



Research article

New records of lichens from foothills of Kumaun Himalayas to the lichen flora of Uttarakhand, India

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Abstract: The paper presents an enumeration of seven lichen species as addition to the lichen flora of foothills of Kumaun Himalayas, Uttarakhand. The enumerated species belong to six genera and six families. The explored area showed dominance of crustose lichens while only two foliose and a single leprose species was recorded. A morpho-taxonomic note together with ecology and distribution of all the recorded lichen species as new addition to lichen flora of Uttarakhand is provided.

Keywords: Lichen - New addition - Foothills - Kumaun Himalayas - Uttarakhand.

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INTRODUCTION

India's ranks fifth with greatest biodiversity in the world, which is about 10% of the 20,000 species of lichens recorded in the world (Groombridge 1992). About 2305 lichen species (with additional 21 species unpublished) under 305 genera and 74 families have been reported to occur on various substrata in tropical, subtropical, temperate and alpine regions of India (Singh & Sinha 2010). The Himalayan region is represented by about 1000 species of lichens out of which 747 species (Rai 2013) are known to occur in Uttarakhand state. The topography of the state provide a wide altitudinal range from plain foothills to higher alpine region, hence the state exhibit tropical type of climate in the lower Himalayan region and temperate to alpine type of climate condition in higher Himalayas (Gupta *et al.* 2016a).

Kumaun region of Himalayas has been the reservoir of enormous natural resources of medicinal wealth. Great altitudinal variations as well as variation in rainfall are the main factors for the rich lichen flora of Kumaun. The intensity of rainfall becomes less and lesser from lower to higher altitude. Number of species is directly proportional to the altitude within the area, lower the altitude lesser the number of species. Mishra & Upreti (2015) carried out the floristic studies in the Kumaun Himalayan region and reported the occurrence of 630 species of lichens belonging to 134 genera and 44 families from the area. The Kumaun Himalayas comprised of six district of Uttarakhand. Amongst all the six districts, Udham Singh Nagar having a subtropical region, is situated at foothills of the Himalayas. The foothill region of Kumaun includes unique physiographic ecosystem as bhabhar and terai (Gupta *et al.* 2016b). The terai region is water logged alluvial plain with gentle South East Slope, deep and fertile moist loamy soil forming marshy land free from boulders and gravels. Being situated in the foothills of the Himalayas, having industrialized areas and agriculture fields, the district exhibit poor representation of lichens as compared to the region at higher altitude and only 28 species of lichen belonging to 17 genera and 13 families are known from the area (Mishra *et al.* 2012).

Mishra *et al.* (2012, 2015) listed a small number of lichen species from the foothills of Kumaun Himalayas in the lichen flora of Kumaun based on the few cursory collection of the area. During a recent intensive and extensive field survey and collection of lichens more than 300 lichen specimens were collected and the identification of the specimens resulted into the addition of seven more taxa to the flora of the state of Uttarakhand.

MATERIALS & METHODS

This study is based on more than 300 specimens of lichens collected from different localities of Udham Singh Nagar district (28°53' – 29°23' N and 78°45' – 80°08' E), located in the foothills of Kumaun Himalayas (Fig. 1). The specimens were collected from different substrata such as barks and twigs from the forests and mango orchards. The various trees (*Eucalyptus*, *Mangifera indica*, *Mallotus philippensis*, *Murraya koengii*, *Shorea robusta* and *Syzygium cumini*) exhibited remarkable growth of lichens. The identification of the specimens was done by studying their morphology, anatomy and chemistry. The morphology was studied using a LaboMed Digi Zoom dissecting microscope, and the anatomical details were studied using a Leica TM DM 500 optical microscope. Colour tests were performed using KOH (K), calcium hypochlorite (C) and para-phenylenediamine (P) solution. Secondary metabolites were identified by thin layer chromatography (TLC) as described by Orange *et al.* (2001) and Elix *et al.* (1993). The chromatograms were done in solvent system A (toluene: dioxane: acetic acid 180:60:8 ml) and solvent EA (Diethyl ether: Acetic acid: 200:2 ml). Specimens were identified by comparing the morphological and the biochemical test results with the literature and identification keys (Singh & Sinha 2010). The identified voucher specimens were deposited in the lichen herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG).



Figure 1. Collecting sites in foothills of Kumaun Himalayas.

RESULTS

The study enlisted seven lichen taxa as new addition to the lichen flora of foothills of the Kumaun Himalayas. The recorded lichen taxa belong to the six genera *viz.* *Anisomeridium*, *Amandinea*, *Graphis*, *Hyperphyscia*, *Opegrapha*, *Lepraria* and six families which are Calicaceae, Monoblastaceae, Graphidaceae, Physciaceae, Rocellaceae and Stereocaulaceae. All the taxa are reported for the first time for Uttarakhand state from the foothills of Kumaun Himalayas.

The study area exhibit dominance of crustose, foliose and leprose lichen growth forms, were found growing on bark and twigs in the forests as well as mango orchards. Though, the area is not rich in lichen diversity but exhibit diversity at generic as well as species level. A brief documentation of each species along with their ecology and distribution is provided.

Species enumeration**Caliciaceae**

Amandinea subduplicata (Vain.) Marbach, Biblioth. Lichenol. 74: 101 (2000). (Fig. 2A)

Thallus corticolous or saxicolous, crustose, smooth or verrucose, 1–2 cm wide; esorediate; apothecia 0.4–0.9 mm wide, lecideine, immersed to adnate; disc black, plane to concave, epruinose; proper margin broad; proper exciple thick; hymenium 80–120 µm thick, not markedly inspersed, but with a few scattered oil droplets in the lower part; asci 8-spored; ascospores *Buellia*-type, olive-green to olive-brown, ellipsoidal, 17–23 × 7–9 µm; thallus K+ yellow, C–, KC–, PD+ pale yellow, UV–; atranorin detected in TLC.

Distribution and ecology: The species is rare but found growing on bark as well as rocks. From India, it has been reported earlier from the states of Madhya Pradesh, Rajasthan and Tamil Nadu. The species is also known from Asia, North and South America.

Specimen examined: Udham Singh Nagar, Khatima, Khatima forests, on bark, 02.09.2015, S. Mishra & G. K. Mishra 15–027744 (LWG).

Graphidaceae

Graphis crebra Vain., Hedwigia 38:256. 1899. (Fig. 2B)

Thallus corticolous, crustose, corticate, dull to somewhat shiny, pale grey; ascomata lirellate, lirellae erumpent with lateral thalline margin, short, unbranched to rarely once branched, straight to slightly curved; labia entire; disc becoming exposed very early, with a distinct white pruina; excipulum laterally carbonized; hymenium inspersed; ascus 8-spored, hyaline, 9–12 celled, 29–33 × 8–9 µm; thallus K+ yellow–orange, C–, KC–, P+, norstictic acid in TLC.

Distribution and ecology: In the Neotropics, *Graphis crebra* is known from Guadeloupe, St. Helena and the Galapagos. During field trip, it was found growing on bark, distributed in the forests of Khatima and Tanda of Udham Singh Nagar district.

Specimens examined: Udham Singh Nagar, Khatima, Khatima forests, on twig of *Shorea robusta*, 02.09.2015, S. Mishra & G. K. Mishra 15–019917, 15–019918 (LWG); Rudrapur, Tanda forests, on bark, 03.09.2015, S. Mishra & G. K. Mishra 15–027702 (LWG); on bark of *Shorea robusta*, 03.09.2015, S. Mishra & G. K. Mishra 15–027710 (LWG); on twig, 03.09.2015, S. Mishra & G. K. Mishra 15–027711 (LWG).

Monoblastiaceae

Anisomeridium albisedum (Nyl.) R. C. Harris, The Bryologist 90 (2): 163 (1987). (Fig. 2C)

Thallus corticolous, crustose, ecorticate, white, UV–; perithecia solitary; ostiole apical; hamathecium filaments thin, anastomosing above the asci; asci 8-spored; ascospores hyaline, 1-septate, ovoid, 9–15 × 4–5 µm, not ornamented, septum mostly median.

Distribution and ecology: A neotropical species has been earlier reported from Maharashtra and Mahabaleshwar in India. In the study area, the species is found growing on bark near base of tree trunk of *Eucalyptus* tree.

Specimens examined: Udham Singh Nagar, Nanak Sagar, Sitarganj, *Eucalyptus*, 02.09.2015, S. Mishra & G. K. Mishra 15–027742, 15–027742/A, 15–027742/B (LWG); Bajpur, way to Kaladhungi, on bark, 03.09.2015, S. Mishra & G. K. Mishra 15–027743 (LWG).

Physciaceae

Hyperphyscia adglutinata var. *adglutinata* (Flörke) H. Mayrhofer & Poelt, Herzogia 5: 62. 1979. (Fig. 2D)

Thallus corticolous, foliose, orbicular, small, 0.6–2.4 cm across, greenish grey to brownish, sorediate; lobes minute, 0.2–0.4 mm wide, slightly pruinose, free from the substratum; lower surface pale, yellowish white to grey white, rhizinate; rhizines dark grey with white tips, soredia capitate, soredia granular, greenish medulla white to greenish; apothecia absent; thallus K–, C–, KC–, P–; no chemicals detected in TLC.

Distribution and ecology: The species is cosmopolitan in distribution and found growing on bark and rarely on rock. During field trip, it is collected from forests as well as mango orchards from various localities (Bajpur, Gadarpur, Kichha, Khatima and Rudrapur) on different phorophytes. Earlier, in India, it is reported from Himachal Pradesh and Jammu & Kashmir. Outside India, it is known from Australia, Bhutan, New Zealand and Taiwan, Africa, Europe, North America.

Specimens examined: Udham Singh Nagar, Bajpur, enroute to Kaladhngi, *Murraya koengii*, 03.09.2015, S. Mishra & G. K. Mishra 15–027791 (LWG); on twigs, 15–027790/A (LWG); Bajpur, on bark *Mallotus philippensis*, 03.09.2015, S. Mishra & G. K. Mishra 15–027789 (LWG); Rudrapur, Tanda, 02.09.2015, S. Mishra & G. K. Mishra 15–027784 (LWG); Kichha, near Rudrapur, *Magnifera indica*, 02.09.2015, S. Mishra & G. K. Mishra 15–027742 (LWG); Khatima, Khatima forests, *Shorea robusta* young bark, 02.09.2015, S. Mishra & G. K. Mishra 15–027786, 15–027786/A(LWG); Gadarpur, before Kelakhera, *Magnifera indica*, 03.09.2015, S. Mishra & G. K. Mishra 15–027742, 15–027796 (LWG).

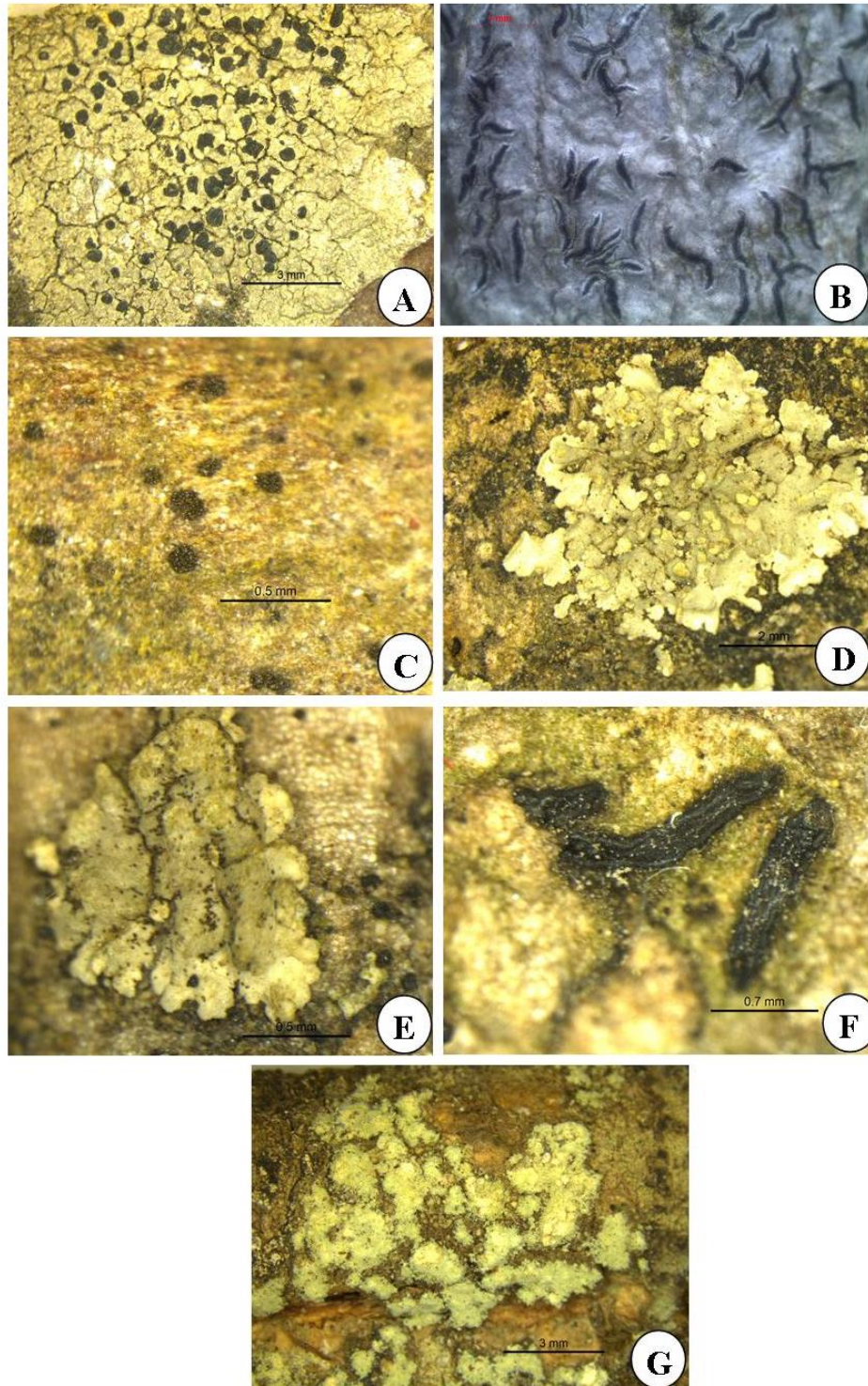


Figure 2. Thallus of newly added lichen taxa to the foothills of Kumaun Himalaya: **A**, *Amandinea subduplicata* (Vain.) Marbach; **B**, *Graphis crebra* Vain.; **C**, *Anisomeridium albisedum* (Nyl.) R. C. Harris; **D**, *Hyperphyscia adglutinata* var. *adglutinata* (Flörke) H. Mayrhofer & Poelt; **E**, *Hyperphyscia adglutinata* var. *pyrithrocardia* (Müll. Arg.) D. D. Awasthi; **F**, *Opegrapha varia* Pers.; **G**, *Lepraria coriensis* (Hue) Sipman.

Hyperphyscia adglutinata* var. *pyrithrocardia (Müll. Arg.) D. D. Awasthi, Comp. Macrolich. India, Nepal & Sri Lanka: 197. 2007. **(Fig. 2E)**

Thallus corticolous, foliose, 1.0–3.0 cm diam., often coalescing with neighbouring thallus, upper surface whitish grey to brownish, darkening at margin, lobes free from substratum, 0.2–0.4 mm wide; soredia capitate to irregular, laminal, soredia farinose lower surface pale at margin, rhizinate, medulla white, sometimes orange and K+ purple; apothecia absent; thallus K–, C–, KC–, P–; skyrin present in TLC.

Distribution and ecology: The species is widely distribution in the Udham Singh Nagar. It is collected from forests of Bajpur, Khatima and Rudrapur on bark and twigs. Previously, it has been reported from Tamil Nadu in India and outside India, recorded from U.S.A.

Specimens examined: Udham Singh Nagar, Rudrapur, Tanda, on bark 03.09.2015, *S. Mishra & G. K. Mishra* 15–027795, 15–027795/A, 15–027792 (LWG); Bajpur, on the way to Kaladhungi, on twig 03.09.2015, *S. Mishra & G. K. Mishra* 15–027793 (LWG); Khatima, Khatima forests, *Shorea robusta* young bark 03.09.2015, *S. Mishra & G. K. Mishra* 15–027794 (LWG).

Rocellaceae

Opegrapha varia Pers. Ann. Bot. (Usteri) 1:30. 1794. **(Fig. 2F)**

Thallus corticolous, crustose, ecorticate, greenish grey, sometimes inconspicuous; ascomata lirellate, lirellae black, mostly simple, rarely furcated, $0.3–0.7 \times 0.1–0.2$ mm, disc slit like, epruinose; exciple brown black to carbonized, convergent, thinning and continuous below hymenium, 16–34 μ m thick; hymenium hyaline to slightly yellowish, upto 38 μ m high; ascus 8–spored, clavate, $57–71 \times 17–22$ μ m; ascospores hyaline, 4–5 septate, middle locule slightly larger, fusiform with thick perispore, $31–34 \times 71–10$ μ m; thallus K–, C–, KC–, PD–; no chemicals detected in TLC.

Distribution and ecology: The species is cosmopolitan and colonize on the bark of the tree. During the study, it has been collected from Bajpur and has been earlier reported from plain areas of Andaman & Nicobar Islands, Kerala and West Bengal. Outside India, it is reported from Australia, Fiji, Indonesia, Hongkong, Papua New Guinea the Philippines and Africa.

Specimen examined: Udham Singh Nagar, Bajpur, enroute to Kaladhungi, on bark, 03.09.2015, *S. Mishra & G. K. Mishra* 15–027802 (LWG).

Stereocaulaceae

Lepraria coriensis (Hue) Sipman, Herzogia 17: 28. 2004. **(Fig. 2G)**

Thallus corticolous, crustose-leprose, yellowish grey, ecorticate, forms a thin to moderately thick, non-areolate crust of powdery granules or, in part, to form irregular rosettes with lobed margins; marginal lobes rounded, 0.5–2.0 mm wide, with raised marginal rim; surface smooth near the margin, with more or less scattered granules in the centre; usnic acid and zeorin present in TLC, pannaric acid derivatives absent.

Distribution and ecology: The species is corticolous reported from Khatima. In India, it has been reported from Karnataka while outside India it is widely distributed in Australia, Korea, Hong Kong and Taiwan, SE Asia, extending to North Australia.

Specimens examined: Udham Singh Nagar, Khatima, Khatima forests, on bark 02.09.2015, *S. Mishra & G. K. Mishra* 15–027721 (LWG), 15–027721/A (LWG).

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