African Crop Science Journal, Vol. 18, No. 3, pp. 127 - 131 ISSN 1021-9730/2010 $4.00

FIRST RECORD OF GENUS LEVEILLULA ON A MEMBER OF THE MORACEAE: *Leveillula taurica* ON *Ficus carica*

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(Received 19 March, 2010; accepted 20 May, 2010)

ABSTRACT

A powdery mildew fungus *Leveillula taurica* (Erysiphales) is reported for the first time on fig tree (*Ficus carica*) (Moraceae) in Sistan region, Iran. One hundred fungal organs including clistothecia, asci, ascospores and conidia, were micrometried by the calibrated Olympus BH2 microscope. All characters of the organs were recorded and drawn using a drawing tube. Conidiophores were with cylindrical foot cells, bearing a single conidium or occasionally with short chains of 2–3 conidia. The fungus produced both primary and secondary conidia. Primary conidia were lanceolate and secondary ones were ellipsoid to cylindrical. Cleistothecia were 160–230 µm in diameter and cleistothecia appendages were myceliod. There were 20-30 cases in each cleistothecia which were clavate stalked. In each ascus, there were 1-4 ascospores which were ellipsoid-ovoid shaped. On the basis of morphological characters of the anamorph and telemorph, this fungus was identified as *Leveillula taurica*. This fungi is the second powdery mildew species in addition to *Oidium erysipheoide* reported for Moraceae. This is also the first report of genus *Leveillula* on Moraceae in the world making Moraceae the latest host family for *Leveillula taurica*.

Key Words: Ascospores, conidia, *Oidium erysipheoide*, powdery mildew

RÉSUMÉ

Le champignon *Leveillula taurica* (Erysiphales), mildiou poudreux, a été signalé pour la première fois sur le figuier (Ficus carica) (Moraceae) dans la région de Sistan en Iran. Cent organes fongiques comprenant l'asci, les ascospores et les conidia ont été measurés à l'aide d'un micromètre à microscope calibré, l'Olympus BH2. Tous les caractères des organes ont été enregistrés et dessinés à l'aide d'un tube pour dessin. Les conidiophores avaient des pattes à cellules cylindriques, munis d'une seule de conidium ou occasionnellement avec des chaînes courtes de 2-3 conidia. Les champignons avaient produit des conidia primaries à bout en forme de lance, ainsi que des conidia secondaires ellipsoides voire cylindriques. Les cléistothèces avaient un diamètre de 160-230 ìm ainsi que des appendices "myceliod". Le nombre d'"asci" variait de 20 à 30 dans chaque cléistothèces, et étaient claviformes et pétiolés. Les ascospores variaient de 1-4 dans chaque ascus, et étaient en forme ovoïde ellipsoïdale. Sur base des caractères morphologiques de l'anamorphe et le télémorphe, ce champignon était identifié comme étant *Leveillula taurica*. Il est la seconde espèce du mildiou podreux, en plus de l' Oïdium erysiphéoide reconnu pour Moraceae. Ceci est aussi le premier rapport du gène Leveillula sur les Moraceaes dans le monde, faisant du Moraceae la dernière famille d'acceuil pour *Leveillula taurica.*

Mots Clés: Ascospores, conidia, *Oïdium erysiphéoide*, oïdium

INTRODUCTION

The cultivated fig, *Ficus carica* L., is a member of the Moraceae and is native to western Asia and the eastern Mediterranean region (from Afghanistan to Greece). This plant is also economically significant in agriculture. The fig fruit is edible in fresh or dried forms but is also used in jam making. It is also rich in many nutrients, and a good source of flavinoids and polyphenols. Records of diseases of Moraceae present only one powdery mildew causing fungal species i.e., *Oidium erysiphoides*, on this host (Amano, 1986; Ershad, 2009). Searches of online databases by Farr *et al*. (2004) found no records of the genus Leveillula on any genera of the Moraceae, nor could such records be found in searches of Biological Abstracts or databases of the USA National Agricultural Library (Agricola). It appears, therefore, that there is no report of the genus *Leveillula* on Ficus species, or any other taxa in the Moraceae.

During the summer 2007, leaves of *F. carica* plants in some gardens in the Sistan region, eastern Iran displayed leaves covered with dense, white fungal mycelia. The fungus caused significant destruction of the crop making infected plants unsuitable for propagation. Preliminary examination revealed the fungus to be a powdery mildew with teleomorphic and anamorphic features conforming to *Leveillula taurica* (Lév.) Arnaud (Erysiphales) (Braun, 1987, 1995).

This fungus attacks an extremely broad range of plants and occurrence on both dicots and monocots (Braun 1987, 1995; Khodaparast *et al.,* 2001). *Leveillula taurica* is "undoubtedly a collective species" (Braun, 1987), yet only *Oidium erysiphoides*, another powdery mildew fungus, has been reported on this host from Iran (Ershad, 2009; Amano, 1986). No reports of any *Leveillula* species on a member of the Moraceae has been made. Because host specificity has been used as a criterion for distinguishing *Leveillula* species (Braun 1987, 1995; Khodaparast *et al.,* 2001), it is possible that this fungus existed on this host but simply remained undescribed. In this study we investigated characteristics of the fungus.

MATERIALS AND METHODS

During the autumn 2007, typical symptoms of powdery mildew were observed in several fig gardens assessed in Sistan region, Iran (Fig. 1). Samples were stained with Lactofushin (Carmichael, 1955) and morphological and morphometrical characteristics of the fungus studied. One hundred of any telemorph organs (ascocarp, ascus, ascospores and appendages of ascocarps) and one hundred of anamorph organs (conidiophore, conidium, germ tube and hyphae) were investigated under the calibrated Olympus BH2 microscope and drawn with the aid of a drawing tube connected to the microscope. Observations of conidial germ tubes was carried out using the method of Hirata (1942). Photographs were taken and identification of species carried out following guidelines of Braun (1987, 1995). Specimens were deposited with the mycological herbarium in the Department of Plant Pathology, Faculty of Agriculture, University of Zabol.

RESULTS AND DISCUSSION

Diseased plants exhibited dense, compact, white mycelia, typically 1–3 cm in length, forming irregular white patches, sometimes effused to cover the whole leaf surface of *F. carica* (Fig. 1). Microscopic examination revealed conidiophores and masses of conidia within the

Figure 1. *Leveillula taurica* on *Ficus carica*. Infected leaf with sporulating mycelia.

mycelia on the leaves. Within mycelia, there was also immature and mature chasmothecia (Fig. 2). Morphological features of the fungus are described as follows:

Infected leaves which tended to become chlorotic and necrotic in areas distal to infections.

Conidiophores were erect, 115-195 x 4/5-7/8 µm, with cylindrical foot cells, 40-126 x 4/5-7/8 µm, bearing a single conidium or occasionally with short chains of 2–3 conidia (Fig. 3A). The fungus produced both primary and secondary conidia. Primary conidia (Fig. 3B) were lanceolate with narrowed apex and relatively broad base, 43–71 x 12–20 µm with L/W 2.5–3.55. Secondary conidia (Fig. 3C) were ellipsoid to cylindrical, 45–67 x 13-22 µm, with germ tubes often arising near end of conidia and seldom arising at the side of conidia. Appressoria were usually absent (Fig. 3D).

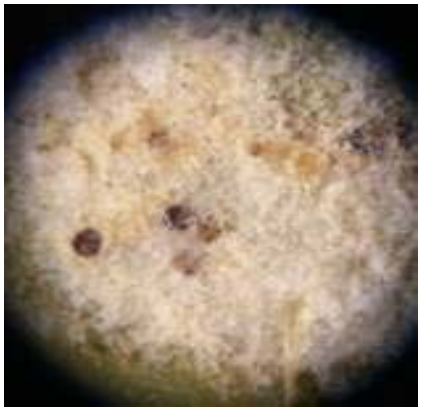

Figure 2. Ascomata of *Leveillula taurica* embedded in the mycelial felt on *Ficus carica* leaves.

Cleistothecia were found embedded in the mycelial felt, became dark brown to black at maturity, were gregarious to scattered (Fig. 2) and measured 160–230 µm in diameter (Fig. 5). Cleistothecia appendages were myceliod, arising from the lower half of ascomata, brown, paler upward (Fig. 4). The number of asci ranged from 20-30 in each cleistothecia, were clavate, stalked and measured, 77-120 x 25-42 µm (Fig. 5). Ascospores ranged from 1-4 in each ascus, and were ellipsoid-ovoid shaped measuring 25-40 x 15-22 µm (Fig. 5).

On the basis of morphological characters of the anamorph and telemorph, this fungus was identified as *Leveillula taurica* (Braun, 1987, 1995). Braun (1987) listed 52 host plant

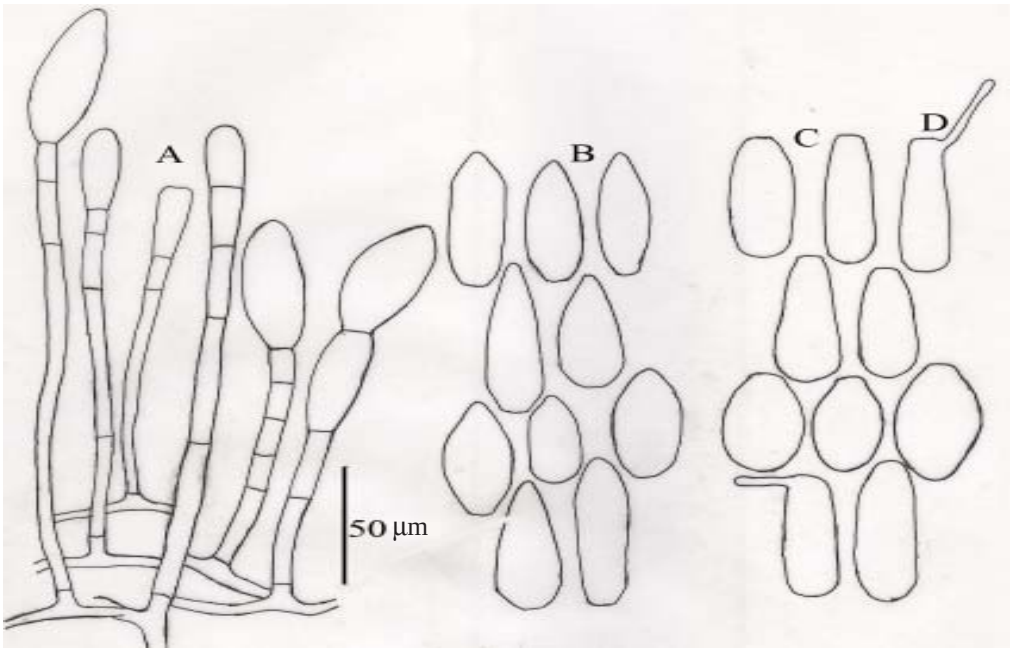

Figure 3. *Leveillula taurica* (anamorph). (A) conidiophores, (B) primary conidia, (C) secondary conidia, (D) germinated conidium.

Figure 4. Cleistothecium of *Leveillula taurica* (10X) on *Ficus carica* with appendages.

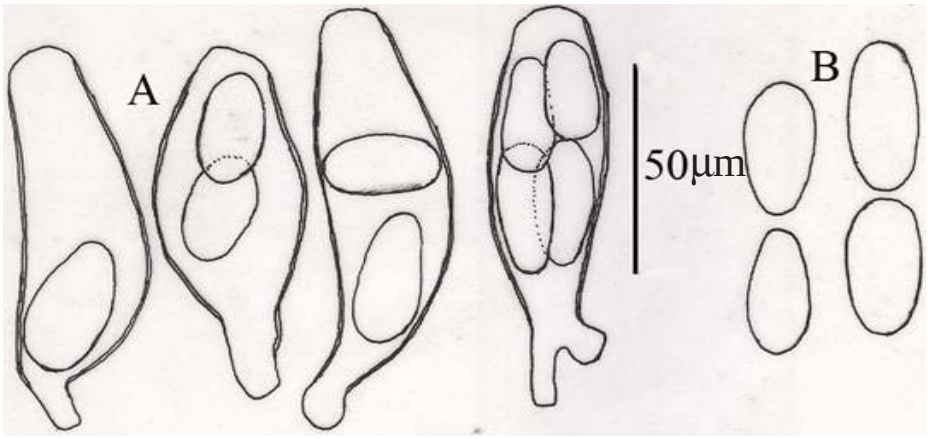

Figure 5. *Leveillula taurica* (telemorph). (A) asci, (B) ascospores

families for *L. taurica* which he regarded as a "collective species." He reviewed earlier attempts to segregate *L. taurica*-like fungi among separate species on the basis of host and concluded that a morphologically-based species concept was preferable given the lack of sufficient host range studies.

In addition to *Oidium erysiphoides* the only powdery mildew reported on this host before (Ershad, 2009; Amano, 1986), *Leveillula taurica* is now the second powdery mildew species to be reported on this host. *Ficus carica* is therefore a new host for this fungal species. This is also the first record of genus Leveillula on Moraceae in world and Moraceae is a new host family for *Leveillula taurica*.

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