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Mangifera indica L. as an Excellent Host Tree for Colonization of Tropical Lichens in India

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ABSTRACT

An enumeration of lichens occurring on *Mangifera indica* tree has been made. The investigation reveals the occurrence of 139 species belonging to 54 genera and 31 families of lichens. The crustose lichens exhibit their dominance with 105 species followed by 30 species of foliose lichens. Among the different states of India, Uttar Pradesh with 59 species has the maximum diversity of lichens found growing on *M. indica* tree followed by Madhya Pradesh with 40 species. A brief account of ecology of lichens growing on mango trees is also provided.

INTRODUCTION

Mangifera indica L., commonly known as mango tree, is the most commercially cultivated tree in India, popular both for its fruit and wood. The wood is used as timber and dried twigs are used for religious purposes. It is an evergreen tree widely distributed in tropical and subtropical regions of the country due to its immense value cultivated on southern Asia for nearly six thousand years (Das *et al.*, 2019). The central Indian regions of the country have the maximum cultivation of mango trees followed by Northeast region of India. The foothills in Indian Himalayan and few regions of Eastern Ghats also cultivate mango trees. In India, mango trees are mostly cultivated on orchards. However, it is sometimes the most preferred avenue tree planted along the roadside in many places. In some of the tropical forest in the central Indian regions and eastern state of Odisha mango trees grow widely. The wild mango trees have small sized fruits than the cultivated varieties. In the upper Western Ghats region, Maharashtra is famous for cultivating an special variety of mangos called "Alphanso", which supports rich growth of foliose lichens *Dirinaria, Pyxine* and Graphidaceous genera such as *Graphis* and *Diorygma*. Among the common Indian tropical trees such as *Ficus, Sygzgyium* and *Shorea*, the mango tree provides an excellent substrate for colonizing lichens due to its good water holding capacity and rough bark texture.

The water holding capacity of the host plays an important role in the colonization of lichens species. According to Brodo (1973), the smoothness, hardness, relative stability and surface features of the substrates are the factors responsible for lichens growth over it, together with the moisture retaining capacity. The texture of substratum, pH, nutrient status, buffer capacity and other ecological variables such as elevation and microclimatic conditions also determine the lichen growth. The species of lichens growing on a different Indian phorophytes have been reported by various authors. Upreti (1994, 1996); Upreti and Chatterjee (1999, 2000) described the details of lichens growing on *Pinus* and *Quercus* trees of Uttarakhand. Satya (2005) reported 64 species of lichens on *Shorea robusta,* 45 species on *Syzgyium cuminii* and nine species on *Mallotous philipensis* in Amarkantak Biosphere Reserve, Madhya Pradesh. Upreti and Divakar (2003) studied lichens of Jim Corbett National Park and reported the occurrence of seven species of lichens on mango tree. Srivastava *et al*. (2004) reported 15 species of lichens growing on mango trees in Bilaspur and Una districts of the state of Himachal Pradesh. Mukhtar (2009) reported 12 lichens species on mango trees in Surinsar-Mansar Wildlife Sanctuary, Jammu and Kashmir. Most of the information on lichens growing over mango tree are scattered in several publications, and a complete account is not available. Thus, the present study

aims to consolidate the account of lichens found growing on M. indica in India and their ecology. The available information will help beginners easily recognize lichens growing especially on mango trees and provide baseline data for carrying out future biomonitoring studies in India.

MATERIALS AND METHODS

The present study is based on published literature, Ph.D. thesis available at Lichenology Laboratory, and previously collected specimens from mango trees deposited in the herbarium LWG of CSIR-National Botanical Research Institute, Lucknow. The morphological and anatomical characters of preserved, unidentified specimens in the LWG were examined using stereo zoom (Leica S8APO) and light (DM2500) microscopes attached to the camera. Thin cross sections of perithecia and apothecia were cut using razor blade under stereo-zoom microscope. All anatomical measurements were recorded in plain water, while 10% KOH was used for a detailed study of asci and ascospores. For spot tests, the usual K, C and P reagents were used, and for identification of lichens substance identification, thin layer chromatography (TLC) was performed in solvent system C following the method of Orange *et al*. (2001). The specimens were preserved in the herbarium LWG

Plate 1. A. Mango orchard in Madhya Pradesh, **B.** Rich habitat for epiphytic lichens, **C.** Growth of *Pyxine cocoes,* and **D**. Growth of *Lepraria lobificans*

Table 1: List of lichens growing on *M. indica* L. trees in India

S. no.	*Name lichens of taxa*	*Families*	*Growth forms*	*States*	*Remarks*
1	*Anisomeridium nidulans* (Müll. Arg.) R.C. Harris	Monoblastiaceae	Crustose	Uttar Pradesh	Gupta (2014)
2	*A. subnexum* (Nyl.) R.C. Harris	Monoblastiaceae	Crustose	Goa and Uttar Pradesh	Phatak *et al*. (2004); Gupta, (2014)
3	*A. tamarindi* (Fée) R.C. Harris	Monoblastiaceae	Crustose	West Bengal	Bajpai *et al*. (2009)
4	*A. terminatum* (Nyl.) R.C. Harris	Monoblastiaceae	Crustose	Uttar Pradesh	Nayaka *et al.* (2011)
5	*Anthracothecium austroindicum* A. Singh	Pyrenulaceae	Crustose	Assam	Daimari *et al*. (2017)
6	*Arthonia arctata* Stirt.	Arthoniaceae	Crustose	West Bengal	Upreti *et al*. (2007)
7	*Arthopyrenia alboatra* Müll. Arg.	Arthopyreniaceae	Crustose	Goa	Phatak *et al*. (2004)
8	*A. grisea* (Schleich. ex Schaer.) Körb.	Arthopyreniaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
9	*Arthothelium abnorme* (Ach.) Müll. Arg.	Arthoniaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
10	*A. chiodectoides* (Nyl.) Zahlbr.	Arthoniaceae	Crustose	Uttar Pradesh	Gupta (2014)
11	*Bacidia* sp.	Ramalinaceae	Crustose	Jammu & Kashmir	Sheikh *et al*. (2009)
12	*Bacidia alutacea* (Kremp.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
13	*B. convexula* (Müll. Arg.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
14	*B. incongruens* (Stirt.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
15	*B. laurocerasi* (Delise ex Duby) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
16	*B. millegrana* (Taylor) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
17	*B. nigrofusca* (Müll. Arg.) Zahlbr.	Ramalinaceae	Crustose	Madhya Pradesh	Mohabe (2011)
18	*B. rubella* (Hoffm.) A. Massal.	Ramalinaceae	Crustose	Himachal Pradesh	Srivastava *et al*. (2004)
19	*B. rufescens* (Müll. Arg.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
20	*B. spadicea* (Ach.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
21	*B. submedialis* (Nyl.) Zahlbr.	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
22	*Bacidina medialis* (Tuck. ex Nyl.) Kistenich, Timdal, Bendiksby & S. Ekman	Ramalinaceae	Crustose	Madhya Pradesh and Uttarakhand	Upreti *et al*. (2010); Mohabe (2011)
23	*Bacidiospora psorina* (Nyl. ex Hue) Kalb	Ramalinaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
24	*Baculifera remensa* (Stirt.) Marbach	Caliciaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
25	*Blastenia ferruginea* (Huds.) A. Massal.	Teloschistaceae	Crustose	Himachal Pradesh	Yadav (2005)
26	*Brigantiaea leucoxantha* (Spreng.) R. Sant. & Hafellner	Brigantiaeaceae	Crustose	Himachal Pradesh	Yadav (2005)
27	*Caloplaca granularis* (Müll. Arg.) Zahlbr.	Teloschistaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
28	*C. kashmirensis* Y. Joshi & Upreti	Teloschistaceae	Crustose	Jammu & Kashmir	Sheikh *et al*. (2009)
29	*C. malaeensis* (Räsänen) D.D. Awasthi	Teloschistaceae	Crustose	Himachal Pradesh and Jammu & Kashmir	Yadav (2005); Sheikh *et al*. (2009)

Cont....

S. no.	*Name lichens of taxa*	*Families*	*Growth forms*	*States*	*Remarks*
30	*Candelaria concolor* (Dicks.) Arnold	Candelariaceae	Foliose	Himachal Pradesh, Jammu & Kashmir and Madhya Pradesh	Yadav (2005); Sheikh *et al*. (2009); Mohabe (2011)
31	*Chrysothrix candelaris* (L.) J.R. Laundon	Chrysotrichaceae	Crustose	Madhya Pradesh	Mohabe (2011)
32	*C. chlorina* (Ach.) J.R. Laundon	Chrysotrichaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
33	*Coccocarpia palmicola* (Spreng.) Arv. & D.J. Galloway	Coccocarpiaceae	Crustose	Maharashtra	Makhija *et al*. (2014)
34	*Cryptothecia* sp.	Arthoniaceae	Crustose	Uttar Pradesh	Nayaka *et al*. (2011)
35	*Cryptothecia lunulata* (Zahlbr.) Makhija & Patw.	Arthoniaceae	Crustose	Uttarakhand	Upreti and Divakar (2003)
36	*C. stirtonii* A.L. Sm.	Arthoniaceae	Crustose	Uttarakhand	Upreti and Divakar (2003)
37	*Diorygma junghuhnii* (Mont. & Bosch) Kalb, Staiger & Elix	Graphidaceae	Crustose	West Bengal	Bajpai *et al*. (2009)
38	*Diplotomma alboatrum* (Hoffm.) Flot.	Caliciaceae	Crustose	Madhya Pradesh	Mohabe (2011)
39	*D. pharcidium* (Ach.) M. Choisy	Caliciaceae	Crustose	Madhya Pradesh	Mohabe (2011)
40	*Dirinaria aegialita* (Afzel. ex Ach.) B.J. Moore	Caliciaceae	Foliose	Himachal Pradesh	Srivastava *et al*. (2004)
41	*D. applanata* (Fée) D.D. Awasthi	Caliciaceae	Foliose	Madhya Pradesh and Uttarakhand	Upreti *et al*. (2010); Mohabe (2011)
42	*D. confluens* (Fr.) D.D. Awasthi	Caliciaceae	Foliose	West Bengal	Bajpai *et al*. (2009)
43	*D. consimilis* (Stirt.) D.D. Awasthi	Caliciaceae	Foliose	Uttar Pradesh and West Bengal	Bajpai *et al*. (2009); Nayaka *et al*. (2011)
44	*Endocarpon nanum* Ajay Singh & Upreti	Verrucariaceae	Squamulose	Uttar Pradesh	Nayaka and Upreti (2011)
45	*Fissurina adscribens* (Nyl.) Z.F. Jia & Lücking	Fissurinaceae	Crustose	Goa	Phatak *et al*. (2004)
46	*Graphis lineola* Ach.	Graphidaceae	Crustose	West Bengal	Bajpai *et al*. (2009)
47	*G. nigroglauca* Leight.	Graphidaceae	Crustose	Goa	Phatak *et al*. (2004)
48	*G. schiffneri* Zahlbr.	Graphidaceae	Crustose	West Bengal	Upreti *et al*. (2007)
49	*G. scripta* (L.) Ach.	Graphidaceae	Crustose	Madhya Pradesh and West Bengal	Bajpai *et al*. (2009); Mohabe (2011)
50	*G. subducta* Vain.	Graphidaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
51	*Heterodermia diademata* (Taylor) D.D. Awasthi	Physciaceae	Foliose	Uttarakhand	Upreti and Divakar (2003)
52	*Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt	Physciaceae	Foliose	Jammu & Kashmir and Madhya Pradesh	Sheikh *et al*. (2009); Mohabe (2011)
53	*H. adglutinata* var. *pyrithrocardia* (Müll. Arg.) D.D. Awasthi	Physciaceae	Foliose	Madhya Pradesh	Mohabe (2011)
54	*H. minor* (Fée) D.D. Awasthi	Physciaceae	Foliose	Uttar Pradesh	Nayaka and Upreti (2013)
55	*H. syncolla* (Tuck. ex Nyl.) Kalb	Physciaceae	Foliose	Madhya Pradesh and Uttar Pradesh	Nayaka and Upreti (2011); Mohabe (2011)

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S. no.	*Name lichens of taxa*	*Families*	*Growth forms*	*States*	*Remarks*
56	*Lecanora achroa* Nyl.	Lecanoraceae	Crustose	Himachal Pradesh, Madhya Pradesh and Uttar Pradesh	Srivastava *et al*. (2004); Yadav (2005); Nayaka and Upreti (2011); Mohabe (2011)
57	*L. alba* Lumbsch	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
58	*L. argentata* (Ach.) Röhl.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
59	*L. austrointumescens* Lumbsch & Elix	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
60	*L. cenisia* Ach.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
61	*L. chlarotera* Nyl.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
62	*L. cinereofusca* H. Magn.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
63	*L. coronulans* Nyl.	Lecanoraceae	Crustose	Madhya Pradesh	Mohabe (2011)
64	*L. flavidofusca* Müll. Arg.	Lecanoraceae	Crustose	Madhya Pradesh	Mohabe (2011)
65	*L. helva* Stizenb.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
66	*L. leproplaca* Zahlbr.	Lecanoraceae	Crustose	Madhya Pradesh	Mohabe (2011)
67	*L. leprosa* Fée	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
68	*L. perplexa* Brodo	Lecanoraceae	Crustose	Madhya Pradesh and Uttar Pradesh	Nayaka and Upreti (2011); Mohabe (2011)
69	*L. rugosella* Zahlbr.	Lecanoraceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
70	*L. subrugosa* Nyl.	Lecanoraceae	Crustose	Madhya Pradesh	Mohabe (2011)
71	*L. tropica* Zahlbr.	Lecanoraceae	Crustose	Himachal Pradesh, Madhya Pradesh and Uttar Pradesh	Srivastava *et al*. (2004); Nayaka and Upreti (2011); Mohabe (2011)
72	*Laurera subbenguelensis* Upreti & A. Singh	Trypetheliaceae	Crustose	Kerala	Upreti and Singh (1987)
73	*Lecidella* sp.	Lecanoraceae	Crustose	Goa	Phatak *et al*. (2004)
74	*Lepraria* sp.	Cladoniaceae	Crustose	Himachal Pradesh and Jammu & Kashmir	Srivastava *et al*. (2004); Sheikh *et al*. (2009)
75	*Lepraria lobata* Elix & Kalb	Cladoniaceae	Crustose	Madhya Pradesh	Mohabe (2011)
76	*L. lobificans* Nyl.	Cladoniaceae	Crustose	Madhya Pradesh	Mohabe (2011)
77	*Leprocaulon coriense* (Hue) Lendemer & B.P. Hodk.	Leprocaulaceae	Crustose	Madhya Pradesh	Mohabe (2011)
78	*Leptogium javanicum* Mont.	Collemataceae	Foliose	Uttarakhand	Upreti and Divakar (2003); Khare (2012)
79	*Leucodecton occultum* (Eschw.) Frisch	Thelotremataceae	Crustose	Andhra Pradesh	Joshi *et al*. (2012)
80	*Malmidea granifera* (Ach.) Kalb, Rivas Plata & Lumbsch	Malmideaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
81	*Megalaria pulverea* (Borrer) Hafellner & E. Schreiner	Megalariaceae	Crustose	Jammu & Kashmir	Sheikh *et al*. (2009)
82	*Opegrapha agelaeotera* Vain.	Opegraphaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
83	*O. astraea* Tuck.	Opegraphaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
84	*O. leptoterodes* Nyl.	Opegraphaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)

Cont....

S. no.	*Name lichens of taxa*	*Families*	*Growth forms*	*States*	*Remarks*
85	*O. maldiveana* Ertz	Opegraphaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
86	*Oxneriopsis bassiae* (Ach.) S.Y. Kondr.	Teloschistaceae	Crustose	Madhya Pradesh and Uttar Pradesh	Nayaka and Upreti (2013)
87	*Parmotrema austrosinense* (Zahlbr.) Hale	Parmeliaceae	Foliose	Madhya Pradesh	Mohabe (2011)
88	*P. mesotropum* (Müll. Arg.) Hale	Parmeliaceae	Foliose	Madhya Pradesh	Mohabe (2011)
89	*P. nilgherrense* (Nyl.) Hale	Parmeliaceae	Foliose	Himachal Pradesh	Yadav (2005)
90	*P. praesorediosum* (Nyl.) Hale	Parmeliaceae	Foliose	Madhya Pradesh	Mohabe (2011)
91	*P. saccatilobum* (Taylor) Hale	Parmeliaceae	Foliose	West Bengal	Bajpai *et al*. (2009)
92	*P. tinctorum* (Despr. ex Nyl.) Hale	Parmeliaceae	Foliose	Himachal Pradesh	Srivastava *et al*. (2004)
93	*Peltula* sp.	Peltulaceae	Squamulose	Madhya Pradesh	Mohabe (2011)
94	*P. steppae* (Kalb) Büdel, Kauff & Bachran	Peltulaceae	Squamulose	Uttar Pradesh	Nayaka and Upreti (2013)
95	*Pertusaria* sp.	Pertusariaceae	Crustose	Jammu & Kashmir	Sheikh *et al*. (2009)
96	*Pertusaria concinna* Erichsen	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
97	*P. granulata* (Eschw.) Flot.	Pertusariaceae	Crustose	Uttar Pradesh	Gupta (2014)
98	*P. leioplaca* (Ach.) DC.	Pertusariaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2011)
99	*P. melastomella* Nyl.	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
100	*P. pallidula* Stirt.	Pertusariaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2011)
101	*P. pertusa* (L.) Tuck.	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
102	*P. pertusella* Müll. Arg.	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
103	*P. punctata* Nyl.	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
104	*P. pustulata* (Ach.) Duby	Pertusariaceae	Crustose	Himachal Pradesh and Madhya Pradesh	Srivastava *et al*. (2004); Mohabe (2011)
105	*P. quassiae* (Fée) Nyl.	Pertusariaceae	Crustose	Madhya Pradesh	Mohabe (2011)
106	*Phaeographis extrusula* (Stirt.) Zahlbr.	Graphidaceae	Crustose	Goa	Phatak *et al*. (2004)
107	*Phaeophyscia hispidula* (Ach.) Essl.	Physciaceae	Foliose	Himachal Pradesh, Madhya Pradesh and Uttar Pradesh	Srivastava *et al*. (2004); Yadav (2005); Mohabe (2011); Nayaka and Upreti (2011)
108	*P. orbicularis* (Neck.) Moberg	Physciaceae	Foliose	Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh and Uttar Pradesh	Srivastava *et al*. (2004); Yadav (2005); Sheikh *et al*. (2009); Mohabe (2011); Nayaka and Upreti (2011)
109	*Phyllopeltula corticola* (Büdel & R. Sant.) Kalb	Peltulaceae	Squamulose	Uttar Pradesh	Gupta (2014)
110	*Phyllopsora furfuracea* (Pers.) Zahlbr.	Ramalinaceae	Crustose	Uttarakhand	Mishra *et al*. 2011
111	*Physcia abuensis* D.D. Awasthi & S.R. Singh	Physciaceae	Foliose	Madhya Pradesh	Mohabe (2011)
112	*P. aipolia* (Ehrh. ex Humb.) Fürnr.	Physciaceae	Foliose	Himachal Pradesh	Srivastava *et al*. (2004)

Cont....

S. no.	*Name lichens of taxa*	*Families*	*Growth forms*	*States*	*Remarks*
113	*P. dilatata* Nyl.	Physciaceae	Foliose	Uttarakhand	Upreti and Divakar (2003)
114	*P. tribacioides* Nyl.	Physciaceae	Foliose	Madhya Pradesh	Mohabe (2011)
115	*Pseudosagedia aenea* (Körb.) Hafellner & Kalb	Trichotheliaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
116	*Pseudoschismatomma rufescens* (Pers.) Ertz & Tehler	Roccellaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2011)
117	*Pyrenula cayennensis* Müll. Arg.	Pyrenulaceae	Crustose	Andaman Island	Upreti (1991)
118	*P. decumbens* (Müll. Arg.) Upreti	Pyrenulaceae	Crustose	Andaman Island	Upreti and Singh (1987)
119	*P. introducta* (Stirt.) Zahlbr.	Pyrenulaceae	Crustose	Uttarakhand	Upreti *et al*. (2010)
120	*P. leucostoma* Ach.	Pyrenulaceae	Crustose	Assam	Daimari *et al*. (2017)
121	*P. ochraceoflava* (Nyl.) R.C. Harris	Pyrenulaceae	Crustose	Assam	Daimari *et al*. (2017)
122	*P. pinguis* Fée	Pyrenulaceae	Crustose	Karnataka	Upreti (1993)
123	*P. subaggregata* Müll. Arg.	Pyrenulaceae	Crustose	Andaman Island	Upreti (1991)
124	*Pyxine himalayensis* D.D. Awasthi	Caliciaceae	Foliose	Uttar Pradesh	Nayaka and Upreti (2013)
125	*P. cocoes* (Sw.) Nyl.	Caliciaceae	Foliose	Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Uttar Pradesh and West Bengal	Srivastava *et al*. (2004); Sheikh *et al*. (2009); Bajpai *et al*. (2009); Mohabe (2011); Nayaka and Upreti (2011)
126	*P. meissnerina* Nyl.	Caliciaceae	Foliose	Madhya Pradesh and Uttar Pradesh	Nayaka and Upreti (2011); Mohabe (2011)
127	*P. petricola* Nyl.	Caliciaceae	Foliose	Himachal Pradesh	Srivastava *et al*. (2004); Nayaka and Upreti (2013)
128	*P. subcinerea* Stirt.	Caliciaceae	Foliose	Himachal Pradesh	Srivastava *et al*. (2004)
129	*Remototrachyna awasthii* (Hale & Patw.) Divakar & A. Crespo	Parmeliaceae	Foliose	Maharashtra	Makhija *et al*. (2014)
130	*Rinodina exigua* (Ach.) Gray	Physciaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
131	*R. sophodes* (Ach.) A. Massal.	Physciaceae	Crustose	Madhya Pradesh	Mohabe (2011)
132	*Sphinctrina anglica* Nyl.	Mycocaliciaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
133	*S. tubaeformis* A. Massal.	Mycocaliciaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
134	*Strigula smaragdula* Fr.	Strigulaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
135	*S. subelegans* Vain.	Strigulaceae	Crustose	Uttar Pradesh	Nayaka and Upreti (2013)
136	*Thelidiopsis mangiferae* Räsänen	Verrucariaceae	Crustose	Jammu Kashmir	Mukhtar (2009)
137	*Trypethelium eluteriae* Spreng.	Trypetheliaceae	Crustose	West Bengal	Upreti and Singh (1985)
138	*T. luteum* Taylor	Trypetheliaceae	Crustose	Odisha	Upreti and Singh (1985)
139	*Xanthoria ulophyllodes* Räsänen	Teloschistaceae	Foliose	West Bengal	Bajpai *et al*. (2009)

after their complete identification. The specimens were identified up to the species level with the help of keys of Awasthi (1991, 2007). The classification of lichens by Lücking *et al.* (2016) was followed for arranging species under their respective families. The identity of species was confirmed by matching with available type specimen or with authenticated specimens available at LWG.

RESULT AND DISCUSSION

The present study revealed the occurrence of 139 species

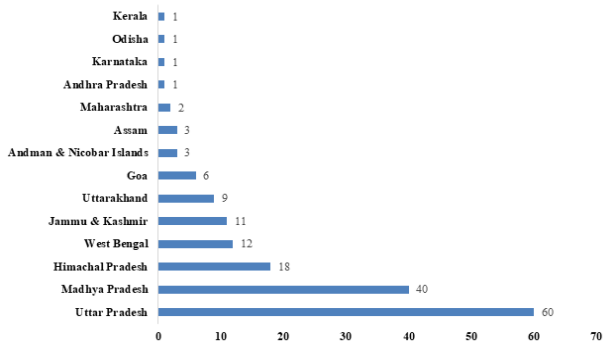

Fig. 1 Lichen diversity in different states in India.

of lichens belonging to 54 genera and 31 families from the 15 different states of the country (Table 1). The crustose lichens exhibited their dominance on the tree represented by 105 species followed by 30 foliose and four species of squamulose lichens. The state of Uttar Pradesh represented maximum diversity of lichens on mango trees with 59 species followed by Madhya Pradesh with 40 species (Plate. 1). The members of family Lecanoraceae with 17 species exhibit their dominance on the tree followed by Ramalinaceae with 14 species. The lichen genus *Lecanora* with 16 species is dominant on mango tree followed by lichen genera *Bacidia* and *Pertusaria,* having 11 species each.

The young, smooth-barked mango trees in moist, shady places provide favourable substratum for the growth of some exclusive taxa of lichens which bear perithecia and eight such species belonging genera *Anthracothecium* and *Pyrenula* were recorded in the present study. The hard fissured bark of mature mango tree is preferred by crustose species of lichens. The mango tree trunk from ground up to four feet exhibits dominance of crustose lichen genera *Lecanora, Caloplaca, Bacidia, Pertusaria* and *Graphis*, whereas above four feet tree exhibited luxuriant growth of foliose lichen species such as *Dirinaria, Hyperphyscia, Parmotrema, Phaeophyscia* and *Pyxine* (Plate 1).

The mango trees mostly have a dome or umbrella-shaped canopy, providing shade and moisture on lower branches. The water holding capacity and pH of bark vary at different niches. The mango tree exhibit four niches within a single tree, the base of the tree has much rough, thick bark laden with soil and usually has growth of mosses with species of lichen genera *Anisomeridium*, *Bacidia* and *Amandinea*. The upper part of the trunk exhibits more or less smooth texture and drier condition. The thick branches have smooth bark, while the twigs are smoother and shiny. The trunk and branches bear species of lichen genus *Dirinaria, Pyxine, Phaeophyscia* and Parmelioid lichens.

In the Himalayan foothills, the moist and shady areas of Assam, Himachal Pradesh, Jammu & Kashmir and Uttarakhand exhibit growth of cyanolichens genera *Coccocarpia* and *Leptogium*. The smooth bark young trees of *Mangifera indica* in thinned out or open canopy orchard exhibit luxuriant growth of species of *Caloplaca, Chrysothrix*, *Graphis* and *Opegrapha*. In Central India mango tree in drier habitat having more sunlight and wind currents bear good growth of lichens species of *Dirinaria, Hyperphyscia* and *Pyxine* from base to top.

CONCLUSION

The epiphytic lichens are widespread and significant component of forest structure and play a vital role in biodiversity conservation and environmental monitoring in tropical and temperate forests (Wang *et al*. 2008; Ellis 2012). The present paper attempts to explain the importance of mango trees in hosting various lichen species. Among the tropical trees mango exhibit a rich diversity of lichens, mostly belonging to lichen family Physciaceae. *Pyxine cocoes* is the most common foliose lichen species found growing luxuriantly on mango orchard in Indian tropical regions and is frequently used for environmental pollution monitoring studies in the area. Based on the present information, mango tree is the best host for lichens to colonize, thus needing special attention for conservation and cultivation. The bark of the trees may become more brittle, uneven cracked as it ages, resulting in changed chemistry; texture and moisture retaining capacity, thereby influencing the type of lichen colonization on it. The young trees generally have a smoother bark that attracts crustose lichens while uneven brittle rough tree surfaces provide suitable substrate for foliose and fruticose lichens to colonize.

During the compilation of the present study, most of the specimens preserved in the herbarium lack host information. Therefore, even though lichens are collected from mango trees, they might not be recorded in many cases. Therefore, fewer lichens are reported from Kerala and other country regions.

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