

Further Additions to Lichen Genus *Buellia* De Not. in South Korea

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The paper describes two new records of the lichen genus *Buellia* (*B. badia* and *B. nashii*) from South Korea. A detailed taxonomic description and comments are presented for both taxa. An updated key representing all *Buellia* species known from South Korea is also provided.

KEYWORDS : Geographical distribution, Lichens, New record, Taxonomy

The present work is a continuation towards a taxonomic treatment of the lichen genus *Buellia* in South Korea. Previously Joshi *et al.* [1] have reported six species of *Buellia* from South Korea. During a recent field trip to Bogil Island and examination of lichen specimens lodged at the Korean Lichen Research Institute (KoLRI) herbarium, we found two new records of *Buellia*: *B. badia* (Fr.) A. Massal., a maritime species found growing parasitically over *Aspicilia cinerea* (L.) Körb. from Bogil Island, and *B. nashii* Bungartz, an inland species reported from Mt. Cheongwan. A detailed taxonomic description along with chemistry, ecological data and illustrations are provided for these taxa. We also provide an updated key to all *Buellia* species reported from South Korea.

The specimens examined from the study area have been deposited at the KoLRI herbarium, Suncheon National University, Korea and Korean National Herbarium (KH).

The specimens were examined using standard microscopical techniques and hand-sectioned under a NIKON C-PS 1068908 dissecting microscope (Nikon, Tokyo, Japan). All measurements were made on material mounted in water, and lactophenol cotton blue was used only as a stain. The anatomical descriptions based on these preparations were made under a NIKON Eclipse E 200 compound microscope. Measurements of thallus layers, apothecia, and ascospores were made at $\times 400$ and $\times 1,000$ magnification. The ascospore dimensions are generally presented as (smallest single value recorded -) smallest mean recorded - largest mean recorded (- largest single value recorded). Spot test reactions were performed on hand sections of thalli and apothecia under a microscope (OLYMPUS BX 50; Olympus, Tokyo, Japan). Secondary metabolites were identified by standard thin layer chromatography, as described by Elix *et al.* [2], Orange *et al.* [3], and White and James [4], mainly using solvent system C.

Artificial key to the lichen genus *Buellia* in South Korea

1. Growing on bark or wood2
- 1a. Growing on rocks4
2. Hymenium with numerous oil droplets; *dispersa*-type proper exciple; asci 8 spored *B. disciformis*
- 2a. Hymenium without oil droplets; *aethalea*-type proper exciple; asci 8 to 16 spored3
3. Thallus indistinct to granular, subsquamulose; asci 16 spored *B. polyspora*
- 3a. Thallus scurfy, rimose to rimose-areolate; asci 8 spored *B. punctata*
4. Thallus lichenicolous (growing over *Aspicilia*); lacking secondary metabolites *B. badia*
- 4a. Thallus not lichenicolous; secondary metabolites present5
5. Thallus deep brown to olive brown; areolate to subsquamulose *B. nashii*
- 5a. Thallus different shades of gray, never brown; distinctly areolate6
6. Thallus with a chalky consistency, and a large amount of calcium oxalate crystals *B. maritima*
- 6a. Thallus without chalky consistency, without calcium oxalate crystals7
7. Medulla amyloid (I+ blue); contains atranorin, chloro-atranorin, norstictic and stictic acids *B. spuria*
- 7a. Medulla non-amyloid (I-); contains atranorin, 2'-*O*-methylperlatolic and confluent acids *B. stellulata*

Taxonomic treatment of the species

Buellia nashii Bungartz (Fig. 1A)

Mycotaxon 90: 90 (2004).

Diagnostic characters. *Thallus* saxicolous, crustose, areolate to subsquamulose, thick, continuous, 0.2~0.5 mm in diam. Surface deep brown to olive brown, dull to \pm shiny, smooth to fissured, epruinose, phenocorticate,

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with thin epinecral layer. Medulla white, with few calcium oxalate crystals (H_2SO_4 + needle shaped crystals). Prothallus absent. Vegetative propagules absent.

Apothecia lecideine, abundant, conspicuous, 0.4–0.6 (~0.7) mm diam., round, solitary to ± clumped, sessile. Disc entirely visible from surface, black, epruinose, initially plane but becoming strongly convex with age. Margin thin, black, usually persistent, rarely excluded with age. Proper exciple *dispersa*-type. Epihymenium aeruginose, pigmentation not continuous with the outer exciple. Hymenium hyaline, not interspersed with oil droplets. Hypothecium deep reddish brown. Paraphyses simple to moderately branched, apically swollen, with a brown pigment cap. Asci clavate, 8-spored. Ascospores brown, 1-septate, oblong to ellipsoid, (11~) 11.7~13.5 (~15) × (6.2~) 6.5~7.3 (~8.2) μm, *Physconia*-type. Pycnidia not seen.

Chemistry. Spot tests: thallus K+ yellow, C–, KC–, Pd+ yellow. Fluorescence: UV–. Iodine reaction: medulla non-amyloid. Secondary metabolites: norstictic and stictic acid.

Ecology. This species was found growing on non-calcareous rocks (siliceous) at an elevation of 550 m.

Geographical distribution. USA, Mexico [5].

Remarks. This species is characterized by areolate to subsquamulose olive brown thallus bearing calcium oxalate crystal inclusions; black, lecideine apothecia and brown, 1-septate, *Physconia*-type ascospores. *Buellia disciformis* (Fr.) Mudd., *B. polyspora* (Willey) Vain. and *B. punctata* (Hoffm.) A. Massal. are the other known montane *Buellia* species in South Korea, which need not be confused with *B. nashii*. *B. disciformis* differs in being corticolous, lacking oil droplets in hymenium, *dispersa*-type proper exciple, and *Callispora*-type ascospores; *B. polyspora* differs in being corticolous, having multispored asci (16-spored), *aethalea*-type proper exciple and *Buellia*-type

ascospores; *B. punctata* differs in lacking calcium oxalate crystals in the medulla and having *Buellia*-type ascospores.

Specimen examined. South Korea, Jeonnam Prov., Jangheung Co., Gwansan-eup, Mt. Cheongwan, 34°32'09.1" N, 126°55'32.3" E, alt. 550 m, on rock, 07 October 2005, L. Lökös, 050653 (KoLRI).

***Buellia badia* (Fr.) A. Massal. (Fig. 1B)**

Memor. Lichenogr. 1853: 124 (1853).

Diagnostic characters. *Thallus* lichenicolous, crustose, bullate to subsquamulose, thick, closely appressed, 0.2–0.5 mm diam. Surface usually chocolate brown, rarely grayish brown, dull, smooth, epruinose, phenocorticate, with thin epinecral layer. Medulla white, lacking calcium oxalate crystals (H_2SO_4 -). Prothallus absent. Vegetative propagules absent.

Apothecia lecideine, abundant, conspicuous, 0.3–0.4 (~0.5) mm diam., round, solitary to ± clumped, sessile. Disc entirely visible from surface, black, epruinose, initially plane but becoming strongly convex with age. Margin thin, black, rarely persistent but excluded with age. Proper exciple narrow, poorly differentiated, *aethalea*-type. Epihymenium brown, pigmentation continuous with the outer exciple. Hymenium hyaline, not interspersed with oil droplets. Hypothecium deep reddish brown. Paraphyses simple to moderately branched, apically swollen, with a brown pigment cap. Asci clavate, 8-spored. Ascospores brown, 1-septate, oblong to ellipsoid, (10~) 11~12.5 (~14) × (5~) 5.3~6 (~6.7) μm, *Buellia*-type. Pycnidia not seen.

Chemistry. Spot tests: thallus K–, C–, KC–, Pd– Fluorescence: UV–. Iodine reaction: medulla non-amyloid. Secondary metabolites: absent, but parasitic thalli contain substance from the host lichen.

Ecology. This species was found growing along maritime regions over *Aspicilia cinerea* on non-calcareous rocks (siliceous) at an elevation of 3 m.

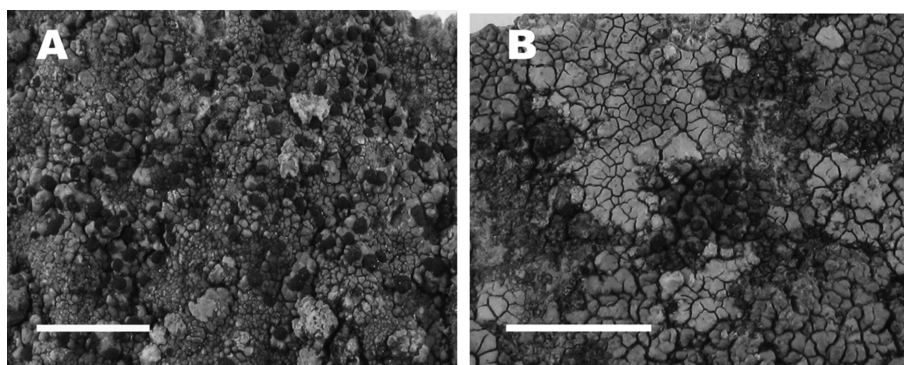


Fig. 1. Habit of *Buellia nashii* Bungartz (scale bar = 5 mm) (A) and *Buellia badia* (Fr.) A. Massal. (scale bar = 5 mm) (B).

Geographical distribution. Europe, Macaronesia, North and South America, Asia, Africa, Australia, New Zealand [6].

Remarks. This species is characterized by bullate to subsquamulose chocolate brown thallus lacking calcium oxalate crystal inclusions; black, lecideine apothecia and brown, 1-septate, *Buellia*-type ascospores. *Buellia maritima* (A. Massal.) Bagl., *B. spuria* (Schaer.) Anzi and *B. stellulata* (Taylor) Mudd. are the other known maritime *Buellia* species in South Korea, which need not to be confused with *B. badia*. *B. maritima* has rimose to rimose-areolate, chalky white thallus bearing norstictic and connorstictic acids; *B. spuria* has a white to grayish thallus, conspicuous black prothallus and bears atranorin, chloro-atranorin, norstictic and stictic acids, while, *B. stellulata* has areolate, whitish gray thallus bearing atranorin, 2'-*O*-methylperlatolic acid and confluent acid.

Specimen examined. South Korea, Jeonnam Prov., Wando Co., Bogil-myeon, Bogil Island, Tong-ri, near Tongri beach, 34°09'68.4" N, 126°35'15.3" E, alt. 3 m, on rock, 06 February 2010, Y. Joshi, H. S. Jeon, M. H. Jeong, 100201 (KoLRI).

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References

1. Joshi Y, Wang XY, Lökös L, Koh YJ, Hur JS. Notes on lichen genus *Buellia* De Not. (lichenized Ascomycetes) from South Korea. *Mycobiology* 2010;38:65-9.
2. Elix JA, Johnston J, Parker JL. A catalogue of standardized thin layer chromatographic data and biosynthetic relationships for lichen substances. Canberra: Australian National University; 1987.
3. Orange A, James PW, White FJ. Microchemical methods for the identification of lichens. 2nd ed. London: British Lichen Society; 2010.
4. White FJ, James PW. A new guide to microchemical techniques for the identification of lichen substances. *Br Lichen Soc Bull* 1985;57(Suppl):1-41.
5. Bungartz F. New and previously unrecorded saxicolous species of *Buellia* s.l. with one septate ascospores from the Greater Sonoran Desert Region. *Mycotaxon* 2004;90:81-123.
6. Coppins BJ, Scheidegger C, Aptroot A. *Buellia*. In: Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW, Wolseley PA, editors. The lichens of Great Britain and Ireland. London: Natural History Museum Publication; 2009. p. 228-38.