

## Phylogenetic placement, floral anatomy, and morphological characterization of the North African pastoral halophyte *Atriplex mollis* Desf. (Amaranthaceae)

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**Abstract:** *Atriplex mollis* Desf. (Amaranthaceae), a North African endemic halophytic species, is further described in this study. Phylogenetic analysis based on a combined dataset of ITS and ETS rDNA and *atpB-rbcL* and *trnK* cpDNA showed that *A. mollis* is closely related to the Malta- and Gozo-endemic *Cremonophyton lanfrancoi* Brullo & Pavone. Given this close phylogenetic relationship, *A. mollis* is also considered among the oldest species of *Atriplex*, together with *C. lanfrancoi*. Molecular data also suggest that *A. mollis* in North Africa, *C. lanfrancoi* on Malta Island, and *Atriplex cana* Ledeb. in Eurasian semideserts constitute a separate clade within the tribe Atripliceae. As an 18-month-old shrub, *A. mollis* can reach a mean height of  $44.06 \pm 8.09$  cm with a leaf area around  $1.24 \pm 0.15$  cm<sup>2</sup>, and can produce seeds in order of  $113.08 \pm 28.52$  g plant<sup>-1</sup>. The anatomy of *A. mollis* shows the presence of male and female developed flowers. Hermaphroditic flowers that may lead to the appearance of male flowers with underdeveloped female organs were rarely found. Three main shapes of ovule (campylotropous, amphitropous, and orthotropous) were found in *A. mollis*.

**Key words:** *Atriplex*, *Cremonophyton*, floral anatomy, ITS, ETS, *atpB-rbcL*, *trnK*, phylogeny, morphology

### 1. Introduction

The genus *Atriplex* is among 12 genera belonging to the tribe Atripliceae. The 11 genera in addition to *Atriplex* are: *Archiatriples* G. L. Chu, *Axyris* L., *Ceratocarpus* L., *Endolepis* Torrey, *Exomis* Fenzl ex Moq., *Grayia* Hooker & Am., *Krascheninnikovia* Gueldenst., *Microgynoecium* Hooker, *Spinacia* L., *Zuckia* Standley, and *Proatriplex* (Weber) H. C. Stutz & G. L. Chu (Flores and Davis, 2001). A large distribution has been recorded for the genus *Atriplex* around the world. Typically, in subtropical and temperate regions *Atriplex* species can be annual or perennial subshrubs or shrubs growing on steppes and in deserts and coastal habitats (Kadereit et al., 2010). Their basic chromosome number is  $x = 9$  (Nobs, 1975) with a variable ploidy level, usually diploid ( $2n = 18$ ), and polyploid only in a few cases.

*Cremonophyton lanfrancoi*, described by Brullo and Pavone (1987) as a new genus of the Amaranthaceae, was subsequently included in the genus *Atriplex* (synonym: *Atriplex lanfrancoi*), according to Kadereit et al. (2010). This species is the exception of the *Atriplex* genus due

to its different chromosome number ( $2n = 20$ ) (Brullo and Pavone, 1987). *Atriplex confertifolia* (Stutz and Sanderson, 1983), *Atriplex cana* (Sukhorukov, 2006), and *Cremonophyton lanfrancoi* (Brullo and Pavone, 1987) are mentioned as ancient lineages of *Atriplex* and represent the Pleistocene and Oligocene/Miocene, respectively.

Regarding the morphological features, small seeds with bracteoles and flowers usually unisexual are the principal characters of *Atriplex* species (Pottier-Alapetite, 1979; Flores and Davis, 2001). This genus contains about 400 species. Among these, 48 species are Mediterranean and habitually used as a fodder reserve (Ortíz-Dorda et al., 2005). According to Le Houerou (1992), the arid lands include 6 autochthone saltbushes, and the introduced, exotic species are mainly from Australia and America.

Among the native species on the southern border of the Mediterranean basin (North Africa), *Atriplex mollis* Desf. has been reported in Tunisia, Algeria, and Libya as endemic (Greuter et al., 1984) and was later observed in Greece (Crete, Chania, and the Island of Gavdopoula) as a supralittoral shrub (Greuter and Raus, 1999). It has been

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