



## Highlighted Student Research

## New multispored species of the lichen genus *Lecanora* from India with an updated world key

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**ABSTRACT:** Six species of *Lecanora* with multispored asci (multispored species) viz., *L. flavothallina*, *L. himachalensis*, *L. jatoliensis*, *L. pruinomarginata*, *L. shimlaensis*, and *L. uttarkashiensis* are described as new to science. *Lecanora flavothallina* is characterized by having characteristic yellow pigments at the thallus margin, *L. himachalensis* is characterized by having a *chlarotera*-type epihymenium and the presence of hypoprotocetraric acid, *L. jatoliensis* has pruinose apothecial discs and usnic acid, *L. shimlaensis* is characterized by having dark brown to black apothecial discs, and an *allophana*-type amphithecium. *L. pruinomarginata* has whitish pruinose apothecial margins and fumarprotocetraric acid, while *L. uttarkashiensis* is characterized by having orange-brown epruinose apothecial discs and zeorin. All six species are reported from Himalayan regions at elevations of 2000 to 3800 m. An updated world key to the known multispored species of *Lecanora* is provided.

**KEY WORDS:** Ascomycetes, Eastern Himalaya, India, Lecanoraceae, *subfusca*-group, taxonomy.

### INTRODUCTION

*Lecanora* Ach. is a cosmopolitan lichenized ascomycete genus of the family Lecanoraceae. At present *Lecanora s. lat.* comprises about 1000 species which are characterized by a crustose to effigurate or placodioid thallus, *Lecanora*-type asci, simple, hyaline ascospores and mostly with a thalline exciple (Lücking *et al.*, 2016; Yakovchenko *et al.*, 2019; Santos *et al.*, 2023). The multispored species of *Lecanora*, i.e. species with multispored asci, share characters with the *Lecanora subfusca* group, which is characterized by a crustose thallus, generally reddish-brown apothecial discs, small to large calcium oxalate crystals and trebouxoid photobionts in the amphithecium, presence of atranorin, and simple, colourless, ellipsoid to broadly ellipsoid ascospores (Brodo, 1984, Lumbsch, 1994; Han *et al.*, 2009). At present the multispored *Lecanora* group consists of a total of 13 species worldwide - *L. bruneri* Imshaug & Brodo, *L. cateilea* (Ach.) A. Massal., *L. japonica* Müll. Arg., *L. loekoessii* L. Lü, Y. Joshi & Hur, *L. moniliformis* L. Lü & Z.T. Zhao, *L. pleospora* Müll. Arg., *L. polysphaeridia* Alstrup, *L. praesistens* Nyl., *L. shangrilaensis* Z.T. Zhao & L. Lü, *L. strobilinoidea* Giralt & Gómez-Bolea, *L. subjaponica* L. Lü & H.Y. Wang, *L. subpraesistens* Nayaka, Upreti & Lumbsch, and *L. weii* L.F. Han & S.Y. Guo (Giralt and Gómez-Bolea, 1991; Alstrup, 1993, Lumbsch, 1994; Guderley and Lumbsch, 1999; Nayaka *et al.*, 2006; Han *et al.*, 2009; Lü *et al.*, 2012; Lü and Zhao, 2017, Qiu and Lü, 2022). Of these, four species: *L. japonica*, *L. praesistens*, *L. subjaponica* and *L. subpraesistens* are known from India (Upreti and Chatterjee, 1997; Nayaka *et al.*, 2006; Sheikh *et al.*, 2006;

Singh and Singh, 2015). A worldwide key to the multispored species of *Lecanora* was provided by Lü *et al.* (2012) and Qiu and Lü (2022). During our recent lichen exploration in Uttarakhand, two interesting specimens of multispored *Lecanora* were collected. While confirming their identity by matching with available multispored *Lecanora* specimens in the herbarium LWG few more interesting specimens were discovered. Therefore, in the present communication, a total of six species of multispored *Lecanora* are being described as new to science.

### MATERIALS AND METHODS

The specimens utilized in the present study are recent collections from different places in the Himalayas as well as previously preserved ones in LWG Herbarium of CSIR-National Botanical Research Institute, Lucknow. The morphological observation and photography were done using a stereo-zoom microscope Leica S9i with integrated digital camera. Anatomical characters were examined using stereo-zoom Leica S8APO and Leica DM2500 microscopes. For the observation of anatomical characters thin, hand-cut sections of thallus and ascomata were mounted in plain water and measurements were made under a light microscope. The amphithecium and epihymenium types were determined by observing size and solubility of crystals in K (10% aq. KOH) and HNO<sub>3</sub> under polarized light as described by Brodo (1984). Two types of epihymenium were found 1) *chlarotera*-type, reddish-brown pigmented and crystals dissolving in both K and HNO<sub>3</sub>; 2) *glabrata*-type, reddish-brown pigmented and lacking crystals. In all six species, the amphithecium



were found to be of *allophana*-type with small crystals extending from the amphithecial medulla into the cortex, partially or completely dissolving in K. For spot tests, the standard reagents of K (10% aq. KOH), C [aq. Ca(OCl)<sub>2</sub>] and P (5% alcoholic *p*-phenylenediamine) were used by following Orange *et al.* (2001). The presence of secondary metabolites was detected by performing thin layer chromatography (TLC) in solvent system 'A' by following Orange *et al.*, (2001). The specimens were identified with the help of literature (Brodo, 1984; Guderley and Lumbsch, 1999; Nayaka, 2004; Lü *et al.*, 2012; Qiu and Lü, 2022).

## TAXONOMIC TREATMENT

*Lecanora flavothallina* R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 1**

Mycobank No.: MB 849555

**Type:** India, Sikkim, North Sikkim, above Lachung Shingritang area, elev. 2900 m, 16 October 2004, D. K. Upreti, S. Chatterjee & P. K. Divakar, 04004298/A (LWG-holotype).

**Diagnosis:** Similar to *Lecanora japonica* but differs in having a yellow-pigmented young thallus margin and a granular epihymenium.

**Description:** Thallus saxicolous, crustose, strongly verrucose-areolate, verrucae dispersed to continuous, cream coloured, epruinose, esorediate. Prothallus whitish grey to black, with yellow pigmented young thallus. Apothecia numerous, 0.5–1.5 mm in diam., clearly raised and constricted at base, round to irregular, distorted at maturity, disc plane, convex at maturity, red-brown to blackish, slightly greyish blue pruinose, margin concolorous with thallus, thin, smooth to crenulate, flexuous, thinning and excluding towards maturity. Amphithecium 40–85 µm thick, with numerous small crystals (*allophana*-type), cortex indistinct or poorly developed. Parathecium hyaline, 12–18 µm thick, lacking crystals. Epihymenium reddish brown, 15–20 µm high, granular (*chlarotera*-type), crystals dissolving in both K and HNO<sub>3</sub>, pigmentation not completely dissolves. Hymenium hyaline, 30–45 µm high, not inspersed. Paraphyses simple to branched, slightly thickened and pigmented at apices. Hypothecium hyaline, 32–45 µm high, not inspersed. Asci clavate to cylindrical, 42–50 × 22–27 µm, 12–16-spored. Ascospores simple, hyaline, ellipsoid to oblong, 9–12 × 4–7 µm. Pycnidia not seen.

**Etymology:** The species epithet refers to the characteristic yellow-pigmented young thallus margin.

**Chemistry:** Thallus and apothecial margin K+ yellow, P-, C-, KC-. TLC: Atranorin, zeorin and hypoprotocetraric acid. Fig. 7(B).

**Ecology and distribution:** *Lecanora flavothallina* was found growing on exposed calcareous rocks in temperate places in Eastern Himalayas. At present the species is reported from its type locality only.

**Remarks:** *Lecanora flavothallina* is characterized by having a strongly verrucose-areolate thallus with yellow pigments towards the margin. At present, this is the only known multisporous species of *Lecanora* with a yellow-pigmented thallus. It is similar to *L. japonica* in having a red brown apothecial disc, an *allophana*-type amphithecium, and up to 16 spores per ascus but *L. japonica* lacks yellow pigmented thallus, granules in the epihymenium and zeorin and by comparatively larger ascospores 12–16 × 6–8 µm (Guderley and Lumbsch, 1999). *Lecanora subpraesistens* also has upto 16-spored asci, red-brown apothecial discs and contains atranorin and zeorin, but it differs in having large crystals in the amphithecium (*pulicaris*-type), and lacking granules in the epihymenium (Nayaka *et al.* 2006). Further, both *L. japonica* and *L. subpraesistens* are usually corticolous whereas *L. flavothallina* is saxicolous.

**Additional specimen examined:** India, Sikkim, North Sikkim, above Lachung Shingritang area, elev. 2900 m, 16 October 2004, D. K. Upreti, S. Chatterjee & P. K. Divakar, 04004298/B (LWG).

*Lecanora himachalensis* R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 2**

Mycobank No.: MB 849556

**Type:** India, Himachal Pradesh, Kullu district, Great Himalayan National Park, Shilt, elev. 2800 m, 4 November 2002, S. Nayaka & R. Srivastava, 02-000577 (LWG, holotype).

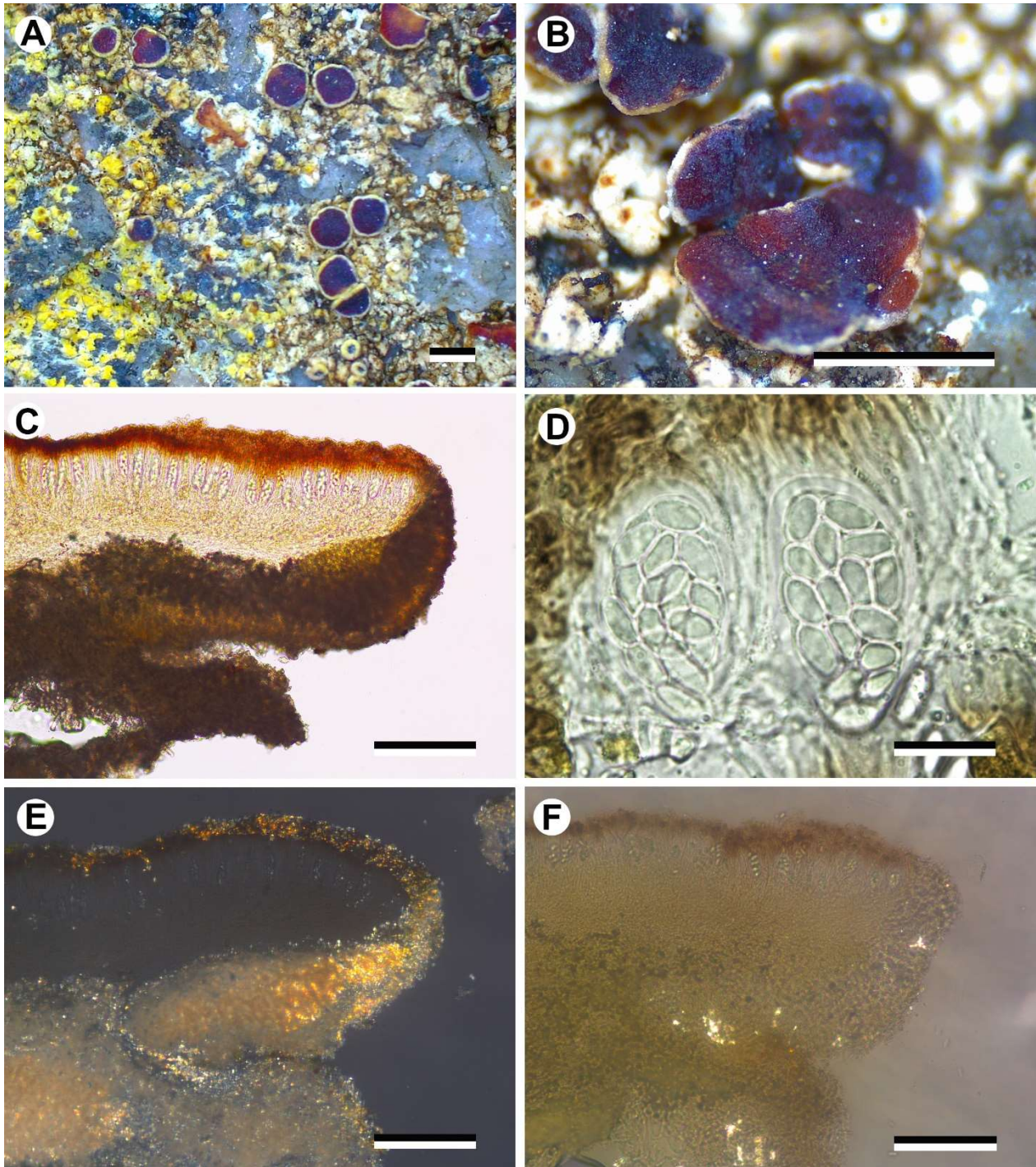
**Diagnosis:** Morphologically similar to *L. japonica* and *L. subjaponica* but differing in having a granular epihymenium and a different chemistry.

**Description:** Thallus corticolous, crustose, greenish grey to dark grey, thin, continuous, smooth, isidia and soredia absent. Prothallus not seen. Apothecia sessile, 0.5–1 mm in diam. Disc reddish-brown, flat to concave, epruinose. Margin prominent, smooth, continuous, whitish grey to grey. Amphithecium 42–95 µm thick, with small crystals (*allophana*-type), dissolving in K, cortex indistinct. Parathecium hyaline, 15–18 µm thick, lacking crystals. Epihymenium orange-brown, 15–22 µm high, granular (*chlarotera*-type), pigmentation and crystals dissolving in both K and HNO<sub>3</sub>. Hymenium hyaline, 55–85 µm high, not inspersed. Paraphyses simple, unbranched. Hypothecium hyaline, 40–90 µm high, not inspersed. Asci clavate, 58–78 × 22–26 µm, 16–32-spored. Ascospores simple, hyaline, ellipsoid, 8–10 × 4–6 µm. Pycnidia not seen.

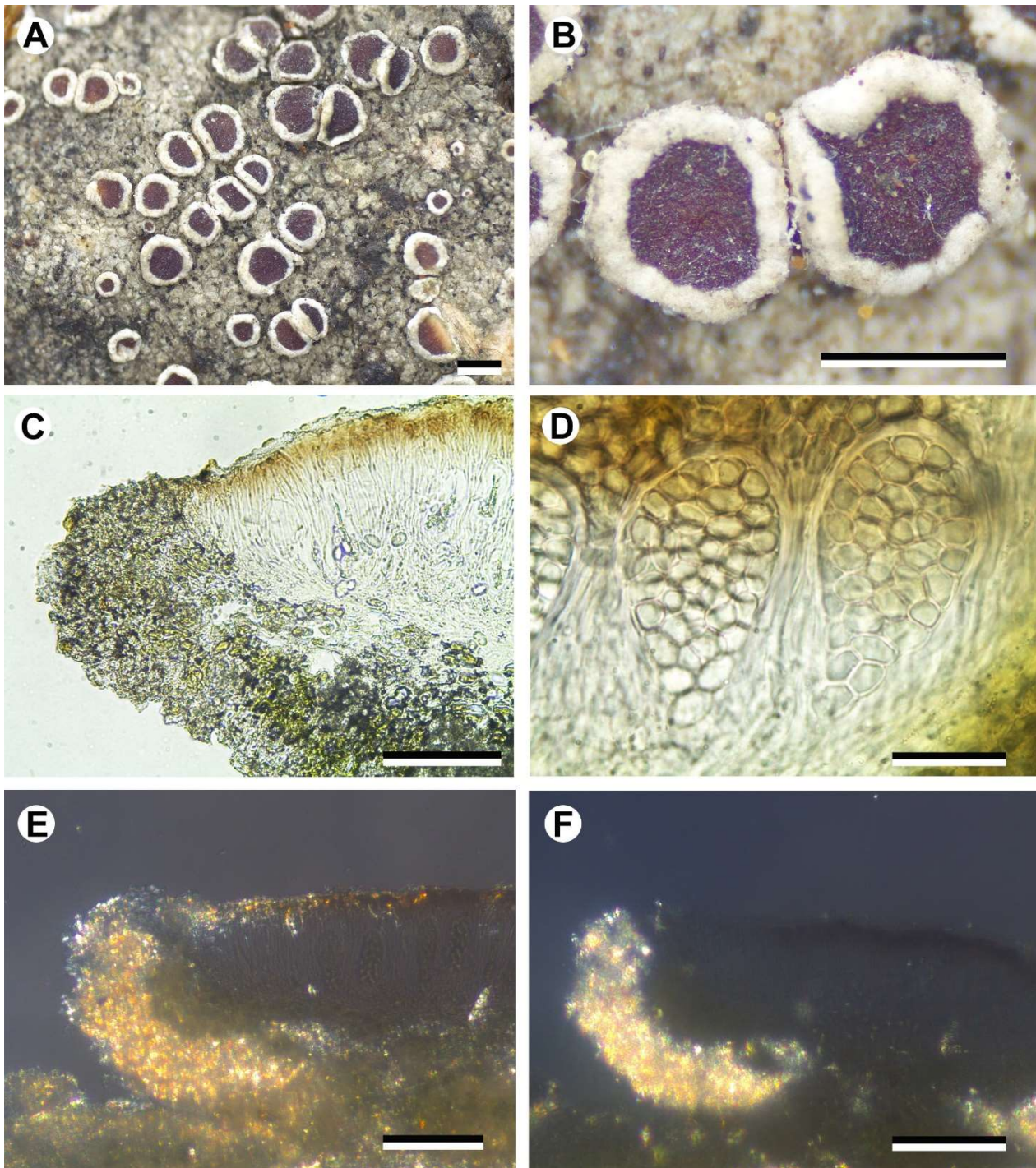
**Etymology:** The species epithet is based on its locality in the Western Himalayan region of the country.

**Chemistry:** Thallus K+ yellow, P-, C-, KC-. TLC: Atranorin, zeorin, hypoprotocetraric and conhypoprotocetraric acid present as major chemical compounds. Fig. 7(D).

**Remarks:** *Lecanora himachalensis* is characterized by having 32-spored asci, reddish-brown apothecial discs, a *chlarotera*-type epihymenium and the presence of hypoprotocetraric acid. Morphologically this species is



**Fig. 1.** *Lecanora flavothallina* (holotype, LWG 04004298/A). **A:** Morphology of the thallus and apothecia. **B:** Enlarged apothecia, **C:** Apothecial section. **D:** Multi-spored asci. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50  $\mu$ m.



**Fig. 2.** *Lecanora himachalensis* (holotype, LWG 02-000577). **A:** Morphology of the thallus and apothecia. **B:** Enlarged apothecia. **C:** Apothecial section. **D:** Multi-spored asci. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50  $\mu$ m.



similar to *L. japonica* and *L. subjaponica*. Both species lack hypoprotocetraric acid, *L. japonica* has 16-spored asci and an egranular epihymenium (Guderley and Lumbsch, 1999) while *L. subjaponica* has an egranular epihymenium, 32-spored asci and a well-developed (50–75 µm thick) amphithecial cortex (Lü et al., 2012). *Lecanora pruinomarginata* described here also has 32-spored asci and a granular epihymenium but it differs in having whitish pruinose apothecial margins, and the presence of fumarprotocetraric acid and the absence of hypoprotocetraric acid.

**Ecology and distribution:** *Lecanora himachalensis* was found growing on the bark of *Quercus* trees in temperate to subalpine forests (elev. 2000–3700 m) of the Western Himalayas.

**Additional specimens examined:** India: Himachal Pradesh: Kullu district, Dhela, elev. 3737 m, 9 June 2004, R. Srivastava, 04–003601 & 04–003606 (LWG); Pardi, elev. 3140 m, 5 November 2002, S. Nayaka & R. Srivastava, 02–000513 (LWG).

***Lecanora jatoliensis*** R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 3**

Mycobank No.: MB 849557

**Type:** India, Uttarakhand, Bageshwar district, en route to Kathaliya from Jatoli village, elev. 2500–3000 m, November 2022, R.S. Adhikari & A. Dwivedi, 22-048248/A (LWG, holotype).

**Diagnosis:** Only known multisporied *Lecanora* species with pruinose apothecial discs and asci more than 16-spored.

**Description:** Thallus corticolous, crustose, whitish-grey, thin, continuous, smooth to slightly verrucose, isidia and soredia absent. Prothallus not visible. Apothecia sessile, round to irregular, up to 2 mm in diam. Disc orange-brown, flat to concave, slightly to heavily blueish grey pruinose, especially in young stage. Margin prominent, smooth, continuous, concolourous with the thallus. Amphithecium 90–120 µm thick, with small crystals (*allophana*-type), partially dissolving in K, cortex indistinct. Parathecium hyaline, 10–15 µm thick, lacking crystals. Epihymenium orange-brown, 15–20 µm high, granular (*chlarotera*-type), pigmentation and crystals dissolving in both K and HNO<sub>3</sub>. Hymenium hyaline, 55–70 µm high, not interspersed. Paraphyses simple, unbranched. Hypothecium hyaline, 50–60 µm high, not interspersed. Asci cylindrical to clavate, 60–70 × 15–22 µm, 16–32-spored. Ascospores simple, hyaline, ellipsoid, 10–13 × 6–8 µm. Pycnidia not seen.

**Etymology:** The species epithet '*jatoliensis*' is based on the name of the locality where the type specimen was collected.

**Chemistry:** Thallus K<sup>+</sup> yellow, P<sup>+</sup> yellow turning orange, C<sup>-</sup>, KC<sup>-</sup>. TLC: Zeorin, usnic atranorin and fumarprotocetraric acid present as major chemical compounds. Fig. 7(F).

**Ecology and distribution:** *Lecanora jatoliensis* was found growing on the bark of *Quercus* trees in temperate

forests of the Western Himalayas. At present, this species is known from its type locality only.

**Remarks:** In having pruinose apothecial discs and the presence of usnic acid this species resembles *L. weii* and *L. strobilinoides*. *Lecanora weii* differs in having 12–16-spored asci and in lacking zeorin and fumarprotocetraric acid while *L. strobilinoides* has a pale yellow to yellowish brown apothecial disc, frequently 1-septate ascospores and lacks atranorin (Han and Guo, 2009; Giralt and Gómez-Bolea, 1991). *Lecanora pruinomarginata* described here also has 32-spored asci and fumarprotocetraric acid but this species lacks usnic acid, contains pruina only in apothecial margins, has consistently 32-spored asci and smaller apothecia (up to 0.7 mm in diam., vs up to 2 mm in this species). *Lecanora sambuci* (Pers.) Nyl. which has been transferred to the genus *Polyozosia* A. Massal. also has 32-spored asci but this species lacks crystals in the amphithecium and secondary metabolites (Guderley and Lumbsch, 1999; Kondratyuk et al., 2019).

**Additional specimen examined:** India, Uttarakhand, Bageshwar district, en route to Kathaliya from Jatoli village, elev. 2500–3000 m, November 2022, R.S. Adhikari & A. Dwivedi, 22-048248/B (LWG).

***Lecanora pruinomarginata*** R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 4**

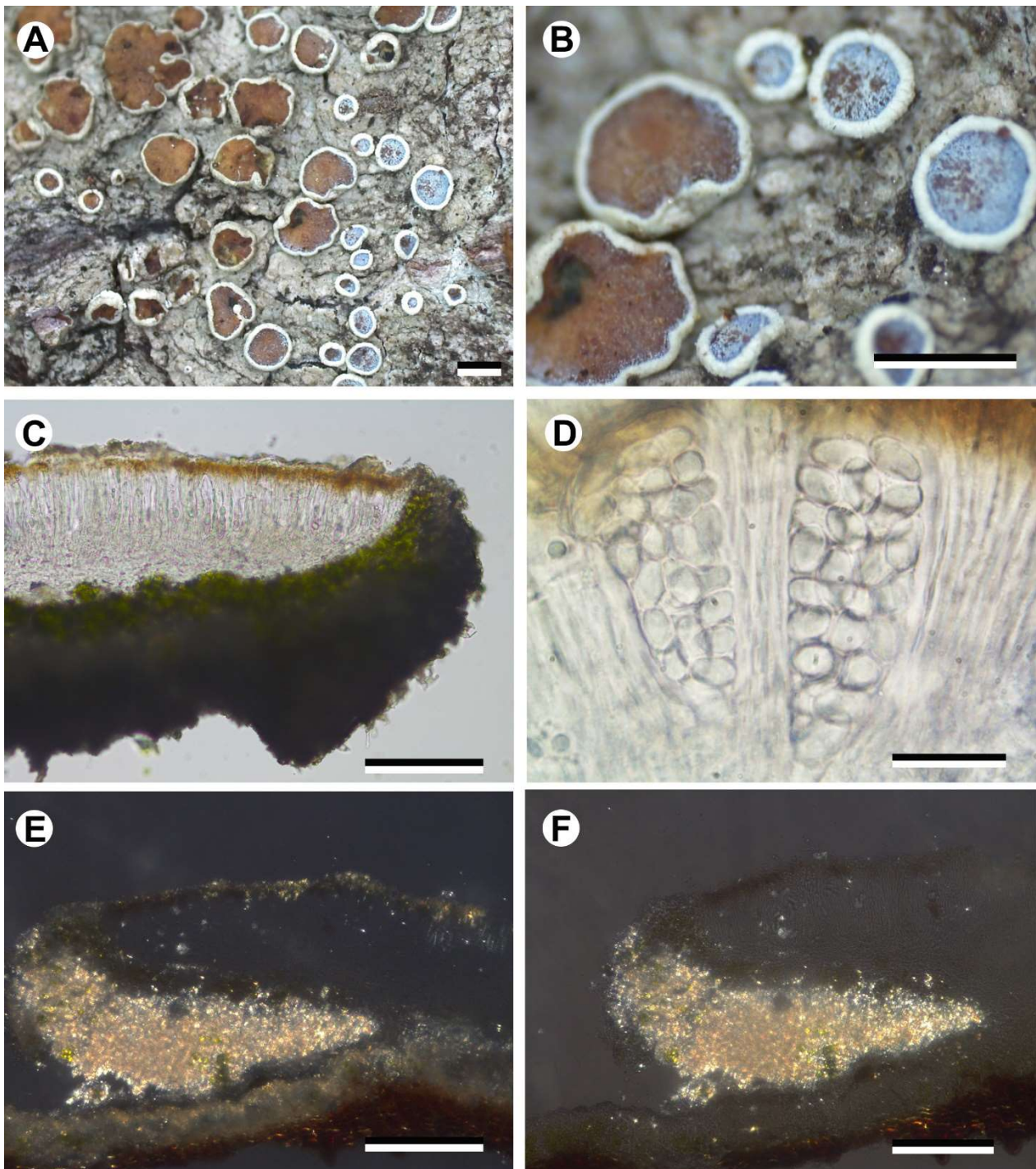
Mycobank No.: MB 849558

**Type:** India, Uttarakhand, Nainital district, Kilbury forest area, elev. 2200 m, 17 July 1998, D.K. Upreti, S. Chatterjee & J. Tandon, 217307/B (LWG, holotype).

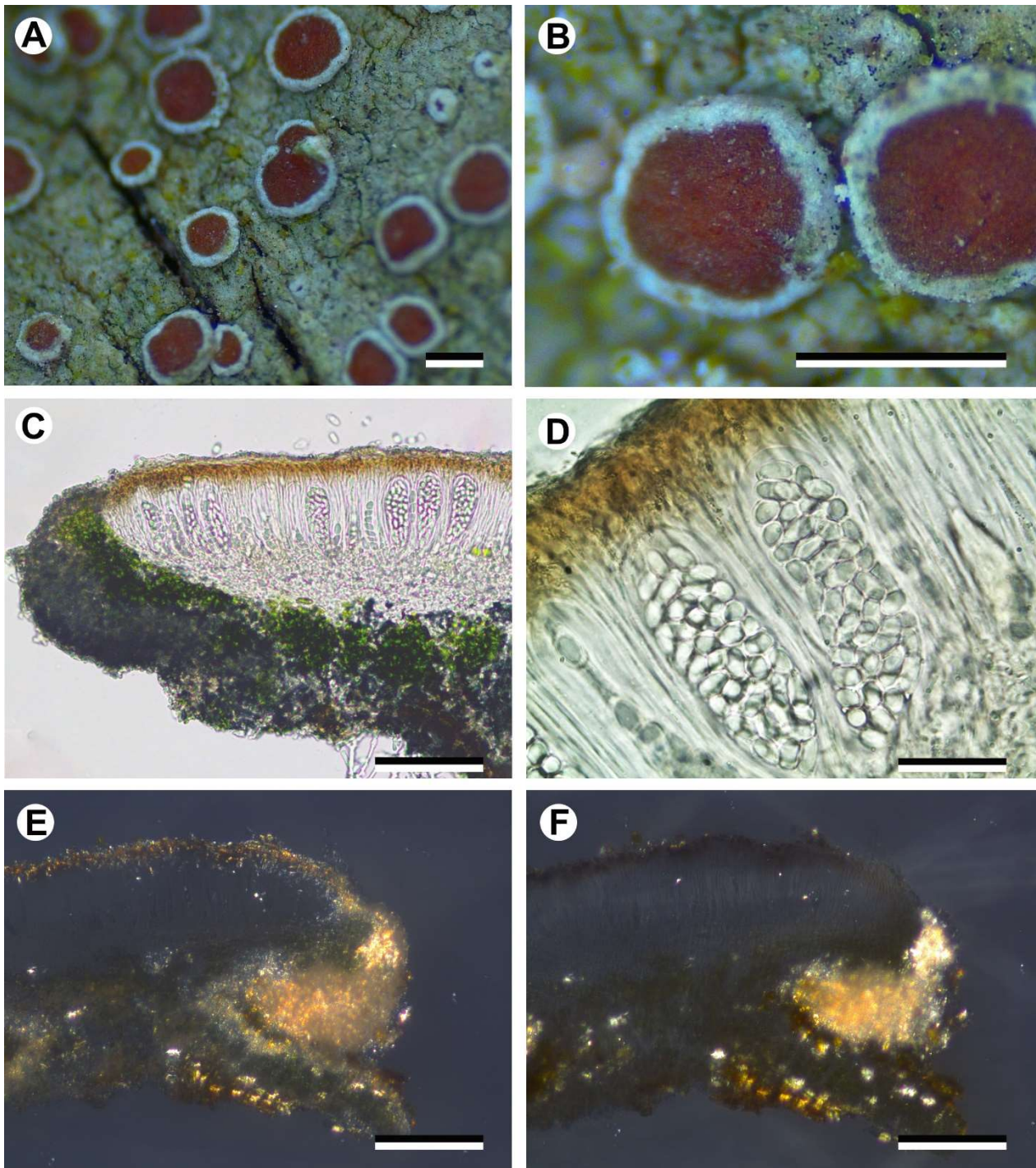
**Diagnosis:** Similar to *Lecanora subjaponica* but differing in having pruinose apothecial margins and presence of fumarprotocetraric acid.

**Description:** Thallus corticolous, crustose, grey to greenish grey, continuous, rough to slightly verrucose, margin inconspicuous. Prothallus indistinct. Apothecia numerous, sessile, lecanorine, round, 0.3–0.7 mm in diam. Disc reddish brown to dark brown, flat to slightly convex, glossy, epruinose. Margin distinct, in level with the disc, entire to incised in young apothecia, slight to densely covered with white pruina. Amphithecium 40–75 µm thick, containing numerous small crystals (*allophana*-type), algal layer continuous to interrupted below hypothecium, cortex indistinct or poorly developed. Parathecium hyaline, 15–25 µm thick. Epihymenium orange-brown, 10–15 µm high, granular (*chlarotera*-type), pigmentation and crystals dissolving in both K and HNO<sub>3</sub>. Hymenium hyaline, 50–75 µm high, not interspersed. Paraphyses simple to slightly branched, not thickened at apices. Hypothecium hyaline, 25–50 µm high, not interspersed with oil droplets. Asci clavate to cylindrical, *Lecanora*-type with an amyloid tholus, 50–75 × 18–25 µm, mostly 32-spored, sometimes with more than 32 spores. Ascospores simple, hyaline, ellipsoid to oblong, 7–11 × 3–5 µm. Pycnidia not seen.

**Etymology:** The species epithet '*pruinomarginata*' refers to the characteristic pruinose apothecial margin.



**Fig. 3.** *Lecanora jatoliensis* (holotype, LWG 22-048248/A). **A:** Morphology of the thallus and apothecia. **B:** Enlarged apothecia. **C:** Apothecial section. **D:** Multi-spored asci. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50  $\mu$ m.



**Fig. 4.** *Lecanora pruinomarginata* (holotype, LWG 217307/B). **A:** Morphology of the thallus and apothecia. **B:** Enlarged apothecia. **C:** Apothecial section. **D:** Multi-spored asci. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50 μm.



**Chemistry:** Thallus and apothecial margin K+ yellow, P+ orange-red, C-, KC-. TLC: Atranorin, zeorin and fumarprotocetraric acid. Fig. 7(C).

**Ecology and distribution:** *Lecanora pruinomarginata* is a corticolous species found growing on barks, especially on twigs of the trees in temperate forests (elev. 2000–3400 m) of the Western and Eastern Himalayan regions.

**Remarks:** *L. pruinomarginata* is characterized by having slightly to densely pruinose apothecial margins, presence of fumarprotocetraric acid, and granular epihymenium (*chlarotera*-type). This species resembles *L. subjaponica* in having red brown apothecial discs, 16–32-spored asci, and an *alophana*-type amphithecium. However, *L. subjaponica* has epruinose apothecial discs with egranular epihymenium and contains only atranorin and zeorin (Lü *et al.* 2012). *Lecanora jatoliensis* described here also has 16–32-spored asci and a granular epihymenium but it lacks usnic acid and has slightly to heavily pruinose apothecial discs and somewhat larger ascospores 10–13 × 6–8 µm vs. 7–11 × 3–5 µm.

**Additional specimens examined:** India: Arunachal Pradesh: West Kameg district, Twang, from Twang to Lumla, near Giose Lumla road, 27°31'57"N, 91°42'52.1"E, elev. 2238 m, 07 March 2019, D.K. Upreti, R. Bajpai & B.N. Singh, 19-035933/B (LWG); Lumla near Bomdir, 27°33'45.72"N, 91°51'14.2"E, 7 March 2019, D.K. Upreti, R. Bajpai & B.N. Singh, 19-035920/B (LWG); Uttarakhand: Almora district, Surmaney, Dhol forest, elev. 2100 m, November 2012, S. Joshi & P. Singh, *s.n.* (LWG); Chamoli district, Auli skeing area, 30°32'47"N, 79°33'13.4"E, elev. 2410 m, 13 May 2011, H. Rai, R. Khare, P. Shukla, 024215 (LWG); Nainital district, on way from Bhawal to Ramgarh, Mahesh Khan forest, elev. 2000 m, 05 May 2022, D. K. Upreti and party, 22-045600/B (LWG); Pithoragarh district, Munsyari, Khaliya top, elev. 2700–3000 m, 17 November 2006, Y. Joshi & R. Bajpai, 06-007042 (LWG); Uttarkashi district, GWLS, Badang to Dal Dhar, near Vijay top, 31°08'35.19"N, 78°09'33.06"E, elev. 3396 m, 8 October 2015, Komal K. Ingle, 015-029616 (LWG); en route to Dehradun, Purola, 30°54'56.04"N 78°06'08.42"E, elev. 1451 m, 8 November 2012, R. Bajpai, 12-016643/B (LWG); en route to Kedarkantha, 2 km before Judatal near cement bridge, 30°03'10.59"N, E78°13'29.30"E, elev. 2088 m, 05 November 2012, R. Bajpai, 12-016638 (LWG); Judatal to Kedarkantha, 31°03'11.47"N, 78°10'59.428"E, elev. 2871 m, 6 October 2013, R. Bajpai, 13-020015/B (LWG); around Osla, near potato field, 31°06'43.17"N, 78°20'54.16"E, elev. 2883 m, 10 June 2012, D.K. Upreti & R. Bajpai, 12-018569/B (LWG); near Chaurangi, 30°38'25.99"N, 78°29'0.94"E, elev. 2219 m, 5 January 2016, Devendra Kumar, *s.n.* (LWG).

***Lecanora shimlaensis*** R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 5**

MycoBank No.: MB 849559

**Type:** India, Himachal Pradesh, Shimla district, Rohru, Larot, en route to Chansal pass, 5 km before, elev. 3149 m, 07 September 2019, R. Bajpai & R. R. Paul, 19-036634/A (LWG, holotype).

**Diagnosis:** Similar to *L. praesistens* in having dark brown to blackish apothecial discs, but differing in having more spores per ascus and an *alophana*-type amphithecium.

**Description:** Thallus corticolous, crustose, greenish grey, thin, smooth, continuous, greenish grey, isidia and

soredia absent. Prothallus not visible. Apothecia sessile, 0.4–0.8 mm in diam. Disc dark brown to black, flat to concave, epruinose. Margin thick, prominently raised, smooth, continuous, concolourous to the thallus. Amphithecium 45–95 µm, with small crystals (*alophana*-type), dissolving in K, cortex indistinct. Parathecium hyaline, 10–15 µm thick, lacking crystals. Epihymenium orange-brown, 15–25 µm high, egranular (*glabrata*-type), pigmentation not dissolving in K. Hymenium hyaline, 35–65 µm high, not inspersed. Paraphyses simple, unbranched, slightly thickened at tips. Hypothecium hyaline, 25–40 µm high, not inspersed. Asci clavate, 55–65 × 16–30 µm, 16–32-spored. Ascospores simple, hyaline, ellipsoid, 7–9 × 4–6 µm. Pycnidia not seen.

**Etymology:** The species epithet *shimlaensis* is based on geographical location of type specimen in Himalayas.

**Chemistry:** Thallus K+ yellow, P-, C-, KC-. TLC: Atranorin, zeorin, hypoprotocetraric and conhypoprotocetraric acid present as major chemical compounds. Fig. 7(A).

**Ecology and distribution:** *Lecanora shimlaensis* was found growing on the bark of *Quercus* trees in the temperate region (elev. 3149 m) of the Western Himalayas. At present, this species is known from its type locality only.

**Remarks:** *Lecanora shimlaensis* is characterized by having an egranular epihymenium, a dark brown to black apothecial disc and the presence of hypoprotocetraric acid in addition to zeorin and atranorin. The only other multispored *Lecanora* species with brown-black apothecial disc is *L. praesistens* but that species has 8–16-spored asci, granular epihymenium and contains large crystals in the amphithecium (Guderley and Lumbsch, 1999).

**Additional specimen examined:** India, Himachal Pradesh, Shimla district, Rohru, Larot, en route to Chansal pass, 5 km before, elev. 3149 m, 07 September 2019, R. Bajpai & R. R. Paul, 19-036634/B (LWG).

***Lecanora uttarkashiensis*** R. Adhikari, Ngangom & Nayaka, *sp. nov.* **Fig. 6**

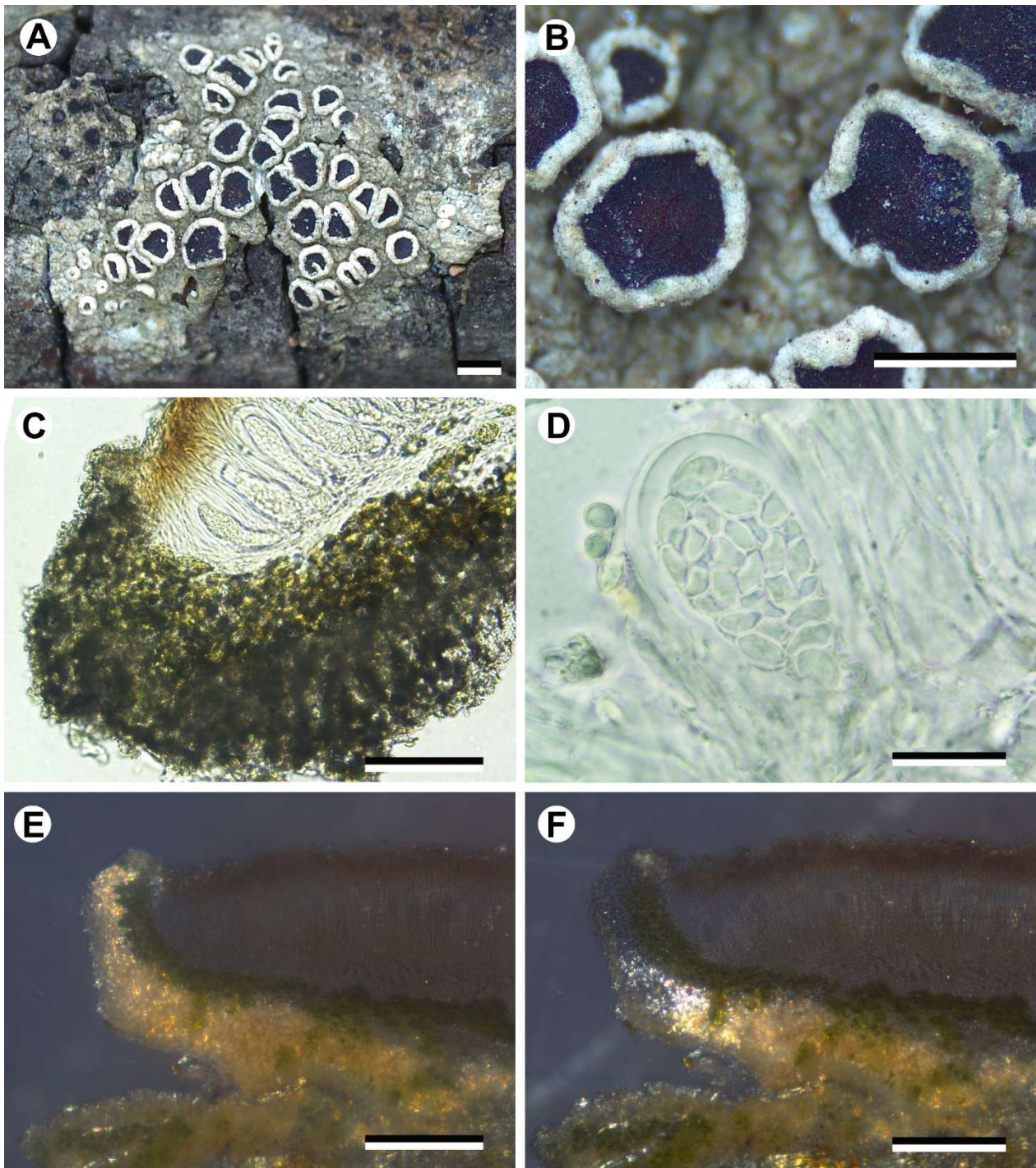
MycoBank No.: MB 849560

**Type:** India, Uttarakhand, Uttarkashi district, GWLS, Dal dhar to Rahla, elev. 3454 m, 10 October 2015, Komal K. Ingle, 015-029644 (LWG, holotype).

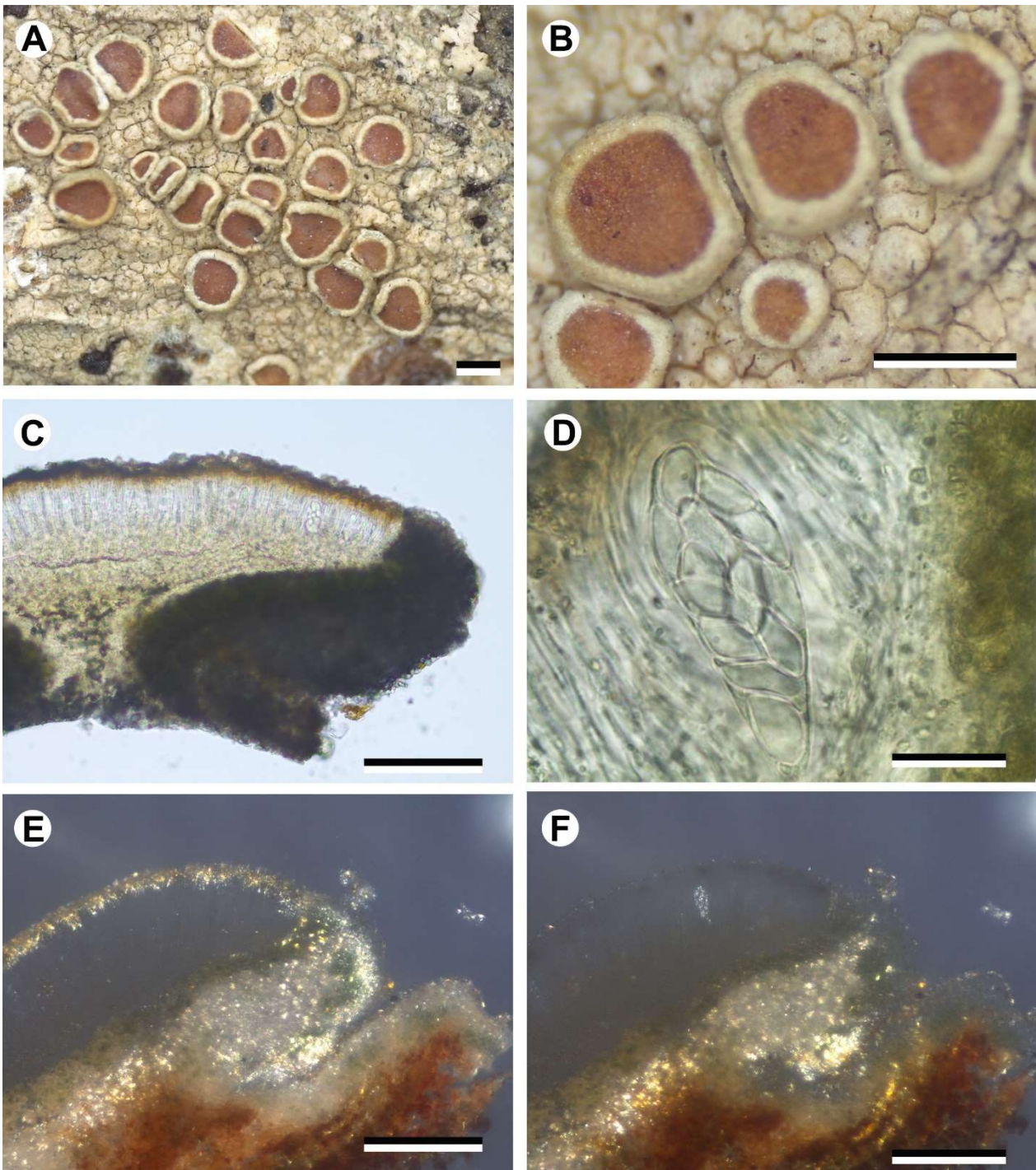
**Diagnosis:** Similar to *L. weii* but differing in having epruinose apothecial discs and containing zeorin in chemistry.

**Description:** Thallus corticolous, crustose, thin, cream-coloured, continuous to slightly cracked, smooth to slightly verrucose, isidia and soredia absent. Prothallus not visible. Apothecia round, sessile, up to 0.8 mm in diam., flat to concave. Disc orange to orange-brown, epruinose. Margin prominent, smooth, continuous, concolourous to the thallus. Amphithecium 90–130 µm thick, with small crystals (*alophana*-type) that are insoluble in K, cortex indistinct.

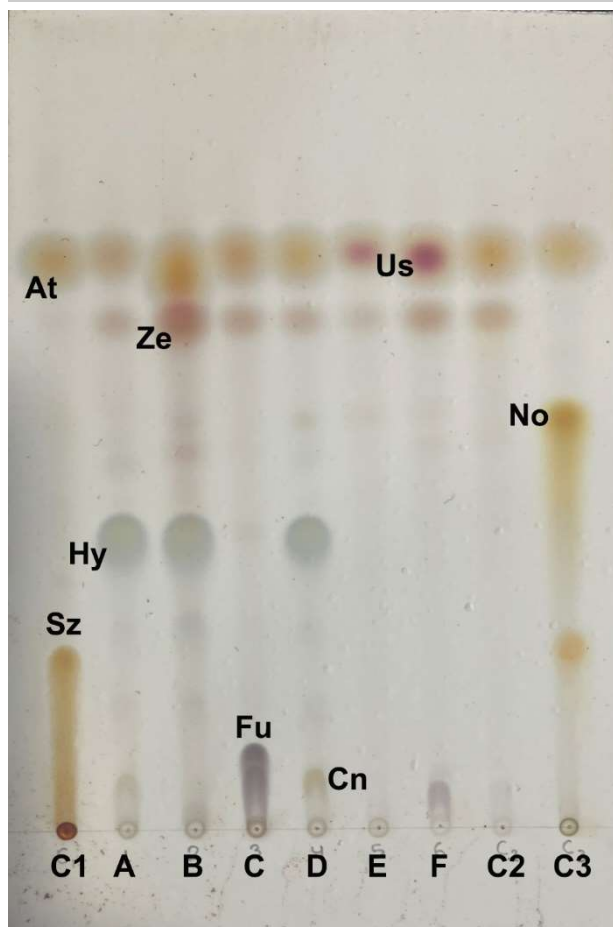




**Fig. 5.** *Lecanora shimlaensis* (holotype, LWG 19-036634/A). **A:** Morphology of the thallus and apothecia. **B:** Enlarged apothecia **C:** Apothecial section. **D:** Multi-spored ascus. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50  $\mu$ m.



**Fig. 6.** *Lecanora uttarkashiensis* (holotype, LWG 015-029644). **A:** Morphology of the thallus and apothecia, **B:** Enlarged apothecia **C:** Apothecial section. **D:** Multi-spored ascus. **E & F:** Apothecial section under polarized light before and after adding 10% KOH. Scale: A–B = 1.0 mm; C–F = 50  $\mu$ m.



**Fig. 7.** TLC plate (in solvent A) C1: Control - *Parmelinella wallichiana* (Taylor) Elix & Hale; A: *Lecanora shimlaensis*; B: *L. flavothallina*; C: *L. pruinomarginata*; D: *L. himachalensis*; E: *L. uttarkashiensis*; F: *L. jatoliensis*; C2: Control - *L. japonica*; C3: Control - *Cratiria obscurior* (Stirt.) Marbach & Kalb. Abbreviations: Sz = Salazinic acid; At = Atranorin; Cn = Conhyprotocetraric acid; Fu = Fumarprotocetraric acid; Hy = Hypoprotocetraric acid; No = Norstictic acid; Us = Usnic acid; Ze = Zeorin.

Parathecium hyaline, 10–15  $\mu\text{m}$  thick, lacking crystals. Epihymenium, orange-brown, 10–16  $\mu\text{m}$  high, granular (*chlarotera*-type), pigmentation and crystals dissolving in both K and  $\text{HNO}_3$ . Hymenium hyaline, 50–55  $\mu\text{m}$  high, not interspersed. Paraphyses simple, unbranched, slightly thickened at tips. Hypothecium hyaline, 35–40  $\mu\text{m}$  high, not interspersed. Asci cylindrical to clavate, 45–60  $\times$  12–17  $\mu\text{m}$ , 8–16-spored. Ascospores simple, hyaline, ellipsoid, 12–17  $\times$  5–7  $\mu\text{m}$ . Pycnidia not seen.

**Etymology:** The species epithet *uttarkashiensis* refers to the locality from where the holotype was collected.

**Chemistry:** Thallus K<sup>+</sup> yellow, P<sup>-</sup>, C<sup>-</sup>, KC<sup>-</sup>. TLC: Zeorin, usnic acid and atranorin present as major chemical compounds. Fig.7(E).

**Ecology and distribution:** *Lecanora uttarkashiensis* was found growing on the bark in temperate forests (elev. 2000–3500 m) of the Western Himalayan region.

**Remarks:** *Lecanora uttarkashiensis* is characterized by having orange to orange-brown epruinose apothecial discs, and the presence of usnic acid along with atranorin and zeorin as major chemical compounds. The other multisporied species with usnic acid and the same number of ascospores are *L. weii* and *L. shangrilaensis*. *Lecanora weii* differs in having pruinose apothecial discs and lacks zeorin (Han and Guo, 2009). *Lecanora shangrilaensis* has a yellow to yellowish brown apothecial disc, contains fumarprotocetraric acid and lacks atranorin (Lü and Zhao, 2017). *Lecanora japonica* also has up to 16-spored asci but it lacks granules in the epihymenium and contains only atranorin and chloroatranorin (Guderley and Lumbsch, 1999).

**Additional specimens examined:** India: Uttarakhand: Almora district, Surmaney, Dhol forest, elev. 2100 m, November 2012, S. Joshi & P. Singh, s.n. (LWG); Bageshwar district, en route to Jatoli from Khathi village, 30°08'30.33"N, 79°55'21.57"E, elev. 2440 m, 03 December 2021, S. Nayaka, R.S. Adhikari & R. Ngangom, 21039179 & 21-039181/B (LWG); en route to Pindari glacier from Dwali to Phurkiya, 30°12'03.8"N, 79°59'53.3"E, elev. 2989 m, 06 October 2015, R. Bajpai & M.K. Tripathi, 15-027575/B (LWG); en route to Pindari glacier from Dwali to Phurkiya, elev. 2734–3210 m, 13 May 2007, S. Joshi & Y. Joshi, 07-008919 (LWG); en route to Pindari glacier from Khathi to Dwali, elev. 2210–3734 m, 12 May 2007, S. Joshi & Y. Joshi, 07-008907 (LWG); en route to Jatoli from Khathi village, 30°08'30.33"N, 79°55'21.57"E, elev. 2440 m, 03 December 2021, S. Nayaka, R.S. Adhikari & R. Ngangom, 21039181/B & 21039179 (LWG); Chamoli district, Sari village, 30°30'963"N, 79°08'343"E, elev. 2000 m, 03 April 2014, V. Shukla & R. Bajpai, 014-023822 (LWG); Uttarkashi district, GWLS, Dal dhar to Rahla, elev. 3454 m, 10 October 2015, Komal K. Ingle, 015-029645 & 015-029645/B (LWG).

#### An updated world key to the known multi-spored species of *Lecanora* (after Qiu and Lü 2022).

1. Ascospores globose, 4.5–5.5  $\mu\text{m}$  in diam., ascus 24–32-spored, thallus indistinct, thin, whitish ..... *L. polysphaeridia*  
Ascospores ellipsoid, >5  $\mu\text{m}$  in length, ascus 16–32-spored ..... 2
2. Ascus up to 16-spored ..... 3  
Ascus up to 32-spored ..... 14
3. Amphithecium with large crystals ..... 4  
Amphithecium with small crystals ..... 6
4. Epihymenium not granulose (*glabrata*-type), zeorin present .....  
..... *L. subpraesistens*  
Epihymenium granulose (*chlarotera*-type), zeorin absent ..... 5
5. Prothallus whitish grey, apothecial disc orange-brown to reddish orange; asci 8(–16)-spored ..... *L. pleospora*  
Prothallus not visible; apothecial disc red brown to blackish orange; asci (8–)12(–16)-spored ..... *L. praesistens*
6. Apothecial disc heavily pruinose ..... 7  
Apothecial disc epruinose or slightly pruinose ..... 9
7. Apothecial sections P<sup>-</sup> (lacking psoromic acid, but containing usnic acid); ascospores 12.0–14.5  $\times$  6.0–8.5  $\mu\text{m}$  ..... *L. weii*  
Apothecial sections P<sup>+</sup> yellow (psoromic acid present, usnic acid absent); ascospores 6.5–12.0(–13.0)  $\times$  (3.5–)5.0–7.5  $\mu\text{m}$  ..... 8
8. Apothecial disc red-brown, heavily bluish grey pruinose, ascus 12–16 spored ..... *L. bruneri*  
Apothecial disc yellowish-brown to orange-brown, heavily to slightly whitish grey pruinose, ascus 8–12-spored ..... *L. cateilea*
9. Thallus yellow pigmented at margin, hypoprotocetraric acid present, on rock ..... *L. flavothallina*  
Thallus not yellow pigmented, hypoprotocetraric acid absent, usually on bark ..... 10
10. Apothecial disc yellowish to yellowish-brown ..... 11  
Apothecial disc orange-brown to red-brown ..... 12
11. Ascospores 7.5–12.5  $\times$  5–7.5  $\mu\text{m}$ , only usnic and fumarprotocetraric



- acid present ..... *L. shangrilaensis*  
 Ascospores 12–16 × 5–9 μm, atranorin, usnic acid, zeorin and norstictic acid present ..... *L. loekoesii*
12. Epihymenium granular (*chlarotera*-type), atranorin, zeorin and usnic acid present ..... *L. utarkashiensis*  
 Epihymenium egranular (*glabrata*-type), chemistry otherwise ..... 13
13. Apothecial margin verruculose to crenate, atranorin and psoromic acid present ..... *L. moniliformis*  
 Apothecial margin usually even, only atranorin present .. *L. japonica*
14. Apothecial disc slightly to heavily pruinose, usnic acid present .. 1 5  
 Apothecial disc epruinose, usnic acid absent ..... 1 6
15. Apothecial disc pale yellow to yellowish brown, ascospores frequently 1-septate, atranorin absent ..... *L. strobilinoidea*  
 Apothecial disc orange-brown to red-brown, ascospores aseptate, atranorin present ..... *L. jatoliensis*
16. Apothecial margin white pruinose, asci frequently with 32 or sometimes more spores, fumarprotocetraric acid present (apothecial margin or thallus P+ red) ..... *L. pruinomarginata*  
 Apothecial margin epruinose, asci 16–32 spored, fumarprotocetraric acid absent (apothecial margin and thallus P-) ..... 1 7
17. Epihymenium granular (*chlarotera*-type), hypoprotocetraric acid present ..... *L. himachalensis*  
 Epihymenium egranular (*glabrata*-type), hypoprotocetraric acid present or absent ..... 18
18. Hypoprotocetraric acid present, apothecial disc dark brown to black, amphithecial cortex not distinct ..... *L. shimlaensis*  
 Hypoprotocetraric acid absent, apothecial disc red brown, amphithecial cortex well developed (50–75 μm thick) *L. subjaponica*

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