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Genus *Pyrgillus* Nyl. (Lichenized Ascomycota: *Pyrenulaceae*) in India

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ABSTRACT: The genus *Pyrgillus* is represented by 4 species from India. A new species, *P. idukkiensis* is described. *P. cubanus* Nyl. is reported as new record for India. A key, revised descriptions and illustrations are provided to facilitate identification of Indian species.

KEY WORDS: Arunachal Pradesh, calicioid lichens, Pyrenulaceae, *Pyrgillus cubanus, Pyrgillus idukkiensis,* taxonomy.

INTRODUCTION

The genus *Pyrgillus* belongs to calicioid group of lichens which are characterised by the presence of mazaedia, accumulating numerous mature ascospores. *Pyrgillus* was established by Nylander (1857) who recognized its similarities with some pyrenocarpous genera. It is now well recognised in the family Pyrenulaceae (Aptroot, 1991; Tibell, 1996; Lumbsch *et al*., 2004). Aptroot (1991, 2009) and Tibell (1996) carried out detailed studies on the taxa.

The genus is characterised by crustose, corticolous, epiphloeodal thallus with *Trentepohlia* as photobiont; sessile, solitary, black, perithecioid, mazaedioid ascomata with carbonized exciple; non inspersed hamathecium, I- with simple paraphyses; 8-spored asci without an ocular chamber; and broadly ellipsoid, brown, distoseptate to euseptate, 1–3 trans-septate ascospores.

The genus occurs on the bark in pantropical regions and widely distributed and known from the collections made from Africa, Australia, Cuba, Java, India, North and South America. It is represented by 5 species worldwide (Kirk *et al*., 2008; Singh and Singh, 2012), of which 2 species *viz*. *Pyrgillus indicus* (Kremp.) Aptroot and *P. javanicus* (Mont. & Bosch) Nyl. were known from India (Singh and Sinha, 2010). But the examination of collections pertaining to these species revealed that they are different taxa due to erroneous identification. During the course of study on lichen collections from Arunachal Pradesh as well as collections preserved in the herbaria of National Botanical Research Institute, Lucknow (LWU-LWG and LWG) and Agarkar Research Institute, Pune (AMH), four species have been identified. Of these, *P. idukkiensis* is described here as new species. *P. cubanus* Nyl. is reported as new record for India. All the species are revised based on new and old collections and a key is formulated for Indian species in the present communication.

MATERIALS AND METHODS

Specimens collected from Arunachal Pradesh and deposited in ASSAM and BSA herbaria and the specimens taken on loan from the herbaria of LWG and AMH were investigated. Morphological observations were made using stereomicroscope (Nikon SMZ 1500). Thin hand-cut sections of thalli and ascomata were mounted in water, 10% KOH, and Lugol's iodine solution. All anatomical measurements were made in water mounts and examined under a compound microscope (Digi 2, Nikon Eclipse 50i). Lichen substances were identified by thin layer chromatography (TLC) in solvent A (180 Toluene: 60 dioxane : 8 acetic acid) following White and James (1985).

TAXONOMIC TREATMENT

Key to the Indian species of *Pyrgillus*

1. Ascospores 1-septate …… 2
2. Ascospores 3-septate ……..…… 3
2. Margin of the excipulum with white pruinose rim, K-; ascocarps 0.6–0.8 mm high above the thallus …… ***P. cubanus***
2. Margin of excipulum with orange-reddish pruinose rim, K+ deep red; ascocarps 1.4–2.1 mm high above the thallus ……..…… ***P. idukkiensis***
3. Margin of the excipulum with greyish margin of excipular rim, K-; ascocarps 0.8–1.1 mm high above the thallus; ascospores 10.5–12(–13) µm long ……..…… ***P. javanicus***
3. Margin of the excipulum with orange-reddish pruinose rim, K+ reddish- violet; ascocarps 1.7–2.3 mm high above the thallus; ascospores (15.3–)16–20 (–22.8) µm long ……..… ***P. tibellii***

Pyrgillus cubanus Nyl., Flora 59: 559.1876; Tibell, Fl. Neotrop. Monogr. 69: 54. 1996. *Pyrgillocarpon cubanum* (Nyl.) Tibell, Beih. Nova Hedwigia 79: 676. 1984. Type. Cuba Wright *s.n.* (Lectotype: H-Nyl. 40428-*n.v.*).

Figs. 1A & B, Fig. 2A

Thallus crustose, corticolous, epiphloeodal,

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continuous, 6–8 cm across, 35–50 µm thick; surface grey to dull white, smooth to minutely verrucose, corticated, lacking a distinct prothallus; cortex 10–15 µm thick, without any crystals; photobiont layer 25–38 µm thick; photobiont *Trentepohlia*; cells 8–12 × 5–6 µm.

Ascomata perithecioid, mazaedioid, sessile, solitary or paired, scattered, partly immersed in substrate, 0.6–0.8 mm high above the thallus, 5.5–0.7 mm wide; excipulum strongly sclerotized, up to 200 µm thick; mazaedium well developed. Margin of the excipulum with white pruinose rim, K-; ostiole apical, 100–200 µm wide. Hamathecium not inspersed, I-; paraphyses, simple, *ca.* 1.5 µm thick. Asci 8-spored, evanescent, cylindrical, with uniseriate and periclinally arranged ascospores, 75–95 × 8–10 µm. Ascospores released and form dry black, powdery mass, brown, ovoid to ellipsoid with rounded ends, 1-septate, distoseptate with one transverse incomplete to complete euseptum, without constriction at septum, 9.0–11.7 × 8.5–10 µm.

Chemistry: Thallus K-, C-, KC-, P-; UV+ yellow, containing lichexanthone.

Remarks: This species is characterised by the white pruinose excipular margin, 1-septate ascospores and presence of lichexanthone. In septation of spores, it closely resembles *Pyrgillus indicus* which has yellow pruinose margin and thallus UV-. The species grows on the bark of trees in open places in subtropical and subtemperate areas. The species is distributed in Australia, Bermuda, Cuba and Papua New Guinea. It is a new record for India.

Specimen examined: INDIA: Arunachal Pradesh, West Kameng district, Saiden-Zirigao; alt. 1500–1850 m; *K.P. Singh, 9316* (ASSAM).

Pyrgillus idukkiensis Kr. P. Singh and Pushpi Singh ***sp. nov.***

Mycobank No. (MB 801754) Figs. 1C & D, Fig. 2B

Type collection : INDIA: Kerela, Idukki district, I.C.R.I campus, Myladumpara, alt. *ca.* 1200 m, on bark of tree, 01.03.1984*, D.D. Awasthi and G. Awasthi 84.47* (holotype: LWU-LWG)

Thallus crustose, corticolous, epiphloeodal, 4–6 cm across, surface matt yellow to yellowish brown, continuous, thick, smooth to cracked, rimose to areolate, *ca.* 200 µm thick, sometimes black spotted, corticate, lacking a distinct prothallus; cortex 25–28 µm thick, without any crystals, prothallus brown-black; photobiont layer 50–65 µm thick; photobiont *Trentepohlia*; cells 10–12 × 5–6 µm.

Ascomata perithecioid, mazaedioid, sessile, solitary or paired, scattered, partly immersed in substrate, conical, 1.4–2.1 mm high; lower part covered by thick thalline margin, upto 200 µm thick. Upper compartment of ascoma long, somewhat cylindrical, 0.9–1.0 mm wide and protruding 0.8–1.1 mm high. Excipulum of the upper compartment strongly carbonized, 150–210 µm thick. Lower compartment 0.7–0.8 mm high and *ca.* 1.3 mm wide, containing many locules enclosed by 140–260 µm thick strongly carbonized wall of the ascoma. Ascospores produced in the lower ovoid locule connected to the upper compartment by a narrow canal, through which the mature ascospores are delivered and accumulated in the upper part of the ascoma. Margin of excipulum with reddish pruinose rim reacting K+ deep red; ostiole apical, obconical, 400–700 µm wide. Hamathecium not inspersed, I-; paraphyses, simple, 1.5–2 µm thick. Asci 8-spored, evanescent, cylindrical, with uniseriate and periclinally arranged ascospores, 83–110 × 7–8.5 µm. Ascospores brown, ellipsoid to oblong, 1-septate, distoseptate, smooth, thick walled, 10.5–14 × 6.5–9 µm; end walls thickened with euseptum material, just like the septum.

Chemistry: Thallus K+ dull yellow to dirty red, C-, KC-, Pd-; UV+ brilliant yellow, containing lichexanthone; TLC- grey and orange pink unidentified substances found at Rf class 3 and Rf class 4 respectively. Excipular margin of ascomata orange-reddish, pruinose rim reacting K+ deep red.

Etymology: The species epithet refers to the name of type locality.

Remarks: *Pyrgillus indicus* was reported from India by Awasthi (1989) as *Pyrgillocarpon indicum* based on collections made from Karnataka and Kerala. The examination of these collections revealed that the thallus is UV+ yellow in addition to orange-reddish excipular margin reacting K+ deep red. However, Tibell (1996) reported as thallus UV- and excipular margin with yellow pruinose rim. This indicates that Indian materials are quite distinct and therefore, a new species-*P. idukkiensis* is proposed to accommodate these Indian materials. It is also clear that *P.indicus* does not occur in India. This new species is clearly distinguished from the morphologically and anatomically similar *Pyrgillus indicus* by its orange-reddish excipular pruinose rim, 1-septate ascospores with thickened end walls just like septum and the presence of lichexanthone. Morphologically it also closely resembles *P. tibellii* which has 3-septate ascospores.

Additional specimens examined: INDIA: Karnataka, Jog falls-Sagar road, 5 km to Sagar, 1974, *Patwardhan and Nagarkar 74.2813* (AMH); 3 Km from Sagar, *Patwardhan and Kulkarni 74.2839* (AMH); Kumali road, 1973, *Kulkarni and Bhade 73.2334* (AMH). Kerela, Idukki district, I.C.R.I campus, Myladumpara, alt. *ca.* 1200 m, on bark of tree, 1984*,* 87183 (LWU-LWG); Santhampara, alt. 1200 m 1984, *D.K. Uperti 87186 A* (LWU-LWG)- erroneously identified as *Pyrgillus indicus.*

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Pyrgillus javanicus (Mont. and Bosch) Nyl., Mem. Soc Sci. Nat. Cherbourg 5: 334. 1857. Tibell, Fl. Neotrop. Monogr. 69: 54. 1996. *Calicium javanicum* Mont. and Bosch in Miq., Pl Jungh. 4: 480. 1855. Type: Indonesia, Java (Holotype: L-*n.v.). Pyrgillus americanus* Nyl., Syn. Lich. 1(2): 168. 1860. Figs. 1E & F, Fig. 2C

Thallus crustose, corticolous, epiphloeodal, 4.5–10 cm across, 0.6–1.2 mm thick, dirty white-greenish grey, continuous, smooth, corticated; prothallus brown-black; cortex 12–15 µm thick, containing minute crystals. Photobiont layer 25–35 µm thick, compactly arranged; photobiont *Trentepohlia*; cells 10–12 × 8–5 µm.

Ascomata perithecioid, mazaedioid, sessile, solitary or paired, 0.8–1.1 mm high, *ca.* 0.7 mm wide; excipulum strongly sclerotized, 150–200 µm thick; the lower part spherical, partly immersed in substrate; covered by thalline margin. Upper compartment of the ascoma short, cylindrical, 0.5–0.7 mm wide and protruding 0.4–0.55 mm above the surface of the thallus. Margin of the excipulum with greyish pruinose rim, K-; ostiole apical, obconical, 200–400 µm wide. Hamathecium not inspersed I-; paraphyses simple, 1.5–2 µm thick. Asci 8-spored, becoming evanescent later on, cylindrical with uniseriate and periclinally arranged ascospores, 70–76 × 6–8 µm. Ascospores dark brown, broadly ellipsoid, 3-septate, distoseptate with darker strands indicating euseptate, smooth, thick walled, (9–) 10.5–12 (–13) × (6.5–) 7–8 µm.

Chemistry: Thallus K-, C-, KC-, P-; UV+ yellow, containing lichexanthone.

Remarks: *Pyrgillus javanicus* is characterised by its excipular margin with greyish pruinose rim, K- and small 3-septate ascospores. Morphologically and anatomically it resembles *P. tibellii* which has orange-reddish pruinose rim reacting K+ violet-red and large ellipsoidal, 3-septate ascospores. The earlier report of this species from India by Awasthi (1989) was erroneous as those collections now belong to *P. tibellii.* The species grows in exposed shady places along the river side on the bark of trees in tropical areas. The species is distributed in Africa, America, Australia, Indonesia, Japan, Madagascar and Philippines.

Specimens examined: INDIA, Arunachal Pradesh, Upper Subansiri district, Taliha B.M.C. area, Subansiri river bed; *K.P. Singh, 10554*, *10538*, *10507*, *10495*, *10517*, *10553* (ASSAM).

Pyrgillus tibellii Kr. P. Singh and Pushpi Singh, Lichenologist 44(6): 773–776, 2012. Type: India Arunachal Pradesh, Papampure district, Sankei view, on bark, 340 m alt. 12 January 1997, *K.P. Singh* 9616 (ASSAM-holotype; BSA- isotype) Figs. 1G & H, Fig. 2D

Remarks: The description and comparison of this species are available elsewhere (Singh and Singh 2012). However, this species is clearly distinguished from other known species of the genus by its large (1.7–2.3 mm high), perithecioid, ascomata, excipular margin with orange-reddish pruinose rim reacting K+ reddish violet and large ((15.3–)16–20 (–22.8) × 7.5–10 µm) ellipsoidal, 3-septate ascospores.

Specimens examined: INDIA: Arunachal Pradesh, Papampure district, Sankei view, on bark, 340 m alt. 12 January 1997, *K.P. Singh* 9616; Tirap district, Namsang, *K.P. Singh* 866 (ASSAM); Kerela, Idukki district, Santhampara, alt. 1200 m 1984, *D.K. Uperti 87186* B (LWU-LWG).

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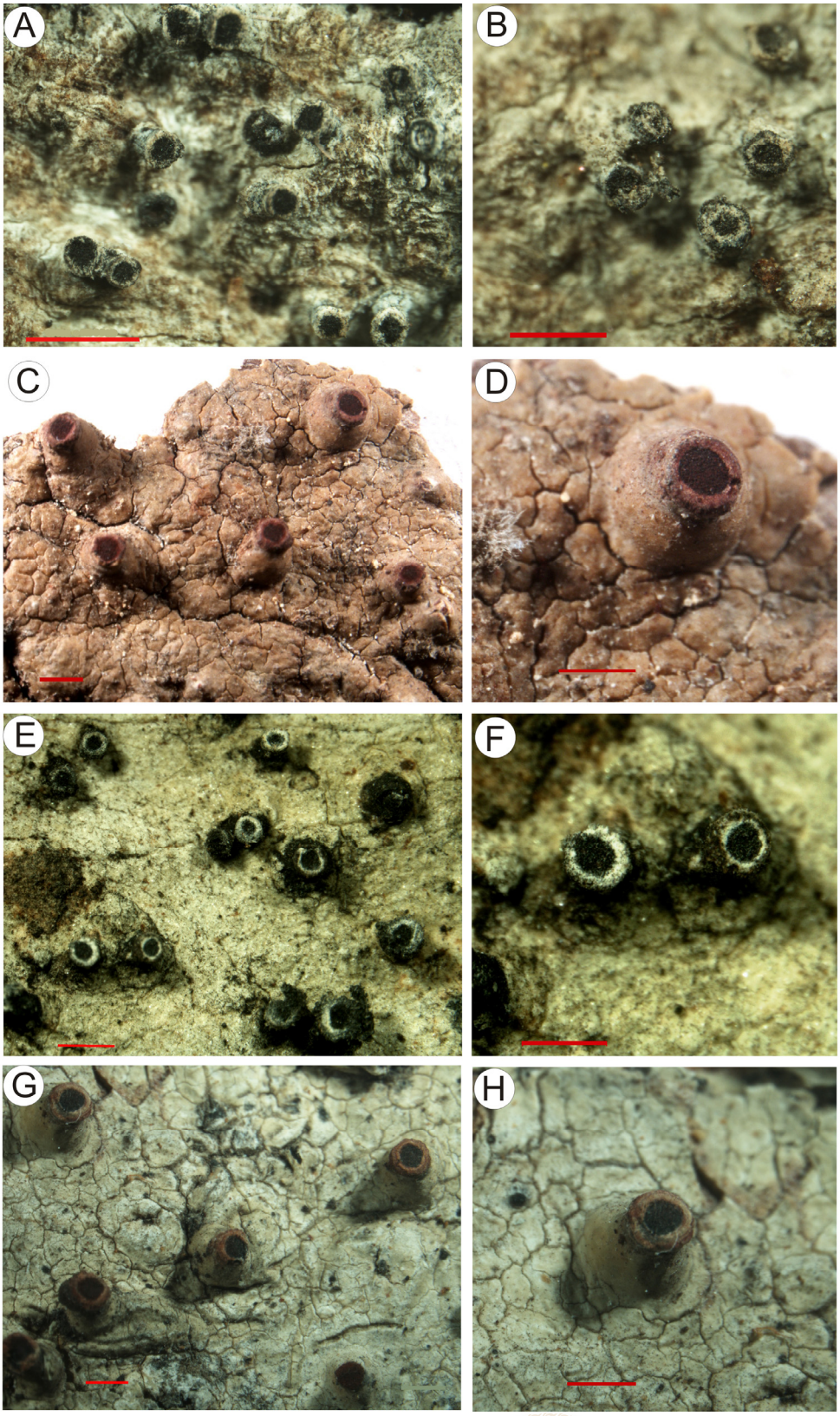


Fig. 1. A-H: Habit with mature ascomata. A & B: *Pyrgillus cubanus*. C & D: *P. idukkiensis* (holotype). E & F: *P. javanicus*. G & H: *P. tibellii*. Scale bar A to F = 1 mm.

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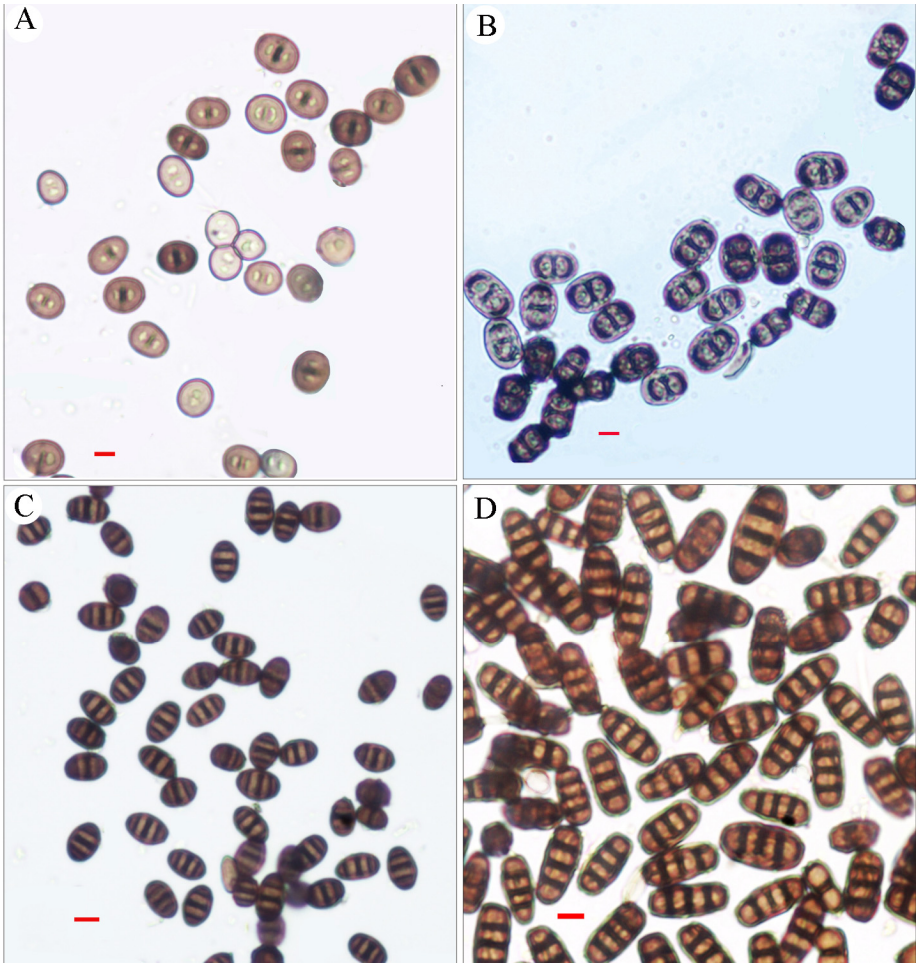


Fig. 2. Mature ascospores. A: *Pyrgillus cubanus*. B: *P. idukkiensis* (holotype). C: *P. javanicus*. D: *P. tibellii*. Scale A to D = 5 µm.

印度產 *Pyrgillus* 屬（子囊菌門：小核衣科）之現況

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摘要：*Pyrgillus*屬目前在印度共有四個種；本文發表了一個新種*P. idukkiensis*以及一個新紀錄種*P. cubanus*。本文並提供檢索表、修訂後的描述及圖片以利物種的鑑定。

關鍵詞：阿魯納恰爾邦、粉果類地衣、小核衣科、*Pyrgillus cubanus*、*Pyrgillus idukkiensis*、分類學。

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