

Study of Identification and Distribution of Cyanolichens from Iran

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Abstract: This study summarizes cyanolichen species known to occur in Iran. Their distribution in the country is mentioned and a key is given for the identification of cyanolichen genera known from Iran. As this group of lichens is very inconspicuous, their identification is very difficult. These species are mostly reported from south, southwest and northeast provinces. As about half of Iran is desert and semi-desert, more research will reveal more species.

Key words: Cyanolichen, determination key, distribution, identification, Iran

INTRODUCTION

Iran with area about 1,648,195 km² is located in south west of Asia between 35°41' N and 51°25' E. Nearly 90% of Iran territory is situated in Iran Plateau district. Iran is generally mountainous and semi-arid. The average elevation of Iran is 1200 m. More than one half of Iran is deserts and semi-deserts, about one third of it is mountainous and a small part of it (containing western plain of Caspian sea and Khuzestan plain) is composed of fertile plains. Lichen flora of Iran is poorly known. First reports dates from over 170 years ago. The first list of lichens was published by Buhse (1860). These studies continued by different scientists. Since 2001 a group of Iranian scientists started to investigate the lichen flora of Iran in association with some European lichenologists. Based on results obtained, a provisional key for lichen genera prepared and made available in the internet by Dr. Sipman in 2003 (Seaward *et al.*, 2004).

The aim of this study, is the preliminary examination of the cyanolichens of Iran. As these lichens are often very inconspicuous, their identification is very difficult. Cyanolichens are dominant part of the vegetation, specially in arid, semi-arid or even more humid regions (Schultz *et al.*, 2000). Because of their ability in nitrogen fixation, they play an important role in ecosystem. This study introduces cyanolichen species known to occur in Iran and shows their distribution in the country. A key has been given for determination of the genera. Since these genera are very similar morphologically, some diagnostic features for distinguishing similar genera have been mentioned.

MATERIALS AND METHODS

This study was performed on specimens from TARI (the herbarium of Research Institute of Forests and Rangelands). Morphological characteristics were studied with a dissecting microscope. Anatomical features were studied by preparing thin sections of the thallus and fruiting bodies with a razor blade. These sections were carried out by use of a light microscope. Because of inadequacy of literature, some articles and images were used from internet sites to help the identification.

RESULTS AND DISCUSSION

There are about 45 species of cyanolichens in Iran which constitute about 11% of all known species to occur in Iran. These cyanolichens include: 1 class, 2 orders, 2 suborders, 7 families, 14 genera and 47 species. These species are mostly reported from south, southwest and northeast provinces. More research will reveal more species. The information are summarized in the Table 1. The key given below treats all cyanolichen genera reported from Iran.

Key to the cyanolichen genera of Iran

- Cyanobiont Nostoc.....2
- Cyanobiont not Nostoc.....8
- Thallus large, several cm across.....3
- Thallus smaller, few mm to few cm across.....4
- Lower surface corticate, smooth and shiny, or fuzzy with a thin tomentum, without rhizins, apothecia on the lower surface of the lobe tips.....Nephroma.

Table 1: The cyanolichen genera and species and their distribution in Iran

Genus	Sp.	Distribution
Collema F.H.Wigg	<i>C. crispum</i> (Huds.)	Khorasan-Mazandaran
	<i>C. cristatum</i> (L.) F.H. Wigg	Khorasan-Golestan-Fars-Lorestan-Kuhgiluyeh O Boirahmad
	<i>C. flaccidum</i> (Ach.) Ach	Mazandaran
	<i>C. furfuraceum</i> (Arnold) Du Rietz	Mazandaran-Golestan
	<i>C. fuscovirens</i> (With.) J.R. Laundon	Fars
	<i>C. polycarpon</i> Hoffm	Kuhgiluyeh O Boirahmad
	<i>C. subflaccidum</i> Degel.	Mazandaran
Gloeoheppia Gyeln	<i>C. tenax</i> (Swartz) Ach.	Khorasan-fars-Lorestan-Kuhgiluyeh O Boirahmad
	<i>G. turgida</i> (Ach.) Gyeln	Hormozgan-Khuzestan
	<i>H. despreauxii</i> (Mont.) Tuck	Lorestan
Heppia Naeg. ex Massal.	<i>H. solorinoides</i> (Nyl.) Nyl.	Lorestan
	<i>L. botryosum</i> (Massal.) Zahlbr.	Khorasan
Lempholemma Korber	<i>L. myriococcum</i> (Ach.) Th. Fr.	Fars
Leptogium (Ach.) Gray	<i>L. polyanthes</i> (Bernh.) Malme	Lorestan-Mazandaran
	<i>L. cyanescens</i> (Rabenh.) Korber	Mazandaran-Golestan
	<i>L. lichenoides</i> (L.) Zahlbr.	Mazandaran-Golestan-Lorestan
	<i>L. plicatile</i> (Ach.) Leighton	Kordestan
	<i>L. saturninum</i> (Dickson) Nyl.	Mazandaran-Golestan
	<i>L. tenuissimum</i> (Dickson) Korber	Khorasan
	<i>L. teretiusculum</i> (Wallr.) Arnold	Mazandaran
Lichinella Nyl.	<i>L. turgidum</i> (Ach.) Crombie	Fars-Golestan
	<i>L. myriospora</i> (Zahlbr.) P. Moreno and Egea ex M. Shultz	Hormozgan
	<i>L. nigritella</i> (Lettau) Moreno and Egea	Kordestan
	<i>L. stipitula</i> Nyl.	Khorasan
Nephroma Ach.	<i>N. parile</i> (Ach.) Ach.	Mazandaran
	<i>N. resupinatum</i> (L.) Ach.	Gilan
Peccania Massal	<i>P. arabica</i> (Müll. Arg) Henssen	Hormozgan-Khorasan
	<i>P. arizonica</i> Tuck. ex Herre	Golestan
	<i>P. coralloides</i> (Massal.) Massal.	Fars-Tehran
	<i>P. terricola</i> H. Magn.	Mazandaran-Gilan-Khorasan
Peltigera Willd.	<i>P. canina</i> (L.) Willd.	Mazandaran-Gilan
	<i>P. horizontalis</i> (Huds.) Baumg.	Gilan
	<i>P. malacea</i> (Ach.) Funck	Mazandaran
	<i>P. neckeri hepp</i> ex Müll. Arg.	Mazandaran
	<i>P. polydactyla</i> (Necker) Hoffm.	Mazandaran
	<i>P. praetextata</i> (Flörke ex Sommerf.) Zopf	Mazandaran-Golestan-Gilan
	<i>P. rufescens</i> (Weis) Humb.	Mazandaran
Peltula Nyl.	<i>P. euploca</i> (Ach.) Poelt	Fars
	<i>P. obscurans</i> (Nyl.) Gyeln.	Khuzestan
Placynthium (Ach.) Gray	<i>P. nigrum</i> (Huds.) Gray	Lorestan
Polychidium (Ach.) Gray	<i>P. tremniacum</i> (Massal.) Jatta	Fars-Kuhgiluyeh O Boirahmad
	<i>P. muscicola</i> (Swartz) Gray	Lorestan
Staurolemma Korb.	<i>S. omphalarioides</i> (Anzi) P.M. JØrg. and Henssen	Mazandaran
Thyrea A. Massal.	<i>Th. confusa</i> Henssen	Fars
	<i>Th. girardii</i> (Du Rietz and Mont.) Bagl. and Carestia	Fars
	<i>Th. plectopsora</i> A. Massal.	Fars-Khorasan
	<i>Th. plicatissima</i> (Nyl.) Zahlbr.	Fars

- Lower surface not corticate, felty, most species with raised or flat, white to black veins, rhizins generally present, either rope-like or tufted, apothecia on the lobe margins.....Peltigera.
- Thallus medium sized and foliose, with lobes usually 2-10mm wide.....5
- Thallus smaller, dwarf fruticose or crustose.....7
- Spores simple.....Staurolemma
- Spores septate.....6
- Thallus corticate.....Leptogium
- Thallus ecorticate.....Collema
- Thallus crustose-warted, foliose or minutely shrubby, upper surface blackish or dark blue-green to olivaceous, gelatinous, thallus not layered, without a well-defined cortexLempholemma.
- Thallus subfruticose, dichotomously branched, lobes terete or flattened but always predominantly erect, upper surface dark, greenish blue to brownish, often shiny towards lobe tips, thallus heteromerous, cortex well-defined.....Polychidium.

- Thallus fruticose, lobules terete or slightly flattened but always predominantly erect and discrete.....9
- Thallus foliose, squamulose or crustose, if appearing fruticose-lobate, then lobes appressed or lobes distinctly flattened.....10
- Thallus fruticose to subfruticose, with erect cylindrical to flattened lobules or foliose, fruiting body a thallinocarp, e.g. hymenium covered by cyanobacterial cells, apothecia concolorous with thallus, blackish olive when wet, ascospores 16-32.....Lichinella
- Thallus foliose with broad lobes, or coralloid to minutely shrubby or folded and umbilicate, fruiting body not thallinocarp, hymenium with red blotches, apothecia dark to black when wet, ascospores 8.....Peccania
- Thallus distinctly gelatinous when wet, thallus foliose to foliose-fruticose, with or without isidia.....Thyrea
- Thallus not or only slightly gelatinous when wet, thallus squamulose or crustose.....11
- Thallus small foliose or crustose, thallus margin often effigurate, stellate to flabellate, upper surface dark olive, brownish or blackish, lower surface usually blackish, thallus indistinctly corticate and stratified.....Placynthium
- Thallus squamulose.....12
- Thallus unstratified, without cortex, hyphae densely reticulate, asci thin-walled, 8-32 spores..... Gloeohyppia
- Thallus stratified, with upper and/or lower cortex, epinecral layer often present, hyphae of algal layer usually arranged perpendicularly.....13
- Thallus subgelatinous when moistened, upper surface olive green to olive brown, rarely black, upper cortex usually absent, lower cortex well developed, asci 16->100 spored, ascospores small, <7.5µm..... Peltula
- Thallus not gelatinous or subgelatinous when moistened, upper surface olive, brownish, gray or blackish, some species with a well developed upper cortex and some with a loosely organized lower cortex, asci (4-)8 spored, ascospores larger, >7.5µm.....Heppia

Collema weber ex wigg: This genus is somehow similar to Leptogium, Lempholemma and Lichinella but there are some differences. Leptogium differs from Collema in having a cortex on at least one surface (Brodo *et al.*, 2001). Moreover, the thallus color in most Leptogium species is grayer or more reddish-brown when dry, with a smoother, more skin-like texture. Collema is commonly greenish-black and is never shiny (Purvis *et al.*, 1992). Lempholemma has simple spores while similar species of Collema have septate spores. Lichenella is blacker and is sometimes pruinose. Its lobes are more strap-shaped and ascending, almost fruticose in habit and its photobiont is different (Gloeocapsa) (Brodo *et al.*, 2001).

Heppia naeg. Ex massal: Heppia is very similar to Peltula. The cyanobiont in Heppia is Scytonema but in Peltula the cyanobiont is from a different genus (Anacystes). Also the spore number (8/ascus in Heppia and 16-100/ascus in Peltula) and ascus structure are different in these genera (Schultz *et al.*, 2002a).

Lichinella Nyl: Lichinella and Thyrea are very similar (with regard to color and general habit). Thyrea species have apothecia buried in the thallus that open by pit-like ostioles while all species of Lichinella have thallinocarpous apothecia, whereby cyanobacterial cells cover the asci (Schultz *et al.*, 2002b).

Nephroma ach: Nephroma and Peltigera are very similar in size, color and habitat, but Nephroma is characterized by the apothecia arising on the lower surface and the presence of a lower cortex (Purvis *et al.*, 1992).

Polychidium (Ach.) gray: The genus is rather distinctive because of its small fruticose growth form with dichotomously branched, terete, corticate lobes. Fruticose species of Lichinella lack any cortex and the hymenium is covered by single-celled cyanobacteria and the asci are polyspored and thin-walled. The fruticose species of Peccania possess single-celled cyanobacteria, the lobes lack any cortex, the upper parts of the hymenium is conspicuously reddish-brown colored, the conidia are larger and filiform and the asci are thin-walled (Schultz *et al.*, 2002b).

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