

## A NEW RECORD OF CRUSTOSE LICHEN SPECIES FOR IRAN

B. Baradaran, S. Saadatmand, M. Haji Moniri, & Y. Asri

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This study employed the survey method for the taxonomic investigation of crustose lichens in the Khorasan-Razavi province between 2018 and 2019. The lichen samples were examined for morphological, anatomical, and ecological features for identification. According to the results, the *Rinodina castanomela* Nyl. was identified as a new report for the lichen flora of Iran. Furthermore, we identified *Lecanographa lyncea* (Sm) Egea & Torrente that was not previously reported from the Khorasan-Razavi province.

Bahram Baradaran, & Sara Saadatmand (correspondence <s\_saadatmand@srbiau.ac.ir>), Department of Biology, Science and Research Branch, Islamic Azad University, Tehran, Iran. -Mahroo Haji Moniri, Department of Biology, Mashhad Branch, Islamic Azad University, Mashhad, Iran. -Younes Asri, Botany Research Division, Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.

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گزارش گل‌سنگ پوسته‌ای جدید برای ایران

بهرام برادران: فارغ‌التحصیل دکتری سیستماتیک گیاهی، گروه زیست‌شناسی، واحد علوم و تحقیقات، دانشگاه آزاد اسلامی، تهران، ایران  
سارا سعادت‌مند: دانشیار، گروه زیست‌شناسی، واحد علوم و تحقیقات، دانشگاه آزاد اسلامی، تهران، ایران  
مهرو حاج‌منیری: گروه زیست‌شناسی، واحد مشهد، دانشگاه آزاد اسلامی، مشهد، ایران  
یونس عصری: دانشیار، بخش تحقیقات گیاه‌شناسی، موسسه تحقیقات جنگل‌ها و مراتع، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران

پژوهش حاضر در فاصله سال‌های ۱۳۹۷ تا ۱۳۹۸ با استفاده از روش پیمایش به بررسی آرایه‌شناسی گل‌سنگ‌های پوسته‌ای استان خراسان رضوی پرداخته است. نمونه‌های گل‌سنگ جمع‌آوری شده از نظر ویژگی‌های ریخت‌شناسی، تشریحی و بوم‌شناسی مورد بررسی قرار گرفتند. بر اساس یافته‌های این پژوهش، گونه *Rinodina castanomela* Nyl. نخستین مرتبه از ایران گزارش می‌گردد. همچنین در میان نمونه‌های جمع‌آوری شده، گونه *Lecanographa lyncea* (Sm) Egea & Torrente نیز شناسایی گردید که پیش از این از استان خراسان رضوی گزارش نشده بود.

### INTRODUCTION

Iran, a vast country in southwest Asia, has a diverse lichen flora due to its climate diversity (Ghorbani 2013; Seaward & al. 2004). Following the publication of the latest comprehensive checklist of Iranian Lichens in 2008 by Seaward and colleagues (Seaward, & al. 2008), extensive studies have been carried out to update the list of Iranian Lichens (Sohrabi, & al. 2019).

However, identifying Iran's lichen flora is still a long-term objective (Seaward, & al. 2004; Seaward, & al. 2008). In this regard, the Khorasan-Razavi province provides an ideal habitat for crustose lichens due to its climatic diversity and extensive substrates (Babaeian & Najafi 2010). According to Haji Moniri and colleagues, 111 species of lichenized and lichenicolous fungi have been reported from north-eastern Iran as of 2014,

including 22, 15, and 34 new taxa for Iran, North Khorasan and Khorasan-Razavi provinces respectively (Haji Moniri & Sipman, 2014). It is estimated that nearly 40% of the known Iranian species have been reported from north-eastern Iran. However, this number is still far from the true diversity of lichens in north-eastern Iran (Haji Moniri & Sipman, 2017). The Binalood and Hazar Masjid mountains in the north of Khorasan-Razavi, with an altitude of more than 3000 meters and diverse topography, play a crucial role in the diversity and richness of the province's saxicolous lichen flora (Haji Moniri 2010). The northern mountains of this province are part of the Khorassan-Kopet Dagh floristic province, which serves as a transitional zone connecting various phytogeographical divisions of the Irano-Turanian region (Memariani &

al. 2022). Due to diverse substrates such as limestone and siliceous rocks, old trees, and broken trunks, it is anticipated that the Khorasan-Razavi province will have a variety of crustose lichens. However, the lichen flora, particularly crustose lichens, has received insufficient attention in the province. As a result, this study was conducted to investigate the biodiversity and taxonomic understanding of crustose lichen flora in the Khorasan-Razavi province. This province is located in north-eastern Iran, bordering Turkmenistan to the north and Afghanistan to the east, at 970 meters above sea level (Fig. 1), (Shojaee & Fallah Ghalhari 2017). We present morphological descriptions of one new Iranian species and one new Khorasan-Razavi province species. We also provide descriptions of the new record's anatomy, distribution and ecology.

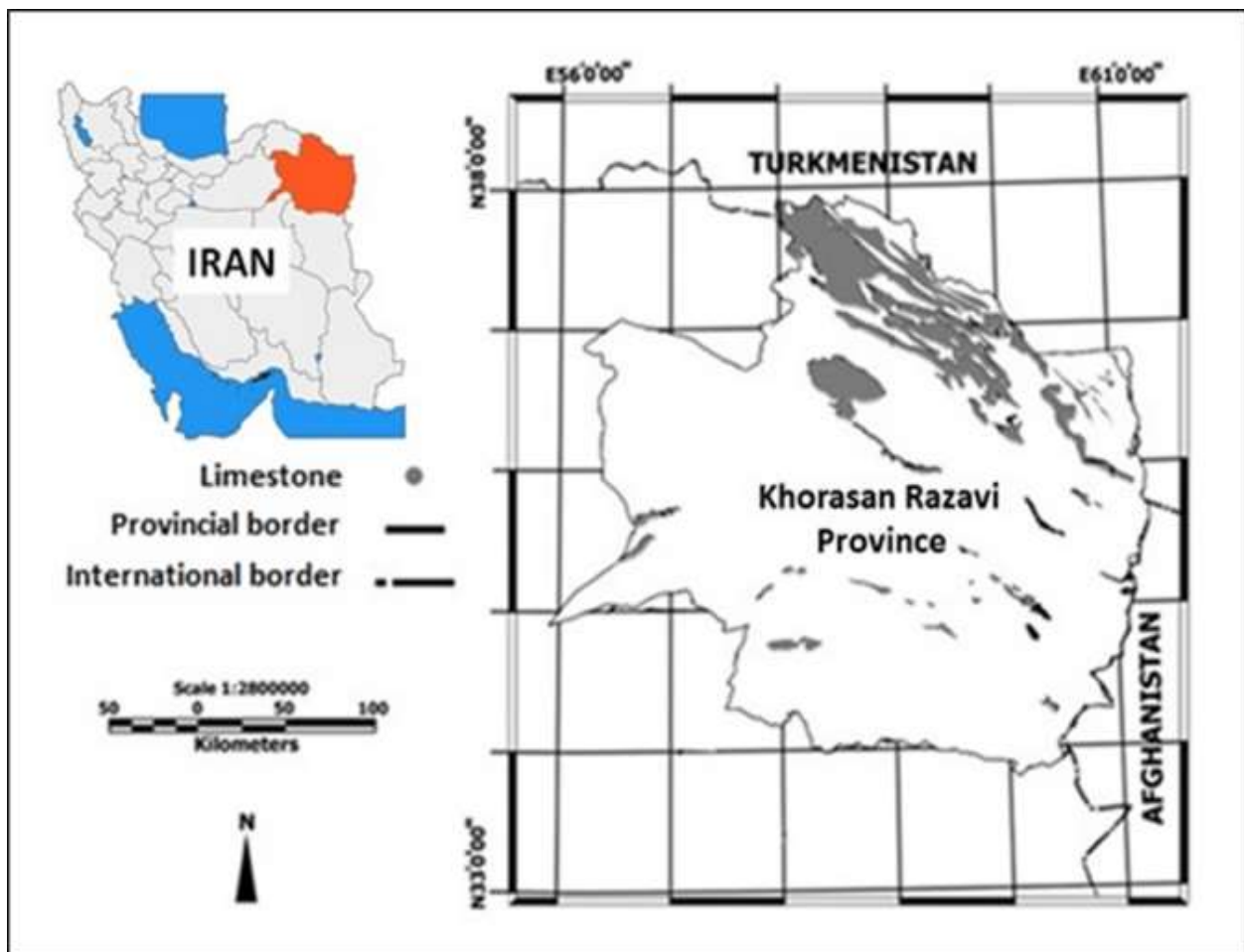


Fig. 1. The comparative map of calcareous substrates in the province of Khorasan-Razavi. This province is in north-eastern Iran ( $36^{\circ} 17' 16.4892''$  N and  $59^{\circ} 36' 57.5004''$  E), adjacent to the borders of Turkmenistan and Afghanistan. Sampling was conducted in 44 separate locations across the province (adapted from maps from the Geological Survey of Iran).

## MATERIALS AND METHODS

Between 2018 and 2019, the first author randomly collected lichen samples from 436 substrates, including limestones, siliceous rocks, wood, and tree bark, in 44 locations in Khorasan-Razavi Province using a survey method. Our fieldwork was located between 36° 19' 16.4892" N and 59° 36' 57.5004" E, which covers 8.8% of Iran's land area. Using geological maps, we selected sampling sites from pristine and accessible areas. All sampling sites were located at least one kilometer apart from each other.

Morphological and anatomical features were used to identify lichen specimens based on our personal examination and identification keys (Brodo & al. 2001; Giralt & Llimona 1997). In this regard, anatomical evaluation was done with a stereoscope (Carl ZEISS-C Stemi, Germany) to determine lichen specimens' vegetative and reproductive characteristics. Additionally, water-mounted hand sections of thallus and apothecia were examined using a light microscope (Carl ZEISS-Axioskope 40, Germany). Ten samples of each lichen species were obtained for this purpose, and ten measurements were made for each specimen using a standard calibrated slide in accordance with the Vondrak protocol (Vondrak & al. 2013). The lichen specimens were further identified using the standard chemical spot test, which involved placing a drop of K (KOH) 10%, C (NaClO), KC, N, and KOH/I solutions on the thallus and apothecia of lichen specimens. Furthermore, hydrochloric acid was used to distinguish between calcareous and siliceous rocks (Orange & al. 2001). All specimens are deposited in the Research Institute of Forest and Rangelands (TARI), Tehran, Iran (number of herbarium codes: 13307 for *Rinodina castanomela* Nyl., and 13306 for *Lecanographa lyncea* (Sm) Egea & Torrente).

## RESULTS AND DISCUSSION

During floristic surveys, we documented the *Rinodina castanomela* Nyl., for the first time from Iran. Furthermore, we identified *Lecanographa lyncea* (Sm) Egea & Torrente that was not previously reported from the Khorasan-Razavi province. The first species belong to Lecanoromycete, while the last is Arthoniomycetes. It is worth noting that the Lecanoromycetes were all previously classified as Discomycetes. Discomycetes are now classified as Pezizomycetes, Lecanoromycetes, Leotiomycetes, and Sordariomycetes.

### *Rinodina castanomela* Nyl., Flora (1886)

Thallus saxicolous, continuous or areolate, convex, surface ochraceous to brown, shiny or white pruinose; margin determinate; no prothallus; no vegetative propagules; apothecia scattered, 0.6-0.9 mm in diameter, typically single on areoles, without stalk; disc black or pruinose, plane becoming convex and sometimes fissured, margin concolorous with thallus; thalline exciple distinct, 87-167.4 µm wide, with epinecral layer; cortex 10-20 µm wide; cortex and medulla without crystals, cortical cells pigmented or not; proper exciple hyaline, 9.7-14.3 µm thick; hymenium hyaline, 96.9-114 µm tall; paraphyses brown, moniliform, rarely branched, with wide apical cell up to 5.3 µm, brown epihymenium; hypothecium hyaline, sometimes pale yellow, interspersed, 57.1-87.5 µm long; asci clavate, 8-spored; ascospores brown, 1-septate, broadly ellipsoid, spore types are the bicincta, 11.4-19.9 (-22.5) × 8.5-11.2 (-14.2) µm, walls dilated at septum in immature spore, poorly developed pigmented bands around locules of spore; conidia rod-shaped up to 5 µm (Fig. 2); pycnidia not seen (Giralt and Llimona 1997).

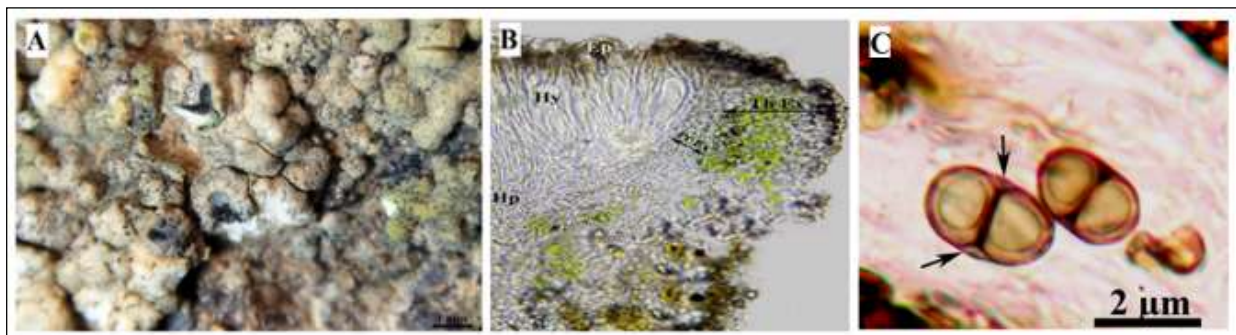


Fig. 2. The morphological and anatomical features of *Rinodina castanomela* Nyl. A, representation of saxicolous thallus and apothecia; B, a cross-section of apothecia; EP (epithecium); Hy (hymenium); Hp (hypothecium); Pr Ex (proper exciple); Th Ex (true exciple); (c) spores are the Bicincta, walls expanded at septum when immature.



**Chemistry:** No lichen substances

**Geographical distribution:** *Rinodina castanomela* is distributed in southern Europe, particularly the Alps, and North America. Also, this species has been reported from China.

**Ecology:** It can grow on limestone and carbonate rocks substrate (Giralt & Llimona 1997; Kaschik 2006).

**Localities and substrate:** We collected *R. castanomela* in April 2019 from two localities including Azghad, Latitude: 36°14'31.9" N, Longitude: 59°21'32.9" E, 1640 m, calcareous substrate, semi-dry ultra-cold climate and Haft-Hoz, Latitude: 36°11' 19" N, Longitude: 59° 33' 24.57" E, 2051 m, calcareous substrate, semi-dry cold climate.

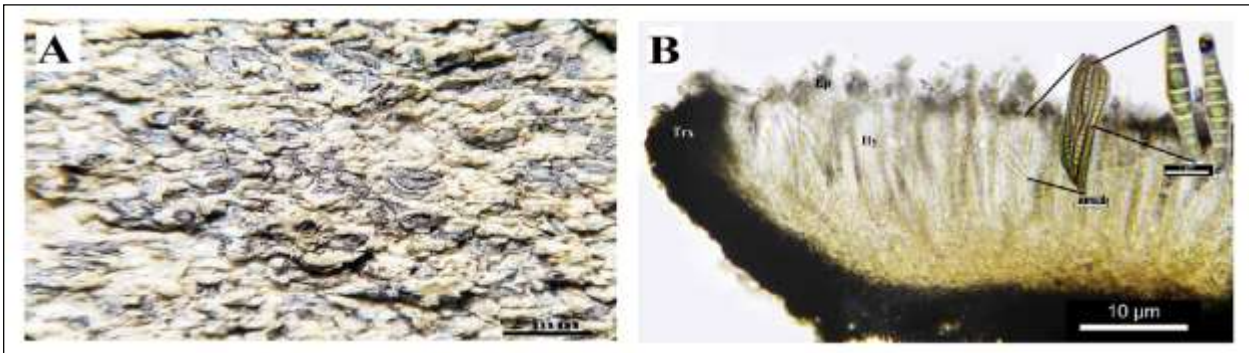


Fig. 3. The morphological and anatomical characteristics of *Lecanographa lyncea* (Sm.) Egea & Torrente. A, crustose-pruinose thallus; B, a cross-section of apothecia, spore fusiform, elongated, needle-shaped at the end, multiple septa; EP (epihymenium); Hy (hymenium); Trx (true exciple).

**Notes:** *Rinodina castanomela* is distinguished from *R. afghanica* and *R. bischoffi* by its brown to pale brown thallus, pruinose disc, hymenium 96.9-114 µm tall, spore 11.4-19.9 (-22.5) × 8.5-11.2 (-14.2) µm, and bicincta-type spores (Kaschik 2006). Furthermore, North American specimens differ from European specimens in lacking oil droplets in the hymenium.

In addition, we identified *Lecanographa lyncea* (Sm) Egea & Torrente (Fig. 3) that was not previously reported from the Khorasan-Razavi province. This species was previously reported from the provinces of Golestan (Kazemi & Ghahramaninezhad 2008), Azerbaijan (Valadbeigi & Sipman 2010), and Ilam (Valadbeigi 2014). *Lecanographa lyncea* is also found in the Mediterranean region, Western Europe, and North America. It grows on dry, rough, rigid, slightly acidic tree bark and wood in forested areas, especially in humid and shaded microclimates (Kazemi & Ghahramaninezhad 2008; Tehler & Egea 1997). We collected *L. lyncea* on April 2019 from Kalate-Ahan, Latitude: 36°15' 48" N, Longitude: 59°20' 08", 1500 m, Oak bark substrate, semi-dry ultra-cold climate.

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