



Morphological and molecular identification of *Alternaria hedjaroudei* sp. nov., a new species in section *Panax* from Iran

ESMAEIL HASHEMLOU^{1,4}, YOUBERT GHOSTA^{2,5}*, ALIREZA POURSAFAR^{1,6} & RAZMIG AZIZI^{1,7}

¹Department of Plant Protection, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran.

²Department of Plant Protection, Faculty of Agriculture, Urmia University, Urmia-Iran.

³Central Laboratory of College of Agriculture & Natural Resources, University of Tehran, Karaj, Iran.

⁴✉ esm.hashemloo@gmail.com; <https://orcid.org/0000-0002-9129-9778>

⁵✉ y.ghosta@urmia.ac.ir; <https://orcid.org/0000-0003-4038-2448>

⁶✉ a.resapoursafar@gmail.com; <https://orcid.org/0000-0002-4296-8197>

⁷✉ razmik.azizi@gmail.com; <https://orcid.org/0000-0002-1288-6967>

*Author for correspondence

Abstract

Alternaria section *Panax* currently includes seven species which are characterized by simple or branched and short to moderately long primary conidiophores as well as by solitary to short simple or branched chains of conidia with moderate to relatively long secondary conidiophores. Two species within the section have been reported to have sexual morphs. During the study of fungi on overwintered stems of *Serratula coriacea* Fisch. & C.A.Mey. (Asteraceae) from different regions of Urmia, West Azarbaijan Province, Iran, 26 isolates (16 from conidia and 10 from single ascospores) representing *Alternaria* characteristics were isolated and studied taxonomically. All the studied isolates formed sexual morph on PDA, PCA, V8-A, and HA media after 2 months incubation in the dark at 4 °C and fully matured after 3 months. Based on morphological characteristics of sexual and asexual morphs and multiple gene sequences analyses (ITS-rDNA, *GAPDH*, *RPB2* and *TEF*), the newly studied isolates represented a new species in *Alternaria* section *Panax*, which is described and illustrated here as *Alternaria hedjaroudei*. *Alternaria hedjaroudei* is phylogenetically close to *A. avenicola*, *A. calycipyricola* and *A. photistica* but it can be distinguished morphologically based on the formation of short chains of conidia (2–3 in a chain), absence of chlamydo-spores, smaller conidia size, relatively short secondary conidiophores, and fewer transverse septa in mature ascospores. Detailed morphological comparisons with other species in the section *Panax* are provided.

Keywords: 1 new species, morphology, phylogeny, *Pleosporaceae*, taxonomy

Introduction

Alternaria Nees: Fr. as a cosmopolitan fungal genus comprises a multitude of species with different life styles such as saprophytes, endophytes and phytopathogens (Rotem 1994, Woudenberg *et al.* 2013, Lawrence *et al.* 2016). As saprophytes, the species were reported from very diverse substrates such as soil, seeds, decaying materials and atmosphere (Thomma 2003, Simmons 2007, Lawrence *et al.* 2012). They can grow on and decay food products and feedstuffs, and produce different mycotoxins and other bioactive compounds (Andersen *et al.* 2001, Labuda *et al.* 2008). From the original description of *Alternaria* by Nees (1816), there have been great controversies in delimitation and identification of species boundaries because of the reliance on morphological characteristics, host specificity and/or examining the isolates directly collected from nature (Elliott 1917, Neergaard 1945, Joly 1964, Simmons 1967, 1992, Nishimura & Kohmoto 1983, Rotem 1994). Due to the effects of environmental and cultural conditions on morphological characteristics of *Alternaria* isolates, Simmons (1992) pointed out optimal standardized growth conditions in order to produce consistent and coherent results. Furthermore, a species-group concept was defined to accommodate taxa with similar sporulation patterns and with high degree of similarity in conidial characteristics, each typified by a representative species. In another work, Simmons & Roberts (1993) subdivided small-spored chain forming taxa into six morphological groups. Later on, several species-groups were described (Simmons 1995, Hong *et al.* 2005, Lawrence *et al.* 2012, 2013). Based on molecular revision of *Alternaria*, it was appeared that *Alternaria* species cluster in several distinct clades which were subsequently proposed as sections and eight *Alternaria* sections were established (Lawrence *et al.* 2013). In another comprehensive phylogenetic study, 18 more phylogenetic groups