



## *Bactrospora totonacae* (Arthoniales, Ascomycota), a new species from Veracruz, Mexico

## *Bactrospora totonacae* (Arthoniales, Ascomycota), una nueva especie de Veracruz, México

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### Abstract:

**Background and Aims:** *Bactrospora* is a genus of crustose lichens characterized by its black, verrucose to denticulate and little apothecia, and mostly acicular, or sometimes muriform spores, longer than wide. The genus is represented by 38 accepted species. The aim of this work is to describe *Bactrospora totonacae*, a new species from the tropical dry forest of Veracruz, Mexico.

**Methods:** The specimens were collected on the “Cerro de los Metates” in the municipality of Actopan, Veracruz, Mexico. Macrochemical tests, UV reaction, and a thin layer chromatography were performed; likewise, the presence of amyloid substances distributed in the thallus and ascomata was verified with Lugol’s solution. The voucher is deposited in the herbarium XALU of the Facultad de Biología of the Universidad Veracruzana.

**Key results:** The new species *Bactrospora totonacae* is characterized by the pruinose K+ reddish magenta in its disc.

**Conclusions:** The described species is unique in *Bactrospora* because the combination of pruinose K+ reddish magenta and a thick carbonized exciple has never been reported in this genus.

**Key words:** Opegraphaceae, Roccellaceae, tropical dry forest.

### Resumen:

**Antecedentes y Objetivos:** *Bactrospora* es un género de líquenes costrosos que se caracteriza por el color negro, aspecto verrucoso a denticulado y pequeño de sus apotecios, posee esporas mayoritariamente aciculares y en ocasiones muriformes, pero siempre más largas que anchas. El género está representado por 38 especies aceptadas. El objetivo de este trabajo es describir *Bactrospora totonacae*, una especie nueva del bosque tropical seco de Veracruz, México.

**Métodos:** Los especímenes fueron recolectados en el “Cerro de los Metates”, municipio Actopan, Veracruz, México. Se realizaron pruebas macroquímicas, reacción UV y cromatografía en capa fina; asimismo, con la solución de Lugol se verificó la presencia de sustancias amiloides distribuidas en el talo y el ascoma. Las muestras estudiadas se depositaron en el herbario XALU de la Facultad de Biología de la Universidad Veracruzana.

**Resultados clave:** La nueva especie *Bactrospora totonacae* se caracteriza por presentar pruina K + magenta rojizo en el disco.

**Conclusiones:** La especie que se describe en *Bactrospora* es única porque la combinación de pruina K + magenta rojizo y un excípulo carbonizado y grueso no había sido reportada en alguna otra especie de este género.

**Palabras clave:** bosque tropical seco, Opegraphaceae, Roccellaceae.

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## Introduction

The order Arthoniales is the third-largest order of lichenized fungi, with more than 1900 species, distributed in seven families and 105 genera (Lücking et al., 2017). The lichenized taxa generally have crustose growth, colonizing a wide variety of substrates, from saxicolous, corticolous, lignicolous to foliicolous, and are especially abundant and diverse towards the coasts (Ertz and Tehler, 2011), where fruticose species such as those belonging to *Roccella* Bory are also frequent (Tehler, 2011; Guzmán-Guillermo, et al., 2020).

*Bactrospora* A. Massal is a crustose genus characterized by its black, verrucose to denticulate and little apothecia, mostly acicular and sometimes muriform spores, usually longer than wide, and its particular *Bactrospora*-type asci (Egea and Torrente, 1993). The genus is represented by approximately 38 species, considering the 34 accepted species (Lücking et al., 2017; Wijayawardene et al., 2018) and some of them recently described (van den Boom et al., 2018; Herrera-Campos et al., 2019). *Bactrospora* has a cosmopolitan distribution, both in tropical and temperate ecosystems (Egea and Torrente, 1993; Sobreira et al., 2015), with several species that are only known from the type locality (Egea and Torrente, 1993; Sobreira et al., 2015). This can be explained since *Bactrospora* specimens can be confused with non-lichenized fungi, being discarded by lichenologists (Sobreira et al., 2015). According to Grube (1998) and Sobreira et al. (2015), this genus belongs to the family Roccellaceae. However, recent studies failed to confirm its relation to this family, since there are still no available sequences of the genus that allow to clarify its phylogenetic relationships (Lücking et al., 2017). Therefore, the position of the genus *Bactrospora* within the order Arthoniales must be treated as *incertae sedis* at the family level (Siljo et al., 2021).

In Mexico, three species of *Bactrospora* are known. Guzmán-Guillermo et al. (2019) and García-Martínez et al. (2021) reported *Bactrospora jenikii* (Vězda) Egea & Torrente and *Bactrospora denticulata* (Vain.) Egea & Torrente, respectively from coastal ecosystems in Quintana Roo (southeastern Mexico) and Herrera-Campos et al. (2019) described *Bactrospora lecanorina* Herrera-Camp., Altamirano & Lücking from Jalisco. The current systematics of this genus follows the combination of characters like shape, measures, and amiloidity of its apothecia and the type of its spores, since

the morphology is somewhat simple. According to Egea and Torrente (1993), the genus has four types of spores: *Dryina*-type, *Homolotropa*-type, *Jenikii*-type and *Patellaroides*-type. Furthermore, recent studies have recognized the presence and chemistry of pruina as an important character for the delimitation of species concept within *Bactrospora* (Berger and Aptroot, 2008; van den Boom et al., 2018).

In the present contribution, we describe *Bactrospora totonacae* Guzmán-Guillermo, Sorcia-Navarrete & Cárdenas-Mendoza as new to science, as part of the ongoing project of the microlichen funga of Veracruz, mainly focused on the tropical dry forest in coastal ecosystems.

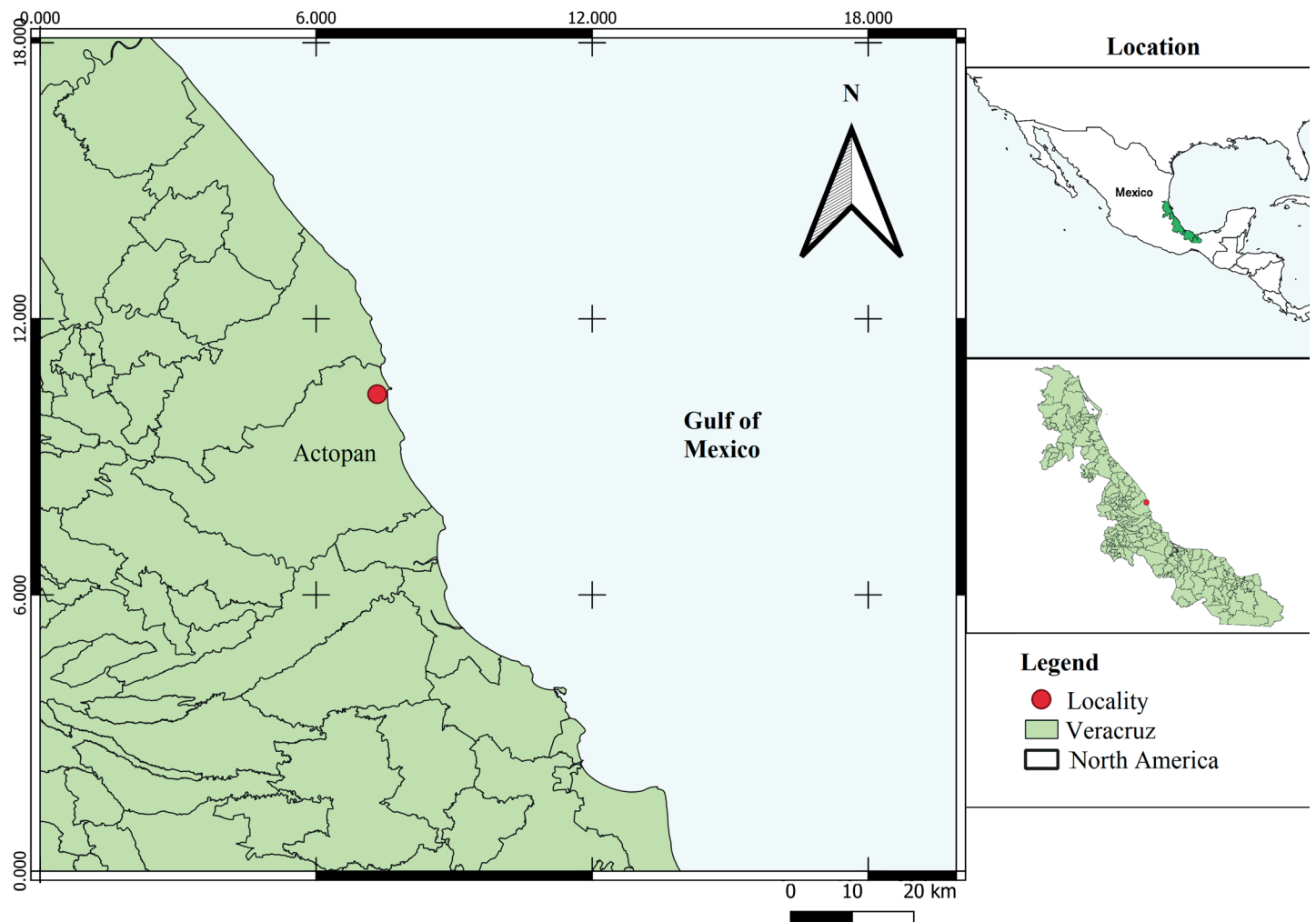
## Materials and Methods

The material here studied was collected in vegetation related to tropical dry forest near the “Cerro de los Metates” (19°40'07.7"N, 96°24'51.7"W, 175 m a.s.l.) in Actopan, Veracruz, Mexico, in 2019 and 2020 (Fig. 1). Specimens were placed in paper bags and transported to the herbarium XALU of the Facultad de Biología of the Universidad Veracruzana, where they were sterilized by freezing. The specimens were analyzed by a stereomicroscope model Stemi Dv4 (Carl Zeiss, Jena, Germany) and microscopic structures were measured with a model Primo Star microscope (Carl Zeiss, Jena, Germany), in the Laboratory of Environmental Quality of the Facultad de Biología of the Universidad Veracruzana. The terminology and characteristics considered in this work follow the concepts of Egea and Torrente (1993). In addition to the macrochemical tests KOH 10% (K), NaClO (C), and KC (modification of K and C), and UV reaction, lichen substances were searched employing thin layer chromatography (TLC) in solvent C (Elix, 2014). Likewise, the presence of amyloid substances distributed in the thallus and ascoma was verified with Lugol's solution (I), performing a pretreatment (IKI) of sections of the thallus and ascomas with potassium hydroxide (KOH 10%).

## Results

### Taxonomy

***Bactrospora totonacae*** Guzmán-Guillermo, Sorcia-Navarrete & Cárdenas-Mendoza, sp. nov. Fig. 2.



**Figure 1:** Type locality of *Bactrospora totonacae* Guzmán-Guillermo, Sorcia-Navarrete & Cárdenas-Mendoza, Veracruz, Mexico.

Mycobank No.: MB 841138

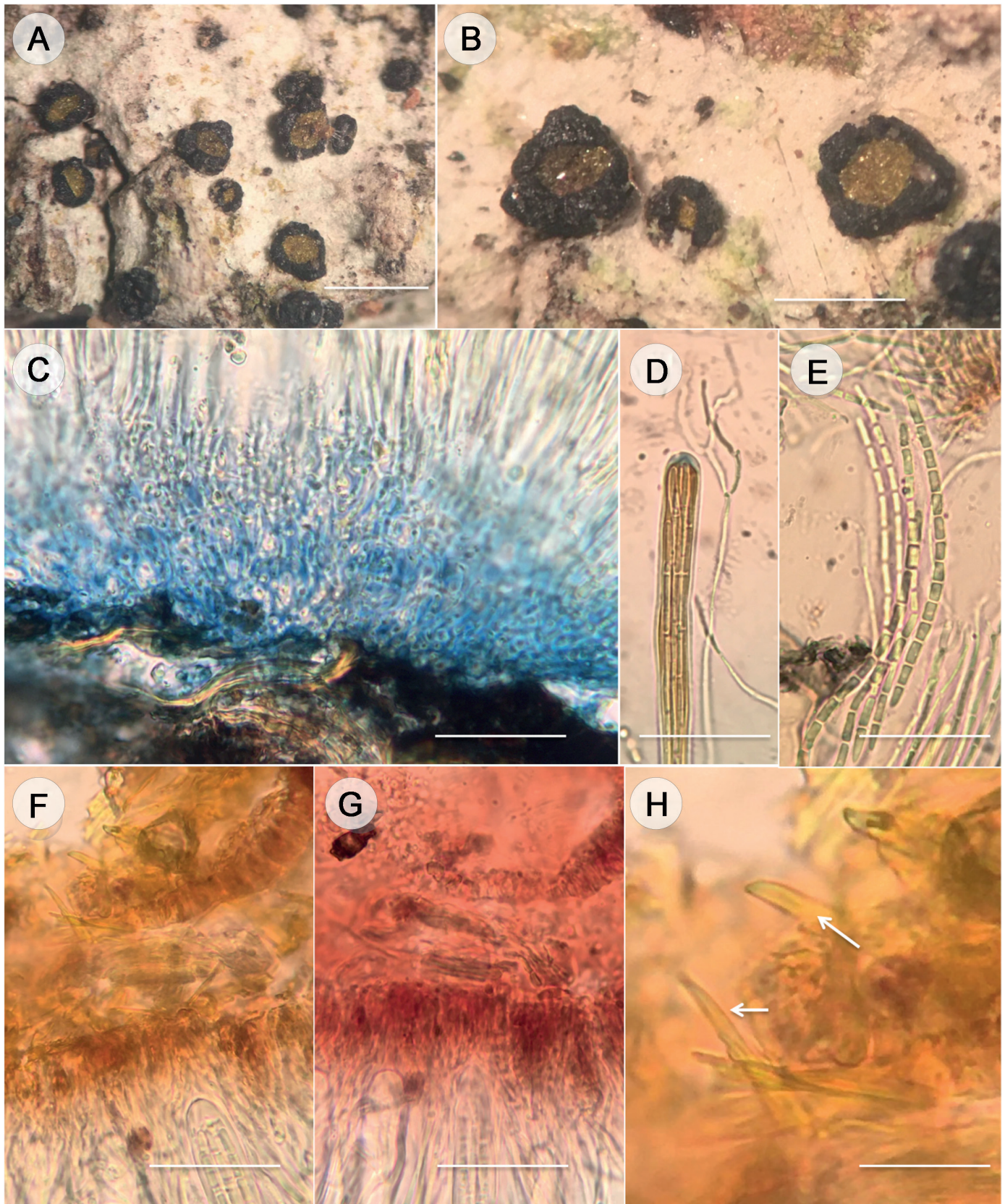
TYPE: MEXICO. Veracruz, municipality of Actopan, Cerro de los Metates, 07.XII.2019, *J. Guzmán-Guillermo 1181-A* (holotype: XALU!).

*Bactrospora totonacae* differs from all *Bactrospora* species with thick carbonized excipulum and *Patellaroides*-type spores by its yellow crystals K+ magenta red. Only *B. ochracea* is similar in its chemistry, but differs from the new species by the carbonized excipulum.

Thallus crustose, whitish, and very thin; apothecia black, sessile, 0.5-1 mm, with a thick carbonized exciple of

40-150  $\mu\text{m}$  and KI-, verrucose at the margin and open below the subhymenium; disc covered with conspicuous yellow crystals; paraphysoids with branched tips, not anastomosed, forming a yellow pseudoepithecium that changes to reddish magenta in K; hymenium not interspersed, hyaline 110  $\mu\text{m}$  tall, I+ red, KI-; subhymenium 50  $\mu\text{m}$  tall, KI+ blue; asci 8-spored, *Bactrospora*-type, 110-124  $\times$  10-11  $\mu\text{m}$ , tholus KI+ blue; spores *Patellaroides*-type, non-spiraled, without constrictions nor breaking into smaller fragments, 70-85  $\times$  (1.5)2-2.5  $\mu\text{m}$  with (13)14-16 septa, I-; pycnidia not seen.

**Etymology:** the epithet refers to the culture “Totonaca” because the type locality was a prehispanic cemetery of this indigenous group. The Totonac played an essential role



**Figure 2:** Holotype of *Bactrospora totonacae* Guzmán-Guillermo, Sorcia-Navarrete & Cárdenas-Mendoza. A-B. apothecia with yellow crystals (scale: A = 0.5 mm; B = 1 mm); C. subhymenium after KI (scale: 10  $\mu$ m); D. asci and paraphysoids after KI (scale: 30  $\mu$ m); E. ascospores (scale: 7.5  $\mu$ m); F. yellow pseudoepithecium in water (scale: 20  $\mu$ m); G. pseudoepithecium in K, the color change is visible (scale: 20  $\mu$ m); H. yellow crystals found on the disc in water (arrows) (scale: 10  $\mu$ m).

in the history of Mexico since they allied with the Spanish army during the conquest of the Aztec empire.

Chemistry: thallus C-, K-, UV-; crystals on the disk C-, K+ reddish magenta; excipulum K+ greenish-brown. TLC: no lichen substances were detected. A TLC for the yellow pigment was not performed, but due to the coloration in KOH (10%), it is considered a compound related to an anthraquinone, possibly the same as *Bactrospora ochracea* Ertz & van den Boom (van den Boom et al., 2018).

Macroecology: corticolous on *Manilkara* sp., growing with *Bactrospora myriadea* (Fée) Egea & Torrente, *Cresponea* sp. and *Trypethelium eluteriae* Spreng. in the tropical dry forest of the “Cerro de los Metates” in the municipality of Actopan, very close to the coast of the Gulf of Mexico. This locality is very promising for the study of Arthoniales, where we reported *Roccella gracilis* Bory for the first time on the Mexican side of the Gulf of Mexico (Guzmán-Guillermo et al., 2020).

Distribution: only known from its type locality.

Additional specimens studied: MEXICO. Veracruz, municipality of Actopan, Cerro de los Metates, 07.XII.2019, *J. Guzmán-Guillermo* 1168 (XALU); loc. cit., 21.XII.2020. *J. Guzmán-Guillermo* 2853 (XALU), 2854 (XALU).

Notes: *Bactrospora totonacae* is characterized by the pruinous K+ reddish magenta in its disc. It is unique within the genus due to the combination of pruinous K+ reddish magenta and a thick carbonized exciple, that has never been reported in *Bactrospora*.

## Discussion

According to the shape and measurements of the *Bactrospora totonacae* spores, it is similar to widely distributed species such as *B. denticulata*, *B. myriadea*, and *B. acicularis* (C. W. Dodge) Egea & Torrente, and other similar species with *Patellaroides*-type spores. It differs from the latter species because none of them have yellow K+ magenta-reddish pruinous on any part of the apothecia. The

literature mentions that *B. myriadea* has yellow pruinous granules that can occasionally be seen without the need of sections (Egea and Torrente 1993; Sobreira et al., 2015), but these granules do not react to K. Two other species of *Bactrospora* are known to possess conspicuous yellow pruinous on the disc or spread over the margin: *Bactrospora flavopruinosa* F. Berger & Aptroot and *B. ochracea*. *Bactrospora totonacae* differs from *B. flavopruinosa* because the latter has considerably smaller spores (45-55 × 1.5-2.5 µm, 9-15-septate) and the yellow pruinous does not generate a reddish-magenta K+ coloration (Berger and Aptroot, 2008). On the other hand, *B. ochracea*, a recently described species from Suriname, has an ascocarp covered by a yellow bloom that reacts K+ reddish magenta, it differs in the size and number of septa of its spores, (40.0-50.0 × (3-)4-5(-)6 µm, 7-13-septate (van den Boom et al., 2018). In addition, *B. ochracea* has an unusual ascocarp in the genus *Bactrospora*, since it does not have a carbonized exciple (van den Boom et al., 2018), which is evident in *B. totonacae*.

## Author contributions

JGG designed and directed the research. JGG, PSN and KCM collected the specimens here studied, JGG and RLH wrote the document and JGG and PSN illustrated the manuscript.

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