

New Distributional Records of Buelliod Lichens from Uttarakhand, IndiaNeha Pal¹, Rakesh Singh Adhikari^{2,3}, Roshinikumar Ngangom^{2,3}, Sanjeeva Nayaka^{2,3*} and Prem Prakash¹¹*Department of Botany, M.B. Govt. P.G. College, Haldwani, Kumaun University, Nainital, Uttarakhand, 263001, India.*²*Lichenology Laboratory, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow, Uttar Pradesh, 226001, India.*³*Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, Uttar Pradesh, 201002, India.***Corresponding author Email: nayaka.sanjeeva@gmail.com*

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ABSTRACT

The present communication reports *Buellia papillosa* Müll. Arg. as new distributional record for lichen flora of India. Additionally, 20 species of buelliod lichens are reported as new records for the state Uttarakhand. A brief description and illustration of newly recorded lichen along with key to all known buelliod lichens from Uttarakhand is provided.

Keywords: *Amandinea*, Biodiversity, Caliciaceae, Saxicolous, Western Himalaya

INTRODUCTION

The lichen genus *Buellia* De Not. s.s. initially described by De Notaris (1846) belongs to family Caliciaceae and to date comprises over 300 species worldwide (Wijayawardene *et al.*, 2022). It is distinguished by its crustose thallus with thin black outline border, medulla often containing calcium oxalate crystals, apothecia with a lecideine or cryptolecanorine margin, hyaline hymenium that may sometimes contain oil droplets, brown hypothecium and brown one to pluriseptate ascospores (Wang *et al.*, 2020). The taxa sharing most of these characters or genera segregated from *Buellia* are collectively called as buelliod lichens, and includes *Amandinea*, *Baculifera*, *Buellia*, *Cratiria*, *Diplotomma*, *Endohyalina*, *Gassicurtia*, *Hafellia*, *Orcularia*, *Sculptolumina*, *Stigmatochroma* and *Tetramelas*. Currently, buelliod lichen comprises approximately 480 species (Lücking *et al.*, 2017).

The first comprehensive study of lichen genus *Buellia* in India was carried out by Singh and Awasthi (1981) where they documented 39 species under *Buellia*. Singh and Sinha (2010) reported a total of 59 buelliod lichen species under the genera *Amandinea*, *Baculifera*, *Buellia*, *Cratiria*, *Hafellia* and *Sculptolumina*. Till date, 87 species of buelliod lichens have been recorded from India representing 10 genera, among them Uttarakhand represents seven genera and 24 species (Sinha *et al.*, 2024). However, a recent study revealed that Uttarakhand has eight genera and 34 species (Ngangom 2025). In our ongoing studies on lichens

of Uttarakhand several buelliod samples were collected. A detailed study of these samples resulted in one new distributional record for India and 20 new additions to Uttarakhand.

MATERIALS AND METHODS

The present study is primarily based on the lichen samples collected from different localities of Binsar Wildlife Sanctuary and Sunderdhunga Glacier Valley, Uttarakhand. Morphological analysis of lichen specimens was carried out under a stereo-zoom microscope Leica S9i. Anatomical details were examined under a compound microscope Leica DM2500. Both the microscopes are integrated with image analysis software. Standard reagents such as 10% KOH (K), calcium hypochlorite (C), *para*-phenylenediamine (P), Lugol's iodine (I), conc. sulphuric acid (H₂SO₄), conc. nitric acid (HNO₃) along with Thin layer chromatography (TLC) in solvent system 'A' (Toluene: 1, 4 dioxane; acetic acid 180: 60: 8 mL) was performed for checking the presence of secondary metabolites (Orange *et al.* 2001). The specimens were identified by following literature Marbach (2000), Sipman (2003). The measurements of asci and ascospores are given as: (minimum–){ $\bar{x}$ –SD }– $\bar{x}$ –{ $\bar{x}$ +SD } (–maximum), where “minimum” and “maximum” are the extreme values observed, $\bar{x}$ mean value, and SD the corresponding standard deviation, followed by the number of measurements (n). Bungartz *et al.* (2004) was followed for the terminology of exciple and for ascospores type Scheidegger (1993) was followed. The nomenclature of lichen species were

updated following indexfungorum.org. The lichen specimens are preserved in herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG). A key for all the 45 species of buellioid lichens occurring in Uttarakhand is provided.

RESULTS

New record for India

Buellia papillosa Müll. Arg., Flora 71: 543 (1888) (Figure 1)

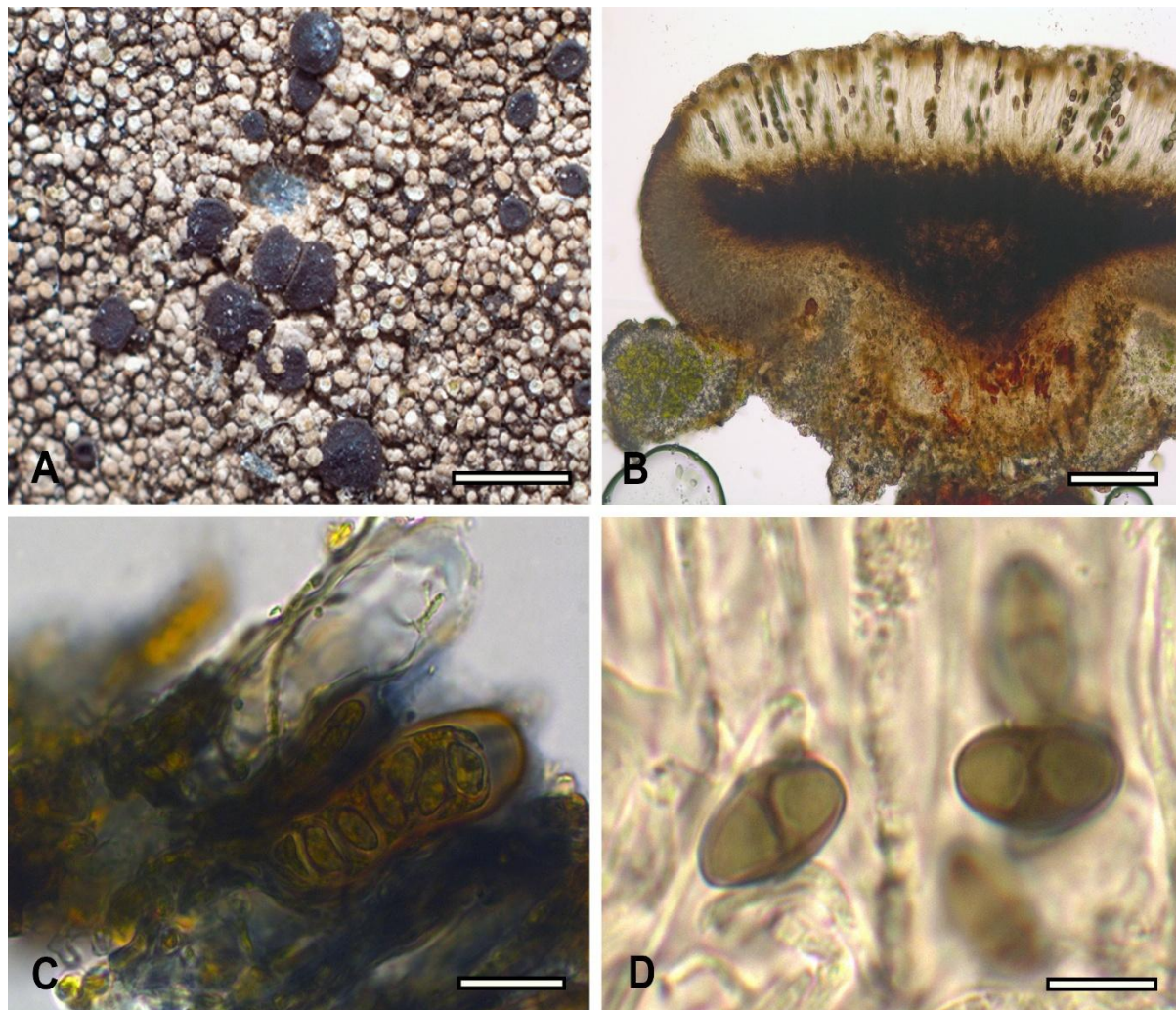


Figure 1: A, Thallus of *Buellia papillosa*; B, Section showing *dispersa*-type exciple; C, Ascus; D, Ascospores. Scale bars: A = 1 mm; B = 50 µm; C–D = 10 µm.

Type: Brazil. Morro de Itambé, 04, 1882, Puiggari, J. I., 2223, G00291521 (G— holotype, image!).

Thallus saxicolous, crustose, thick, pale grey to dark grey, epilithic, with erect, dense, cylindrical papillae, resembles isidia; prothallus not seen; medulla white, I–, H₂SO₄–. Apothecia lecideine, sessile, 0.5–1 mm in diam.; disc black, epruinose, plane, becoming slightly convex at maturity, margin distinct, reduced with age; exciple *dispersa*-type (Bungartz *et al.*, 2007), 60–90 µm wide, aeruginose pigments absent (K–, HNO₃ –), outermost layer dark brown, middle light brown; epihymenium brown, 10–15 µm high; hymenium hyaline, not inspersed, 50–90 µm high; paraphyses

simple, apically swollen, with brown pigment cap (cf. *elachista* brown), aeruginose pigment absent. Hypothecium dark brown, 50–120 µm high. Asci 8-spored, clavate, *Bacidia*-type, (43.0–) 44.71–52.21 (–55) × (10–) 11.66–17.94 (–20) µm (n = 15). Ascospores 1-septate, brown at maturity, oblong to ellipsoid, not curved, *Buellia*-type, proper septum and spore wall thin, not thickening during spore ontogeny, ornamentation absent, (13.0–) 13.85–16.65 (–17.25) × (5.75–) 5.96–7.3 (–8.0) µm (n = 20). Pycnidia not observed.

Chemistry: Thallus K–, P–, C–, UV–; medulla non-amyloid, I–. Secondary metabolites: unidentified brown-grey spot at R_f class 4.

Distribution: Earlier, it was reported from Paraguay and Alberta (Müller 1888, John 1989). However, in India, it is reported for the first time and was found growing on the rocks at an elevation 1585 m in Sunderdhunga valley.

Specimen examined: India, Uttarakhand, Bageshwar district, en route to Loharkhet from Saung, 30.0533° N, 80.0144° E, elev. 1585 m, on rock, 17 July, 2022, R.S. Adhikari, 22-047447 (LWG-70839).

Remarks: *Buellia papillosa* is morphologically similar to *Cratiria dissimilis* (Nyl.) Marbach in having isidia, however, the later species has corticolous habit and have true isidia, a thinner hypothecium, and presence of norstictic acid and atranorin (Marbach 2000). This species can be distinguished from other saxicolous *Buellia* species by its distinctly papillate thallus (Müller 1888). The description provided here is based on Indian specimens, which match well with the protologue and the holotype photo of *Buellia papillosa*, and additional observations have been incorporated.

New Distributional records for Uttarakhand

1. *Amandinea errata* Marbach, Biblioth. Lichenol. 74: 68 (2000)
Distribution: India (Jammu and Kashmir) (Haq *et al.*, 2019)
Specimen examined: India, Uttarakhand, Bageshwar district, en route to Baluni to from Kathaliya village, 29.948036° N, 79.908661° E, elev. 1115 m, on bark, 30 June 2022, R.S. Adhikari, 22-046714/C (LWG-70698).
2. *Amandinea incrustans* (J. Steiner) Marbach, Biblioth. Lichenol. 74: 75 (2000)
Distribution: India (Himachal Pradesh) (Sinha *et al.*, 2024)
Specimen examined: India, Uttarakhand, Bageshwar district, Kapkot village, 29.948036° N, 79.908661° E, elev. 1115 m, on bark, 30 June 2022, R.S. Adhikari, 22-047431 (LWG-70782).
3. *Amandinea submontana* Marbach, Biblioth. Lichenol. 74: 105 (2000)
Distribution: India (Assam, Maharashtra and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Gonap Beat, 29.701867° N, 79.75835° E, elev. 2360 m, on bark, 13 December 2022, S. Nayaka *et al.*, 22-371166 (LWG-70296).
4. *Baculifera micromera* (Vain.) Marbach, Biblioth. Lichenol. 74: 134 (2000)
Distribution: India (Tamil Nadu) (Sinha *et al.*, 2024).
Specimens examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Badhaur Beat, 29.6508° N, 79.664619° E, elev. 2213 m, on bark, 14 December 2022, S. Nayaka *et al.*, 22-368510 (LWG-70816); Bageshwar district, Kapkot village, 29.948036° N, 79.908661° E, elev. 1115 m, on bark, 30 June 2022, R. S. Adhikari, 22-049398/B (LWG-70784).
5. *Baculifera xylophila* (Malme) Marbach, Biblioth. Lichenol. 74: 148 (2000)
Distribution: India (Jammu & Kashmir) (Haq *et al.*, 2019).
Specimens examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Kaparkhan Beat, 29.682861° N, 79.727547° E, elev. 1929 m, on bark, 16 December 2022, S. Nayaka *et al.*, 22-368580 (LWG-70821); Bageshwar district, Kapkot village, 29.948036° N, 79.908661° E, elev. 1115 m, on bark, 30 June 2022, R. S. Adhikari, 22-046721 (LWG-70783).
6. *Buellia alboatrior* (Nyl.) Zahlbr., Cat. Lich. Univers. 7: 441 (1931)
Distribution: India (Bihar, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Odisha, Rajasthan Uttar Pradesh and West Bengal) (Sinha *et al.*, 2024)
Specimen examined: India, Uttarakhand, Bageshwar district, en route to Baluni from Kathaliya village, 30.216147° N, 79.907669° E, elev. 3815 m, on bark, 16 June 2023, R.S. Adhikari & K. K. Ingle, 23-049406 (LWG-70719).
7. *Buellia ceylanensis* Zahlbr., in Reichinger, Denkschr. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 88: 31 (1911)
Distribution: India (Madhya Pradesh, Manipur, Meghalaya, and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary,

- Kaparkhan Beat, 29.673808° N, 79.718533° E, elev. 1939 m, on rock, 16 December 2022, S. Nayaka *et al.*, 22-368810 (LWG-70820).
8. *Buellia demutans* Zahlbr., Cat. Lich. Univers. 7: 348 (1931)
Distribution: India (Mizoram and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Gonap Beat, 29.701867° N, 79.75835° E, elev. 2360 m, on bark, 13 December 2022, S. Nayaka *et al.*, 22-368514 (LWG-70348).
 9. *Buellia flavelloides* S.R. Singh & D.D. Awasthi, Biol. Mem. 6(2): 177 (1981)
Distribution: India (Andhra Pradesh, Jammu and Kashmir and Kerala) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Gonap Beat, 29.699628° N, 79.760317° E, elev. 2320 m, on bark, 15 December 2022, S. Nayaka *et al.*, 22-368508 (LWG-70328).
 10. *Buellia indica* S.R. Singh & D.D. Awasthi, Biol. Mem. 6(2): 186 (1981)
Distribution: India (Himachal Pradesh, Madhya Pradesh, Maharashtra, Manipur and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Mori village, 29.465978° N, 79.709577° E, elev. 1918 m, on rock, 12 December 2021, R. S. Adhikari, 21-049410 (LWG-70824A).
 11. *Buellia manipurensis* Kr.P. Singh & S.R. Singh, Geophytology 12(1): 128 (1982)
Distribution: India (Himachal Pradesh and Manipur) (Sinha *et al.*, 2024).
Specimens examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Gonap Beat, 29.701867° N, 79.75835° E, elev. 2360 m, on rock, 13 December 2022, S. Nayaka *et al.*, 22-371795/A (LWG-70346); Bageshwar district, en route to Khati from Kharkiya village, 30.094711° N, 79.916839° E, elev. 2061 m, on rock, 1 December 2021, S. Nayaka *et al.*, 21-045140 (LWG-70753).
 12. *Buellia nilgiriensis* S.R. Singh & D.D. Awasthi, Biol. Mem. 6(2): 187 (1981)
Distribution: India (Andhra Pradesh, Rajasthan and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Kaparkhan Beat, 29.673808° N, 79.718533° E, elev. 1939 m, on bark, 16 December 2022, S. Nayaka *et al.*, 22-371793 (LWG-70819).
 13. *Buellia pallidomarginata* A. Nordin, Symb. Bot. Upsal. 33(no. 1): 79 (2001)
Distribution: India (Madhya Pradesh) (Sinha *et al.*, 2024)
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Badhaur Beat, 29.6508° N, 79.664619° E, elev. 2213 m, on bark, 14 December 2022, S. Nayaka *et al.*, 22-368505 (LWG-70818).
 14. *Buellia palniensis* S.R. Singh & D.D. Awasthi, Biol. Mem. 6(2): 188 (1981)
Distribution: India (Himachal Pradesh, Jammu and Kashmir, Maharashtra, Manipur and Tamil Nadu) (Sinha *et al.*, 2024).
Specimen examined: India, Uttarakhand, Almora district, Mori village, 29.465978° N, 79.709577° E, elev. 1918 m, on rock, 12 December 2021, R. S. Adhikari, 21-049410 (LWG-70824B).
 15. *Buellia proximata* H. Magn., Ark. Bot. 32A (no. 2): 51 (1945)
Distribution: India (Assam, Chhattisgarh, Kerala and Tamil Nadu) (Sinha *et al.*, 2024)
Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Binsar Beat, 29.707392° N, 79.758411° E, elev. 2392 m, on bark, 13 December 2022, S. Nayaka *et al.*, 22-371751 (LWG-70177).
 16. *Buellia solediata* (Tuck.) H. Magn., Ark. Bot., Ser. 2 3(no. 10): 374 (1955)
Distribution: India (Jammu and Kashmir) (Sinha *et al.*, 2024)
Specimen examined: India, Uttarakhand, Bageshwar district, en route to Baluni top from Kathaliya village, 30.216147° N, 79.907669° E, elev. 3815 m, on bark, 16 June 2023, R.S. Adhikari & K.K. Ingle, 23-049409 (LWG-70711).
 17. *Buellia subdisciformis* (Leight.) Jatta, Nuovo G. bot. ital. 24(1): 21 (1892)

Distribution: India (Andhra Pradesh, Jammu and Kashmir, Manipur and Tamil Nadu) (Sinha *et al.*, 2024)

Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Patanianail Beat, 29.669669° N, 79.718189° E, elev. 1941 m, on rock, 16 December 2022, S. Nayaka *et al.*, 22-372403 (LWG-70822).

18. *Buellia subnexa* Vain., Bot. Tidsskr. 29: 115 (1909)

Distribution: India (Arunachal Pradesh and Jammu and Kashmir) (Sinha *et al.*, 2024).

Specimen examined: India, Uttarakhand, Bageshwar district, en route to Khati from Kharkiya village, 30.094711° N, 79.916839° E, elev. 2061 m, on bark, 1 December 2021, S. Nayaka *et al.*, 21-045137 (LWG-70751).

19. *Diplotomma pharcidium* (Ach.) M. Choisy, Bull. mens. Soc. linn. Soc. Bot. Lyon 19(7): 156 (1950)

Distribution: India (Karnataka, Kerala, Madhya Pradesh and Tamil Nadu) (Sinha *et al.*, 2024).

Specimen examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Gonap Beat, 29.701867° N, 79.75835° E, elev. 2360 m, on bark, 13 December 2022, S. Nayaka *et al.*, 22-368511 (LWG-70321).

20. *Sculptolumina japonica* (Tuck.) Marbach, Biblioth. Lichenol. 74: 296 (2000)

Distribution: India (Karnataka, Madhya Pradesh, Manipur, Tamil Nadu) (Sinha *et al.*, 2024).

Specimens examined: India, Uttarakhand, Almora district, Binsar Wildlife Sanctuary, Badhaur Beat, 29.6508° N, 79.664619° E, elev. 2213 m, on bark, 14 December 2022, S. Nayaka *et al.*, 22-368504 (LWG-70817); Bageshwar district, Saung to Loharkhet, 30.037528° N, 79.953111° E, elev. 1587 m, on bark, 1 July 2022, R. S. Adhikari, 22-049538 (LWG-70845).

Key to the species of buellioid lichens from Uttarakhand

1. Thallus lichenicolous.....**Group A**
 - Thallus autonomous/lichenized.....2
2. Thallus saxicolous.....**Group B**

Thallus corticolous, terricolous, musicolous.....**Group C**

Group A

1. Ascospores 1-septate, thallus on *Aspicilia* sp., *Circinaria* sp., *Myriospora* sp., ascospores 9–13 × 5–7 µm.....*Buellia badia*

Ascospores 3-septate, thallus on *Physcia* sp. ascospores 15–23 × 6–9 µm.....*Tetramelas pulverulentus*

Group B

1. Thallus with cylindrical papillae which resemble isidia, ascospores *Buellia*-type, 13–17 × 6–8 µm.....*Buellia papillosa*

Thallus lacking papillae.....2

2. Thallus UV+ orange, ascospores 11–15 × 5–7 µm.....*Buellia nilgiriensis*

Thallus UV–.....3

3. Ascospores 3-septate. 18–35 × 7–11 µm.....*Buellia manipurensis*

Ascospores 1-septate.....4

4. Lichen substances absent.5

Lichen substances present.....7

5. Thallus pale brown, areolate, margin appear subsquamulose, ascospores 14–20 × 7–11 µm.....*Buellia indica*

Thallus grey, margin non squamulose.....6

6. Thallus whitish grey, exciple light brown, ascospores 12–15 × 7–8 µm.....*Buellia leptoclone*

Thallus grey, exciple dark brown, ascospores 13–17 × 9–10 µm.....*Amandinea incrustans*

7. Apothecia irregular shape, remaining immersed, not becoming sessile, ascospores 10–15 × 6–8 µm.....*Buellia aethalea*

Apothecia rounded.....8

8. Exciple with aeruginose pigments (HNO₃+ violet)9

Exciple lacking aeruginose pigments (HNO₃–).....10

9. Thallus with norstictic acid, ascospores 10–14 × 6–7 µm.*Buellia spuria*

Thallus lacking norstictic acid, ascospores 13–17 × 7–9 µm.....*Buellia palniensis*

10. Atranorin absent, thallus grey-brown, K⁻, ascospores 8–13 × 5–7 µm.....*Buellia ceylanensis*

Atranorin present.....11

11. Exciple *aethalea*-type, ascospores 13–20 × 5–9 µm.*Buellia meghalayensis*

Exciple *leptocline*-type, ascospores 9–15 × 5–8 µm.....*Buellia subdisciformis*

Group C

1. Thallus sorediate.2

Thallus lacking vegetative propagules.....3

2. Ascospores transversely 3-septate becoming submuriform, ascospores 11–19 × 5–9 µm.....*Buellia sorediate*

Ascospores 1-septate, ascospores 13–19 × 6–10 µm.....*Buellia betulinoidea*

3. Asci up to 8-spored.....4

Asci >8-spored.....28

4. Ascospores 1-septate5

Ascospores >1-septate, submuriform or muriform.....21

5. Asci mostly 2–4-spored6

Asci 8-spored.....7

6. Asci mostly 2-spored, ascospores 25–42 × 10–15 µm..*Buellia dissa*

Asci 4-spored, ascospores 30–40 × 14–18 µm.....*Buellia tetrapla*

7. Thallus UV+ orange, ascospores 10–15 × 5–8 µm.....*Buellia flavelloidea*

Thallus UV–.....8

8. Hymenium interspersed.....9

Hymenium clear.....11

9. Exciple *aethalea*-type, mature ascospores *Mischoblastia*-type, lacking lichen substances, ascospores 17–24 × 8–12 µm.....*Sculptolumina japonica*

Exciple *dispersa*-type, mature ascospores *Buellia*- or *Callispora*-type, lichen substances present.....10

10. Ascospores 22–32 × 13–15 µm.....*Buellia demutans*

Ascospores 15–20 × 7–9 µm.....*Buellia disciformis*

11. Thallus K⁻, P⁻, C⁻ (lichen substances absent), exciple *aethalea*-type.....12

Thallus K⁺ yellow or red (lichen substances present), exciple *aethalea*- or *dispersa* - type.....16

12. Ascospores *Orcularia*-type, 15–20 × 7–8, mature ascospores becoming tetralocular,.....*Orcularia placodimorpha*

Ascospores *Buellia*-type.....13

13. Epithymenium with aeruginose pigment (HNO₃⁺ violet).....14

Epithymenium lacking aeruginose pigment (HNO₃⁻).....15

14. Thallus K⁺ yellow, atranorin present; ascospores 14–16 × 6–7.....*Baculifera micromera*

Thallus K⁻, atranorin absent; ascospores 15–19 × 5–7 µm.....*Baculifera xylophila*

15. Ascospores 19–24 × 9–12 µm (most ascospores exceeding 20 µm length).....*Amandinea montana*

Ascospores 8–16 × 5–9 µm (most ascospores under 15 µm length).....*Amandinea punctata*

16. Ascospores *Cratiria*-type, with distinct apical wall thickenings, 12–18 × 6–8 µm.....*Cratiria obscurior*

Ascospores *Buellia*-type or placodimorphic.....17

17. Thallus K⁺ yellow (norstictic acid absent).....18

Thallus K⁺ yellow turning red (norstictic acid present).....19

18. Ascospores 13–18 × 7–8 µm.....*Amandinea submontana*

Ascospores 15–23 × 8–10 µm.....*Amandinea subduplicata*

19. Ascospores placodimorphic, with 2–3 interconnected locules on either side of the middle septum, 14–22 × 5–9 µm.....*Buellia almorensis*

Ascospores *Buellia*-type.....20

20. Hypothecium 150–200 µm high, ascospores 12–17 × 5–7 µm.....*Baculifera remensa*

Hypothecium 60–100 µm high, ascospores 14–19 × 7–9 µm.....*Baculifera curtisii*

21. Ascospores persistently 3-septate.....22
 Ascospores 3-septate becoming submuriform to muriform.....24
22. Thallus C+ orange, arthothelin present, ascospores $20\text{--}27 \times 8\text{--}10 \mu\text{m}$*Tetramelas triphragmioides*
 Thallus C-, arthothelin absent.....23
23. Exciple *leptocline*-type, ascospores $15\text{--}20 \times 5\text{--}9 \mu\text{m}$, diploicin absent.....*Buellia pallidomarginata*
 Exciple *dispersa*-type, ascospores $20\text{--}27 \times 8\text{--}9 \mu\text{m}$, diploicin present.....*Buellia proximata*
24. Thallus K+ yellow turning red (norstictic acid present), ascospores $20\text{--}35 \times 13\text{--}18 \mu\text{m}$...*Buellia himalayensis*
 Thallus K+ yellow or K- (norstictic acid absent).....25
25. Thallus K- (lichen substances absent).....26
 Thallus K+ yellow (lichen substances present).....27
26. Disc white pruinose, apothecia up to 1 mm diam., ascospores $12\text{--}19 \times 6\text{--}9 \mu\text{m}$...*Diplotomma alboatrum*
 Disc epruinose, apothecia up to 0.5 mm diam., ascospores $16\text{--}20 \times 6\text{--}9 \mu\text{m}$*Diplotomma pharcidium*
27. Ascospores $16\text{--}20 \times 8\text{--}10 \mu\text{m}$*Buellia alboatrior*
 Ascospores $28\text{--}33 \times 10\text{--}12 \mu\text{m}$*Cratiria submuriformis*
28. Asci up to 32-spored, ascospores $9\text{--}10 \times 4\text{--}5 \mu\text{m}$*Amandinea polyspora*
 Asci up to 16-spored.....29
29. Thallus K- (lacking lichen substances), ascospores *Buellia*-type, $10\text{--}13 \times 5\text{--}7 \mu\text{m}$*Amandinea errata*
 Thallus K+ yellow turning red (norstictic acid present), ascospores *Callispora*-type.....30
30. Epihymenium K+ violet, ascospores $11\text{--}18 \times 5\text{--}7 \mu\text{m}$*Buellia pleiotera*
 Epihymenium K-, ascospores $11\text{--}15 \times 5\text{--}6 \mu\text{m}$*Buellia subnexa*

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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