

NEW DISTRIBUTION AND HOST RECORDS FOR *Puccinia atrofusca* AND OTHER NOTABLE *Puccinia* SPECIES (UREDINALES) FROM CENTRAL ASIA

ANDRZEJ CHLEBICKI & M. CATHERINE AIME

Abstract. Several species of *Puccinia* were recently collected in the Himalayan region of Central Asia from Kazakhstan and Tibet. *Puccinia atrofusca* (Dudley & C. H. Thomps.) Holw. is reported for the first time from India, in the Ladakh Mountains (West Tibet, Kashmir and Jammu provinces). The first record of a rust pathogenic on *Polygonum songoricum* Schrenk is recorded for *Puccinia nitidula* Tranzschel in Tranzschel & Serebrian. in Kazakhstan. *Puccinia saxifragae* Schltdl. and *P. allii* (DC.) F. Rudolphi are also newly reported from Kazakhstan. These species are described, illustrated and discussed.

Key words: Uredinales, *Allium*, *Kobresia*, *Polygonum*, *Saxifraga*, Tibet, Thian Shan, Asia

Andrzej Chlebicki, Department of Mycology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland; e-mail: chlebick@ib-pan.krakow.pl

M. Catherine Aime, USDA-Agricultural Research Service, Systematic Botany and Mycology Laboratory, 10300 Baltimore Ave, Beltsville, MD 20705, USA; e-mail: cathie@nt.ars-grin.gov

INTRODUCTION

Few data exist on the range and occurrence of phytopathogenic Uredinales (rust fungi) in the Himalayan region of Central Asia. Recent collecting expeditions in the Himalayas have yielded several notable rust fungi. The present paper reports three new distribution records for rusts in the genus *Puccinia* from the Thian Shan mountain range of Kazakhstan and one new record for West Tibet in India. We also report a rust, *Puccinia nitidula* Tranzschel in Tranzschel & Serebrian., pathogenic on *Polygonum songoricum* Schrenk, which constitutes the first rust record for this host.

MATERIAL AND METHODS

Dried spores were mounted in lactophenol by gently heating to boiling point and examined under a light microscope (LM) Olympus BX-51 with an oil immersion lens at magnification of $\times 1000$. Thirty spores of each specimen were measured. Slides in lactophenol were prepared for LM photographs. For SEM studies, dried spores were coated with gold, ca 20 nm, and photographed using a scanning electron microscope FEI

Quanta 200. Host plants were identified on the basis of *Flora of Ladakh* (Kachroo *et al.* 1977) and *Flora of Kazakhstan* (Pavlov 1960). Specimens are deposited in KRAM (W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland), PRM (National Museum in Prague, Czech Republic) and/or BPI (U.S. National Fungus Collections, Beltsville, MD, U.S.A.).

RESULTS

Puccinia allii (DC.) F. Rudolphi

Linnaea 1: 92. 1829.

Telia brown to almost black, ellipsoid, often confluent, covered by epidermis, parallel to veins on leaves and stems. Teliospores chestnut brown, two-celled, variable in shape (Fig. 1A), germ pore indistinct. One-celled amphispores present but rare.

NOTES. *Puccinia allii* is a common, cosmopolitan pathogen of garlic and leeks reported from Europe, Africa, Asia, North America, South America and New Zealand (Gäumann 1959;

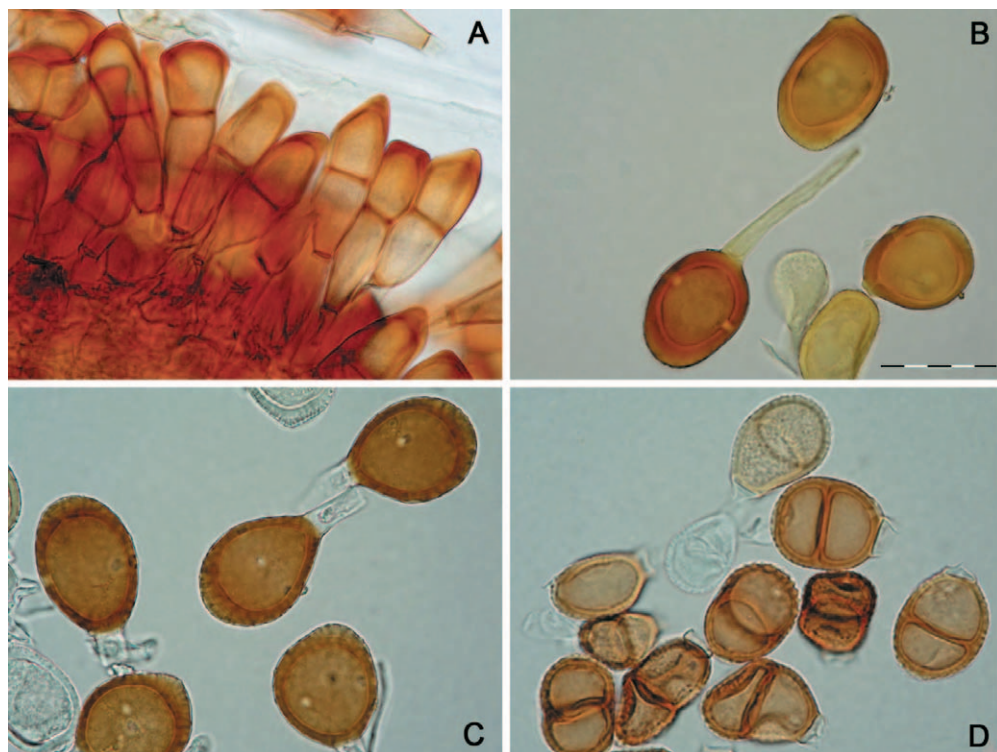


Fig. 1. *Puccinia alii* (DC.) F. Rudolphi: A – teliospores (KRAM F 55188). *Puccinia atrofusca* (Dudley & C. H. Thomps.) Holw.: B – amphispores from Ladakh Mts., India, (KRAM F 55236), C – amphispores and urediniospores from China (HMAS 65640). *Puccinia nitidula* Tranzschel in Tranzschel & Serebrian.: D – teliospores (KRAM F 55200). Scale bar = 30 µm.

Majewski 1970; Azbukina 1984). It is autoecious on a number of *Allium* species in Asia, including *A. porrum* L., *A. splendens* Willd. ex Schult. & Schult. f., and *A. strictum* Schrad. (Azbukina 1984). To our knowledge this is the first report of this fungus from Kazakhstan.

MATERIAL EXAMINED. KAZAKHSTAN. THIAN SHAN, Zailijskij Alatau Mts., valley of Issyk river, meadow near river, 1800 m elev., 43°13'58"N/77°24'36"E, on stems of *Allium* sp., 21 July 2005, leg. A. Chlebicki, KRAM F 55188.

Puccinia atrofusca (Dudley & C. H. Thomps.) Holw.

J. Mycol. **10**: 228. 1904.

Amphisorii elliptical to oval, red-brown, not covered by epidermis. Amphispores chestnut-red, clavate to ovoid (Fig. 1B), 25–37 × 18–22 µm with

wall 2–3 µm thick, covered by triangular spines ca 1 µm high, which are more densely distributed in the upper portion (Figs 2A & B), two equatorial germ pores, pedicel hyaline up to 60 µm long. Teliospores occasionally present, 40–49 × 10–19 µm, upper cell larger, apex thickened to 9 µm, slightly constricted at the septum.

NOTES. Only a few species of *Puccinia* are known to occur on *Cyperaceae* in the Himalayas: *P. canaliculata* (Schwein.) Lagerh. on *Cyperus* sp., *P. caricis-gibbae* Dietel on *Carex* sp., *P. cyperi* Arthur on *Cyperus pilosus* Vahl., *P. dioicae* var. *extensicola* (Plowr.) D. M. Hend. on *Carex* sp., *P. hyalina* M. S. Jacks. on *Carex* sp., *P. kyllingae-brevifoliae* Miura on *Kyllinga brevifolia* Rottb., *P. limosae* Magnus on *Carex teres* Boott, *P. lyngbyei* Miura on *Carex* sp., *P. caricina* DC. on *Kobresia persica* Kük. & Bornm., and *P. atrofusca*

on *Carex* sp. Of these, only *P. atrofusca* fits the combined morphological characters found in the Tibetan material. *Puccinia atrofusca* is heteroecious, with the aecial stage on species of Asteraceae and appears to belong to Savile's (1970) *P. littoralis*–*P. helanathi* lineage of Cardueae rusts. These rusts are characterized by laterally flattened urediniospores with two equatorial pores, one on each face. Areas surrounding the pores are devoid of spines.

Puccinia atrofusca is known from parts of Asia and North America (Farr *et al.* 2005). In Asia the aecial stage of *P. atrofusca* is widespread on *Artemisia* spp. (Azbukina 1984; Zhuang 1986), but only a few Asiatic collections containing the alternate state have been reported, these occurring on *Carex* sp. (China), *Carex pachystylis* J. Gay (Tadzhikistan) and *Kobresia capillifolia* (Decne) C. B. Clarke var. *filifolia* (China, Tadzhikistan) (Korbonskaya 1951, 1954; Jørstad 1959; Zhuang & Wei 1994). Recently, uredosori collected on *Carex curvula* All. in the Alps were identified as part of *P. atrofusca* s.l. (Zwetko *et al.* 2004), extending the known range for this species complex to Europe.

Puccinia atrofusca forms amphisorii containing one-celled amphispores and occasional two-celled teliospores. *Puccinia universalis* Arthur was described as a morphologically similar species that does not, however, produce amphispores. Nonetheless Arthur (1934) later synonymized *P. universalis* with *P. atrofusca*, and most modern authors follow Arthur. Two other species are morphologically similar to *P. atrofusca*, *P. caricis-siderostictae* Dietel reported on *Carex siderosticta* var. *stenophylla* (Kitag.) Kitag. in Japan (Saccardo 1912) and *P. caricis-nubigenae* Padwick & A. Kahn on *Carex nubigena* D. Don *ex* Tilloch & Taylor collected in the mountains of Patala in India (Padwick & Khan 1944). However, neither of these species produce amphispores and both have narrower urediniospores than those of *P. atrofusca*.

Amphispores in the Tibetan material of *P. atrofusca* (Figs 1B and 2A & B) are less echinulate than those in the Chinese collection (HMAS 65640) (Fig. 1C). In Russia *P. atrofusca* (as *P. universalis*) produces urediniospores and teliospores

but no amphispores and occurs chiefly on *Carex stenophylla* Wahlenb. (Ulyanishchev 1978). In the Himalayas, numerous specimens of *C. stenophylla* were checked for the presence of rust, but none were found on this host; *P. atrofusca* occurred here exclusively on *Kobresia capillifolia*. The recorded variations in echinulation, teliospore and amphispore production, and host preference make it most likely that *P. atrofusca* actually consists of a complex of closely related species that warrant detailed systematic study. To our knowledge this is the first record of the *P. atrofusca* complex in India.

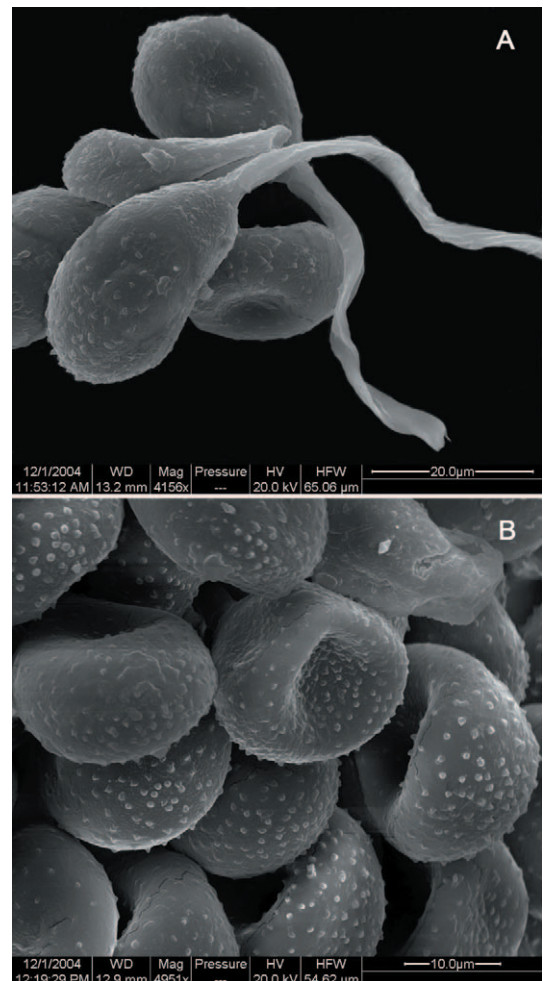


Fig. 2. Amphispores of *Puccinia atrofusca* (Dudley & C. H. Thomps.) Holw. from India (KRAM F 55236). A – side view, B – top view.

MATERIAL EXAMINED. INDIA. Jammu and Kashmir provinces, West Tibet, Ladakh Mts., Sabu near Leh, 3825 m elev., 34°09'24"N/77°39'42"E, on standing, senescent and dead stems of *Kobresia capillifolia*, 23 June 2004, leg. A. Chlebicki, KRAM F 55236. CHINA. Tibet, Gyirong (Everest Himalaya), 3500 m elev., on dead stems of *Carex* sp., 20 Sept. 1990, leg. J. M. Zhuang, HMAS 65640.

Puccinia nitidula Tranzschel

in Tranzschel & Serebrian., Myc. Ross. exsicc. no. 158 & 159. 1911.

Telia coffee-brown, hypophyllous, oval, ± densely distributed on the leaf surface near leaf veins. Teliospores (Fig. 1D) 30–34 × 19–22 µm, ellipsoid to clavate, not constricted at the septa, wall verrucose, of uniform thickness, with two germ pores, the upper cell possessing an apical pore, the lower cell possessing an inferior pore, pedicel hyaline, up to 50 µm long.

COMMENTS. Many collections of *P. nitidula* contain smooth teliospores, although verrucose teliospores may also occur within this taxon (Li 1988). *Puccinia nitidula* has been reported from Siberia, Japan, China, and parts of Europe (Li 1988). It is a heteroecious fungus with the aecial stage occurring on members of the Apiaceae and the telial stage on several genera of Polygonaceae (Farr *et al.* 2005). In Central Asia *P. nitidula* has been reported on *Polygonum amplexicaule* D. Don (Ono 1992; Okane *et al.* 1992; Ono & Kakishima 1992; Ono *et al.* 1995), *P. viviparum* L. (Ono 1992; Ono & Okane 1995), *P. alpinum* All., *P. polymorphum* Ledeb., *Aconogonon molle* (D. Don) H. Hara (Kakishima *et al.* 1993), *Angelica acutiloba* (Siebold & Zucc.) Kitag. var. *iwatensis* (Kitagawa) Hikino (Hiratsuka *et al.* 1992), *Pleuropterypyrum divaricatum* (L.) Nakai (*Polygonum divaricatum* L.), *Pleuropterypyrum undulatum* (Murr.) A. Löve & D. Löve (Denchev 1995) and *Koenigia islandica* L. (Jørstad & Christoffersson 1958). Zhuang and Wei (1994) report *P. nitidula* from the Tibetan Himalaya on *P. amplexicaule*. To our best knowledge this is the first record of *P. nitidula* from Kazakhstan, as well as the first record of any rust pathogen on *P. songoricum*.

MATERIAL EXAMINED. KAZAKHSTAN. THIAN SHAN, Dzhungar Alatau Mts., valley of Arasan river, 2680 m elev., 44°46'N/78°27'E, on leaves of *Polygonum songoricum* Schrenk, 18 Aug. 2002, leg. A. Chlebicki, KRAM F 55200. Thian Shan, Zailijskij Alatau Mts., valley of Issyk river, mosaic of meadows near river and tall spruce forest (*Picea schrenkiana* Fisch. & C. A. Mey.), 2340 m elev., 43°10'23"N/77°27'21"E, on leaves and axis of inflorescences of *Polygonum undulatum* (L.) Berg., 26 July 2005, leg. A. Chlebicki, KRAM F 55190.

Puccinia saxifragae Schldl.

Flora Berolinensis 2: 134. 1824.

Telia pale brown, oval, 0.4–5.0 mm long, 0.3–2.0 mm wide, located on petioles, peduncles, stems and abaxial side of leaf, sometimes confluent. Teliospores oblong-ellipsoidal, slightly constricted at the septum, 33–40 × 15–18(20) µm, the apex thickened up to 5 µm, wall faintly striate, germ pore apical in the upper cell and near the septum in the lower cell.

NOTES. *Puccinia saxifragae* is an autoecious species, circumboreal in distribution, that is pathogenic on various members of the Saxifragaceae (Farr *et al.* 2005). In addition to *Saxifraga* other potential host genera on record are *Heuchera* L., *Mitella* L., and *Tiarella cordifolia* L. (Farr *et al.* 2005). In the Himalayas this species is known from *Saxifraga sibirica* L. in the Pakistan Himalayas (Ono 1992) and on *S. pseudopallida* Engl. & Irmsch. from Tibet (Saville 1973). Azbukina (1984) noted it on six species of *Saxifraga* (among them *S. fusca* Maxim., *S. nelsoniana* D. Don, and *S. serotina* Sipliv.) in the Russian Far East. *Puccinia saxifragae* has previously been reported on *S. cernua* L. in Finland, Iceland, Norway, Sweden, and the Kola Peninsula of Russia (Hylander *et al.* 1953; Jørstad 1951; Karatygin 1999). To our knowledge this is the first record of this fungus in Kazakhstan.

MATERIAL EXAMINED. KAZAKHSTAN: Thian Shan, Zailijskij Alatau Mts., valley of Issyk river, above the point where the Issyk divides into two brooks, 3288 m elev., 43°08'03"N/77°30'11"E, on living leaves of *Saxifraga cernua* L., 3 Aug. 2005, leg. M. Chlebická & A. Chlebicki, KRAM F 55187.

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