

Biodiversity of *Fusarium* species in Mexico associated with ear rot in maize, and their identification using a phylogenetic approach

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Abstract

Fusarium proliferatum, *F. subglutinans*, and *F. verticillioides* are known causes of ear and kernel rot in maize worldwide. In Mexico, only *F. verticillioides* and *F. subglutinans*, have been reported previously as causal agents of this disease. However, *Fusarium* isolates with different morphological characteristics to the species that are known to cause this disease were obtained in the Highland-Valley region of this country from symptomatic and symptomless ears of native and commercial maize genotypes. Moreover, while the morphological studies were not sufficient to identify the correct taxonomic position at the species level, analyses based in the Internal Transcribed Spacer region and the Nuclear Large Subunit Ribosomal partial sequences allowed for the identification of *F. subglutinans*, *F. solani*, and *F. verticillioides*, as well as four species (*F. chlamydosporum*, *F. napiforme*, *F. poae*, and *F. pseudonygamai*) that had not previously been reported to be associated with ear rot. In addition, *F. napiforme* and *F. solani* were absent from symptomless kernels. Phylogenetic analysis showed genetic changes in *F. napiforme*, and *F. pseudonygamai* isolates because they were not true clones, and probably constitute separate sibling species. The results of this study suggest that the biodiversity of *Fusarium* species involved in ear rot in Mexico is greater than that reported previously in other places in the world. This new knowledge will permit a better understanding of the relationship between all the species involved in ear rot disease and their relationship with maize.

Key words: fungus, ITS, nLSU, seed, *Zea mays*

Introduction

Maize (*Zea mays* L.) is one of the four basic food staples of the world population [1] and at the same time is the crop that has the first place in production volume in the world. In developed countries most of the maize produced is used for animal feed and industrial uses other than human food [2]. In Mexico maize is the main human food source and *per capita* consumption is estimated to be 328 g day⁻¹ [3].

The majority of the reported maize diseases, affecting roots, stalks, ears, and kernels, are caused by fungi [4]. Among these diseases, ear rot is one of

the most important in all the countries where this cereal is grown. In addition to reduced crop yield, ear rot adversely affects the physical, physiological, and phytosanitary qualities of the seed [5, 6]. The causal agents reported worldwide as responsible for ear rot are *Fusarium proliferatum*, *F. subglutinans*, and *F. verticillioides* [4]. These pathogens survive in the soil, in infected plant debris, and inside apparently healthy seed and can affect the embryo and pericarp without visible symptoms. Infection can be seedborne and systemic in the crop from seedling to harvest, or starting during the pollination where the silks are