

# Lichen Floral Studies on *Artocarpus heterophyllus* Tree Trunk in Different Eco -Regions of Sri Lanka

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## ABSTRACT

Information on lichen flora in Sri Lanka is scarce. Therefore a study was carried out to investigate lichens growing on a common tree species in all five eco regions (Montane, Wet, Intermediate, Arid and Dry zone) of Sri Lanka. The species found in all regions was *Artocarpus heterophyllus* (jak). Lichen flora found on bark of jak trees between 1.5 m and 2 m above the ground level was studied. Six hundred and sixty three specimens belonging to twenty five genera and thirteen families were examined. Twenty genera were found to be crustose and five were foliiose. No fruticose lichen was found in any region. Of all identified lichens 40% were belonged to Graphidaceae species which the most frequently was found lichen family in all regions. The second highest (17%) was belonged to family Phyciaceae. The most frequently encountered genus of lichens in all five regions with in the study area of the tree trunk was *Graphis* species

*Heterodermia* and *Pertusaria* were found only in montane zone while *Leptogium* was found only in lowland wet zone. *Thelotrema*, *Ocellularia*, *Myriotrema* and *Chrysothrix* were found only in Intermediate zone. *Parmelia* was restricted to wet zone while *Dirinaria*, *Dimerella* and *Porina* were restricted to dry zone. Differences in distribution of some lichens can be explained with rain fall, temperature and humidity.

*Graphis* and *Opegrapha* were found on jak tree trunks in all studied sites indicating that it can be well adapted to any environmental condition in Sri Lanka.

**KEYWORDS:** Lichens, Jak, *Graphis*, *Opegrapha*, Eco-regions

## INTRODUCTION

Lichen is one of the most remarkable alliances in nature. They are slow growing and drought tolerant for extend periods. It is estimated to be about 30,000 species living worldwide (Nash 111, 1996). Physiologically, lichens are divided in to 3 major types as crustose, foliose and fruticose. Further, squamulose and placodioid are considered as intermediate types.

They are biologically distinct entities composed of an algal or cyanobacterial partner (photobiont) and a fungal (mycobiont) partner living in a symbiotic state (Wolseley and Hudson, 1995). The photobiont is a member of the chlorophyta (green algae) in about 90% of cases, and cyanobacteria (blue-green algae) in about 10% of cases (Ahmadjian, 1967).

Lichens vary greatly in their ecological requirements but almost all of them can grow in places that only receive periodic moisture (Wetmore, 1993). Therefore, finding the ecological factors affecting lichens are important for identification of their distribution. Light and relative humidity during the night are the most important factors for the growth of lichens (Osathanon and Boonpragob, 2005). Will-wolf, 2005 reported that lichen communities differ in sunnier, drier sites than shadier moist sites and also varies with the tree communities. So it is important to identify the effect of ecological and environmental factors for lichen growth in Sri Lanka.

*Artocarpus heterophyllus* Lam., commonly known as jak or jack fruit, is an important evergreen tree (Barrau, 1996; Morton, 1965; Soepadmo, 1991;

Popenoe, 1974; Purselove, 1968; Thomas, 1980). which play a key role in home gardens and tree planting programmes, in Sri Lanka. The tree is valuable for its fruit, leaves (shade and fodder) and timber (Kulshreshtha and Sur, 1998). Howard, 1951 reported that jak is superior to other types of trees in many ways. *Artocarpus heterophyllus* is a tree which is distributed in all ecological regions in Sri Lanka. It can be found easily in most of the home gardens in the country. Although lichens can colonize a wide range of substrata, most species occupy only a limited variety of surfaces and some are quite substratum-specific (Anon, 1992). Also Polyiam and Boonpragob, 2005 reported that the greatest difference in lichen community was reported with the host species. It is also known that many lichens are tree specific (Misra and Agrawal, 1984). Beta diversity values and canonical correspondence analysis (CCA) indicated that host tree species was the most important factor governing the differences in lichen communities (Polyiam, 2005). Therefore jak is a good host tree to identify lichens specific to single tree species in Sri Lanka. So that, it is decided to carry out a comparative study of lichen species on jak in all ecological regions (Wet zone, Dry zone, Intermediate zone, Montane zone and Arid zone) of Sri Lanka.

In many lichens sexual state is rare, and vegetative reproduction is wide spread in many genera. In the field lichen taxa can be circumscribed by a number of morphological characters that are the result of the partnership of both symbionts. However

the fungal partner is specific to the lichen taxon. So that the classification of lichens are based on the sexual characteristics of the fungal partner. In order to distinguish genera and species their reproductive structures and other thallus characters are widely used in artificial keys (Wolseley and Hudson, 1995). The keys developed by Indian lichenologist Dharani Dhar Awasti can be used to identify lichens in Sri Lanka. At early 1868 G.H.K. Thawaitis, Director of the Royal Botanical Garden at Peradeniya collected lichens mainly from Sri Lanka. W.A. Leighton also contributed for lichen studies and identified 99 species in 1870. M.E. Hale collected lichens from the canopy of Dipterocarpus trees in lowland rain forest. However several lichenologists contributed and 659 species have been recorded in Sri Lanka. According to the above objectives the present study will strengthen the lichen taxonomic studies in Sri Lanka.

### MATERIALS AND METHODS

A preliminary survey was carried out to identify a tree species rich in lichen flora on its trunk and also present in all eco-regions of Sri Lanka. The most common tree species bearing considerable amount of lichens was *Artocarpus heterophyllus* (Jak tree)

#### Site Description

Ten sites covering all major eco-regions of Sri Lanka were selected. Those were Boragas (Hakgala) and Boralanda for Montane zone, Ratnapura for Wet lowland zone, Kurunagala and Mahawa for Intermediate zone, Dambulla, and Maradankadawala for Dry zone, Hambanthota, and Suriyawewa for Arid zone. Elevation of each site was recorded using a GPS and Meteorological data (Mean annual temperature, Mean annual rain fall, Mean annual relative humidity) were obtained from the nearest Meteorological stations of Department of Meteorology. All those information is given in table 1.

Table 1 - Climatic conditions of selected sites:

Region	Mean rain fall mm/yr	Mean temperature C/yr	Mean humidity /yr	Elevation m
a	131.53	16.75	88.5	1564
b	131.53	16.75	88.5	1455
c	196.58	31.88	94.5	1344
d	141	31.95	86.83	544
e	141	31.95	86.83	567
f	103.5	32.8	91	432
g	103.5	32.8	91	455
h	87.08	31.13	87	164
i	87.08	31.13	87	58

- a = Boragas (Hakgala)
- b = Boralanda
- c = Rathnapura
- d = Kurunagala
- e = Mahawa
- f = Dambulla
- g = Maradankadawala
- h = Hambanthota
- i = Suriyawewa

#### Study Plots

A cluster of twelve number of *Artocarpus* trees situated close by within 1 km<sup>2</sup> was selected for the examination of lichen colonies growing on the tree trunks with in 0.5 m thick band, marked 1 m above the ground level. All the tree trunks examined were larger than 1 feet girth at breast height (GBH). Two thin colour ribbons were used to mark the 0.5 m thick region on the tree trunks that used to examine lichens. A magnifying glass (10 x) was used to observe the lichens on tree trunks. A half of the lichen colony was removed with sufficient part of the bark from the trees using a chisel and a hammer. Lichens were wrapped with soft tissues and packed them in the pre prepared paper packets.

#### Identification

Lichens were identified upto generic level, following the artificial key of Dharani Dhar Awasti (1991). This was carried out at the National Herbarium; Peradeniya. The main features examined for identification were external and internal morphology of lichens and the chemical analysis. Further, the thallus characters and the algal partner (Photobiont) were considered.

Microscopic slides of thallus and apothesium were prepared and observed through the microscope to examine the features that help to identify the lichens. Thin sections of lichen thallus and fruiting bodies were taken using a micro tome (cold tome) from National Plant Quarantine Services, Katunayaka whenever possible. Spot tests were also performed according to the guidelines given in National work shop on lichens (1999).

Lichens were identified up to generic level using morphological characters of lichens and chemical spot tests according (Awasthi, D.D., 1991) and (Wolseley and Aguirre - Hudson, 1997a).

#### Preservation

Lichens were preserved in pockets prepared by 80gsm papers. Fragile and rare specimens were mounted on a piece of hard board before putting them into packets. Lichen information such as the name (species or Genera), family, site, elevation, recorder name and date of collection were labeled on the packets. The preserved lichens were stored in the Department of Plantation Management, Wayamba University of Sri Lanka, Makadura, Gonawila.

**Table 2 - Lichen distribution in different eco-regions in Sri Lanka:**

Family	Genus	Montane Zone		Low Land Wet Zone	Intermediate Zone		Dry Zone		Arid Zone	
		a	b		c	d	e	f	g	h
1. Bacidiaceae	Bacidia	0	0	0	4	44	8	7	26	34
2. Physciaceae	Buellia	0	0	0	3	4	2	2	8	7
	Pyxine	0	0	0	14	11	11	8	14	21
	Diplotomma	0	0	0	4	0	2	0	11	13
	Heterodermia	17	11	0	0	0	0	0	0	0
	Dirinaria	0	0	0	0	9	13	8	8	11
3. Gyalectaceae	Dimerella	0	0	0	0	5	2	4	5	4
4. Thelotremataceae	Myriotrema	0	0	0	11	0	0	0	0	0
	Ocellularia	0	0	0	7	0	0	0	0	0
	Thelotrema	0	0	0	4	0	0	0	0	0
5. Trichotheliaceae	Porina	0	0	0	0	31	36	24	10	18
6. Chrysothricaceae	Chrysothrix	0	0	0	21	0	0	3	0	0
7. Parmeliaceae	Parmelia	25	14	16	0	0	0	0	0	0
	Relicina	11	2	0	0	0	0	0	0	0
8. Collemataceae	Leptogium	0	0	6	0	0	0	0	0	0
9. Pertusariaceae	Pertusaria	14	9	0	0	0	0	0	0	0
10. Haematommataceae	Haematomma	10	8	0	5	0	2	0	4	3
11. Lecanoraceae	Lecanora	24	12	0	9	9	9	0	5	8
12. Graphidaceae	Graphis	31	16	48	28	12	11	8	18	16
	Graphina	0	0	28	18	0	0	0	10	12
	Phaeographina	0	0	16	12	6	4	0	4	6
	Phaeographis	0	0	9	13	0	0	0	0	0
	Glyphis	0	0	0	4	0	1	2	2	3
	Sarcographa	0	0	8	11	0	0	0	0	0
13. Opegraphaceae	Opegrapha	6	5	5	7	6	7	5	9	11

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**RESULTS AND DISCUSSION**

Lichen genera identified from all five eco-regions are given in Table 2. Altogether six hundred and sixty three lichen colonies were examined from ten sites. Twenty five genera belonging to thirteen families were identified and recorded. Twenty lichen genera were crustose while five were foliose. Any other types of lichens were not found. However some lichens could not be identified as they do not have reproductive structures necessary for identification process

Lichen floral studies were scarce in Sri Lanka and evidently we could find only few published data on lichen flora in Sri Lanka. Lichen studies on specific trees were not found. None of these studies

help to understand the distribution of lichens in Sri Lanka. The present study revealed that two genera namely Graphis (Graphidaceae) and Opegrapha (Opegraphaceae) are present in all eco-regions of Sri Lanka at least on tree trunks of jak. Presence of some lichens in certain areas has been recorded by various scientists earlier (Hale, M.E., 1981), Almquist in 1879, Kurokawa and Mineta from 1966-1968, Mobery, Awasti, Makhil and patwardhan, Breuss, Vezda from 1984-1997 and (Wijerathne and Attanayaka, 2004). But their distribution has not been studied.

Several families and genera seem to flourish best in warm and moist conditions of tropics. Among crustaceous families Thelotremataceae and Graphidaceae are abundant in Sri Lanka (Hale, 1981). Of all lichens studied 18% were Graphis and 5% were Opegrapha suggesting that Graphis is the most abundant lichen numbers of genera were found in the family Graphidaceae county six genera on jak. The second highest was family Physciaceae contributing with five genera. Among the identified lichens Chrysothrix belonging to family Chrysothricaceae and Myriotrema, Ocellularia and Thelotrema belonging to Thelotremataceae family were only found in Kurunagala. Heterodermia and Pertusaria

were only found in Hakgala. This may be due to high elevation, high humidity and low temperature. Leptogium lichens in family Collemataceae were only found in Rathnapura where elevation is low and night humidity is high. Bacidia, Buellia, Pyxine and Diplotoma generas were distributed in low elevation, high temperature dry areas.

In tropics lichens come under the influence of different climates. In Sri Lanka there are different climatic zones hence there may be different lichen communities in different ecological conditions that prevail (Wijeyatna, 2004). As with other groups of organisms, lichen distribution is determined by variations in the environment: some lichens are more drought-resistant than others, some more tolerant of heat or cold, some are able to cope with higher or lower light intensities, and some tolerate different combinations of heat and moisture (Anon, 1992).

Ten years meteorological data (rain fall, mean maximum temperature, mean minimum temperature and night humidity) of sites (Obtained from the nearest Met station) were significantly different with lichen distribution from each other. Indicating environmental factors has an effect on lichen distribution in Sri Lanka. Though there are different environmental factors prevailing in different regions Graphis and Opegrapha generas survive in all eco-regions on jak showed that these particular generas can withstand different ecological conditions.

The Algal partners include Chlorococcaceae, Trebouxia, Trentepohlia, Nostoc and some green algae. Trentepohlia was the most frequent photobiont which encountered 48%. Next most photobiont is green algae (28%) then Trebouxia (16%), Chlorococcaceae (4%) and cyanobacteria Nostoc were found about 4% (Figure 1).

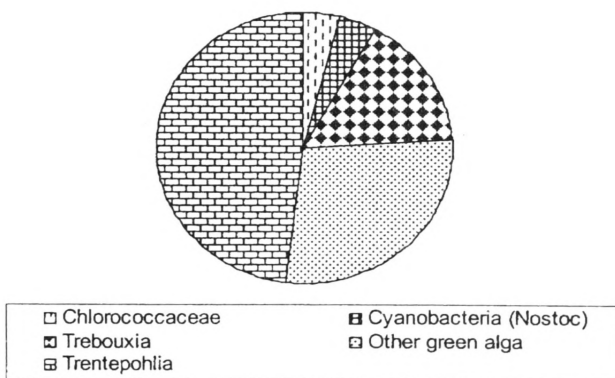


Figure 1 - Photobiont distribution of identified lichens:

### CONCLUSIONS

In this study 25 lichen genera belonging to 13 families were identified. Of all identified lichens 18% were Graphis and it was the most frequently found species. The second highest was Graphina species. According to this investigation changes in environmental conditions are rapidly reflected in the lichen flora on jak in different eco regions. But two species namely Graphis and Opegrapha were common to all eco-regions in Sri Lanka showing its adaptability to different environmental factors. As published data on lichen flora in Sri Lanka is scarce, these data is very important to develop a database on lichens in Sri Lanka. However, further studies are necessary to identify lichens on other species for broad picture on lichen flora on different species.

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