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Is morphology in *Cercospora* a reliable reflection of generic affinity?

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Abstract

Cercospora (Mycosphaerellaceae) is a large genus of fungi comprising many important plant pathogens. In recent years DNA-based studies have revealed multiple genera of cercosporoid fungi being poly- and paraphyletic. Among these genera, the genus *Cercospora* has always been perceived as monophyletic. In the present study, phylogenetic inferences based on partial gene sequences of the LSU, ITS, ACT, TEF1-α and HIS loci, elucidated a cercospora-like taxon from *Ammi majus* to cluster in a clade apart from *Cercospora s. str.* In spite of numerous *Cercospora* spp. presently known from their DNA sequence data, this collection represents the first concrete evidence to the fact that the morphological characters previously attributed to *Cercospora s. str.* evolved more than once in the Mycosphaerellaceae. The genus *Neocercospora* is subsequently introduced to accommodate the Iranian taxon occurring on *A. majus*. Further collections on other hosts and from different continents are now required to establish the prevalence and relative importance of species of *Neocercospora*.

Key words: biodiversity, cercosporoid hyphomycetes, Mycosphaerellaceae, *Neocercospora*, phylogeny

Introduction

Cercosporoid fungi or *Cercospora s. lat.* belonging to Mycosphaerellaceae (Capnodiales), include numerous economically significant plant pathogens causing leaf spots on a wide variety of woody and herbaceous plants, but also can cause necrotic lesions on flowers, fruits, bracts, seeds and stems (Goodwin *et al.* 2001, Crous & Braun 2003, Agrios 2005). They are found in different geographical and climatic zones across the world, and are especially abundant and diverse in tropical and subtropical areas (Braun *et al.* 2013, 2014). The frequent association of cercosporoid fungi with plant diseases has stimulated substantial interest in this group, and much of this attention has been focused on the systematics of species and genera in this complex (Deighton 1976, Pretorius *et al.* 2003, Braun & Crous 2005, Crous *et al.* 2006, Arzanlou *et al.* 2008, Nakashima *et al.* 2011, Braun *et al.* 2013).

The first genus of cercosporoid hyphomycetes, *Passalora*, was introduced by Fries (1849), followed by *Cercospora* introduced by Fresenius (in Fuckel 1863). Since then, the taxonomy of this group has proven highly problematic. Chupp (1954) published the first monograph of cercosporoid hyphomycetes in which he followed a very broad generic concept and reduced many of the cercosporoid genera to synonymy with the genus *Cercospora*. Contrary to this approach, Deighton (1967, 1973, 1976, 1979, 1987, 1990) and Ellis (1971, 1976) in their treatments of cercosporoid fungi narrowed the generic concept of *Cercospora s. lat.* and divided it into smaller morphological units. Later, Crous & Braun (2003) reviewed the genera of cercosporoid fungi and, due to numerous morphologically intermediate taxa and the first phylogenetic results based on DNA sequence data being available at the time (Crous *et al.* 2000), rearranged them into four genera *viz. Cercospora*, *Passalora*, *Pseudocercospora* and *Stenella*. These cercosporoid genera are mainly separated based on a combination of characters, of which the structure of the conidiogenous loci (scars) and hila, and the presence or absence of pigmentation in conidiophores and conidia are considered to be the most important (Crous & Braun 2003).

With progress towards a stable phylogeny for the Mycosphaerellaceae (Arzanlou *et al.* 2007, Crous *et al.* 2007,

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