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Review

What is in a name? *Terfezia* classification revisited

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ABSTRACT

Desert truffles (mycorrhizal hypogeous *Ascomycota*) are found in arid and semi-arid areas of the globe and have great ecological and economic importance. *Terfezia* is undoubtedly the most diversified of all desert truffle genera, but its taxonomy is far from resolved. Specifically, the large number of newly described species plus the high intraspecific morphological variability observed within some *Terfezia* lineages as rendered the use of molecular techniques mandatory for specimen's discrimination. But the subsequent increasing amount of sequence data produced also a huge number of undescribed *taxa* that required determination. We compiled and used the public available ITS data on *Terfezia* spp. on the custom-curated UNITE database to reconstruct the genus phylogeny. We found at least 17 distinct lineages within the genus and successfully resolved some of the more pressing taxonomic issues, namely the *T. leptoderma/olbiensis* complex and some misapplied synonymy. Based on this resolved phylogeny, and motivated by the recent new described species, we proposed an identification key to *Terfezia* genus highlighting the importance of morphological and ecological characterization.

1. Introduction

Desert truffles are hypogeous *Ascomycota* that have evolved in several lineages within the *Pezizaceae*, and are typically found in arid and semi-arid areas throughout the world (Moreno et al., 2014; Morte et al., 2009; Navarro-Ródenas et al., 2011). They represent a key component of the mycological flora around the Mediterranean basin, establishing important mycorrhizal symbioses with diverse host plants, most often members of the Cistaceae (Díez et al., 2002; Kagan-Zur and Roth-Bejerano, 2008). Many of them are endemic and overall play an essential role in soil conservation - preventing erosion and desertification - of Mediterranean shrublands and xerophytic grasslands (Honrubia et al., 1992).

Terfezia Tul. & Tul. is undoubtedly the most diversified of all desert truffle genus (Kovács and Trappe, 2014). The first *Terfezia* species was described by Moris, as *Tuber arenarium* Moris, from Sardinia in 1829. Soon after, Tulasne and Tulasne, described two more *Terfezia* species which they named *Choiromyces olbiensis* and *C. leptodermus*. Only in 1851, the same authors proposed the creation of the genus *Terfezia*. At the time, they included five species within the genus: *T. arenaria*, *T. leptoderma*, *Terfezia olbiensis* - previously described - plus *T. berberidiodora* and *T. oligosperma* (Alsheikh, 1994; Kovács and Trappe, 2014). Meanwhile several other species were described and later, in 1869, summarized in the book "La Truffe" by Chatin. The first identification keys for the African, Asian, European and North American species were provided by Fischer, Bataille, Mattirolo and Gilkey but it was Alsheikh who, in 1994, first monographed the genus worldwide (Alsheikh, 1994).

Despite the aforementioned contributions, the nomenclatural and taxonomic history of the genus is filled with several old species names, many of them synonyms of earlier described species (Alsheikh, 1994), some lacking useful diagnostic features and most of them rarely cited after the first time (Zitouni-Haouar et al., 2018). The situation lingered in the pre-molecular era because the criteria for separating and/or identifying groups of species were limited largely to morphological, anatomic and chemical features (Bordallo and Rodríguez, 2014) which were not always unambiguous. As pointed out by Díez et al. (2002), the use of this type of features alone for classifying desert truffles is challenging, due to the reduced set of morphological characters and their homoplasy. The observed morphological convergence is likely to be environmental conditioned, but the possibility that in some cases speciation has occurred with hardly detectable morphological changes should also be acknowledged (Bordallo and Rodríguez, 2014; Díez et al.,

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