe and North America, also in Cenral Asia: Karakorum Mts. on *Poa pratensis*; Kashmir (India) on *Poa* sp., *Heracleum thomsonii*, and *Scorzonera divaricata*; Turgaj (Kazakhstan) on *Achnatherum splendens* (Shoemaker & Babcock 1992). *Carex griffithii* is a new host plant for this fungus.

***Comoclathris planispora*** (Ellis) Harr, Nova Hedwigia 20: 868, 1971. FIGURE 2D

ASCOMATA scattered, immersed, globose, slightly flattened, strongly setose or devoid of setae, SETAE 3–4 septate, up  $100 \mu\text{m}$  long,  $10\text{--}12 \mu\text{m}$  diam. at base, ASCI cylindric clavate, bitunicate  $130\text{--}162 \times 29\text{--}32 \mu\text{m}$ , ASCOSPORES pale brown, ellipsoidal with 5 transverse septa (rarely 6) and one longitudinal dorsoventral septum through the 4 central segments,  $36\text{--}42 \times (13\text{--})15\text{--}20 \times 8\text{--}10 \mu\text{m}$  (FIG. 2D).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on sheaths of *Carex griffithii*, Plots 1B, 1D, 3C, 4B, 3B, 4D, 4C.

COMMENTS—The fungus commonly occurs on sedge stems and leaves in the investigated area. It is a species with alpine distribution, noted in Europe, North America and India (Kashmir) on 10 host plants, among them on *Carex* sp., *Deschampsia cespitosa*, *Elymus* sp. and *Trisetum spicatum* (Shoemaker & Babcock 1992). *Carex griffithii* is a new host plant for this fungus.

***Cyathicula cyathoidea*** (Bull.) Thüm., Fungi Austriaci no. 1115, 1874.

Specimens from *Primula nivalis*: APOTHECIA cupulate, grey-brown, stipitate, 300–480 µm diam. when rehydrated, MARGIN finely denticulate, medullar EXCIPULUM pale yellow, ASCI octosporous, 45 × 5 µm (dead state), clavate, mainly arising from simple septa, apical ring of the *Conchatium*-type, IKI+ blue, ASCOSPORES one celled, hyaline, cylindric-clavate, slightly curved 8–9 × 1.5–2.2 µm, PARAPHYSES filiform, septate, slightly thickened at the rounded tips, with many droplets inside upper part (living state), slightly exceeding the dead asci. EXCIPULAR HYPHAE distinctly pale brown, smooth, rhomboid crystals present on the outer surface of apothecium. Specimens from *Carex griffithii* (KRAM F 46568): APOTHECIA 190–340 µm diam. when dry, 370–600 µm diam. when rehydrated, STIPE dull light, up to 300 µm long, EXCIPULUM honey coloured, apothecium surface with densely distributed rhomboid crystals, margin denticulate, ASCI arising from simple septa, 50–60 × 4.6–5.2 µm (dead state), IKI +, ASCOSPORES hyaline, nearly straight, 9–11 × 1.8–2.2 µm, PARAPHYSES filiform, septate, with slightly thickened apex, containing many droplets (living state), 1.7–2.4 µm diam., exceeding the dead asci for 6.5–8.6 µm diam. The fungus from *Festuca coelestis* has similar ascospores 7.6–10 × 2.4–2.7 µm, but the droplets in the paraphyses are not so densely distributed as in the collection from *Primula nivalis*, top of paraphyses 2.3–3.2 µm diam.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Primula nivalis* Pall. Plot 2C, *Festuca coelestis* Plots 3B, 4B and *Carex griffithii* Plots 3B, 4B.

COMMENTS—The collections differ from typical *C. cyathoidea* by pale brown excipular hyphae (not hyaline) and darker apothecia. However, they possess an apical ring of the *Conchatium*-type characteristic of the *C. cyathoidea*-group (Triebel & Baral 1996). Carpenter (1981) noted the species on 103 host taxa from Europe, both Americas, Africa, Australia and Asia, also from Kazakhstan (Altai Mts).

***Cyathicula brunneospora*** M. Chlebická & Chleb., Mycotaxon 100: 38, 2007

APOTHECIA shortly stipitate, RECEPTACLE dark, covered with pale powder, rhomboid crystals on the outer surface of apothecium present. Outer layers of ECTAL EXCIPULUM dark brown, inner layers and medulla hyaline, hymenium dark brown. ASCI 113–119 × 13.5–16 µm (dead state) arising from croziers, apical apparatus inamyloid in MLZ, KOH/MLZ, IKI, KOH/IKI. ASCOSPORES pale brown when young, dark brown when mature, smooth, mostly 3-septate, 23–29.5 × 5.9–7.2 µm, surrounded by a hyaline, gelatinous sheath. PARAPHYSES hyaline and septate in their lower parts, branched in their upper parts, with enlarged, 3.8–4.5 µm broad, smooth, pale brown tips. For a more detailed description of the fungus see Chlebická & Chlebicki (2007).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead lying leaves and culms of *Carex griffithii*, 1C, 3C, 4A, 4B, 4C, 4D and culms of *Festuca coelestis*, Plot 3A.

COMMENTS—The species is close to *Crocicreas melanosporum* (Rehm) S.E. Carp. 1980 = *Cyathicula melanospora* (Rehm) Chlebická & Chleb. 2007. In the collection on *Carex*, *Cyathicula brunneospora* occurred on the dead plant parts in a big tussock of the sedge.

***Cyathicula spicarum*** (Rehm) E. Müll., Beitr. Kryptogamenfl. Schweiz. 15(1): 35, 1977.

Specimens from *Festuca coelestis*: APOTHECIA shortly stipitate, 190–250 µm diam. when dry, light brown, margin inrolled, hymenium and EXCIPULUM hyaline, only surface of excipulum darker, ASCI with croziers, 42–55 × 4.6–5.3 µm (dead state), apical ring in 3% KOH + MLZ pale blue, SPORES non-septate, hyaline, with two oil drops at the ends, 9.3–10.2 × 2.4–2.6 µm, PARAPHYSES hyaline, nearly cylindrical, diam: 2.5–2.8 µm, exceeding asci by 5.7–9.3 µm, smooth. Specimens from *Carex griffithii* (KRAM F 56190): APOTHECIA 170–250 µm diam. when dry, EXCIPULUM light brown, margin inrolled, ASCI 39–45 × 4.2–5.9 µm (dead state), SPORES hyaline, eguttulate, 7.4–9 × 2.0–2.3 µm, PARAPHYSES hyaline, nearly cylindrical, 1.8–2.4 µm diam., exceeding the asci for 4.7–9 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Festuca coelestis*, Plot 2B and *Carex griffithii*, Plot 3C.

COMMENTS—This is a graminicolous species, known also from *Festuca ovina*, noted mostly at high alpine and boreal regions (Carpenter 1981).

***Davidiella tassiana*** (De Not.) Crous & U. Braun, Mycol. Prog. 2: 8, 2003.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Anthoxanthum alpine* Å. Löve & D. Löve, Plots 1D, 3B, 4D; *Carex griffithii*, Plots 1A, 2A, 2C, 3A, 3B, 4D; *Festuca coelestis*, Plots 1A, 4D; *Leontopodium leontopodium* (DC.) Hand.-Mazz., Plot 4D; *Saussurea* sp., 2D; *Saxifraga cernua*, Plots 3A, 2C; *Silene adenopetala*, Plot 4B; *Waldheimia tridactylites* Plots 3D, 2D, 1B; *Cerastium cerastoides* (L.) Britton, Plot 1C.

COMMENTS—This is a common species on various plants, cosmopolitan (Schubert et al. 2007).

***Didymosphaerella spartii*** (Fabre) Chleb., Mycotaxon 110: 444, 2009, FIGURE 2 B

Bas: *Didymosphaeria spartii* Fabre, Ann. Sci. Nat., Bot., sér. 6, 9: 83, 1879.

≡ *Sphaeria spartii* Castagne, Cat. Pl. Marseille: 169, 1845, nom illegit., non Nees : Fr. 1823.

≡ *Microthelia spartii* (Fabre) Kuntze, Revis Gen. Pl. 3(2): 498, 1898.

≡ *Montagnula spartii* (Fabre) Aptroot, Nova Hedwigia 60: 342, 1995.

= *Didymosphaeria elbursensis* Petrak, Ann. Naturh. Mus. Wien. 50: 429, 1940.

ASCOMATA globose ca 240 µm diam., peridium wall widest in lower part, textura angulata, ASCI bitunicate, clavate 110–130 × 20–21 µm, ASCOSPORES 1-septate, slightly constricted at the septum, clear reddish brown, hemispores unequal, upper hemispore wider and slightly pointed, (20–)24–27 × 11–12 µm, wall thick and finely verruculose (FIG. 2B, left side), gelatinous sheath 3–7 µm thick, uniseriate in the lower part and biseriate in upper part of ascus, INTERASCAL HYPHAE (cellular pseudoparaphyses) narrow, 1–1.4 µm diam. in its lower part and 2.2 µm diam. in upper part.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Carex griffithii* and *Anthoxanthum alpinum*, coll.: A. Chlebicki, Plot 1C, 2C, 3B.

COMMENTS — Barr (2001) lectotypified the genus *Didymosphaerella* Cooke by *Didymosphaerella longipes* (Trab.) Cooke 1889. She placed the genus in her new family *Montagnulaceae* M.E. Barr and transferred *Montagnula* Berl. species with two celled ascospores to the genus *Didymosphaerella*. The fungus from Tian Shan is identical with *Didymosphaeria elbursensis* (Fig.2B right side) noted on *Festuca sulcata* in Mt. Damawed in Elburs Mts. (Iran), which Aptroot (1995a,b) synonymized with *Montagnula spartii*. He also included here some species noted on palm leaves, brooms, *Ephedraceae* and *Poaceae* which according to him do not differ much in morphological structure. Aptroot (1995a) pointed out that *M. spartii* has thicker ascospore wall than *M. opulenta* (De Not.) Aptroot (≡ *D. opulenta* (De Not.) Checa & M.E. Barr, which Barr (2001) restricted to collections from *Opuntia*). Both Tian Shan and Elburs specimens of *D. spartii* possess thick walled ascospores (FIG.1B). However size and shape of these ascospores are different from other taxa included by Aptroot (1995a) in *M. spartii*. Aptroot (1995a) mentioned as host plants some other grasses such as

*Festuca brachyphylla*, *Puccinellia angustata* and *Stipa himalaica*. The species was noted in North America, Greenland and Asia.

***Sclerostagonospora* sp.**

FIGURE 4 B

CONIDIOMATA immersed, CONIDIA pale brown with surrounded tips, three septate, 14–19 × 4–5 µm (FIG. 4B).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Festuca coelestis* Plots 2B, 3C; *Anthoxanthum alpinum* Plot 1A.

COMMENTS—Close occurrence of the fungus with *Didymosphaerella spartii* indicate that it can be tentatively recognized as possibly its anamorph.

***Fusarium* sp.**

CONIDIOMATA 460 × 370 µm, pale orange, situated on lower part of plant cushion in contact with soil, CONIDIA hyaline 4–6 celled, falcate 31–40 × 3.8–4 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on internal cushion stems of *Thylacospermum caespitosum* (Cambess.) Schischk., Plot 2D.

***Glomerella graminicola* D.J. Politis, Mycologia 67: 61, 1975.**

ASCI cylindrical, ASCOSPORES hyaline, one-celled 9–12 × 4–5 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves of *Anthoxanthum alpinum*, Plot 4A.

COMMENTS—The fungus commonly occurs on all senescent and dead leaves. Its anamorph was earlier noted on leaves of *Anthoxanthum odoratum* in New Zealand (Pennycook 1989). Sutton (1980) applied *C. graminicola* only to collections from *Zea*. It seems that fungi included in *G. graminicola* form a complex of similar species.

***Heteropatella umbilicata* (Pers.) Jaap, Annls mycol. 5: 266, 1907.**

CONIDIOMATA black, unilocular, depressed at the centre, 250–300 µm diam, thick walled cells, textura angulata, CONIDIA hyaline 3-celled, 27–30 × 1.8–2 µm, apical cell prolonged with an unbranched appendage.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead stems of *Saxifraga cernua*, Plot 2C.

COMMENTS—The fungus was noted in temperate and arctic-alpine areas. Sutton (1980) mentioned 10 host plants, among them alpine plants such as *Oxyria digyna*, *Bartsia alpina*, but also *Daucus carota* and *Pastinaca sativa*. Chlebicki (2002a) noted it in Arctic Siberia on *Salix reticulata*.

***Hysteropezizella fuscella* (P. Karst.) Nannf., Nova Acta R. Soc. Scient. Upsal. Ser. 2, 8(2): 115, 1932.**

APOTHECIA sessile, dark, erumpent, rarely immersed, 240–300 µm diam, with many pale hairs at the margins, ASCI 85–88 × 12–13 µm (dead in water), apical ring IKI deep red, croziers absent, ASCOSPORES 14–18 × 5–6 µm (dead in water), aseptate with two big oil drops, PARAPHYSES lanceolate, 75–100 long, up to 5 µm wide in upper part, rough, slightly longer than asci.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems and leaves of *Carex griffithii*, Plots 2A, 3A, 4A, 1B, 2B, 3B, 4B, 1C, 2C, 3C, 4C, 1D, 2D (det. H.O. Baral, H.B 8462).

COMMENTS—This species is very similar to *Coronellaria caricinella* (P. Karst.) P. Karst. 1870, the latter differing in longer marginal hairs and paler apothecia. *Hysteropezizella fuscella* is very common discomycete on *Carex griffithii*.



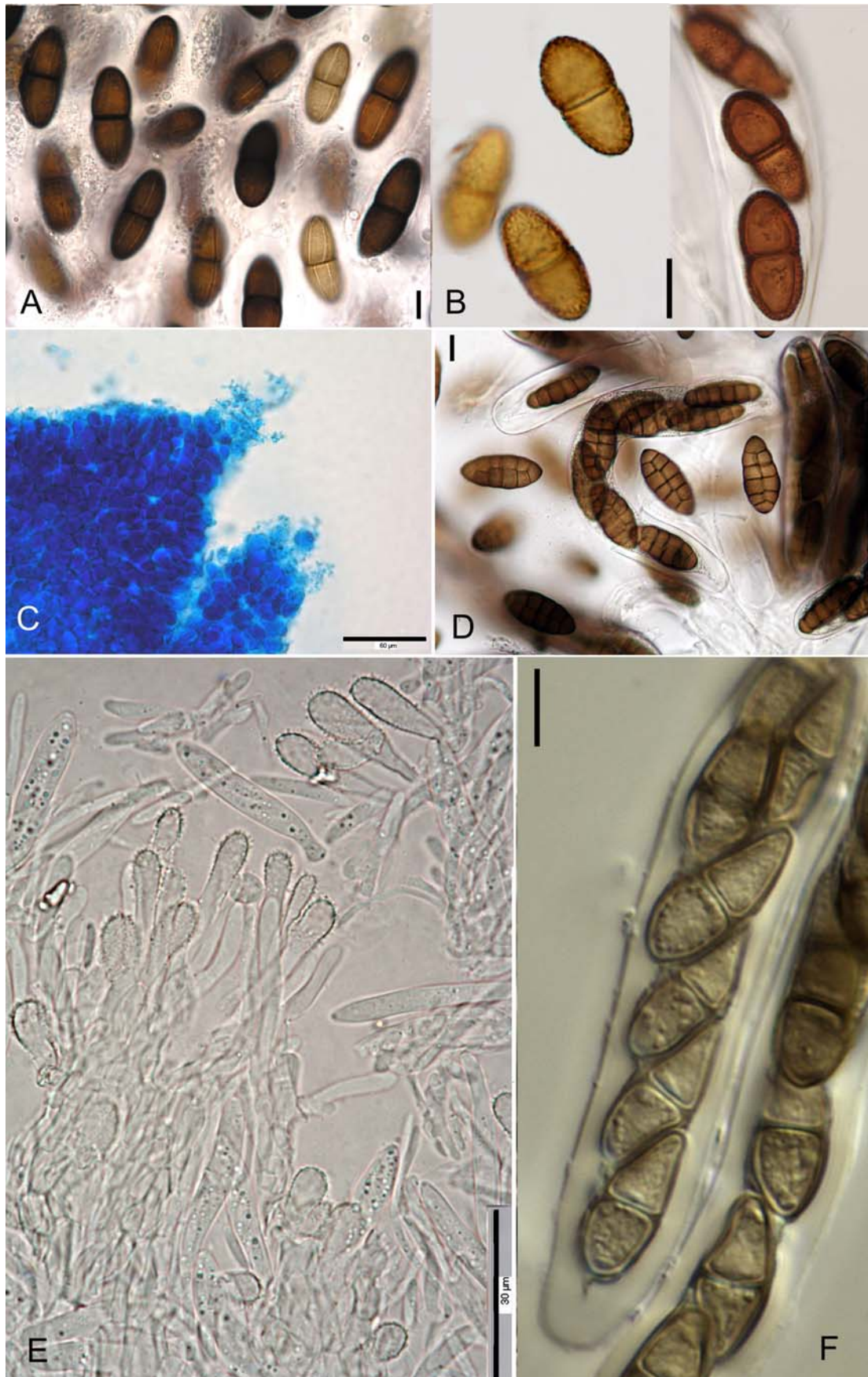


FIG. 2. *Cainia graminis*: A. ascospores with gelatinous sheaths. *Didymosphaerella spartii*: B. ascospores, left side-specimen from Tian Shan, right side-specimen from Elburs Mts.; *Calyptella campanula*: C. margin in cotton blue; *Comoclathris planispora*: D. asci and ascospores; *Cistella tianschanica*: E. hairs; *Protoventuria juniperina*: F. asci and ascospores. Scale bar: C, E = 30  $\mu$ m, other = 10  $\mu$ m

***Hymenella*** sp.

On *Silene adenopetala* – orange conidiomata, conidiophores hyaline, branched and septate, conidia cylindric, hyaline  $5 \times 1.2\text{--}1.5 \mu\text{m}$ ; on *Saussurea* sp. – conidiomata pink, slightly pulvinate ca  $300 \mu\text{m}$  diam, conidiophores hyaline, branched and septate, conidia hyaline, cylindric  $5\text{--}6 \times 1.5\text{--}1.8 \mu\text{m}$ ; on *Carex griffithii* – conidiomata slightly pulvinate to flat, conidiophores hyaline, branched, septate,  $1\text{--}2 \mu\text{m}$  diam, conidia cylindric, hyaline  $(5.5\text{--})6\text{--}8 \times 1.4\text{--}1.6 \mu\text{m}$ ; on *Oxyria digyna* – conidia  $6\text{--}8 \times 1.4\text{--}1.6 \mu\text{m}$ .

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Silene adenopetala*, Plot 3D; *Saussurea* sp., Plot 2D; *Carex griffithii*, Plots 4A, 1B, 1C, 3D; on stems of *Oxyria digyna* L. Hill, Plot 4A.

COMMENTS—These collections have the morphological attributes of *Hymenella* Fr. and *Illosporium* Mart. However, *Illosporium* is considered to be the anamorph of the lichenicolous genus *Pronectria* Clem. (Rossman et al 1999), whereas these collections were all on angiosperm hosts.

***Keissleriella culmifida*** (P. Karst) S.K. Bose, Phytopath. Z. 41: 188, 1961.

ASCOSPORES  $23\text{--}29 \times 6\text{--}10 \mu\text{m}$ , mostly 3 septate, gold-brown, gelatinous sheath  $8\text{--}10 \mu\text{m}$  thick.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Festuca coelestis*, Plot 4A.

COMMENTS—The fungus was noted only on single plant in the investigated area. The species is known from Fennoscandia (Eriksson 1967) on *Nardus*, *Festuca*, *Poa*, *Agrostis*, *Calamagrostis*, *Deschampsia*, *Phleum* and *Elymus*.

***Lachnellula arida*** (W. Phillips) Dennis, Persoonia 2: 183, 1962.

APOTHECIA solitary, sessile or on a short stalk, rehydrated 25 mm diam., disc flat, orange, outer surface covered by orange-brown, septate and granulate hairs, ASCI cylindric  $60\text{--}65 \times 7\text{--}8 \mu\text{m}$  or  $70\text{--}80 \times 5.7\text{--}7 \mu\text{m}$  (dead state), inamyloid IKI, with perforated crosiers ASCOSPORES uniseriate,  $9\text{--}11 \times 4\text{--}6 \mu\text{m}$  or  $7.3\text{--}10 \times 4\text{--}5.5 \mu\text{m}$  (living state), hyaline, smooth, egg-shaped with a few minute oil drops.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on senescent and dead twigs of *Juniperus sibirica* Burgsd., Plot 3C (det. H.O. Baral, H.B. 8030).

***Lagarobasidium detriticum*** (Bourdot & Galzin) Jülich, Persoonia 10: 334, 1979.

MYCELIUM white, covered surface of dead sedge stem.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on very old stem of *Carex griffithii*, Plot 4A (det. Z. Pouzar).

COMMENTS—The species with rather a broad ecological niche, noted on different plants: *Pteridium*, *Rubus*, *Juniperus*, *Juncus*, *Equisetum*, *Carex*, *Alnus*, *Betula*, *Populus* and *Sorbus* (Eriksson & Ryvarden 1976, Parmasto 1968, H. Knudsen in litt.).

***Lophodermium alpinum*** (Rehm) Weese, Mitt. Bot. Inst. Tech. Hochsch. Wien 10: 80 (1933).

APOTHECIA subepidermal  $440\text{--}520 \mu\text{m}$  long,  $190\text{--}220 \mu\text{m}$  wide, ASCI sessile, cylindric-clavate  $66\text{--}97 \times 14\text{--}15 \mu\text{m}$ , ASCOSPORES hyaline, filiform  $42\text{--}53 \times 1.2\text{--}1.6 \mu\text{m}$  with mucous sheath, PARAPHYSES filiform, recurved at the tip.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Festuca coelestis*, Plots 2B, 3A, 4A, 4D; *Carex griffithii*, Plot 3D.

COMMENTS—Almost all grasses were inhabited by this fungus in the investigated area. Dennis (1981) noted the species on leaves of *Festuca brachyphylla* and *F. jansenii* in Jensen's Nunataks in Greenland. His fungus as well as Tian Shan one possess narrower ascospores than in typical specimens of *L. alpinum*. *L. alpinum* was noted in alpine environs of Europe and North America (Nogrsek & Matzer 1994).

**Melampsora epitea** Thüm. Mittheil. Forstl. Versuchs. Öster. 2: 38, 1879.

UREDINIA 20–21 × 13–15 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Salix alata*, Plot 2D.

COMMENTS—This species is common on willows.

**Microbotryum adenopetalae** M. Lutz, Kremler & Chleb., Mycol. Res. 112: 1287, 2008.

FIGURE 3 A–C

Mass of TELIOSPORES brownish-violet, fill flower calyx above ovary. Teliospores brown, globose to subglobose or ovoid 6–8(–9) × 5.3–7.4(–8) µm diam., reticulate (FIG. 3A). MESHES of reticulum 5–7 per spore diam., (0.6–)0.8–1(–1.2) µm in diam. MURI 0.3–0.5 µm high, mostly covered by small, irregular, broadly surrounded warts up to 0.14 µm high, interspaces smooth or finely rough. BASIDIA hyaline, mostly straight, very rare branched, 10–24 × 4–5 µm, 2–4 celled, slightly constricted at septa (FIG. 3B), BASIDIOSPORES hyaline, elliptical, one-celled 5.2–7(–8) × 2–3 µm, with 1–3 oil drops (FIG. 3C).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, inside flowers of *Silene adenopetala*, 29 July 2005, coll.: M. Suková & A. Chlebicki, KRAM “F” 55201, Plots 1A, 2A.

COMMENTS—*M. adenopetalae* is a very peculiar species because the ustulospores are completely filling the calyx above the ovaries. In infected flowers I cannot find anthers, moreover ovaries were not fully developed. It resembles the type of infection of *Microbotryum major* (J. Schröt.) G. Deml. & Oberw. 1982 and *M. savilei* Denchev 2007 (Lutz et al. 2008) but differs in smaller number meshes per spore diam. and muri covered by small warts. The type locality is situated below the square at 3288 m elev. I also found this fungus in two plots of investigated square L1 at 3440 m and in all sixteen plots of the highest square L2 near the glacier margin (3532 m elev.). It means that the pathogen can invade plants growing near the glacier margin.

**Mytilinidion acicola** G. Winter, Hedwigia 19: 176, 1880.

HYSTEROTHECIA laterally compressed, shell shaped, 180–260 µm wide with longitudinal slit along the upper edge, black. ASCI cylindrical 110–116 × 10–11 µm, ASCOSPORES brown, 3-septate, 19–20 × 6–7 µm, constricted at the septa.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead needles of *Juniperus sibirica*, Plot 3C.

COMMENTS—The species was known from the Alps, Scotland and Scandinavia on *Juniperus communis* (Holm & Holm 1977, Kirk & Spooner 1984, Eriksson 1992).

**Nectriella bloxamii** (Berk. & Broome) Fuckel, Jb. Nassau. Ver. Naturk. 29–30: 21, 1875.

PERITHECIA scattered, globose 200–240 µm diam., orange, base embedded in the leaf tissue, ASCI narrowly clavate 70–74 × 11–12 µm, ASCOSPORES pale green, 1-septate, slightly roughened 13–17 × 5–7 µm, slightly constricted at the septum.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves and stems of *Waldheimia tridactylites* Plot 3A (det. Amy Rossmann); *Carex griffithii* Plot 3C, *Saussurea* sp., Plot 4A.

COMMENTS—The species was reported from Europe and New Zealand on dead leaves of *Helianthus tuberosus*, *Oenanthe crocata* and *Heracleum sphondylium* (Rossmann et al. 1999).

**Periconia byssoides** Pers., Syn. Meth. Fung. 1: 18, 1801.

CONIDIOMATA with conidia spherical, verrucose 12–14.5 µm diam.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems of *Festuca coelestis*, Plot 3D, (only 4 conidiomata).

COMMENTS—It is a saprobic species growing on dead plant substrata.

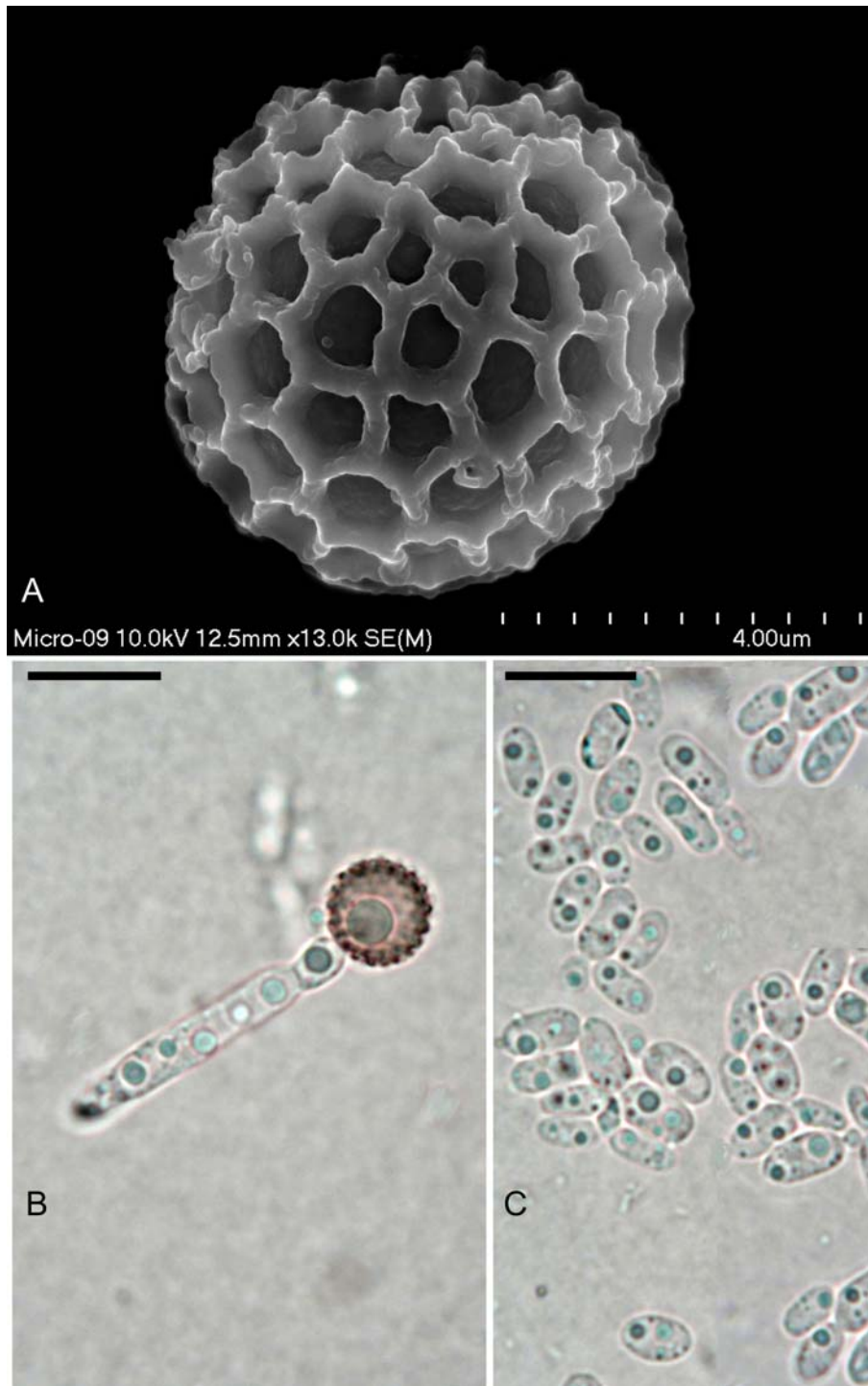


FIG. 3. *Microbotryum adenopetalae*: A. teliospora; B. basidium; C. basidiospores. Scale bar: B, C = 10  $\mu$ m

***Phaeosphaeria alpina*** Leuchtm., Sydowia 37: 117, 1984.

ASCI 67–80  $\times$  14–19  $\mu$ m, ASCOSPORES brown, 3-septate 23–28  $\times$  7–9  $\mu$ m.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems and leaves of *Carex griffithii*, Plots 1C, 4C, 4D.

COMMENTS—It is a fungus previously noted on plants from alpine and subalpine area of the Alps (Leuchtmann 1984, Scheuer 1988, Nograsssek (1990). The Tian Shan specimens possess more pointed and curved ascospores than Alpine specimens illustrated by Leuchtmann

(Leuchtmann 1987, fig. 1d). Moreover I have not observed a gelatinous sheath in the ascospores of these specimens.

***Phaeosphaeria culmorum*** (Auersw.) Leuchtm., Sydowia 37: 113, 1984.

ASCOMATA gregarious, mostly immersed in culms, subglobose, slightly flattened 160–200 µm diam., non-papillate, ASCI cylindric-clavate 60–80 × 11–13 µm, ASCOSPORES 3-septate, only slightly constricted at the septa, pale yellow-brown, 18–20 × 5–6 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves and sheaths of *Carex griffithii*, Plots 1B, 3A, 2C, 4D.

COMMENTS—The ascomata are commonly distributed on almost all culms and old leaves of the host plant. It is the most common species of *Phaeosphaeria* in the investigated area. The fungus occurs on grasses and members of *Cyperaceae* (Eriksson 1967, Leuchtmann 1984).

***Phaeosphaeria herpotrichoides*** (De Not.) L. Holm. Symb. Bot. Upsal. 14(3): 115, 1957.  
FIGURE 4C

ASCOMATA 120–160 µm diam, immersed inside plant tissue, tomentose (hairs up to 70 µm long), ASCI octosporous (FIG. 4C), ASCOSPORES plae olivaceous, 30–32 × 6–7 µm, 9-celled (2–1–6), 3rd cell wider, 6th cell longer.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems and inflorescences of *Anthoxanthum alpinum*, Plots 2B, 3D; *Festuca coelestis*, Plot 4A.

COMMENTS—The fungus was noted only two times in the investigated area. Holm (1957) noted it on many grasses. Eriksson (1967) presented 8 different forms of this species. Also Leuchtmann (1987) noted its five forms. The Tian Shan specimens are similar to Eriksson's form 7, because of tomentose ascomata, whereas ascospores resembles his form 6, however these spores are devoid of gelatinous sheaths.

***Phoma*** sp 1.

CONIDIOMATA pycnidial superficial 240–280 µm diam., with small ostiole, wall thin textura angularis, CONIDIA hyaline one celled with oil drop at each end 4–5 × 1.5–2 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on *Cerastium cerastoides*, Plot 2C.

***Phoma*** sp. 2

CONIDIOMATA superficial, 300–400 µm diam., black, with small ostiole. CONIDIA hyaline, one-celled 4–5 × 2 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves and stems of *Thylacospermum caespitosum*, Plot 2D inside cushion.

COMMENTS—The growth inside the plant cushion protected the fungus against loss of humidity, low and high temperature, and provided strong insulation.

***Phomatospora berkeleyi*** Sacc., Grevillea 4: 22, 1875.

ASCOMATA ca 200 µm diam., embedded in plant tissue, ASCI cylindrical, p. sp. 58–79 × 4.6–5.2 µm, pedicel 18–20 µm, ASCOSPORES hyaline, with oil drop an both ends, 9–10 × 3–3.4 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Primula nivalis*, Plot 2C; old stems of *Anthoxanthum alpinum*, Plot 4D.

***Pirottaea atrofusca*** Chleb. & Chlebická, Mycotaxon 100: 45, 2007      FIGURE 4A

Specimens on *Festuca coelestis*: APOTHECIA sessile, cup shaped, (80–)100–120 µm diam, dark brown (FIG. 4A), HAIRS cylindrical with hyaline wall, brown-red inside, 4–10 × 4–4.5 µm, densely distributed in the upper part of apothecium, ECTAL EXCIPULUM textura prismatica, cells pale brown. ASCI ± clavate, 8-spored, narrower in the upper part 38–42 ×

4.5–5.2 µm, ASCOSPORES aseptate, hyaline narrowly fusoid, 10–11 × 1.5–2.2 µm, PARAPHYSES filiform, not exceeding the asci.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Festuca coelestis*, Plot 4A, Holotype: KRAM “F” 55672; on leaves of *Anthoxanthum alpinum* Plot 3D, KRAM “F” 46565.

COMMENTS—This is a recently described species which is here found on leaves of *Anthoxanthum alpinum* for the first time. Apothecia on *Anthoxanthum alpinum* are similar to the type collection 100–160 µm diam. when dry, with abundant and densely distributed black grana 5–7 µm diam. in its upper part (FIG. 4A), whereas setae are longer (15.5–18.4 × 3.7–4.1 µm), with their main part pale brownish to hyaline, while only the upper part of the setae is dark brown, asci 36–41 × 6–8 µm, ascospores 9–10 × 1.8–2.2 µm, with some oil drops inside.

*Pleospora ambigua* (Berl. & Bres.) Wehm., Mycologia 43: 42, 1951.

ASCOMATA ca 140–160 µm diam., SETAE dark brown, septate and pointed 140–200 µm long and 5–8 µm wide at the base, ASCI cylindric clavate 98–116 × 15–18 µm, ASCOSPORES brown, with 7 transverse septa and single longitudinal septa, slightly constricted at septa, ends pointed and slightly paler 22–25 × 8–10 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves of *Anthoxanthum alpinum*, Plots 3A, 4D.

COMMENTS—The Tian Shan specimens differ from the European ones by having very long setae, up to 200 µm and distinctly pointed ascospores. It is a common fungus in alpine and arctic areas (Holm & Holm 1993).

*Pleospora brachyspora* (Niessl) Petr., Ann. Naturh. Mus. Wien 50: 445, 1940.

ASCOMATA ca 200 µm diam, ASCI 84–100 × 25–28 µm, ASCOSPORES with 7 transverse septa and 1–3 longitudinal septa, 25–28 × 12–13 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on stems and leaves of *Cerastium cerastoides*, Plot 1C.

COMMENTS—Typical *P. brachyspora* has somewhat bigger ascospores. It is an alpine species noted on many different host plants, e.g. on *Cerastium* (Müller 1951).

*Pleospora graminearum* Wehm., World Monogr. Genus Pleospora: 103, 1961.

FIGURE 5B

ASCOMATA covered by epidermis, setae absent. ASCI: 106–122 × 16–20 µm. ASCOSPORES yellowish brown, narrowly obovoid fusoid, asymmetric, transversely 7–10-septate with 3 longitudinal septa in central cells, constricted at the first formed septum. Ascospores from asci: 35–39 × 14–16 µm (FIG. 5B), in some collections with gelatine sheath (ascospores lying on the leaves 51–109 × 21–28 µm).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Carex griffithii*, Plots 1A, 4A, 2B, 1D, 2D, 1C, 4C; *Festuca coelestis*, Plots 2A, 4A; *Anthoxanthum alpinum*, Plot 2D.

COMMENTS—*P. graminearum* is a very common species in the Alps (Crivelli 1983), noted also in North America (Wehmeyer 1961) and Greenland (Alstrup et al. 2000).

*Pleospora helvetica* Niessl Verh. Nat. Ver. Brünn 15: 191, 1876.

ASCOMATA superficial, covered by setae up to 160 µm long, 3–7 septate, 6–7 µm diam in the lower part, ASCOSPORES pale brown 36–38 × 16–19 µm.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves and stems of *Saussurea* sp. Plot 2D; *Waldheimia tridactylites* Plots 1A, 3A, 4A, 1B, 2B, 3B 4B, 3C, 2D, 3D, 4D, KRAM “F”; *Silene adenopetala*, Plot 3A; *Anthoxanthum alpinum*, Plot 3B.

COMMENTS—*P. helvetica* is a very common species on alpine plants.

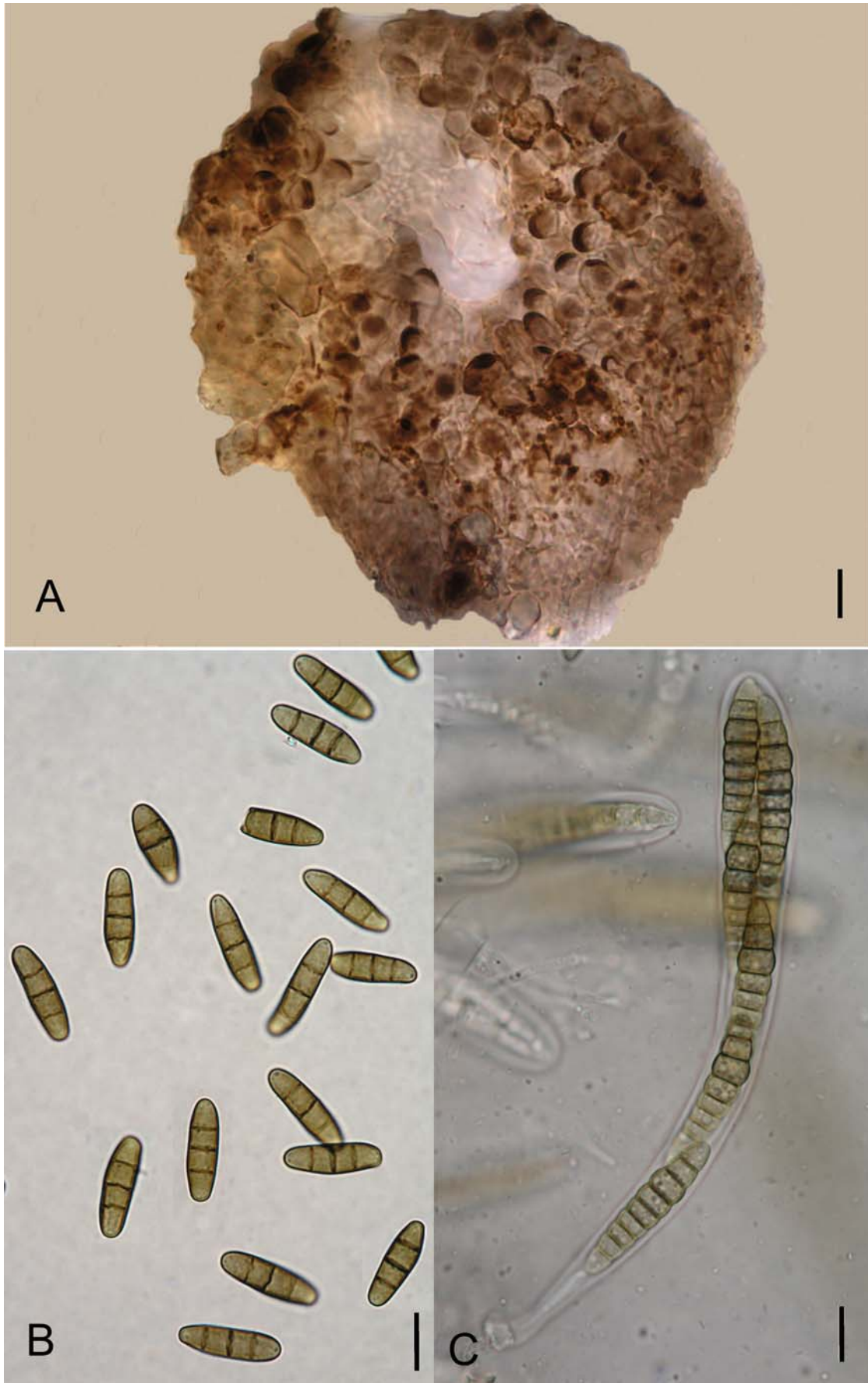


FIG. 4. *Pirottaea atrofusca*: A. apothecium with grana; *Sclerostagonospora* sp.: B. conidia; *Phaeosphaeria herpotrichoides*: C. ascus with ascospores. Scale bar: A, B, C = 10  $\mu$ m

***Pleospora primulae*** Crivelli, Heterog. Ascomyc. Pleospora: Vorschlag für eine Aufteilung (Diss. Eid genössischen Technischen Hochschule Zürich 7318): 82, 1983.

FIGURE 5C

ASCOMATA scattered, embedded in leaf tissue 140–180(–240)  $\mu\text{m}$  diam, OSTIOLE prominent, protruding periderm, ostiole area covered by short setae up to 70  $\mu\text{m}$  long, ascomatal WALL textura angulata. ASCI saccate 94–110  $\times$  34–36  $\mu\text{m}$ , ASCOSPORES honey-brown, with 7 transverse septa and 1–3 longitudinal septa, constricted at the first septa, 36–46  $\times$  16–21  $\mu\text{m}$  (FIG. 5C).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on old leaves of *Primula nivalis*, Plot 1B.

COMMENTS—Crivelli (1983) and Nogrsek (1990) noted it on *Primula auricula*, *P. chusiana* and *Phyteuma orbiculare*.

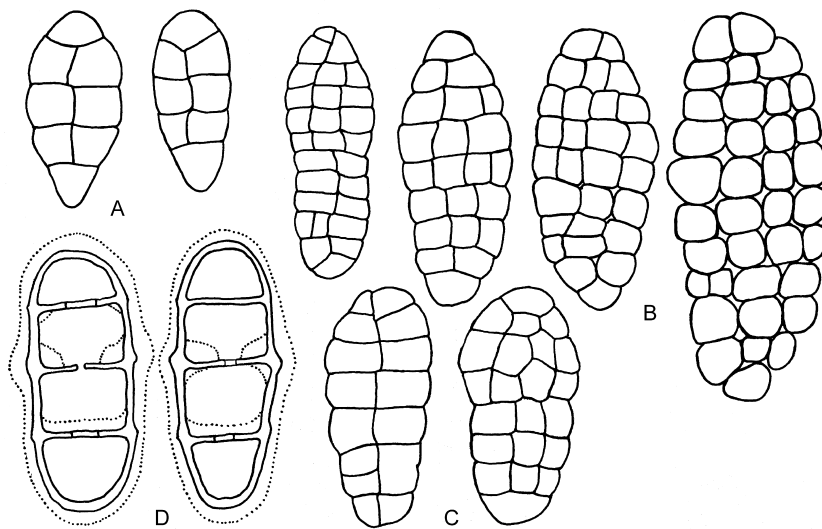


FIG. 5. Ascospores: A: *Comoclathris pentamera*; B: *Pleospora graminea* (spores from the asci on the left, spores lying on the leaf on the right side); C: *Pleospora primulae*; D: *Wettsteinina oreophila*. Scale bar = 10  $\mu\text{m}$

***Protoventuria juniperina*** Chleb. Mycotaxon 110: 446, 2009. FIGURE 2F

MYCELIUM superficial, producing subcuticular hyphae, sometimes forming dark blotches. ASCOMATA globose, 120–200  $\mu\text{m}$  diam., surface strongly setose, SETAE 70–100  $\mu\text{m}$  long, 3  $\mu\text{m}$  wide at the base, pointed, ASCI bitunicate, clavate 70–76  $\times$  13–14  $\mu\text{m}$ , ASCOSPORES olivaceous to greenish, septate, upper hemispore slightly wider, smooth, 13–20  $\times$  7–8  $\mu\text{m}$ , constricted at the septum, contents finely guttulate (FIG. 2F). HAMATHECIUM: pseudoparaphyses sparse, septate and branched, ca 1  $\mu\text{m}$  wide, exceeding asci.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves of *Juniperus sibirica*, 3 Aug. 2005, coll.: A. Chlebicki, Holotype-KRAM "F" 46550, Plot 3C.

COMMENTS—The species is somewhat similar to the members of *Herpotrichiellaceae*. But these fungi possess poorly developed interascal elements or are lacking the tissues (Barr 1972, Untereiner et al. 1995). The fungus from Tian Shan is rather a member of *Pleosporales* than *Dothideales* because of the presence of a distinct hamathecium. It is similar to the fungi from the genus *Protoventuria* Berl. & Sacc. of *Venturiaceae*. The members of the genus *Protoventuria* possess hypostroma, intramatrical and subcuticular hyphae. However the species previously arranged in the subgenus *Venturioides* M.E. Barr of *Gibbera* Fr. and transferred to the *Protoventuria* (Barr 1989) have slight amounts of superficial and intramatrical hyphae. Holm & Holm (1977) noted two species of venturiaceous fungi on leaves of *Juniperus communis*: *Gibbera* sp. and *Seynesiella juniperi* (Desm.) G. Arnaud 1918.



Of them *Gibbera* sp. is more similar to the fungus from Tian Shan, but possesses light greenish and fusiform ascospores.

*Puccinia saxifragae* Schltld., Fl. Berol. 2: 134, 1824.

AMPHISORI red-brown, not covered by epiderm, AMPHISPORES covered by triangular spines, chesnut-red  $25\text{--}37 \times 18\text{--}22 \mu\text{m}$ , TELIOSPORES occasionally present. Detailed description of this collection in Chlebicki & Aime (2006).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Saxifraga cernua*, Plot 3B.

COMMENTS—Amphisori of this rust commonly occur on the plants growing in the vicinity of the plant limit zone (Chlebicki & Aime 2006). It is an autoecious pathogenic species, circumboreal in distribution, noted on various members of *Saxifragaceae*.

*Scutellinia kerguelensis* var. *microspora* W.Y. Zhuang, Fung. Divers. 18: 220, 2005.

APOTHECIA 2–3.4 mm diam., red when fresh, later brown-yellow with gold-brown multiseptate hairs up to  $360\text{--}700 \mu\text{m}$  long and up to  $25 \mu\text{m}$  wide in lower part, base mostly bifurcate, wall of hair 1.5–2  $\mu\text{m}$  wide, ASCI  $200\text{--}205 \times 14\text{--}20 \mu\text{m}$ , ASCOSPORES broadly ellipsoid, with single (dead state) to many guttules (living state), covered by very small warts  $0.3 \mu\text{m}$  high, mostly confluent,  $17\text{--}21 \times 13\text{--}16 \mu\text{m}$ , PARAPHYSES clavate, exceeding the dead asci.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, found abundantly, on the soil under *Carex griffithii* and *Primula nivalis*, Plot 2A.

COMMENTS—The spores of *S. kerguelensis* (Berk) Kuntze var. *kerguelensis* are bigger  $22\text{--}28 \times 14\text{--}22 \mu\text{m}$  (Hansen & Knudsen 2000) than in type variety. Zhuang (2005) described a new variety from Sichuan, noted on wet wood, charcoal and bare soil. The collection from Tian Shan is very similar to the China collections.

*Seimatosporium lichenicola* (Corda) Shoemaker & E. Müll., Canad. J. Bot. 42: 405. 1964.

CONIDIOMATA acervular, corticolous dark brown to black. CONIDIA 3-septate, fusiform ( $16\text{--}17\text{--}20\text{--}21$ )  $\times 7\text{--}7.6 \mu\text{m}$ , appendages lacking.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on senescent twigs of *Salix alata*, Plot 4A.

COMMENTS—All senescent young twigs were covered by conidiomata of this fungus. *S. lichenicola* is a common species on various host plants, including *Salix longifolia* (Sutton 1980).

*Trichometasphaeria barriae* Chleb. Mycotaxon 110: 448, 2009 FIGURES 6A–E

ASCOMATA (FIG. 6A) partially embedded in the substratum, rarely erumpent, gregarious,  $340\text{--}420 \mu\text{m}$  wide, ca  $500 \mu\text{m}$  high, wall  $24\text{--}44 \mu\text{m}$  thick, composed of an external dark layer with 3 rows of cells and an internal light layer with 2–3 rows of cells, textura angularis, subiculum absent, with a distinct OSTIOLE ca  $160 \mu\text{m}$  diam,  $90\text{--}100 \mu\text{m}$  high, covered by short (up to  $70 \mu\text{m}$  long and  $4\text{--}6 \mu\text{m}$  wide) straight or slightly curved septate setae (FIG. 6C), paler at the tips and sometimes slightly rough, surface of ascomata covered by very long, curved, darker, septate, thick walled and downward growing hyphae,  $5\text{--}6 \mu\text{m}$  diam. at the base, ASCI clavate,  $120\text{--}140\text{--}150 \times 24\text{--}26\text{--}27 \mu\text{m}$  (FIG. 6E), ASCOSPORES  $37\text{--}44\text{--}45 \times 10\text{--}14\text{--}15 \mu\text{m}$ , 3-septate, constricted at the suprmedian septum, slightly asymmetric, pale brown, distal cells slightly paler (FIG. 6B) PSEUDOPARAPHYSES ca  $2 \mu\text{m}$  diam., branched and septate, very abundant in the centrum, hyaline, their cells inside granulate (FIG. 6D).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on tips of stems and leaves of *Waldheimia tridactylites*, 3 Aug. 2005, Holotype-KRAM "F" 46551 Plot 2C, Isotype KRAM "F" 46552, Plot 4C.

COMMENTS—Yuan & Barr (1994) described a new species, *T. papillisetosa* Z.Q. Yuan & M.E. Barr 1994 from Tian Shan (China), on decorticated branches of *Pentaphylloides fruticosus*. Both *T. barriae* and *T. papillisetosa* are similar in ascomata, their setae are septate, erect, and

with paler tips while the ascospores are larger than in other species. But the ascospores of *T. barriae* are smooth walled in comparison with the verrucose ascospores of *T. papillisetosa*. Both these species occur in Tian Shan.

***Typhula uncialis*** (Grev.) Berth. Bull. Mens. Soc. Linn. Lyon 45: 83, 1976

FRUIT BODIES simple, clavate, white, stem 600–1200 µm long, 220–360 µm wide, sterile stalk 300–400 µm long, finely puberulous to slightly pubescens. HYPHAE with clamps, BASIDIA with 4 sterigmata 24–25 × 4.4–5.2 µm. BASIDIOSPORES subamygdaliform, 5–8 × 1.2–2.2 µm, crystals 3–9(–10) µm diam., subglobose, sparsely verrucose, with blunt or pointed processes.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on dead leaves of *Carex griffithii*, Plots 3A, 4B.

COMMENTS—Corner (1950) gives a description of three different collections of *Pistillaria uncialis* (Grev.) Corner. Of them a fungus from a dead stick possesses crystals inside longitudinal hyphae. However Berthier (1974, 1976), in spite of lacking a sclerotium, recognized this species as *Typhula* Fr. and placed them in the subgenus *Gliocoryne* Maire. The Tian Shan fungus possesses numerous crystals in the hymenium and inhabits old destroyed sedge leaves.

***Ustilago striiformis*** (Westend.) Niessl, Hedwigia 15: 1, 1876.

SORI parallel to the leaf veins, covered by epidermis, spore mass dark brown, SPORES echinulate, ovoid to irregular 12–15 × 9–11 µm, light brown.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Anthoxanthum alpinum*, Plot 2C.

COMMENTS—*U. striiformis* is a common species on many graminoid host plants (Vánky 1994).

***Veronaea thylacospermi*** Chleb. Mycotaxon 110: 449, 2009 FIGURES 6 F–I

CONIDIOPHORES simple, smooth, brown, 1–3(–8) septate, 35–100 × 3–4 µm, basal cell inflated 6–10 µm wide (FIG. 6F), fertile part taller than basal part, forming slightly flexuose rachis with scattered, hyaline and small. Apically pointed denticle-like CONIDIOGENOUS LOCI, 0.3 µm high, 0.5 µm wide (FIG. 6 H, I). CONIDIA hyaline 12–14 × 3–4 µm, two celled, lower cell longer and wider than upper one, wall slightly verruculose (FIG. 6G). Paler mycelial hyphae distributed inside host cells.

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on leaves of *Thylacospermum caespitosum*, 3 Aug. 2005, coll.: A. Chlebicki, Holotype-KRAM “F” 46601, Plot 2C.

COMMENTS—No species of this genus was reported earlier from *T. caespitosum*. Its conidia are similar to these of *Veronaea caricis* M. B. Ellis, illustrated by Ellis (1976). Whereas small, pointed conidiogenous loci are very similar to those of the genus *Myrmecridium* Arzanlou et al., the fungi in the genus *Veronaea* Cif. & Montemart. are distinct from species of *Fusicladium* Bonord. by having a well-developed rachis with densely aggregated scars. The next similar genus *Veronaeopsis* Arzanlou & Crous has rachides often geniculate, short conidiophores and more prominent and denticle-like conidiogenous loci. *Myrmecridium* possesses hyaline vegetative hyphae, rachides with scattered, small and pointed denticles, conidia one celled with a wing-like gelatinous sheath (Arzanlou et al. 2007). The Tian Shan fungus belongs to *Veronaea* like clade with verruculose conidia (as in *Veronaea*) and denticle-like conidiogenous loci (as in *Myrmecridium*). This fungus is a transitional form between the genus *Veronaea* and *Myrmecridium*, however its two celled conidia devoid of gelatinous sheath indicate a relationship with *Veronaea*.

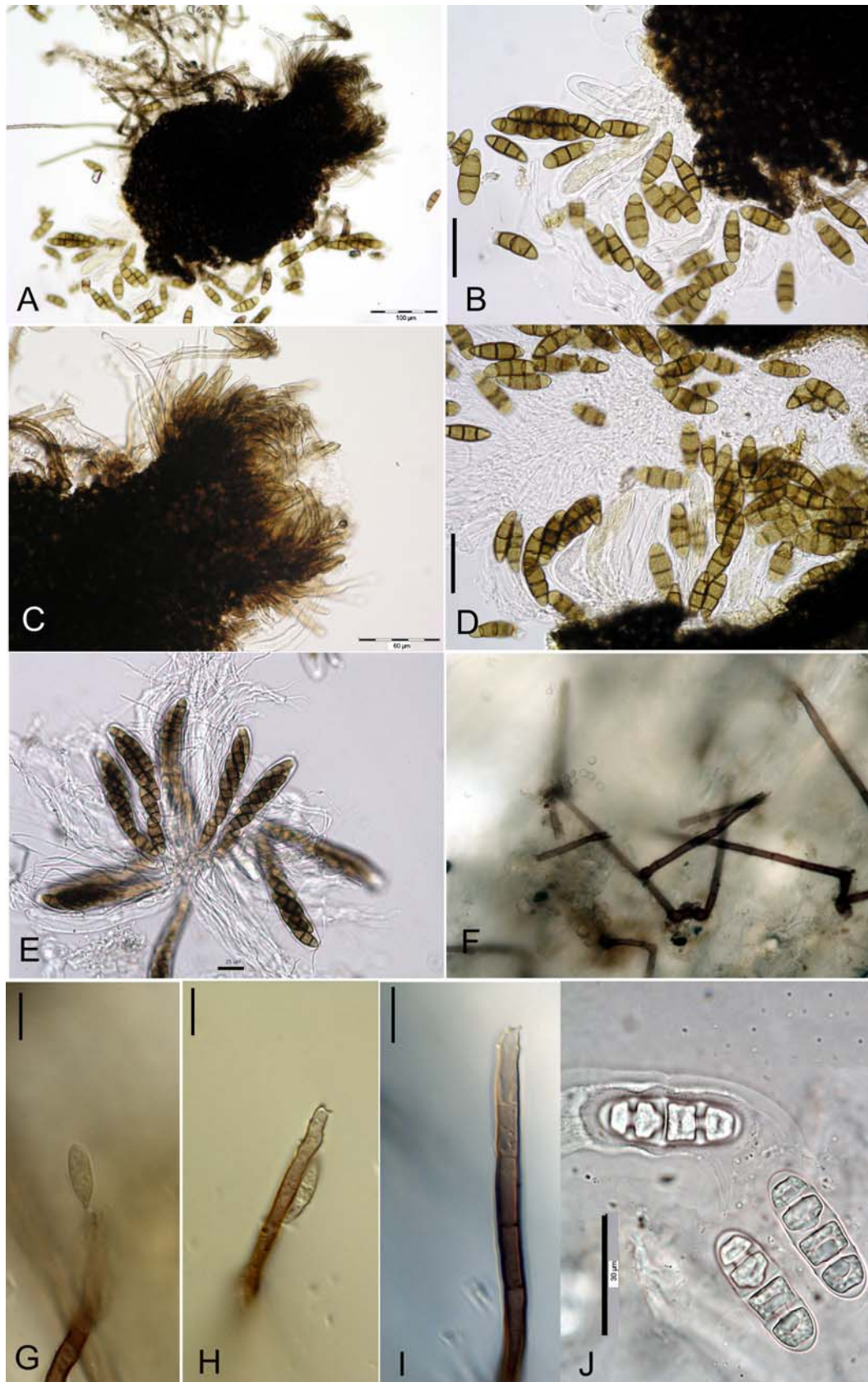


FIG. 6. *Trichometasphaeria barriae*: A. ascoma; B. ascospores, C. ostiole with setae, D. hamathecium and ascospores, E. asci; *Veronaea thylacospermi*: F. conidiophores with inflated basal cell, G. conidium, H, I. rachis with scattered, denticle-like conidiogenous loci. *Wettsteinina oreophila*: J. ascospores. Scale bar: A = 100 µm; C = 60 µm; B, D = 40 µm; E = 25 µm; G, H, I = 10 µm; J = 30 µm

*Wettsteinina oreophila* Shoemaker & C.E. Babcock, Canad. J. Bot. 65: 386, 1987.

FIGURE 5D, 6J

ASCOSPORES 29–38 × 11–14 μm, 3-septate, the second cell from apex enlarged with slightly swollen zone adjacent to primary septum, additional septa with distinctly smaller swollen zones, not constricted, gelatinous sheath slightly swollen just above the first septum (FIG. 5D, 6J).

SPECIMENS EXAMINED: KAZAKHSTAN, TIAN SHAN: permanent plots, on pedicel, below inflorescence of *Carex griffithii*, only some ascospores present Plots 1C, 2A, 2D, 3D.

COMMENTS—This alpine species was noted on *Carex atrata* in Punjab, India, on *Carex melonantha* in Kashmir and *Carex parviflora* in the Alps (Shoemaker & Babcock 1987). Tian Shan specimen differs from type collection by presence in ascospores the swollen zones adjacent to additional septa. The specimens found on dead leaves of *Thylacospermum caespitosum* (plots 2C and 2B) belong to a new species of *Wettsteinina*, but a very scanty collection does not enable its precise description and is too sparse for a type collection.

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### Literature cited

- Alstrup V, Hansen ES, Daniels FJA. 2000. Lichenized, lichenicolous and other fungi from North and North-East Greenland. *Folia Cryptog. Estonica* 37: 1–20.
- Aptroot A. 1995a. Redisposition of some species excluded from *Didymosphaeria* (*Ascomycotina*). *Nova Hedwigia* 60: 325–379.
- Aptroot A. 1995b. A monograph of *Didymosphaeria*. *Stud. Mycol.* 37: 1–160.
- Arzanlou M, Groenewald JZ, Gams W, Braun U, Shin H-D, Crous PW. 2007. Phylogenetic and morphotaxonomic revision of *Ramichloridium* and allied genera. *Stud. Mycol.* 58(1): 57–93.
- Barr ME. 1972. Preliminary studies on the *Dothideales* in temperate North America. *Contr. Univ. Michigan Herb.* 9(8): 523–638.
- Barr ME. 1989. The *Venturiaceae* in North America: revision and additions. *Sydowia* 41: 25–40.
- Barr ME. 2001. *Montagnulaceae*, a new family in the *Pleosporales*, and lectotypification of *Didymosphaerella*. *Mycotaxon* 77: 193–200.
- Berthier J. 1974. Le genre *Typhula* (Clavariacees) et les affines. Classification-espèces nouvelles. *Bull. Soc. Linn. Lyon* 43: 182–188.
- Berthier J. 1976. Monographie des *Typhula* Fr., *Pistillaria* Fr. et genres voisins. *Bull. Soc. Linn. Lyon. Spec. no.* 1–213.
- Carpenter SE. 1981. Monograph of *Crocicreas*. *Mem. New York Bot. Gard.* 33: 1–290.
- Chlebicki A. 2002a. Biogeographic relationships between fungi and selected glacial relict plants. *Monogr. Bot.* 90:1–230.
- Chlebicki A. 2002b. Two cypericolous smut fungi (*Ustilaginomycetes*) from the Tian Shan and their biogeographic implications. *Mycotaxon* 83: 279–286.
- Chlebicki A. 2003. *Anthracoidea stenocarpae*, the orthographically correct name for a species described from Tian Shan. *Mycotaxon* 88: 469.

- Chlebicki A. 2006. Two species of smut fungi on *Polygonaceae* from Tian Shan, Kazakhstan. Czech Mycol. 58: 99–104.
- Chlebicki A. 2009. Fungi on higher plants of the upper limit of alpine zone: new species from Tian Shan. Mycotaxon 110: 443–450.
- Chlebicki A, Aime C. 2006. New distribution and host records for *Puccinia atrofusca* and other notable *Puccinia* species (*Uredinales*) from Central Asia. Polish Bot. J. 51: 87–91.
- Chlebická M, Chlebicki A. 2007. *Cyathicula brunneospora* and *Pirottaea atrofusca*, two new *Helotiales* from Tian Shan (Kazakhstan). Mycotaxon 100: 37–50.
- Clark WS, Richardson MJ, Watling R. 1983. *Calyptella* root rot – a new fungal disease of tomatoes. Plant Pathol. 32: 95–99.
- Cooke WB. 1961. The cyphellaceous fungi. A study in the *Porotheliaceae*. Sydowia, Beih. 4: 1–144.
- Corner E.J.H. 1950. Monograph of *Clavaria* and allied genera. Annals of Botany Memoirs 1: 1–740.
- Crivelli PG. 1983. Ueber die heterogene Ascomycetengattung *Pleospora* Rabh.; Vorschlag für eine Aufteilung. Dissertation ETH Zürich 7318: 1–213.
- Dennis RWG. 1981. The fungi of Jensen's Nunataks, West Greenland. K. Norske Vidensk Selsk. Skr. 3: 1–20.
- Ellis MB. 1976. More dematiaceous Hyphomycetes. CMI, Kew, Surrey. 507 pp.
- Eriksson J, Ryvarden L. 1976. The Corticiaceae of North Europe. Vol. 4. Blindern, Oslo, Fungiflora p. 547–886.
- Eriksson OE. 1967. On graminicolous *pyrenomycetes* from Fennoscandia 2. Phragmosporous and scolecosporous species. Arkiv for Botanik serie 2, 6(9): 381–440.
- Eriksson OE. 1992. The non-lichenized *pyrenomycetes* of Sweden. Btj tryck, Lund, Sweden. 208 pp.
- Gaffyorov YS. 2005. Micromycetes on vascular plants in Namangan Region. Thesis of the PhD of Biol. Sci. Tashkent 2005.
- Hansen L, Knudsen H. 2000. Nordic *Ascomycetes* 1. Nordsvamp, Copenhagen. 309 pp.
- Holm L. 1957. Études taxonomiques sur les Pléosporacées. Symbolae Botanicae Upsalienses 14(3): 1–188.
- Holm K, Holm L. 1977. Nordic Junipericolous *Ascomycetes*. Acta Universitatis Upsaliensis. Symbolae Botanicae Upsalienses 21(3): 1–70.
- Holm L, Holm K. 1993. The genus *Pleospora* s. l. from Svalbard. Sydowia 45: 167–187.
- Kirk PM, Spooner BM. 1984. An account of the fungi of Arran, Gigha and Kintyre. Kew Bull. 38 : 503–597.
- Korbonskaya JaI. 1951. Species novae Uredinarum a Republica Tadzchikica. Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 7: 178–181.
- Korbonskaja JaI. 1954. Rzhavichnije griby Tadzchikistana. Trudy Akad. Nauk Tadzchiksk. SSR 30: 1–95.
- Leuchtmann A. 1984. Über *Phaeosphaeria* miyake und andere bitunicate Ascomyceten mit mehrfach quersetierten Ascosporen. Sydowia 37: 75–194.
- Leuchtmann A. 1987. *Phaeosphaeria* in the Arctic and Alpine zones. In: G. A. Laursen, J. F. Ammirati & S. A. Redhead (eds.) Arctic and alpine mycology 2. Environm. Sci Res. 34: 153–161.
- Lutz M, Piątek M, Kemler M, Chlebicki A, Oberwinkler F. 2008. Anther smuts of *Caryophyllaceae*: molecular analyses reveal further new species. Mycol. Res. 112: 1280–1296.
- Magnes M, Hafellner J. 1991. Askomyceten auf Gefäßpflanzen an Ufern von Gebirgssen in den Ostalpen. Biblioth. Mycol. 139: 1–182.

- Müller E. 1951. Die schweizerischen Arten der Gattungen *Clathrospora*, *Pleospora*, *Pseudoplea* und *Pyrenophora*. *Sydowia* 5: 248–310.
- Neubert K, Mendgen K, Brinkman H, Wirsig SGR. 2006. Only few fungal species dominate highly diverse mycofloras associated with the common reed. *Appl Environ. Microbiol.* 72: 1118–1128.
- Nogrsek A. 1990. Ascomyceten auf Gefäßpflanzen der Polsteregggrasen in den Ostalpen. *Bibl. Mycol.* 133: 1–271.
- Nogrsek A, Matzer M. 1994. Nicht-pyrenokarpe Ascomyceten auf Gefäßpflanzen der Polsteregggrasen II. Arten auf *Cyperaceae* und *Poaceae*. *Nova Hedwigia* 58: 1–48.
- Parguey-Leduc A, Chadeffaud M. 1963. Les asques du *Cainia incarcerata* (Desm.) von Arx et Müller et la position systématique du genre *Cainia*. *Rev. Mycol.* 28(3–4): 200–234.
- Parmasto E. 1968. *Conspectus Systematis Corticiacearum*. Institute of Zoology and Botany, Estonian Academy of Sciences, Tartu.
- Pennycook SA. 1989. Plant diseases in New Zealand 3. Vol. Pl. Dis. Div. D.S.I.R., Auckland.
- Raitviir A. 2004. Revised synopsis of the *Hyaloscyphaceae*. *Scripta Mycologica* 20: 1–133.
- Rappaz F. 1995. *Anthostomella* and related xylariaceous fungi on hard wood from Europe and North America. *Mycol. Helv.* 7(1): 99–168.
- Rossman AY, Samuels GJ, Rogerson CT, Lowen R. 1999. Genera of *Bionectriaceae*, *Hypocreaceae* and *Nectriaceae* (*Hypocreales*, *Ascomycetes*). *CBS. Stud. Mycol.* 42: 1–248.
- Scheuer Ch. 1988. Ascomyceten auf Cyperaceen und Juncaceen im Ostalpenraum. *Bibl. Mycol.* 123: 1–274.
- Schwartzman SR. 1962. Flora sporovykh rastenij Kazakhstana 2. Golovnevye griby (Smut fungi). IAN Kazakhskoj SSR, Alma Ata. 369 pp.
- Schubert K, Groenewald JZ, Braun U, Dijksterhuis J, Starink M, Hill CF, Zalar P, de Hoog GS, Crous PW. 2007. Biodiversity in the *Cladosporium herbarum* (*Davidiellaceae*, *Capnodiales*), with standardisation of methods for *Cladosporium* taxonomy and diagnostics. *Stud. Mycol.* 58: 105–156.
- Shoemaker RA, Babcock CE. 1987. *Wettsteinina*. *Canad. J. Bot.* 65: 373–405.
- Shoemaker RA, Babcock CE. 1992. Applanodictyosporous *Pleosporales*: *Clathrospora*, *Comocloathris*, *Graphyllum*, *Macrospora*, and *Platysporoides*. *Canad. J. Bot.* 70: 1617–1658.
- Simmons E. G. 2007. *Alternaria*, an identification manual. CBS Biodiversity Series 6: 1–775.
- Suková M. 2004. Fungi on *Juncus trifidus* in the Czech Republic. *Czech Mycol.* 56: 63–84.
- Suková M, Chlebicki A. 2004. Fungi on *Juncus trifidus* in the Czech Republic (II) with taxonomical notes to some species. *Czech Mycol.* 56: 203–221.
- Sutton BC. 1980. *The Coelomycetes*. CMI, Kew, Surrey. 696 pp.
- Triebel D., Baral H. O. 1996. Notes on the ascus types in *Crocicreas* (*Leotiales*, *Ascomycetes*) with a characterization of selected taxa. *Sendtnera* 3: 199–218.
- Untereiner WA, Straus NA, Malloch D. 1995. A molecular-morphotaxonomic approach to the systematics of the *Herpotrichiellaceae* and allied black yeast. *Mycol. Res.* 99(8): 897–913.
- Vánky K. 1994. *European smut fungi*. G. Fischer Verlag. Stuttgart-New York. 570 pp.
- Vasyagina MP. 1977. Additions to the *Ustilaginales* flora of Kazakhstan. *Bot. Mater. Gerb. Bot. Akad. Nauk Kazakhsk. SSR* 10: 101–105.
- Wehmeyer LE. 1961. A world monograph of the genus *Pleospora* and its segregates. Univ. of Michigan Press, Ann Arbor. Wiltshire. 451 pp.
- Wehmeyer LE. 1975. The pyrenomycetous fungi. *Mycol. Memoir* 6: 1–250.

- Yuan Z-Q, Barr ME. 1994. New ascomycetous fungi on bush cinquefoil from Xinjiang, China. *Sydowia* 46(2): 329–337.
- Zhuang WY. 2005. Re-disposition of specimens filed under *Lachnea* in HMS. *Fungal Diversity* 18: 211–224.