

# Notes on Occurrence of Fruticose Lichens in Joram Top, Ziro Valley, Arunachal Pradesh with 10 New Records to the State

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**Abstract:** The paper enumerates 22 fruticose lichens species collected from 'Joram Top', a small village in Ziro Valley of Arunachal Pradesh. The lichen taxa belong to four genera; *Cladonia* (7 spp.), *Ramalina* (5 spp.), *Teloschistes* (1 sp.) and *Usnea* (9 spp.). The species of *Usnea* and *Ramalina* were most common in the area and found growing as epiphytes over tree trunks and twigs, whereas species of *Cladonia* were found growing over soil and rocks in moist places. *Teloschistes* found to be a rare lichen in the area was growing intermingled with *Usnea* and *Ramalina*. The study also resulted in 10 species as new records to the lichen flora of Arunachal Pradesh – *Cladonia subradiata*, *C. subulata*, *C. verticillata*, *Ramalina hossei*, *R. pollinaria*, *Teloschistes flavicans*, *Usnea eumitrioides*, *U. lucea*, *U. luridiorufa*, and *U. spinosula*. The lichens are considered as indicators of air pollution. The luxuriant growth of fruticose lichens clearly indicates that Joram Top area is still free from air pollution.

**Keywords:** Lichenized fungi, cryptogam, biodiversity, North East India, Parmeliaceae.

## 1. Introduction

Lichens are composite, symbiotic organisms made up of an alga (or cyanobacteria) and a fungus. They are ubiquitously distributed and an important component of the biodiversity [1]. Lichen are of great economic importance; they are used as spice, medicine, dye and perfume by man since the time immemorial [2]. The lichen extracts have shown potential biological activities such as antimicrobial, antioxidant, anticancerous, anti-inflammatory, hepato-protective, cardio-protective *etc.* [3]. The lichens are also sensitive to air pollution and climate change and hence they are called as bioindicators. The lichens are being utilized biomonitoring the environmental changes worldwide [4]. By their appearance the lichens can be grouped into three main growth forms : 1. crustose - where the thallus is closely attached to the substratum without leaving any free margin 2. foliose - the thallus in this case is loosely attached at least at the margin 3. fruticose - the thallus is attached to the substratum at one point and remaining major portion is either growing erect or hanging. The fruticose lichen usually appears as small shrub or bush [5].

In the world there are about 20,000 species of lichens and India is represented by 2500 species distributed under 322 genera and 72 families. Out of the total, about 23% of the taxa are endemic to India. Within India Western Ghats and Himalayas are the hotspots of lichen diversity. Eastern Himalayas harbors a total of 1250 species, Western Ghats 1210 and Western Himalayas with 972 species. Among various states Tamil Nadu is represented by maximum number of lichens with 812 species [6]. Although India being a megadiverse country with several biodiversity hotspots and

phytogeographical regions lichen wealth of the country is insufficiently explored. In comparison to other conspicuous plant groups in the natural landscape, lichens are the most overlooked. The lichens have received little scientific attention due to the difficulties in their identification and most of the earlier collections including the type specimens are preserved in different European herbaria, hence unavailable for comparison. There are several ecologically interesting habitats which need to be explored for documentation of lichens. The north-eastern part of India is one such region with huge lichen biodiversity needing to be surveyed. In the present study Ziro Valley in Arunachal Pradesh is chosen for detailed exploration.

Arunachal Pradesh has rich floristic diversity, higher incidence of rare and threatened taxa. Approximately 5000 angiosperms taxa including 600 orchids along with 400 ferns, 48 gymnosperms, an equally high number of unexplored algae, fungi, lichens and bryophytes inhabited in its diverse habitats. Presence of numerous primitive plant species and wild relatives of cultivated plants truly justifies the region to be recognized as “cradle of flowering plants”. However, systematic floristic studies on lichens of Arunachal Pradesh is recently initiated. Routh *et al.* [7] recorded 42 lichen species from Sessa Orchid Wildlife Sanctuary in Arunachal Pradesh while Pinakiyo *et al.* [8] studied the diversity and distribution of lichens 10 sites within the Mehao Wildlife Sanctuary revealing 177 species, belonging to 71 genera and 35 families. Singh and Pinakiyo [9] reported four species of foliicolous lichens while Khare *et al.* [10] documented the occurrence of a rare lichen *Ophioparma ventosa* (L.) Norman, from alpine areas of Arunachal Pradesh. Rout *et al.* [11-12] recorded the utilization of lichens by ethnic people in

the state. Singh and Singh [13-14] discovered *Pyrgillus tibellii* Kr. P. Singh and Pushpi Singh as new species, while *P. cubanus* Nyl. and *P. javanicus* (Mont. and Bosch) Nyl. as new records for India from the state. Recently, Singh *et al.* [15] studied the Thelotrema-like Graphidaceae of Arunachal Pradesh and described *Rhabdodiscus indicus* Pushpi Singh & K.P. Singh as new species while *Ocellularia neopertusariiformis* Hale and *O. subgranulosa* (Homchantara & Coppins) Lumbsch & Papong as new records from India. These studies clearly indicate that Arunachal Pradesh is an interesting site for lichen growth. At present the state is represented by more than 33% of the total Indian flora, out of which about 30% are endemic to the entire Indo-Malayan Region.

## 2. Materials and Methods

**2.1 Study site:** The present study is restricted to 'Joram Top', a small village near Hapoli in Ziro Valley of Arunachal Pradesh (Fig. 1). The Ziro Valley is one of the prettiest landscapes in India located in Lower Subansiri district about 167 km away from capital Itanagar. It has been a favourite town for World Heritage Site for a number of years now. 'Joram Top' is situated at coordinates of 27°31'55"N longitude, 93°47'39"E latitude and altitude of 1080 m. With its moderate climatic conditions and variable rainfall Joram Top harbours rich diversity of plants and animals. The lichens with their luxuriant growth on soil, rock and plants make one of the most obvious and eye catching vegetation in this area.



**Figure 1:** Map of Arunachal Pradesh showing Joram Top village in Ziro valley

### 2.2 Collection, preservation and identification of lichens

A total of 200 lichens samples were collected by one the author (KR) from the forested areas of Joram Top during the year 2008. The specimens were collected from all possible substrata such as soil, rock, shrubs, tree trunks and twigs. The specimens were segregated, dried and preserved in the herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG). The lichen specimens were investigated morphologically, anatomically and chemically following recent literature [16]. The colour tests were performed with the routine reagent *i.e.* K (5% potassium hydroxide), C (aqueous solution of calcium hypochloride) and P (paraphenylene diamine). Some lichen specimens were

investigated with Thin Layer Chromatography (TLC) in solvent system A (toluene: dioxine: acetic acid) by Walker and James [17] method. The classification of Lumbsch and Huhndorf [18] followed for arranging species under various families.

## 3. Result and Discussion

The identification of lichen samples resulted in 62 species of macrolichens (foliose, fruticose and large squamulose forms). Among them fruticose lichens with 22 species make their prominent representation under four genera such as *Cladonia*, *Ramalina*, *Teloschistes* and *Usnea* (Table 1). The

**Table 1:** List of fruticose lichens identified from forested areas of Joram Top (New refers to Arunachal Pradesh)

	Lichen species	Family	Remarks
1.	<i>Cladonia cartilaginea</i> Müll. Arg	Cladoniaceae	
2.	<i>C. coniocraea</i> (Floerke) Spreng.	Cladoniaceae	
3.	<i>C. corniculata</i> Ahti & Kashw	Cladoniaceae	
4.	<i>C. rei</i> Schaer.	Cladoniaceae	
5.	<i>C. subradiata</i> (Vain.) Sandst.	Cladoniaceae	New
6.	<i>C. subulata</i> (L.) Weber ex F.H. Wigg.	Cladoniaceae	New
7.	<i>C. verticillata</i> (Hoffn.) Schaer.	Cladoniaceae	New
8.	<i>Ramalina</i> cfr. <i>himalayensis</i> Räsänen	Ramalinaceae	
9.	<i>R. conduplicans</i> Vain.	Ramalinaceae	
11.	<i>R. hossei</i> Vain.	Ramalinaceae	New
10.	<i>R. pollinaria</i> (Westr.) Ach.	Ramalinaceae	New
12.	<i>R. sinensis</i> Jatta	Ramalinaceae	
13.	<i>Teloschistes flavicans</i> (Sw.) Norm.	Teloschistaceae	New
14.	<i>Usnea aciculifera</i> Vain.	Parmeliaceae	
15.	<i>U. baileyi</i> (Stirt.) Zahlbr.	Parmeliaceae	
16.	<i>U. bismolluscula</i> Zahlbr.	Parmeliaceae	
17.	<i>U. eumitrioides</i> Mot.	Parmeliaceae	New
18.	<i>U. fragilis</i> Stirt.	Parmeliaceae	
19.	<i>U. lucea</i> Mot.	Parmeliaceae	New
20.	<i>U. luridiorufa</i> Stirt.	Parmeliaceae	New
21.	<i>U. rubicunda</i> Stirt.	Parmeliaceae	
22.	<i>U. spinosula</i> Stirt.	Parmeliaceae	New

genus *Usnea* dominated fruticose lichen community with 9 species followed by *Cladonia* and *Ramalina* with 7 and 5 species respectively. *Teloschistes* found to be the rare lichen in the study area is represented by only one species *T. flavicans* (Sw.) Norm. The species of *Usnea* and *Ramalina* were the most abundant lichens in the area and found growing as epiphytes over tree trunks and twigs. Some of the large species such as *U. baileyi* found hanging from twigs covered the whole tree. On the other hand species of *Cladonia* were found growing over soil and rocks in moist places. They almost covered the ground like carpets. It is observed that the *Cladonia* species grew in mixed population giving a tough challenges for collection and identification; whereas *T. flavicans* found growing intermingled with *Usnea* and *Ramalina*, and hence evading the sight of collectors. Therefore only one specimen could be collected.

Present study also resulted in 10 species as new records for Arunachal Pradesh. Their brief description and distribution in India are as follows;

***Cladonia subradiata* (Vain.) Sandst.** (Fig. 2): Primary thallus squamulose, greenish brown on upper side, white on lower side. Podetia 15-20 mm tall, simple to sparingly branched, corticated at base, granulose sorediate upwards, with microsquamulose, hymenial discs brown. Chemistry: P+ orange-red, fumarprotocetraric acid present. Earlier this species was known from Himachal Pradesh, Jammu and Kashmir, Sikkim and Tamil Nadu [19]. Specimens examined: On rock, 08-027027, 08-027033, 08-027034 (LWG); on soil, 08-027032 (LWG).

***Cladonia subulata* (L.) Weber ex F.H. Wigg.** (Fig. 3): Primary thallus squamulose, grey-white to dark, persistent. Podetia greyish green to grey-brown, 10-20 mm tall, escyphose, sparingly branched, subulate, corticated or decorticate at base and with microsquamules, farinose-sorediate upwards, hymenial discs brown. Chemistry: Podetia P+ red, fumarprotocetraric acid present. Earlier this species was known from Jammu and Kashmir, Sikkim and Uttarakhand [19]. Specimens examined: On soil, 08-027030/A (LWG).



**Figure 2:** *Cladonia subradiata*, 3. *C. subulata*

***Cladonia verticillata* (Hoffn.) Schaer.** (Fig. 4): Primary thallus squamulose, brown, lobed, persistent. Podetia grey-green, 15-35 mm tall, areolate-subcorticate, esorediate, scyphose; scyphi 3-5 mm wide, shallow, closed, squamulose, dentate, profusely proliferating from centre into many tiers of scyphi, hymenial discs brown. Chemistry: Podetia P+ red, fumarprotocetraric acid present. Earlier this species was known from Meghalaya, Sikkim and Uttarakhand [19]. Specimens examined: On rock, 08-027024 (LWG); on soil, 08-027023 (LWG).

***Ramalina hossei* Vain.** (Fig. 5): Thallus tufted, erect, up to 4-6 cm tall, yellowish grey to brownish, branches up to 2 mm wide, nervosa, pseudocyphellate, granular sorediate, minute spinules present at the rim of soralia, chondroid tissue cracked, medulla solid. Apothecia absent. Chemistry: Usnic acid and sekikaic acid aggregate present. Earlier this species was known from Meghalaya, Uttarakhand and West Bengal hills [20]. Specimens examined: On bark, 08-027069, 08-027071 (LWG).



**Figure 4:** *Cladonia verticillata*, 5. *Ramalina hossei*

***Ramalina pollinaria* (Westr.) Ach.** (Fig. 6): Thallus up to 4 cm tall, brownish, branches flattened, 5-12 mm wide, much branched at apices, granular sorediate, chondroid tissue not

cracked, medulla solid. Apothecia absent. Chemistry: Usnic acid and evernic acid present. Earlier this species was known from Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir and Uttarakhand [20]. Specimens examined: On bark, 08-027075, 08-027129 (LWG).

***Teloschistes flavicans* (Sw.) Norm.** (Fig. 7): Thallus erect to pendent, irregularly branched, branches terete, up to 0.5-0.8 mm thick, yellow to orange-red, smooth, white-granular sorediate, soralia orbicular to elongate, fibrils black tipped, scattered. Apothecia absent. Chemistry: Thallus K + purple-violet, parietin present. Earlier this species was known from Karnataka, Kerala and Tamil Nadu [20]. Specimens examined: On bark, 08-027110 (LWG).



**Figure 6:** *Ramalina pollinaria*, 7. *Teloschistes flavicans*

***Usnea eumitrioides* Mot.** (Fig. 8): Thallus subcaespitose, up to 5-7 cm tall, basally blackish, yellow brown to olivaceous brown upwards, branching dichotomous to sympodial, divergent, lateral branch-lets dense, surface branches minutely tuberculate-isidiate, isidia whitish, filiform, central axis pale. Apothecia absent. Chemistry: Medulla K+ red, P+ deep yellow, stictic acid complex present. Earlier this species was known from Himachal Pradesh, Nagaland, Sikkim, Tamil Nadu, Uttarakhand and West Bengal-hills [20]. Specimens examined: On bark, 08-027070 (LWG); on thorny tree bark, 08-027008/A (LWG).

***Usnea lucea* Mot.** (Fig. 9): Thallus erect, caespitose, up to 5 cm tall, rigid, yellowish to reddish brown, shiny, papillate, branching subdichotomous to sympodial, main branches constricted and articulate at base, lateral branch-lets dense, short, pseudocyphellate, cortex double layered, central axis solid, colourless. Apothecia terminal, up to 8 mm in diam., margin and receptacle ciliate. Chemistry: Medulla P+ yellowish, stictic acids present. Earlier this species was known from Tamil Nadu [20]. Specimens examined: On thorny tree bark, 08-027014 (LWG).



**Figure 8:** *Usnea eumitrioides* 9. *Usnea lucea*

***Usnea luridorufa* Stirt.** (Fig. 10): Thallus erect, caespitose, up to 4-5 cm tall, yellowish brown to darker brown, branching dichotomous to sympodial, main branches non-articulate and non-inflated, lateral branch - lets very dense, lacking papillae, pseudocyphellae, isidia and soredia, cortex single layered, central axis solid, yellowish. Apothecia



absent. Chemistry: Medulla K+ yellow then red, P+ deep yellow to red; norstictic, salazinic and stictic acids present. Earlier this species was known from Himalaya (no precise locality), Kerala, Sikkim and Tamil Nadu [20]. Specimens examined: On tree trunk, 08-027062 (LWG).

***Usnea spinosula* Stirt.** (Fig. 11): Thallus erect, up to 3.5 cm tall, greenish brown to brown, branching subdichotomous to sympodial, main branches nonarticulate, non-inflated, annularly cracked, papillate, lateral branchlets with spinules in tufts, broken and decorticated, central axis solid, colourless. Apothecia terminal, up to 8 mm in diam., margin ciliate. Chemistry: Medulla K+ yellow then red, P+ yellow, stictic acid complex present. It is an endemic species to India, earlier recorded from Kerala and Tamil Nadu [20]. Specimens examined: On bark, 08-027061 (LWG); on wild rose tree trunk, 08-027015 (LWG).



**Figure 10: *Usnea luridiorufa*, 11. *U. spinosula***

#### 4. Conclusion

The lichens are sensitive to air pollution and climate change and therefore they are called as bioindicators. The fruticose lichens are more sensitive in comparison to foliose forms and crustose ones are pollution tolerant [21]. However the luxuriant growth of fruticose lichens in Joram Top clearly indicates this area is still free from air pollution. The present study would be helpful for future biomonitoring studies in the area.

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