



Published by

www.researchtrend.net

Distribution Pattern and Ecology of Usneoid lichens in Western Ghats, Southern India

Archana R. Mesta¹, Vinayaka S Kanivebagilu^{1*} and Rajeswari N²

¹Dept. of Botany, Kumadvathi First Grade College, Shimoga Road, Shikaripura-577427, Shimoga, Karnataka

²Dept. of Botany, Sahyadari Science College, Shimoga-577402, Karnataka

*Corresponding author: ks.vinayaka@gmail.com

| Received: 30 October 2015 | Accepted: 29 December 2015 |

ABSTRACT

The present paper deals with the diversity, distribution and ecology of 38 species of Usneoid lichens from the different states like Kerala, Karnataka, Tamil Nadu, Maharashtra and Goa parts of Western Ghats, Southern India. The study area mainly contains compositions of vegetations like evergreen, semi-evergreen, moist deciduous, dry deciduous and scrub forests. Out of the collected lichen species, majority of them are corticolous (66%), followed by ramicolous (19%) and only 3 of them are saxicolous, 2 are occurs on both saxicolous / corticolous and only one is terricolous species. The collected *Usnea* lichens were found to be spread between 500- 3000m of altitude. The maximum numbers of lichens recorded were found between 2000-2500m of altitude (40 %), only one *Usnea* lichen is recorded from low altitude. The evergreen forests records the maximum number of 16 species, followed by 10 species in Mountain forest, 7 in deciduous and 5 in semi evergreen forest. Among the different states Tamil Nadu records the occurrence of Maximum, i.e., of 33 species which is followed by Kerala, Karnataka and Maharashtra. There is no *Usnea* lichens were recorded from the Goa state. The present study provides the baseline information regarding lichen diversity in the Western Ghats region.

Key Words: *Usnea*, lichen, Forest, Karnataka, corticolous.

Lichens are biologically distinct entities composed of a fungus (mycobiont) with a algal partner (photobiont), usually either a green algae or cyanobacterium. They grow in diverse climatic conditions and on diverse substrates. The ability to quickly absorb and retain water from many sources makes it possible for lichens to live in harsh environment like deserts, polar regions and on exposed surfaces like bare rocks, walls, roofs and tree branches. The genus *Usnea* is regarded as one of the taxonomically most difficult genera of macrolichens. Most of the species are widespread and highly variable in morphology. Lichens are diverse in tropical rain forests and some studies

have focused on ecological questions such as vertical distribution and habitat preference (Cornelissen & Steege 1989; Cornelissen & Gradstein 1990; Wolf 1993; Komposch & Hafellner 2000; Herrera- Campos *et al.* 2004; Peroz *et al.* 2008). Several authors have discussed parameters influencing the distribution of epiphytic lichens, including rainfall, temperature, light, shade, humidity, age of the tree and substrate factors such as texture, water relation and chemistry (Brodo 1973; Brodo 1989; Dettki 1998; Brodo *et al.* 2001). The proportion of foliose and fruticose lichen increases with altitude, where as crustose are the main component of epiphytic

community in the lowland rain forests (Sipman & Harris 1989).

Usnea Adans. is a large genus in the family Parmeliaceae, with more than 350 species (Clerc 1998) that are widely distributed in polar, temperate and tropical regions. The Genus is recognized based on the fruticose thallus, branches with a cartilaginous central axis and the presence of Usnic acid in the cortex. At the species level, the extensive plasticity of morphological characters, in response to environmental parameters, greatly challenges the delimitation of species (Clerc 1998). Microhabitat differences play an essential role in explaining patterns of species composition and diversity at the scale of individual trees. Lichens are very sensitive to the deterioration of air quality, therefore they have also been used as atmosphere pollution indicators (Brodo 1961; Crespo *et al.* 1981; Lawrey 1981; Asta *et al.* 2002; Carreras & Pignata 2002). The difference in vegetation and climatic condition influences the diversity and distribution of *Usnea* in the Western Ghats. Therefore the present work aims to study the diversity of *Usnea* species and their distribution pattern in different altitude in the study area.

MATERIALS AND METHODS

Study area

We selected Western Ghats as our study area. Western Ghats is one of the World's diversity hotspots, which stretches from Tapti valley in the north of Gujarat to Kanyakumari in Tamil Nadu, covering a distance of 1600 km with over 100km wide. The Western Ghats runs through different states of south-western India such as Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala, and covers various types of vegetations including evergreen, semi evergreen, deciduous, scrub and Montana forests (Fig. 1). In Karnataka we made collections from Kodachadri, Kemmangundi, Mullayangiri, Kuduremukh, Bandipura, Koorg, Mugilpete, Sharavathi river basin area, in Kerala- Munnar, Rajamala, Waynad, Idduki, Kottayam, Periyar, and Tattakadu, in Tamil Nadu- Doddabetta, Ooty, Koonor, Kodaikanal, Salam (Yevcaud), Emerald Beat and Avalanche, in Maharashtra- Mahabaleswar, Panchagani, Sattara, Junnar and in Goa- Panjim, Madgaon, Vasco and Ponda.

Methodology

Survey was done regularly in different habitats of Western Ghats. The representative lichen specimens were collected along with their substratum irrespective of their growth form. The three major substrates such as wood, rock and soil were considered as the microhabitats, the woody substratum includes tree trunks, branches, twigs, wood logs and stumps. The corticolous lichens

growing on tree trunks at reachable height usually collected and canopy lichens found fallen on the ground was collected. The data on locality, altitude, vegetation type, and microhabitat were recorded. The specimens were identified with the help of morphological, anatomical and chemical tests. The identification of collected lichens is done by using standard manual (Awasthi 2000; Awasthi 1986).

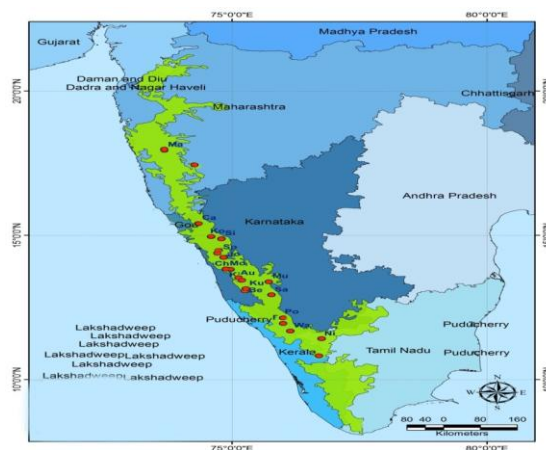


Fig.1. Map showing the study area

RESULTS AND DISCUSSION

In Karnataka, Kerala and Tamil Nadu states we have selected eight study sites and in Maharashtra and Goa we have selected four study sites. Totally we collected 38 species of *Usnea* from our study area, which are distributed more in the state of Tamil Nadu, followed by Kerala, Karnataka and Maharashtra. No specimens were collected from the state Goa (Fig. 2). The study area includes different forest types such as evergreen, semi evergreen, deciduous, scrub and Montana forests. More number of species is found in Montana forests and few are found in semi- evergreen and deciduous forests, no specimens are recorded from scrubby forests (Table. 1 & 3). Photographs of some lichens are presented in plate 1.

Table 1: Shows the number of *Usnea* species in different types of forests

Sl. No.	Nature of forests	No of Species
1.	Mountain forests	33
2.	Evergreen /Semi-evergreen forests	06
3.	Deciduous forests	02
4.	Scrubby forests	Nil

Table 2: Showing the host plant with pH and No. of colonies

Sl No.	Name of the host plant	pH of the Bark	No. of colonies /5 cm ³
1	<i>Gnidia glauca</i>	07±0.5	6
2	<i>Syzygium cumini</i>	06±0.3	1
3	<i>Hypericum mysurense</i>	07±0.3	5
4	<i>Glochidiom Sps</i>	06±0.1	2
5	<i>Memecylon Sps</i>	06±0.7	1
6	<i>Pinus Sps</i>	06±0.6	3
7	<i>Thea sinensis</i>	06±0.9	1
8	<i>Grevillea robusta</i>	07±0.1	1
9	<i>Eucalyptus Sps</i>	06±0.2	3

The *Usnea* is collected from different altitudes ranging from 500- 3000 MSL (Table. 3). The distribution of *Usnea* is highest at 2500m and less at 500m. (Fig.3). *Usnea* specimens were collected from the different substratum such as rocks, barks, twigs and soil. More number of *Usnea* specimens was collected from barks, which is followed by twigs, rocks and only few specimens are found on soil. (Fig. 4). Among the corticolous and ramicolous species of *Usnea* lichens the host plants are identified. The major host plants were *Gnidia glauca*, *Syzygium cumini*, *Hypericum mysurense*, *Glochidiom spp*, *Memecylon spp*, *Pinus spp*, *Thea sinensis*, *Eucalyptus spp*, *Grevillea robusta*. etc.

Table 3: Table showing the list of different species of *Usnea* with its locality, altitude and habitat

Sl. No.	Species name	Locality	Altitude	Habitat
1	<i>Usnea aciculifera</i> Vain.	Tamil nadu , Kodaikanal hills	2264m	Citrus tree
2	<i>Usnea austroindica</i> G. Awasthi	T.N, udakamandalam Dist. Sholar at 8-9 miles Ooty-Mysore road & Botanical garden Ooty	2134m	On tree twig
3	<i>Usnea baileyi</i> (Stirt.) Zahlbr.	Pykara forest range shoal near pykara	2134m	Tree trunk
4	<i>Usnea bismolliscula</i> Zahlbr.	Along borders of tee plantation, Rajamallay, munnar idukki dist. Kerala	1500-1600m	Bark of tree
5	<i>Usnea complanata</i> (Müll. Arg.) Motyka	TN, Palni Hills, Kodaikanal	2134m	Tree
6	<i>Usnea compressa</i> Taylor	T.N, udakamandalam Dist. On the way to doddabetta peak	1828m	On trees
7	<i>Usnea coralline</i> Motyka	T.N, udakamandalam Dist. On the way to doddabetta peak	2500-2633m	Twig
8	<i>Usnea dasaea</i> Stirt.	T.N, udakamandalam Dist. Sholar at 8-9 miles Ooty-Mysore road	2134m	On tree
9	<i>Usnea eumitriodes</i> Motyka	Kerala, Idukki Dist. Thenmallay, Tea-estate area near Munnar along road side.	1800m	Bark of tree
10	<i>Usnea fragilis</i> Stirt.	Kerala, Kottayam, way to Vandiperiyar	836m	Bark
11	<i>Usnea ghattensis</i> G.Awasthi	Karnataka, Dakshina kannada dist. SulliaMaharashtra, Satara Dist. Mahabaleshwar, Pratap Singh Park	108m 1348m	Bark
12	<i>Usnea gigas</i> Motyka	Kerala, Munnar, Rajamala	1520m	Bark
13	<i>Usnea hirta</i> (L.) E.H.Wigg.	India, TN,Salem Dist.Yevcaud, Shevory Hills,Sanyasi Hills	1400-1500m	Rocks
14	<i>Usnea himalayana</i> C. Bab.	T.N, Udakamandalam Dist. On the way to doddabetta peak	2633m	On trees
15	<i>Usnea himantodes</i> Stirt.	TN, Madhurai Dist. Kodaikanal Piller rocks	2500m	Tree
16	<i>Usnea cf. inermis</i> Moryka	TN, Nilgiri Hills, Ooty, below Doddabetta Peak in Eucalyptus plantation	2250-2400m	Bark of Eucalyptus tree

17	<i>Usnea leucospilodea</i> Nyl.	Karnataka, Shimoga, Sagar, Sharavati River basin, Mattikoppa	603m	Fallen twig
18	<i>Usnea lucea</i> Motyka	TN, Nilgiri hills, Emerald Beat, opposite & south of Mukurti Lake & Nilgiri peak	2286m	Tree
19	<i>Usnea luridorufa</i> Stirt.	Karnataka, Dakshina Kannada, Sullia, Subramanya Kumaraparvata	1200m	Bark
20	<i>Usnea maculata</i> Stirt.	T.N, udakamandalam Dist. Shoals at 8-9 miles ooty- Mysore road	2134m	Twigs
21	<i>Usnea nilgirica</i> G. Awasthi	Kerala, Idukki Dist. Thekkady, Sankunthala Kadu PTR	1337m	Santalum album
22	<i>Usnea orientalis</i> Motyka	Karnataka, Chikkamagaluru Dist. Kemmangundi & Kerala, Idukki Dist. Munnar, Rajamala	1000m & 1600m	Bark
23	<i>Usnea pangiana</i> Stirt.	Kerala, Idukki Dist. Way to Myladumpara to Munnar Chinnakanal area	1350m	Bark
24	<i>Usnea picta</i> (J. Steiner) Motyka	TN, Nilgiri hills, Udakamandalam, Dodda betta Peak	2438-2621m	Rhododendron
25	<i>Usnea pictoides</i> G. Awasthi	Kerala, Idukki Dist. Thenmallay tea estate area near Munnar, along road side	1800m	Cinnamon
26	<i>Usnea pseudosinensis</i> Asahina	Kerala, Munnar, Rajamala	1670m	Bark
27	<i>Usnea rigidula</i> (Stirt.) G. Awasthi	T.N, udakamandalam Dist. Road side Shoals at 8-9 miles ooty- Mysore road & Karnataka, Dakshina kannada dist. Subramanya, Kumaraparvata	1500 M & 2134m	On stones
28	<i>Usnea rubicunda</i> Stirt.	T.N, udakamandalam Dist. Coonoor near Sim's Park.	1750m	Bark
29	<i>Usnea sinensis</i> Motyka	TN, Nilgiri hills, Udakamandalam, Dodda betta Peak	2500-2633m	Twig
30	<i>Usnea splendens</i> Stirt.	TN, Nilgiri Hills, Kodanad, in Shola near forest rest house.	2042m	Bark
31	<i>Usnea spinosula</i> Stirt.	Tamil nadu , Kodaikanal hills	2340m	Twig
32	<i>Usnea stigmata</i> Motyka	TN, Nilgiri hills, Udakamandalam & Karnataka, Chikamagalore Dist. Way to Kemmangundi	1842m & 1400m	Tree
33	<i>Usnea stigmatoides</i> G. Awasthi	TN, Nilgiri Hills, Ooty-Kotagiri road on way to Mayani from Doddabetta road	2134-2286m	Eucalyptus tree trunk at base
34	<i>Usnea subflorida</i> (Zahlbr.) Motyka	TN, Nilgiri hills, Avalanche Emerald road, along road side & Kerala, Idukki Dist. Munnar towards Anajirangal dam	2134m & 1550 m	Ground
35	<i>Usnea subfloridana</i> Stirt.	Kerala, Idukki Dist. Tekkady Periyar Tiger Reserve	2019m	Tree
36	<i>Usnea thomsonii</i> Stirt.	TN, Nilgiri hills, Ooty, on the way to Doddabetta & Kerala, Idukki Dist. Munnar, Rajamala	2500-2633m & 1600m	Bark
37	<i>Usnea undulata</i> Stirt.	Tamil nadu , Kodaikanal hills	2340m	Twig
38	<i>Usnea vulneraria</i> Motyka	TN, Nilgiri hills, Ooty, on the way to Doddabetta	2500-2633m	Tree

The pH of the bark was estimated for the collected host plants. All the barks show the pH ranging between 6.0 to 7.5. Among these, the host plants whose bark pH ranging from 7.3 to 7.6 harbours more number of *Usnea* colonies (Table-2). Among the eight lichenogographic regions of India, Western Ghats secures Second position in terms of higher lichen diversity with 800 species

and occupy second in terms of endemism with 140 species (Singh & Sinha 1997, 2010). The study conducted at Western Ghats reported 949 total species of lichens among them 30 *Usnea* species are recorded (Nayaka & Upreti 2006). The present study reveals a rich diversity of *Usnea* lichen with 38 species in



U. aciculifera Vain.



U. ghattensis G. Awasthi



U. eumitriodes Mot.



U. undulata Stirton



U. austroindica G. Awasthi



U. splendens Stirton

Plate 1: Pictorial representation of few *Usnea* species collected in the study area

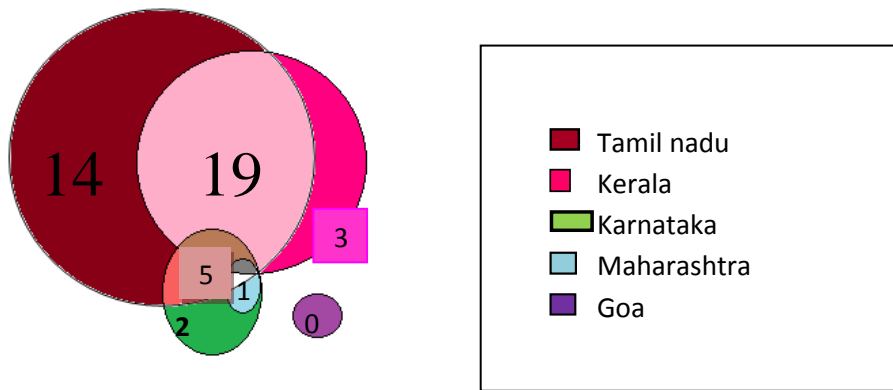


Fig. 2. Venn-diagram showing the distribution of Lichens in Different States.

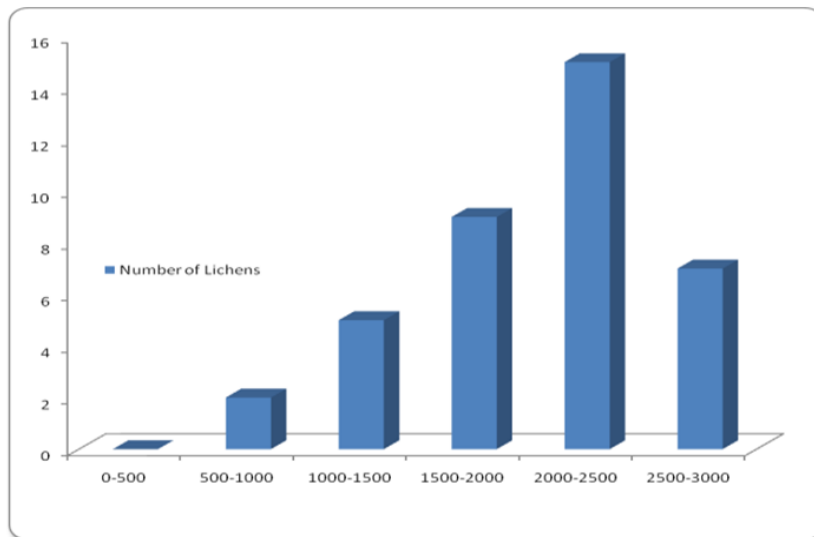


Fig. 3. Graph showing the distribution of *Usnea* in different altitudes

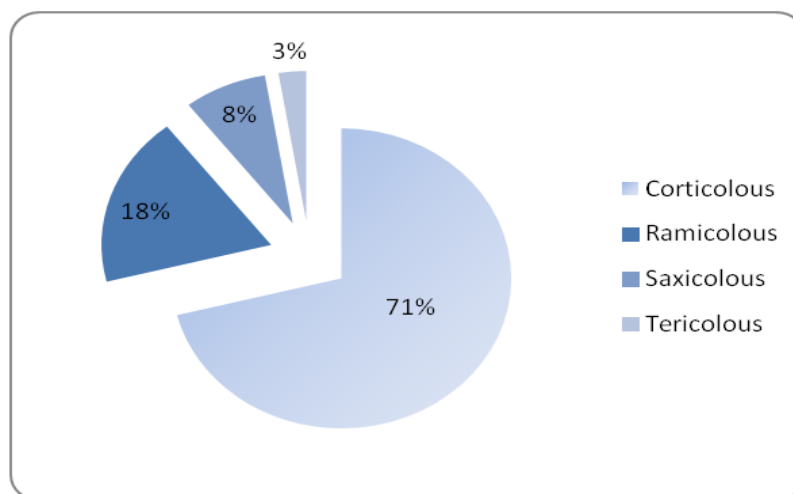


Fig. 4. Pi- Chart showing the substrate specificity of *Usnea* lichens

Western Ghats. The species diversity of *Usnea* in Uttarakhand shows the 28 species of *Usnea* (Shukla *et al.* 2014). Generally lichen flora shows strong correlation with the climatic conditions and arboreal elements of flora of the regions. Moist condition favours the growth of *Usnea* species (Halonen 2000; Shukla *et al.* 2014). In the present study also we got majority of species found abundantly in cold humid forest types and higher altitudes.

The presence of 38 species of *Usnea* in the study area reveals the rich lichen diversity that too the diversity of *Usnea* genus in the Western Ghats. This study provides a data base of the lichen *Usnea* genus in Western Ghats.

ACKNOWLEDGEMENTS

The authors are thankful to the DST-SERB for financial support throughout the work. We are grateful to the Nayaka & Upreti, National Botanical Research Institute, Lucknow and B.C. Behra, Agarkar Research Institute, Puna for moral support and valuable guidance for the work. We are thankful to Swamy Vivekananda Vidya Samsthe, Shikaripura, Shimoga for providing platform for conducting the current research work.

REFERENCES

- Asta J, Erhardt W, Ferretti M, Fornasier U, Kirschbaum U, Nimis PL, Purvis OW, Pirintson S, Scheidegger C, van Haluwyn C, Wirth V. 2002. Mapping lichen diversity as an indicator of environmental quality. Pages 273-279. In P.L. Nimis, C.Scheidegger & P.A. Wolsely (eds.), Monitoring with Lichens- Monitoring Lichens. NATO Science Series, IV, vol. 7. Kluwer, Dordrecht.
- Awasthi DD. 2000. A Compendium of the Macrolichens from India, Nepal and Sri Lanka. *Bishen Singh Mahendra Pal Singh Publishers and Distributors of Scientific Books*, Dehra Dun, India.
- Awasthi G. 1986. Lichen genus *Usnea* in India. *Journ. Hattori Bot. Lab.* No. 61:333-421
- Broad K. 1989. Lichens in southern woodland. Forestry Commission. Handbook 4. Her Majesty's Stationery Office, London.
- Brodo IM. 1961. A study of lichen ecology in Central Long Island, New York, New York. *American Midland Naturalist* 65: 290-310.
- Brodo IM. 1973. Substrate Ecology. In V. Ahmadjian & M.E.Hale (eds.), *The lichens*. Academic Press, New York. Pages 401-441.
- Brodo IM, Sharnoff SD, Sharnoff S. 2001. *Lichens of North America*. Yale University Press, New Haven.
- Carreras H, Pignata M. 2002. Biomonitoring of heavy metals and air quality in Cordoba City, Argentina, using transplanted lichens. *Environ Pollution* 117:77-87.
- Clerc P. 1998. Species concept in the genus *Usnea* (lichenized Ascomycetes). *Lichenologist* 30(4-5), 321-340.
- Cornelissen JHC, Steege H. 1989. Distribution and ecology of epiphytic bryophytes and lichens in dry evergreen forest of Guyana. *J Tropical Ecol* 5:131-150.
- Cornelissen JHC. Gradstein SR. 1990. On the occurrence of bryophytes and macrolichens in different lowland rain forest type at Mabura Hill, Guyana. *Tropical Bryol* 3: 29-35.
- Crespo A, Barreno E, Sancho LH, Bueno AG. 1981. Establecimiento de una red de valoracion de pureza atmosferica en la prurincia de la Corona mediante bioindicadores liquenicos. *Lazava* 3: 289-311.
- Dettki H. 1998. Dispersal of fragments of two pendulous lichen species. *Sauteria* 9:123-132.
- Halonen P. 2000. Studies on the lichen genus *Usnea* in East Fennoscandian & Pacific North America. Oulu University Library. Oulu 1-29.
- Herrera-Campos M, Lücking R, Perez R.E, Campos A, Martinez P, Barcenos A. 2004. The foliicolous lichen flora of Maxico. V. Biogeographical affinities, altitudinal preferences, and an updated checklist of 293 species. *Lichenologist* 36: 309-327.
- Nayaka S. & Upreti DK. 2006. Status of Lichen Diversity in Western Ghats. <http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/lichens>.
- Komposch H. & Hafellner J. 2000. Diversity and vertical distribution of lichens in a Venezuelan tropical low land rain forest. *Selbyana* 21: 11-24.
- Lawrey J. 1981. Evidence for competitive release in simplified saxicolous lichen communities. *Am J Bot* 68: 1066-1073.
- Perez R, Miranmontes N, Rosales J, Quiroz H. 2008. Macroliquenes corticolas en dos species de coniferas del Parque Nacional Laguna de Zempolas. *Acta Universitaria* 18: 33-39.
- Shukla P, Upreti DK, Tewari LM. 2014. Lichen genus *Usnea* (Parmeliaceae, Ascomycota) in Uttarakhand, India. *Curr Res Environ Appl. Mycol* 4 (2): 188-201
- Singh KP. & Sinha GP. 1997. Lichens. In: Floristic Diversity and Conservation Strategies in

-
- India (ed. V. Mudgal and P.K. Hajra), 1: 195-234. Calcutta, India: Botanical Survey of India.
- Singh KP. & Sinha GP. 2010. Indian Lichens: Annotated checklist. Botanical survey of India, Kolkata.
- Sipman HJM, Harris RC. 1989. Lichens. 303-309. In: Tropical rain forest ecosystems- Biogeographical and Ecological Studies (ed. Lieth, H. and M.J.A. Werger), Ecosystems of the World 14B, *Elsevier*, U.K.
- Wolf JHD. 1993. Diversity patterns and biomass of epiphytic bryophytes and lichens along an altitudinal gradient in the northern Andes. *Annals of the Missouri Botanical Garden*, 80: 928-960.