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Fungi associated with foliar diseases of *Tecoma stans* in Tlaxcala, Mexico

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Abstract

During 2015, leaves, stems, and pods of *Tecoma stans* showing symptoms of galls, rust, and powdery mildew were collected from public gardens located in Panotla, Tlaxcala, Mexico. The fungi present in the tissues were characterized morphologically using light microscopy. Galls on leaves, stems, and pods and erumpent pustules on leaves were associated with two rust fungi, *Prospodium transformans* and *P. appendiculatum*. The fungus associated with powdery mildew symptoms was identified as *Phyllactinia obclavata*. To the best of our knowledge, this is the first report of *P. obclavata* causing powdery mildew in *T. stans* in Mexico.

Key words – *Prospodium transformans* – *Prospodium appendiculatum* – *Phyllactinia obclavata* – morphology

Introduction

Yellow bells (*Tecoma stans* (L.) Juss. ex Kunth), family Bignoniaceae, is a small perennial tree or shrub native to tropical America with a natural distribution from the southern USA to Argentina (Mabberley 2008, Martínez & Ramos 2012). It is also widely cultivated as an ornamental and street tree (Gentry 1992). This plant also has a wide range of pharmacological and medicinal applications, since most of its parts (leaves, root, flower, seed, fruit, bark) have been reported for medicinal purposes (Singh et al. 2013, Anburaj et al. 2016).

Alternaria tenuissima, Armillaria mellea, Cercospora spp., *Colletotrichum* sp., *Oidium* sp., *Phyllosticta* sp., *Prospodium* spp. and *Pseudocercospora* spp. are the main pathogenic fungi reported causing diseases in *T. stans* worldwide (Farr & Rossman 2018). Rusts (Pucciniales) are the most important group of fungi on this plant. According to Carvalho & Hennen (2010), there are six species of *Prospodium* (*P. abortivum, P. aculeatum, P. appendiculatum, P. elegans P. mexicanum* and *P. transformans*) that cause rust symptoms in yellow bells plants. León-Gallegos & Cummins (1981), Wood (2014) reported *Prospodium* spp. on *T. stans* in Mexico, but the state of Tlaxcala was

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not included in their reports. Braun & Cook (2012) recorded four powdery mildews (Erysiphales) associated with *Tecoma* spp. (*Phyllactinia obclavata* (as *Ovulariopsis obclavata*), *O. tabebuiae-aureae*, *Erysiphe peckii*, and *E. peruviana*. However, there are no records of Erysiphales infecting *T. stans* in Mexico. The present research identifies by morphological examination the fungi associated with symptoms of rust and powdery mildew on *T. stans* in Tlaxcala, Mexico.

Materials & Methods

Sample collection

From February to August 2015, symptoms of rust and powdery mildew were surveyed on *T. stans* trees in public gardens located in Panotla, Tlaxcala, Mexico (19°18’50” N; 98°16’02” W). Disease incidence and severity was quantified during these surveys. Leaves, stems, and pods of *T. stans* with symptoms of rust and powdery mildew were collected, placed in plastic bags and later dried to be deposited in the Herbarium of the Department of Agricultural Parasitology at Chapingo Autonomous University.

Morphology

For the morphological characterization of rust fungi, glass slides with glycerin were made with longitudinal sections of the fungal structures (uredinial and telial stages) present on surface of fresh leaves and galls (sori) in stems and pods. For the powdery mildew, fungal structures were mounted in lactic acid and gently heated. Microscopic examination and measurements of fungal structures were performed using an Olympus BX41 compound microscope (Olympus, Japan) with differential inference contrast illumination and equipped with a Moticam 580 camera (Motic, China).

Results & Discussion

Rust symptoms (erumpent pustules) were observed on the lower surface of leaves. Galls (sori) were observed on leaves, stems, and pods. Rust incidence reached 100% and severity ranged between 30–40%. Powdery mildew signs were observed on the lower surface of leaves with a 100% incidence and severity from 40–60%.

Based on morphological examination, two species of rust fungi were identified. The rust associated with erumpent pustules on the lower surface of the leaves had uredinia that were hypophyllous, subepidermal, and erumpent. Urediniospores (n = 50) were radially asymmetric, ellipsoid, light brown, 22–28 × 20–25 µm. Paraphyses were incurved, short, and hyaline. Telia were subepidermal and blackish brown (Fig. 1A–B). Teliospores (n = 100) were ellipsoid to oblong-ellipsoid, two-celled, dark brown, 42–54 × 29–35 µm (Fig. 1C–D), constricted at septum; pedicels were hyaline, persistent, 63–75 µm long and with 3 pairs or more of dichotomously branched appendages (Fig. 1E–F). These characters agree with those described by Hernández & Hennen (2003), Carvalho & Hennen (2010), Bhasabutra et al. (2012) for *Prospodium appendiculatum* (Winter) Arthur. Recently, López-Alzate & Salazar-Yepes (2017) described *P. appendiculatum* var. *colombiana* on *T. stans* in Colombia. This new variety has short, deciduous pedicels that are laterally inserted and lacking appendages, which is quite distinct from *P. appendiculatum*.

The rust associated with galls on leaves (Fig. 2A–B), stems, and pods had teliospores (n = 100) that were ellipsoid, two-celled, light brown, 25–33 × 19–23 µm, and with a short pedicel without appendages (Fig. 2C–D). The morphological characteristics were consistent with those reported by León-Gallegos & Cummins (1981), Carvalho & Hennen (2010) for *Prospodium transformans* (Ellis & Everh.) Cummins.

The present study detected *P. appendiculatum* and *P. transformans* for the first time in *T. stans* trees in the state of Tlaxcala, Mexico. Previously, García-Alvarez (1976) reported the occurrence of *P. appendiculatum* on *T. stans* in the states of Morelos and Oaxaca, Mexico. However, that report was not supported by morphological evidence. Subsequently, León-Gallegos

& Cummins (1981) identified *P. appendiculatum* and *P. transformans* on *T. stans* and *T. mollis* distributed in several states from Mexico. Recently, Wood (2014) recorded the occurrence of *P. appendiculatum* and *P. transformans* in *T. stans* distributed in the states of Chiapas, Guerrero, Jalisco, Queretaro, Oaxaca, Michoacan, and Veracruz, and mentioned that there is variation within the species as to the specific biotypes of the host that individual isolates can infect.

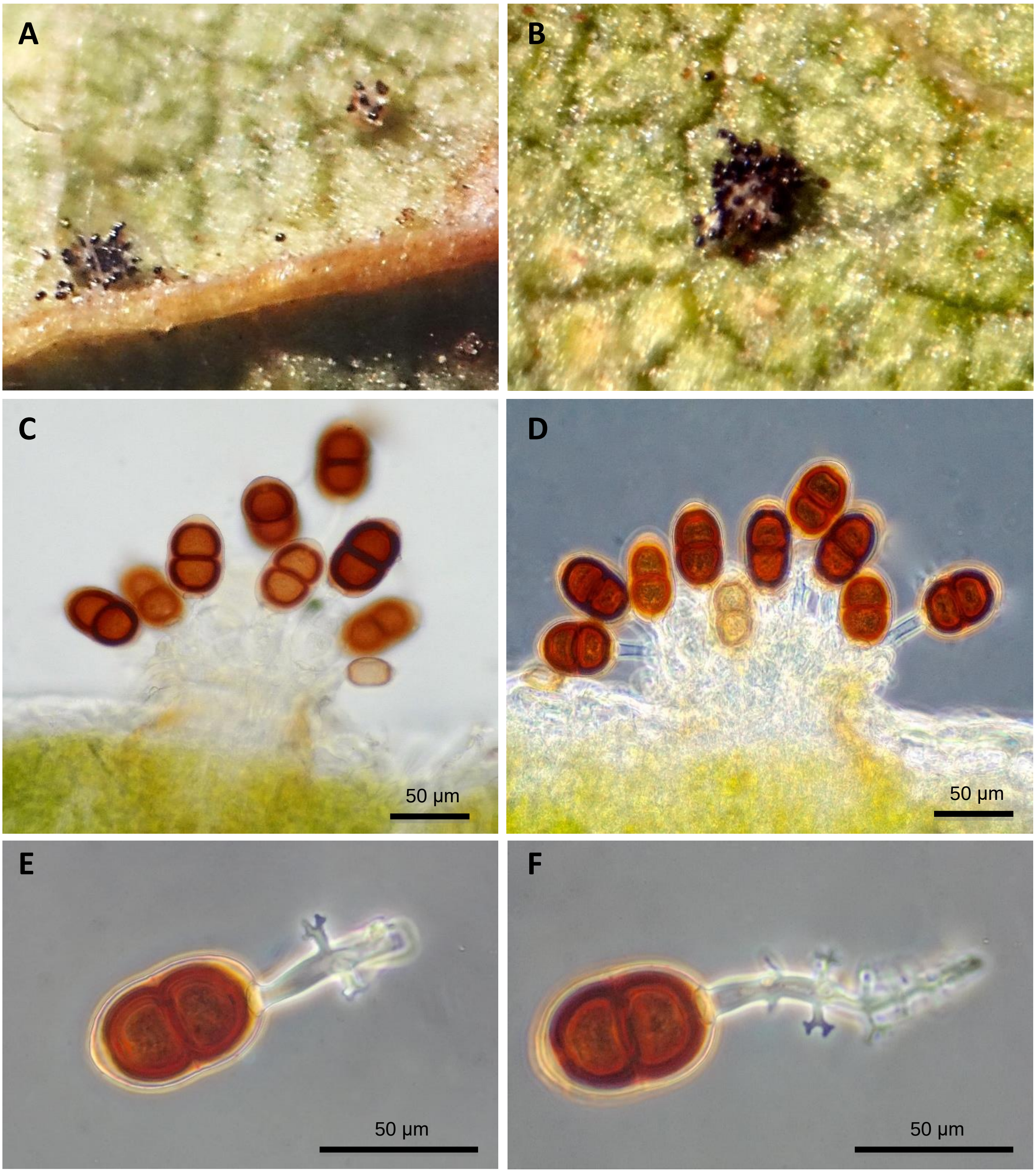

Fig 1 – Microscopic characteristics of *Prospodium appendiculatum* on *Tecoma stans*. A–B Close-up views of telia on the lower surface of leaves. C–D Longitudinal sections of telia showing teliospores. E–F Teliospores with appendages.

Symptoms of powdery mildew on leaves of *T. stans* showed irregular chlorotic lesions on the upper surface (Fig. 3A) and whitish to greyish fungal growth on the lower surface (Fig. 3B).

Microscopic examination revealed that hyphal appressoria were lobed and solitary or opposite in pairs. Conidiophores (*n* = 20) were erect, straight or slightly curved at the base, unbranched, cylindrical to filiform, 218–445 × 4.9–8.1 µm, and arising from superficial hyphae (Fig. 3C). Foot-cells of conidiophores were straight, cylindrical, 134–205 µm long, followed by 1 to 3 shorter cells or sometimes followed by a longer cell (Fig. 3D). Primary conidia (*n* = 50) were lanceolate, narrowed towards the pointed apex, 62.3–74.9 × 20.1–26.5 µm (Fig. 3E). Secondary conidia (*n* = 50) were clavate, ellipsoid to ovoid, 56.4–66.2 × 17.7–27.8 µm (Fig. 3F). Germ tubes were lateral, short, and with nipple-shaped appressoria. Chasmothecia were not observed. The specific measurements and morphological features were consistent with those reported for *Phyllactinia obclavata* (syn. *Ovulariopsis obclavata*) (Braun & Cook 2012, Kirschner et al. 2017).

Ovulariopsis obclavata was recently reassigned as *Phyllactinia obclavata* based on phylogenetic confirmations (Takamatsu et al. 2016) and it has been reported infecting *Tabebuia heterophylla* (Braun 1987, Kirschner et al. 2017) and *T. insignis* (Braun & Cook 2012) in Barbados; on *T. heterophylla* and *Handroanthus impetiginosus* in Argentina (Takamatsu et al. 2016); on *T. serratifolia* in Brazil; on *Spathodea campanulata* in Panama (Takamatsu et al. 2016, Kirschner et al. 2017); and on *T. rosea* in Venezuela (Kirschner et al. 2017).

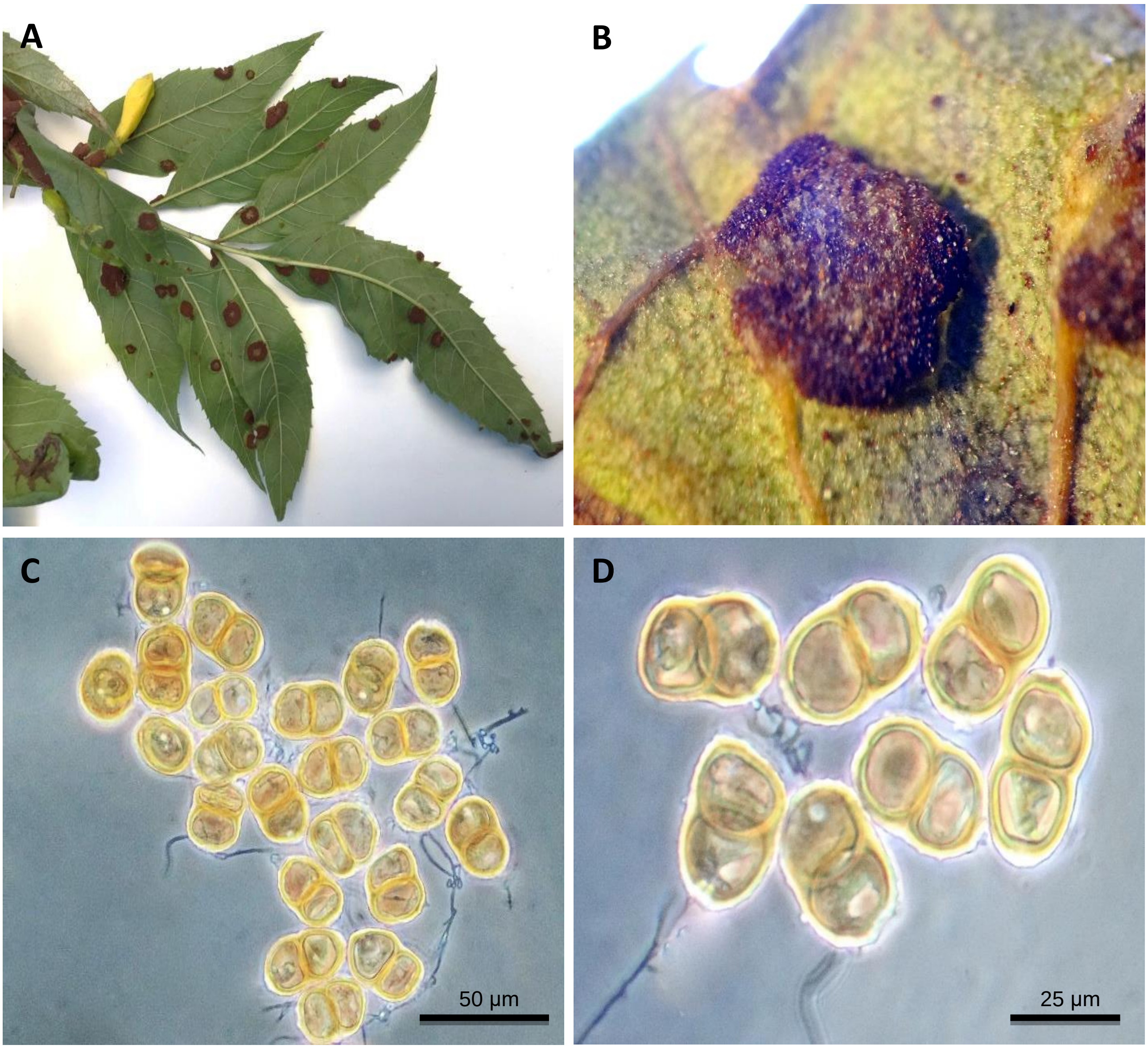

Fig 2 – *Prospodium transformans* on *Tecoma stans.* A Galls on lower surface of leaves. B Close-up view of a sorus. C–D Teliospores.

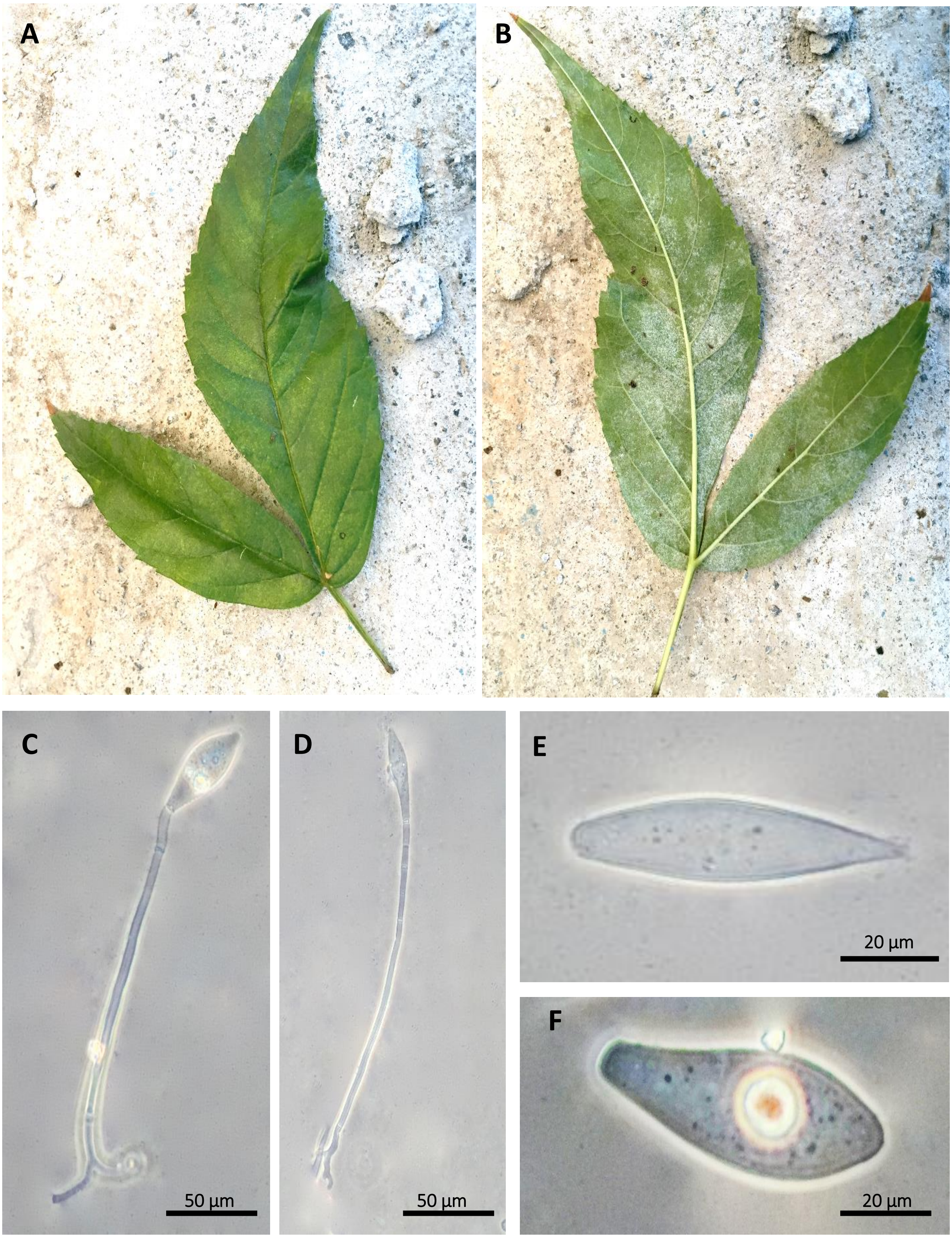

Fig 3 – *Phyllactinia obclavata* on *Tecoma stans.* A Upper surface of a leaf exhibiting irregular chlorotic lesions. B Lower surface of a leaf showing fungal growth. C–D Conidiophores with conidia. E Primary conidium. F Secondary conidium.

Our research demonstrated the occurrence of *Prospodium appendiculatum* and *P. transformans* causing rust symptoms on *T. stans* trees in the state of Tlaxcala, Mexico.

Furthermore, this is the first report of *Phyllactinia obclavata* causing powdery mildew of *T. stans* in Mexico. All three diseases represent a threat for *T. stans* trees in Mexico.

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