Revista Mexicana de Micología vol. **41**: 73-77 **2015**

Stephanospora michoacanensis (Stephanosporaceae, Agaricales), a novel sequestrate truffle from North America

Stephanospora michoacanensis (Stephanosporaceae, Agaricales), una nueva trufa encontrada en América del Norte

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Abstract

Stephanospora michoacanensis is presented as a new species from North America. This angiocarpic species is recognized by its yellow-cream peridial surface color and broadly ellipsoid to subglobose, spiny or crested, inamyloid spores with a distinct, complete or nearly complete corona at its base. *Stephanospora michoacanensis* is similar to *S. caroticolor,* but *S. caroticolor* has a bright yellow to reddish yellow peridial surface, and larger spores. *Stephanospora michoacanensis* also resembles *S. chilensis,* but *S. chilensis* has a brownish-ochraceous to reddish orange peridial surface, spiny spores that lack crest-like features. Illustrations of macro-and microscopic features are presented.

Keywords: truffles, hypogeous, carrot-red truffles, sequestrate, *Lindtneria*.

Resumen

Se presenta *Stephanospora michoacanensis* como una nueva especie de América del Norte. Esta especie angiocárpica se reconoce por el color amarillo crema del peridio, las esporas subglobosas a globosas, con espinas o crestas inamiloides, y con una corona distintiva completa o casi completa en su base. *Stephanospora michoacanensis* es similar a *S. caroticolor,* pero esta última tiene un color amarillo brillante a amarillo rojizo en la superficie del peridio y basidiosporas más grandes. *Stephanospora michoacanensis* también se parece a *S. chilensis,* pero esta presenta el color del peridio pardo-ocráceo a anaranjado-rojizo, y esporas espinosas sin crestas. Se incluyen ilustraciones de los caracteres, tanto macro como microscópicos.

Palabras clave: trufas, hongos hipogeos, trufas rojo-zanahoria, secotiode, *Lindtneria*.

Introduction

Stephanospora was named by Patouillard in 1914 (Kirk *et al.*, 2008), and the name is derived from the Greek *stephano* (a crown) and *-spora* (seed or spore) hence "crowned spore" referring to the crown-like collar present at the base of the spore (Castellano *et al.*, 1989). The genus belongs to the family Stephanosporaceae (syn: Lindtneriaceae) but its taxonomic placement to order remains unsettled. It has been placed variously in the Hymenogastrales (as *Octaviania* Vitt., Cunningham, 1979), Stephanosporales (Larsen, 1986), Aphyllophorales (Cas-

Recibido / Received: **31/03/2014**
Aceptado / Accepted: **02/02/2015**

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tellano *et al*., 1989), Stereales (Pegler *et al*., 1993; Montecchi and Sarasini, 2000), and the Agaricales (Kirk *et al*., 2008; as *Octaviania*, Singer and Smith, 1960; Binder *et al*., 2010). Currently, only four *Stephanospora* species are known worldwide (Calonge *et al*., 2002; Vidal, 2004; Vernes and Trappe, 2007; Kirk *et al*., 2008), and none from North America, although the genus has been reported from DNA sequences (Lynch and Thorn, 2006; Edwards and Zak, 2010). *Stephanospora* has been found from forest without ECM host plant and no ECM root tip sequences close to *Stephanospora* have been observed (Tedersoo *et al*., 2010). On the other side, the genus has been quoted as part of the diet of small marsupials (Vernes and Trappe, 2007). In addition to the unique corona at the base of the spores, the genus is characterized by an angiocarpic, hypogeous basidioma, arachnoid-like, evanescent peridium, and a gleba with irregularly-shaped, usually empty locules. Recent molecular analysis of the ITS region has shown that *S. caroticolor* (Berk.) Pat. is related to the epigeous, saprophyte, resupinate fungus *Lindtneria trachyspora* (Bourdot and Galzin) Pilát (Martin *et al*., 2004). After carefully scrutiny of this infrequent and interesting species from Mexico, we conclude that it is a novel species, and we propose it as *S. michoacanensis*.

Material and methods

Methods of collection and macroscopic and microscopic study were generally those of Castellano *et al*. (1989). Colors of fresh sporocarps are in general terms by the authors. Dried specimens were hand-cut and mounted in 5% KOH, tripan blue in lactoglycerol or sterile water for microscopic observation. Forty-five spores were measured to estimate size and length-width ratio (Q). Spore dimensions are without ornamentation. Herbaria are abbreviated according to Index Herbariorum (Thiers, continuously updated).

Taxonomy

Stephanospora michoacanensis Guevara & Castellano sp. nov.

Figures 1-2

Mycobank MB 804334

Etymology: Latin, *michoacan-* (Michoacán State, Mexico) and *ensis* (from, origin). In reference to the origin of the type species "from Michoacán".

Holotype hic designatus: Guevara 1220 (ITCV 1220).

Basidiomata 8-9 mm in diam, subglobose to slightly flattened, fragile, spongy, flexible, partially wrinkled. Peridial surface dry, cream to pale brown with brown stains, not changing when handled, with narrow, pale olive-brown rhizomorphs randomly attached (Figure 1A). Peridiopellis very thin or absent, nearly indistinguishable from gleba in some areas. Gleba cream, loculles 0.2-1 mm broad, ellipsoid, angular, flat or irregular, some exhibit hyphal or arachnoid-like, white hyphal strands inside the locules, not changing when handled (Figure 1B). Columella absent. Odor indistinct. Taste not recorded.

Basidiospores broadly ellipsoid to subglobose, 9-12 (-13) x 6-8 (-9) µm, (Q = 1.18), sterigmal attachment sometimes present. A distinct, partial or complete corona at base, 4-5 (-9) µm broad, 1.5-3 µm long (Figures 1C and D). Spines 2-3 x 1.5-2 µm, forming crests 5-6 (-8) µm long by 3-4 (-5) µm high, thin-walled, in KOH hyaline singly, pale yellow in mass, in tripan blue violet-blue (Figure1D), inamyloid, nondextrinoid. Basidia clavate to cylindrical, usually curved at the base, 23-30 (-31) x 10-13 (-14) µm, thin-walled, 2-4-spored (Figure1E), sterigmata hyaline, distinct, 1-6 (-10) x 1-2 (-3) µm, content granular, violet-blue in tripan blue. Cystidia absent. Hymenophoral trama 57.5-85 (-137) µm thick, of hyaline to pale brown, thin-walled, globose or subglobose cells, 5-30 (-37) µm broad (Figure 1F). Hymenophoral hyphae usually collapsed near the peridium. Peridium 10-25 (-30) µm thick, of thin-walled, cylindrical, slightly branched, hyaline to pale brown or brown, closely interwoven hyphae 1.5-3 µm broad, with scattered, brown mycelial strands (Figure 1G). Clamp connections present (Figure 1H).

Distribution, habitat and season: Mexico, Central Mexico (Trans-Mexican Volcanic Belt). Two fruiting bodies only known from the type locality in the state of Michoacán (Figure 2),

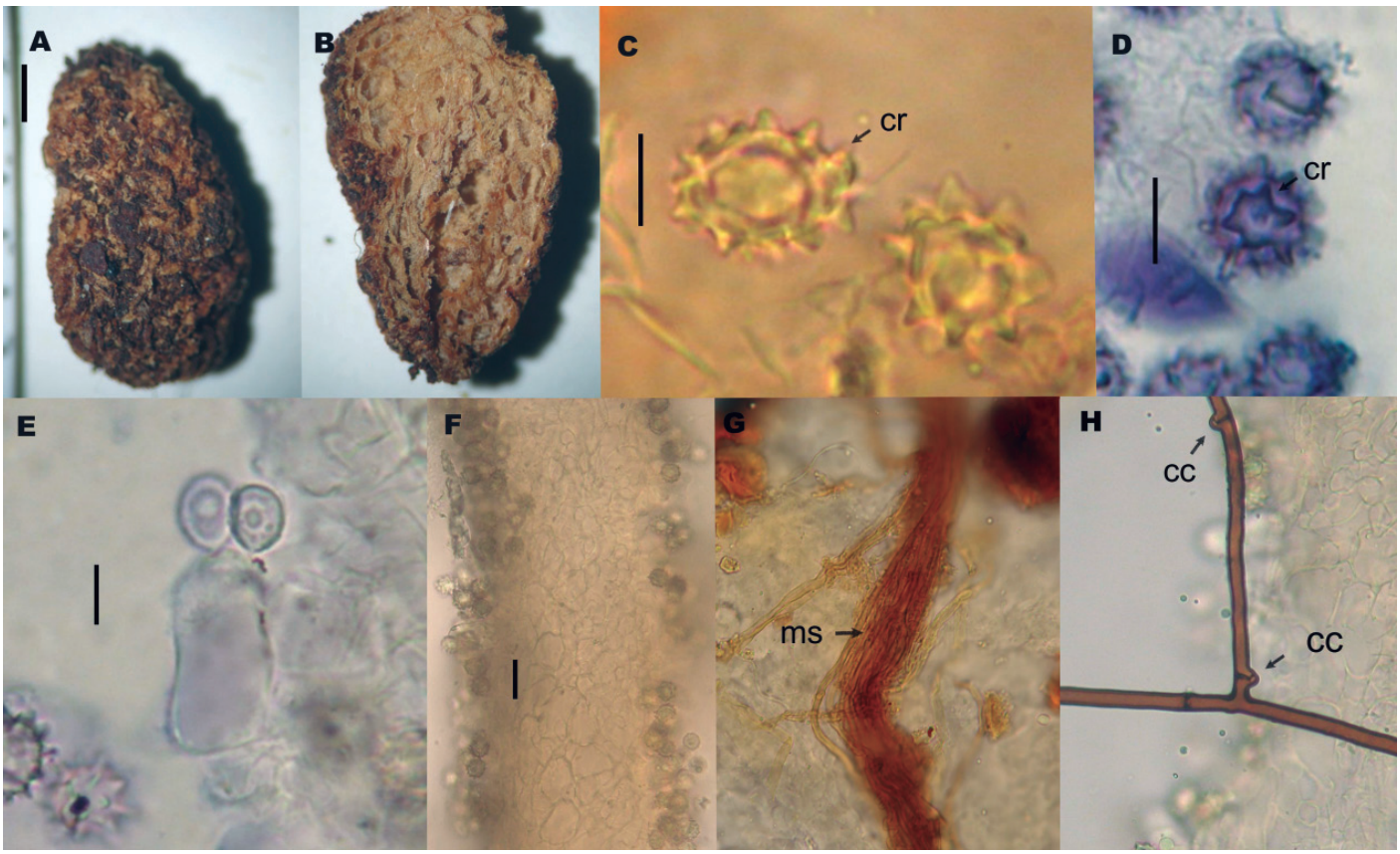

Figure 1. *Stephanospora michoacanensis* (Holotype - Guevara1220, ITCV). A; Basidioma (bar = 1 mm), B; Basidioma in cross section (Gleba), C; Basidiospores (cr = crown) in KOH (bar = 5 µm), D; Basidiospores in tripan blue (cr = crown) (bar = 5 µm), E; Inmature basidium with two basidiospores (bar = 10 µm), F; Hymenophoral trama (bar = 25 µm), G; Peridial mycelial strand (ms), H; Mycelial strand hypha with clamp connections (cc).

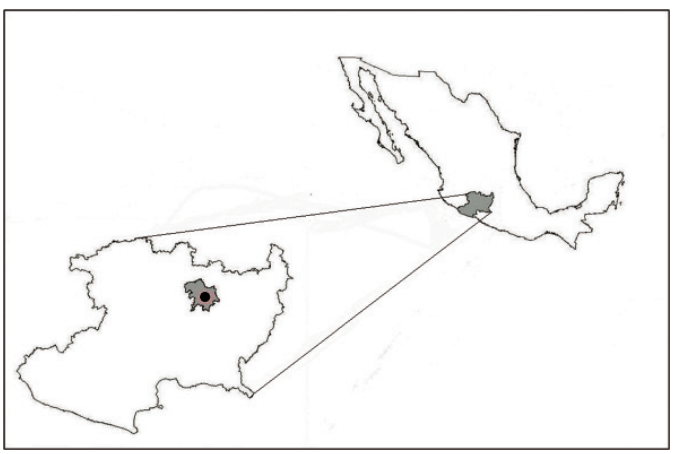

Figure 2. Distribution of *Stephanospora michoacanensis* (Holotype - ITCV 1220).

hypogeous, solitary, under *Quercus* sp. in a pine-oak forest with *Q. castanea*, *Q. obtusata*, *Q. magnilifolia*, *Q. rugosa*, *Pinus leiophyla*, *P. pseudostrobus*, and *P. michoacana*. Associated with some mesophytic elements, e.g., *Terstroemia pringlei*, *Styrax argenteus*, *Cornus disciflora* and *Symplocus citrea*, autumn, at approximately 2300 m.s.n.m. elevation.

Collection examined: Mexico, Michoacán, Puerto Madroño, 20 km south of Morelia City, ejido Atecuaro, Municipality of Morelia, 18 October 2011, *Guevara* 1220 (ITCV 1220).

Discussion: This species is similar to *Stephanospora chilensis* (E. Horak) J.M. Vidal, but the basidiome of *S. chilensis* is reddish-orange or orange-brown when dry, spores are 7.5-9 µm of diameter, with more spines and without crests; the peridium lacks mycelial strands, and the hyphae lack clamp connections. In contrast, *S. michoacanensis* has a cream to pale brown peri-

Table 1. Comparative morphology of *Stephanospora* species

Taxon	*Peridium color*	*Spore size and shape*	*Corona*	*Clamp connections*	*Distribution*
S. aurantiaca (R. Heim & Malencon) J.M. Vidal	White, yellowish white to deep orange	10-14 (-15.5) x (7.5-) 10-13 µm, globose to subglobose	Incomplete to slightly distinctive	Present on mycelial strands	UK, Spain
S. caroticolor (Berk.) Pat.	White, yellowish to reddish yellow	10-13.5 (-15) x 7.5-10 µm, ovoid	Distinctive	Present on mycelial strands	France, UK Germany, Spain, Switzerland,
S. chilensis (E. Horak) J.M. Vidal	Similar to *S. caroticolor*	9-12.5 x 7.5 -9 µm, ovoid	Slightly distinctive	No reported	Chile, Germany
S. flava (Rodway) G.W. Beaton, Pegler & T.W.Young	Canary yellowish	9-11.5 (-12.5) x 8.5-10.5 (12) µm, globose to subglobose	Distinctive	No reported	Australia
S. michoacanensis Guevara & Castellano	Cream to pale brown with brown stains	9-12 (-13) x 6-8 (-9) µm, broadly ellipsoid to subglobose	Partial to distinctive	Present on mycelial strands	Mexico

dial surface, spiny spores with crest-like structures, narrow spores, 6-8 (-9) µm), clamp connections, and has distinct, mycelial strands in the peridium. *Stephanospora michoacanensis* is also similar to *S. caroticolor* (Berk.) Pat., from European temperate forests but can be distinguished by its pale yellow-ochre, orange to reddish yellow peridial surface, large spores, 10-13.5 (-15) x 7.5-10 µm, and a more prominent, complete corona. *Stephanospora michoacanensis* also resembles *S. flava* (Rodway) G.W. Beaton, Pegler *et* T.W.K. Young, and *S. aurantiaca* (R. Heim *et* Malencon) J.M. Vidal from Australia and Europe, but both these species differ by having larger spores, 9-11.5 (-12.5) x 8.5-10.5 (-12) µm and 10-14 (-15.5) x (7.5-) 10-13 µm, respectively, and the color of the peridial surface in *S. flava* is canary yellow when fresh, ochraceous or pale reddish brown after drying, while in *S. aurantiaca* the peridial surface color is white, yellowish white to deep orange (Palacios and Laskibar, 1991; Vidal, 2004) (Table 1). *Stephannospora* is morphologically similar to *Mayamontana* Castellano, Trappe & Lodge, described from Central America but differs microscopically by having smooth spores with utricle (Castellano *et al*., 2007).

Acknowledgments

The senior author would like to thank DGEST, PROMEP and CONACyT for the economic support of this research.

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