

SOME ADDITIONS TO THE UREDINALES OF AZAD JAMMU AND KASHMIR (AJ & K), PAKISTAN

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Abstract

Melampsora laricis-populina, *Phragmidium shogranense*, *Puccinia coronata* var. *coronata*, *P. menthae* and *P. nitidula* were collected and described from Azad Jammu and Kashmir, Pakistan as new records for this area.

Introduction

Azad Jammu & Kashmir lies in the Northeast of Pakistan. It consists of an arc-shaped stretch of territory with an area of approximately 13,296 sq kms bordering Indian-occupied Jammu and Kashmir to the East, Punjab to the South and Northwestern Frontier province to the West, and the Northern Areas (NA) of Pakistan to the North. Azad Kashmir has very significant geographical distribution among mountainous ranges. It comprises foothills of the Himalayas rising to Jamgarh Peak (4,734 m) with the Northwestern reaches of the Pir Panjal Range (3,753 m) to the South. Azad Kashmir can be divided into two geographical zones, hilly and mountainous to the North and East while areas to the South and West consist mainly of valleys and plains. This area lies between 30° and 35° North latitude and has subtropical highland climate with 150 cm average rainfall. Temperature and rainfall vary across the four districts of Azad Kashmir and adjacent Northern Areas (Singh *et al.*, 2004).

Due to extensive topographic variations in the areas of Azad Kashmir, there exists a diversity of plant species. Its flora ranges from the thorn bush type of the arid plains to the temperate and alpine flora of the higher altitudes. Prominent among the trees are *Taxus wallichiana* Zucc., *Cornus macrophylla* Wall., *Diospyros lotus* L., *Viburnum cylindricum* Ham. ex D. Don, *Acer oblongum* L., *Rhus succedanea* L. etc. Common shrubs include *Juniperus squamata* Duch. Ham. ex Lambert, *Sageretia theezans* (L.) Brongn., *Dodonaea viscosa* (L.) Jacq., *Solanum verbascifolium* auct. non L., *Lonicera quinquelocularis* Hardw., and *Lyonia ovalifolia* (Wall.) Drude. Perennial herbs include *Geranium nepalense* Sweet, *Boenninghausenia albiflora* (Hk.) Reichb. ex Heynh., *Oxalis acetosella* L., and *Androsace umbellata* (Lour.) Merrill (Ali & Qaiser, 1986). At the higher altitudes there are Birch (*Betula utilis* D. Don), Barbers (*Berberis lycium* Royle) and a large number of herbal plants. Mountainous region in the state are covered with dense Deodar (*Cedrus deodara* (Roxb. ex Lamb.) G. Don), Fir (*Abies pindrow* Royle), and Pine (*Pinus wallichiana* A.B. Jackson). Walnut (*Juglans regia* L.), and Willow (*Salix* spp.) are some of the trees, which are the part of the rich flora of Neelum Valley (Azad Kashmir) and adjacent northern areas of Pakistan (Prithivi, 1978).

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About 10.6% of the total flora of Pakistan is represented in the area of Azad Kashmir and adjacent Northern Areas of Pakistan (Ali & Qaiser, 1986). This floristically rich area has a number of host plants, but it is still poorly explored uredinologically. Uptil now, about 25 species of rust fungi have been described/ reported from Azad Kashmir (Ahmad, 1956a, b; Gjaerum and Iqbal, 1969; Kakishima *et al.*, 1993a, b; Ahmad *et al.*, 1997; Afshan *et al.*, 2010). These figures indicate that the number of rust species collected from these areas is far less in relation to the vegetation.

All these attempts of exploring diversity of rust fungi from Azad Kashmir and adjacent Northern Areas were confined to the limited areas and no comprehensive surveys of these floristically rich areas have been made so far. Vast areas of Neelum Valley (Azad Kashmir) are still unexplored and uredinologically poorly known.

Materials and methods

Melampsora laricis-populina on *Populus alba*, *Phragmidium shogranense* on *Rubus pungens*, *Puccinia coronata* var. *coronata* on *Agrostis gigantea*, *P. menthae* on *Mentha longifolia* and *Nepeta campestria* and *P. nitidula* on *Bistorta amplexicaulis* were collected and described from Azad Kashmir for the first time. In order to explore the diversity of Uredinales of Azad Kashmir, rusted plants are collected from different areas of Neelum valley. The specimens were listed, mounted on herbarium sheets and deposited in the LAH herbarium. New observations on previously known species are also made.

Free hand sections of rusted portions of material and spores were mounted in lactophenol and gently heated. The preparations were observed under a NIKON YS 100 microscope. Drawings of spores and paraphyses were made using a camera lucida (Ernst Leitz, Wetzlar, Germany). Spore dimensions were measured using an ocular micrometer. At least 25 spores were measured for each spore stage.

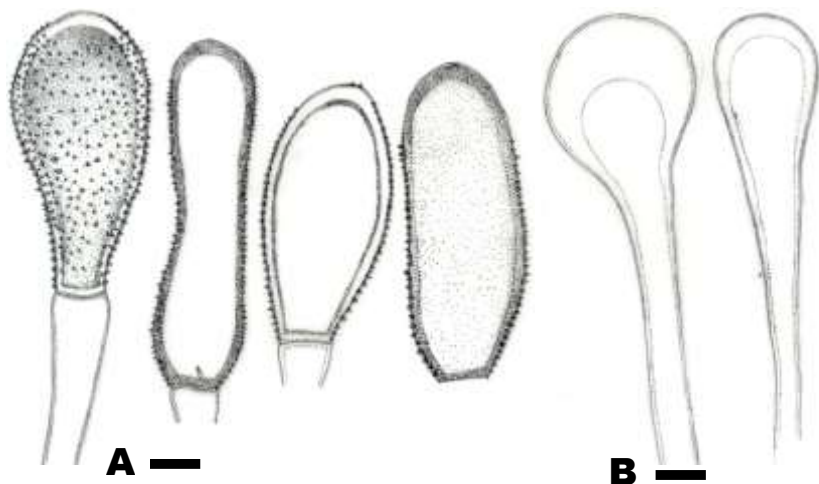
Result and Discussion

Melampsora laricis-populina Kleb., *Z. PflKrankh. PflPath. PflSchutz* 12: 43 (1902) = *Melampsora populi* (Sowerby) M. Morelet, *Cryptog. Mycol.* 6(2): 107 (1985) (Figs. A-B)

Spermogonia, aecia and telia unknown. Uredosori mostly hypophyllous, rarely epiphyllous, in little groups, $0.07\text{--}0.1 \times 0.1\text{--}0.4$ mm, yellow to yellowish orange, rounded, at first covered by the raised epidermis, distributed over the whole leaf surface. Urediniospores oblong to broadly ellipsoid or obovoid, hyaline to light yellow with yellowish granules, $(9\text{--}) 11\text{--}20 \times (25\text{--}) 30\text{--}42$ ($\text{--}47$) μm , wall $2\text{--}4$ μm thick, echinulate except at the smooth apex; germ pores obscure; pedicel hyaline, $6\text{--}7 \times 10\text{--}24$ μm . Paraphyses clavate to capitate, hyaline to pale yellow, $15\text{--}20 \times 50\text{--}71$ μm , wall thick, up to 10 μm at the apex and 4 μm thick at the sides.

Material examined: On *Populus alba* L., Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchhal, at 3000 m a. s. l., 03 November, 2006. NSA # 905. (LAH Herbarium No. NSA 1019).

Melampsora laricis-populina has been reported on leaves of *Populus nigra* L. from Mansehra (NWFP) by Kaneko (1993). It is a new record for Azad Jammu and Kashmir.



Figs. A-B: *Melampsora laricis-populina* (A). Lucida drawing of urediniospores (B). Capitate paraphyses. Scale Bar for A = 12 μ m & B = 10 μ m.

Phragmidium shogranense Petr., *Sydowia* 8: 162 (1954) (Fig. C)

Spermogonia, aecia and uredinia not found. Telia hypophyllous, minute or medium, black, scattered. Teliospores pale brown to cinnamon brown, cylindric, rounded at both ends, 3-6 septate, usually 4-5 septate, at septa not or slightly constricted, 28-33 \times 63-75 μ m, epapillate, apex 3-5 μ m thick, rounded, wall 1.5-3 μ m thick, smooth; germ pores 2 in each cell, equatorial; pedicel hyaline, 10-15 \times 50-80 μ m.

Material examined: On *Rubus pungens* Cambess., with state III, Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchhal, at 3000 m a. s. l. 03 November, 2006. NSA # 909. (LAH Herbarium No. NSA 1027).

Phragmidium shogranense has been reported on *Rubus* sp., from Kaghan valley, Shogran, Swat state and Miana (Ahmad *et al.*, 1997). It is a new record from Azad Kashmir.

Puccinia coronata* var. *coronata Corda, *Icon. fung.* (Prague) 1: 6 (1837) (Figs. D-E)

Spermogonia and aecia unknown. Uredinia amphigenous, mostly on adaxial leaf surface, yellowish brown to cinnamon brown, 0.07-0.09 \times 0.1-0.3 mm; with few colorless to light brown, cylindrical to clavate paraphyses, less common, apex 12-13 μ m wide while 7-9 μ m thick below, up to 50 μ m long. Urediniospores globose-subglobose or ellipsoid, (15-) 17-21 \times (17-) 19-28 μ m; germ pores 5-9, scattered, obscure; wall 1.3-2 μ m thick, echinulate, golden brown to cinnamon brown. Pedicel minute, deciduous, 4-8 \times 10-12 μ m. Telia amphigenous or on abaxial surface, long, covered by an epidermis, or only tardily exposed, blackish brown, with a few brown stromatic paraphyses, sori scarcely loculate, sori 0.06-0.08 \times 0.09-0.2 mm. Teliospores clavate to ellipsoid or oblong, 10-16 (-20) \times (35)- 47-56 (-62) μ m (excluding digitations), digitations 2-several, 5-12 μ m long, wall up to 2 μ m thick at sides, smooth, chestnut brown, paler basally, about 2-4 (-6) μ m thick apically excluding digitations. Pedicel short, yellowish brown to brown, 6-7 \times 9-15 μ m.

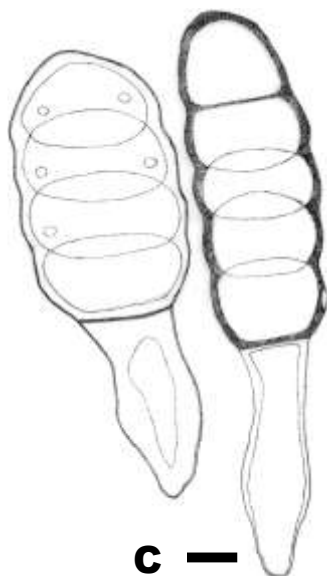
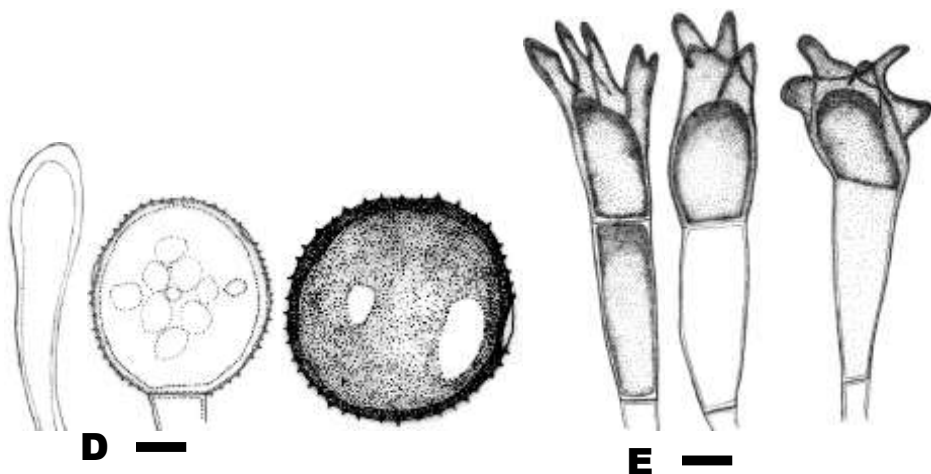


Fig. C. Lucida drawing of teliospores of *Phragmidium shogranense*. Scale Bar = 15 μ m.



Figs. D-E: Lucida drawings of *Puccinia coronata* var. *coronata* (D). Echinulated urediniospores and clavate paraphyses (E) Coronate teliospores. Scale bar = 10 μ m.

Material examined: On *Agrostis gigantea* Roth, with II + III stages, Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchhal, at 3000 m a. s. l., 03 November, 2006, NSA # 908. (LAH Herbarium No. NSA 1043).

Puccinia coronata var. *coronata* has been reported on *Lolium persicum* from Quetta by Malik *et al.*, (1968) and Malik & Virk (1968); on *Agrostis* sp., from Swat, Kaghan valley, Peshawar valley, Karachi and Faisalabad by Malik & Khan (1944), Ahmad (1956a, b), Ghaffar & Kafi (1968), Jorstad & Iqbal (1967); and on *Festuca* sp. from Swat by Ono & Kakishima (1992).

P. coronata var. *coronata* is a new record for Azad Kashmir.

Puccinia menthae Pers., *Syn. Meth. Fung.* (Göttingen) 1: 227 (1801) (Figs. F-G)
= *Puccinia clinopodii* DC., in de Candolle & Lamarck, *Fl. franç.*, Edn 3 (Paris) 5/6: 57 (1815)
= *Aecidium menthae* DC., in de Candolle & Lamarck, *Fl. franç.*, Edn 3 (Paris) 5/6: 95 (1815)

Spermogonia and aecia not found. Uredinia hypophyllous, brown, rounded, scattered, $0.06-0.09 \times 0.1-0.3$ mm. Urediniospores globose to obovoid or ellipsoid, $15-24 \times 20-27$ μm ; wall up to 2.5 μm thick, echinulate, hyaline to light yellow; germ pores 2, equatorial; pedicel hyaline, $4-5 \times 24$ μm . Telia mostly hypophyllous, rarely amphigenous, on leaves, petioles and stems, rounded, blackish brown, scattered, pulverulent, $0.07-0.2 \times 0.1-0.5$ mm. Teliospores ellipsoid to obovoid, rounded at both ends, not or slightly constricted at the septum, $19-24 \times 25-33$ μm (mean 21×28 μm), verrucose, chestnut brown, wall $1.4-3$ μm thick at sides, $3-5$ μm thick apically, apex rounded; germ pores 2, apical in distal cells and close to septum in proximal cells, with a hyaline papilla; pedicel hyaline, fragile, $5-7 \times 37-100$ μm .

Material examined: On *Mentha longifolia* Huds., with III stage, Pakistan, Azad Jammu & Kashmir, Neelum valley, Sharda, at 1981 m a. s. l., 3rd November, 2006. NSA # 903. (LAH Herbarium No. NSA 1068).

On *Nepeta campestris* Benth., with II & III stages, Pakistan, Azad Jammu & Kashmir, Neelum valley, Sharda, at 1981 m a. s. l., 3rd November, 2006. NSA # 904. (LAH Herbarium No. NSA 1069).

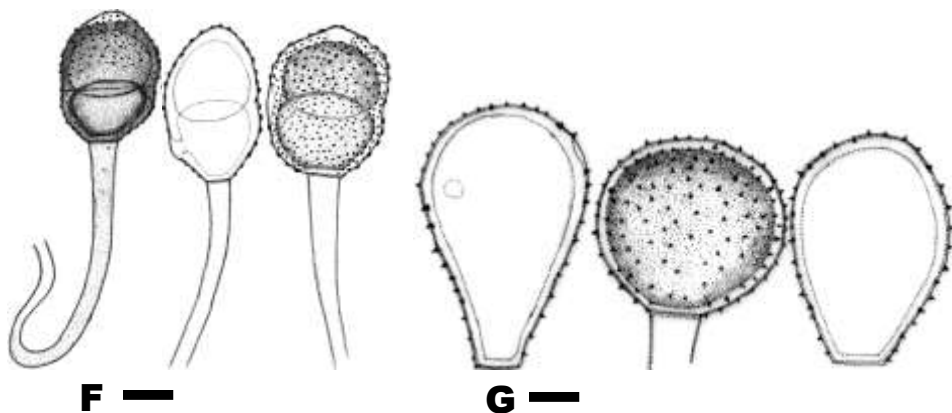
Puccinia menthae is a new record for Azad Kashmir. It has been reported on *Mentha sylvestris* L. from Quetta, Chillianwala, Mingora, Poonch, Kaghan valley, Naran, Murree hills and Peshawar; on *Origanum vulgare* L. from Kaghan valley, Naran, Sharhan & Changla Gali; on *Calamintha umbrosa* Rchb. and *C. clinopodium* Benth. from Kaghan, Batakundi, Changla Gali, Swat, Kalam & Naran; on *Nepeta* sp., from Kaghan valley (Ahmad, 1956a, b).

Puccinia nitidula Tranzschel, in Tranzschel & Serebrian, *Myc. Ross.* exsic. no. 158 & 159: (1911) (Figs. H-I).

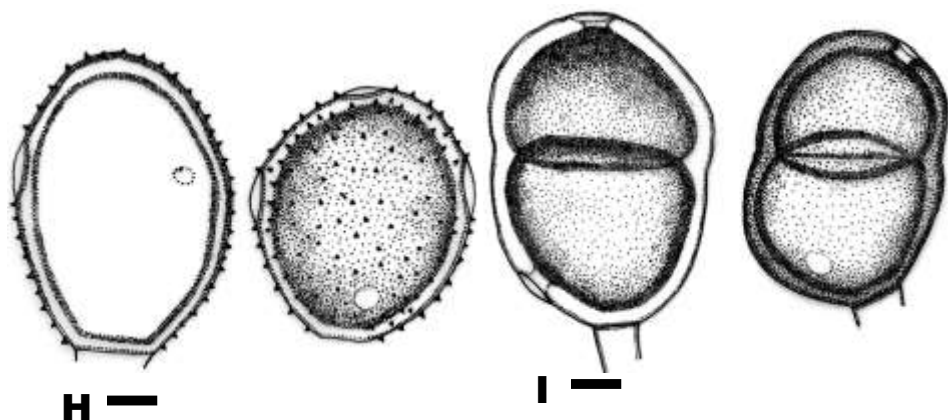
Spermogonia and aecia unknown. Uredinia amphigenous, but mostly hypophyllous, light brown, scattered, irregular, $0.07-0.2 \times 0.1-0.3$ mm. Urediniospores globose to subglobose or ellipsoid, pale brown to yellowish brown, $(17-)$ $19-24 \times 18-26$ μm (22×23 μm on the average); germ pores 3-4, equatorial; wall $2-2.6$ μm thick, echinulate; pedicel short, not persistent. Telia amphigenous, but chiefly hypophyllous, dark brown to black, scattered or clustered, naked, irregular patches, $0.09-0.1 \times 0.1-0.3$ mm. Teliospores ellipsoid to broadly ellipsoid or obovoid, rounded at both ends, not or slightly constricted at the septum, $18-24 \times 27-33$ (-35) μm (mean 21×31 μm), brown to chestnut-brown, wall $1-2$ μm thick at sides, $2-4$ μm thick apically; germ pores 2, apical or sub apical in distal cells and close to the pedicel or between the pedicel and septum in proximal cells, with hyaline umbos over germ pores; pedicel hyaline, short, $3-8 \times 12-20$ μm .

Material examined: On *Bistorta amplexicaulis* (D. Don) Greene, (= *Polygonum amplexicaule* D. Don), Pakistan, Azad Jammu & Kashmir, Neelum valley, Muchhal, at 3000 m a. s. l., 3rd November, 2006, NSA # 900 (LAH Herbarium # NSA 1073).

Puccinia nitidula is a new record from Azad Kashmir. It has been reported on *Bistorta amplexicaulis* (D. Don) Greene and *Bistorta vivipara* (L.) Delarbre from Swat valley and Kaghan valley by Ono & Kakishima (1992) and Ono (1992).



Figs. F-G: Lucida drawings of *Puccinia menthae* (F) Teliospores (G) Echinulated urediniospores. Scale bar for F = 14 μm & G = 8 μm .



Figs. H-I: Lucida drawings of *Puccinia nitidula* (H). Echinulated urediniospores showing equatorial germ pores (I) Teliospores. Scale bar for H = 7 μm & I = 8 μm .

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