INTRODUCTION

The genus *Tamarix* (Tamaricaceae) includes, according to different authors, between 65 and 90 species (Baum, 1978; Liu Shu, 2007) that are native to Asia, Africa and Europe. Many *Tamarix* species grow in xeric environments with some degree of salinity, and species are common in deserts, coastal sand dunes, salt marshes and ravines, although some species are also able to occur in freshwater habitats such as river banks. The complex taxonomy of this genus has been reported several times since the XIX century (Bunge, 1852; Baum, 1978; Zohary, 1987). Some of the characters that have been used for species separation are in fact variable in individuals of the same species, or even in a single individual (Jahandiez & Maire, 1932; Quézel & Santa, 1963). Of the 14 species included in *Flora Europaea* (Baum, 1990), four were cited for the Iberian Peninsula and the Balearics (e.g., Cirujano, 1993; Mateo & Crespo, 2009; Salazar & Quesada, 2010). The present study is aimed to clarify the relationships between these species.

MATERIAL AND METHODS

For this study around 170 herbarium specimens of *T. africana*, *T. boveana* and *T. dalmatica* from ABH, HUAL, G, JAEN, K, MA, MPU, PR, PRC, UIB, VAL and W (acronyms according to Thiers, 2011) were examined. These included the holotype (PRC) and two isotypes (W and PR) of *T. dalmatica*, and also isotypes of *T. boveana* and *T. africana*. Se realiza una comparación morfológica entre las tres especies y un estudio crítico de las causas que han provocado dicha confusión. Así mismo, se discute la variabilidad existente en algunos caracteres morfológicos utilizados para la identificación de estas especies, así como algunas discrepancias entre las descripciones originales publicadas y el material tipo. Como conclusión se descarta la presencia de *T. dalmatica* en la flora ibero-balear.

Keywords: *Tamarix dalmatica*, *Tamarix boveana*, *Tamarix africana*, morphological characters, taxonomy, systematics, Iberian Peninsula.

Abstract


The presence of *Tamarix dalmatica* in the Iberian Peninsula, and its confusion in Spain with the native species *T. boveana* and *T. africana*, is discussed. A morphological comparison between these three species, and a critical study of the causes for the confusion between them, is presented. This includes an analysis of the variability in some morphological characters used for the identification of these species, together with clarifications of some discrepancies between the original descriptions and our observations of the type material. As a conclusion, *T. dalmatica* is excluded from the Iberian and Balearic floras.

Keywords: *Tamarix dalmatica*, *Tamarix boveana*, *Tamarix africana*, morphological characters, taxonomy, systematics, Iberian Peninsula.

Resumen


Se discute la presencia de *Tamarix dalmatica* en la Península Ibérica e Islas Baleares. Se pone de manifiesto la frecuente confusión de esta especie, en el territorio peninsular, con las nativas *T. boveana* y *T. africana*. Se realiza una comparación morfológica entre las tres especies y un estudio crítico de las causas que han provocado dicha confusión. Así mismo, se discute la variabilidad existente en algunos caracteres morfológicos utilizados para la identificación de estas especies, así como algunas discrepancias entre las descripciones originales publicadas y el material tipo. Como conclusión se descarta la presencia de *T. dalmatica* en la flora ibero-balear.

Palabras clave: *Tamarix dalmatica*, *Tamarix boveana*, *Tamarix africana*, caracteres morfológicos, taxonomía, sistemática, Península Ibérica.

* Corresponding author.
The morphological characters of the studied materials of T. boveana and T. dalmatica were compared with the original descriptions and with morphological data taken from other studies (Bunge, 1852; Baum, 1978; Cirujano, 1993). For species identification various monographs were used (Bunge, 1852; Baum, 1978; Cirujano, 1993). Author abbreviations follow Brummitt and Powell (1992), and have been updated according to the IPNI (2011). Detailed photographs of T. africana, T. boveana and T. dalmatica were made using a binocular microscope (Olympus SZX12) with adapted camera.

RESULTS

Our study of the herbarium specimens (Appendix 1) identified as T. dalmatica in Spain in various reports revealed that most of them correspond in fact to T. boveana, and some to T. africana, but none was found to correspond to T. dalmatica. The reports of T. dalmatica in Majorca could not be checked because no vouchers were found in the herbaria consulted. However, since no specimen resembling T. dalmatica has been found among the Balearic collections studied, or was collected during the last years of our research, its presence in the Balearic Islands is very unlikely.

Tamarix boveana and T. africana are the two species in the Iberian Peninsula that most resemble T. dalmatica. The latter species has often been confused with T. boveana due to some similarities in floral morphology, although in the field T. africana looks much closer to T. dalmatica.

Despite their general similarity, some differences can be highlighted: T. dalmatica and T. africana have similar leaves, although those of T. africana are markedly auriculate, but in both species the longest leaves are shorter than 4 mm, whereas those of T. boveana can reach up to 7 mm. The racemes (Fig. 1) of T. boveana are longer and wider (up to 12 cm long and 13 mm wide) than those of T. dalmatica (up to 6 cm long and 7 mm wide) and T. africana (up to 6.5 cm long and 7 mm wide).

Bracts are also quite similar in T. africana and T. dalmatica, being typically broadly triangular to oblong, obtuse, and usually shorter than 3 mm, almost equaling the calyx or slightly overtopping it. Those in T. boveana are also oblong and obtuse, but they are much longer, clearly overtopping the calyx, and frequently reaching 5-6 mm in length (Fig. 2). The flowers of T. africana are usually pentameric, whilst those of T. boveana and T. dalmatica are usually tetramerous. Although all three species show exceptions, T. dalmatica is the most variable in the number of pieces in the floral whorls. The size of the sepals can overlap in all three species, but whilst those in T. boveana can reach 3.5(4) mm in some cases, in T. dalmatica and T. africana they are usually smaller (Fig. 2). Petals are elliptic-oblong to obovate unguiculate in T. boveana, whereas they are ovate to elliptical (or oblong-cuneate in var. fluminensis Maire) in T. africana, and obovate elliptical with a cuneate base in T. dalmatica (Fig. 2). The ovary of T. africana bears 3 styles, whereas in T. boveana it usually has 4 styles (rarely 3). Similarly, T. dalmatica usually has 4 styles, but 3-styled ovaries are not uncommon and this species is the most variable of the three with regard to this character.

Some differences can also be found in the habitat requirement. T. boveana is hyper-halophilous, whereas T. dalmatica and T. africana are halo-tolerant, and able to grow near freshwater environments. More complete descriptions of the three species are given below.

DISCUSSION

The confusion that led to several erroneous reports of T. dalmatica in the Iberian Peninsula was probably due to a number of factors. A widely used character to distinguish between species or groups of species in Tamarix is the nectariferous disc (Baum, 1978; De Martis & al., 1984; Cirujano, 1993). Baum (1978) established three types of nectariferous disc according to the fusion of the stamen filaments to the disc: synlophic, paralophic, and holophoric.

Although this is a very useful character, it can be problematical since differences between synlophic and paralophic discs are often very weak. Distinction between paralophic and holophoric discs can also be unclear, particularly when the lobes are not well developed and the disc is circular in shape. Some authors have questioned the reliability of the nectariferous disc shape for some species (Zohary 1987), and in the Flora of China (Liu Shu, 2007), only two types are distinguished: those in which the staminal filaments are inserted on top of the disc lobes, and those in which the filaments are inserted between the lobes. According to the observed variability, the option of using only two types of nectariferous disc seems to work better in the species with marked morphological plasticity. Disc type may have been a reason for some misidentifications.

The disc of T. dalmatica has been defined as paralophic in several works, whilst T. africana and T. boveana discs were defined as synlophic (Baum, 1978; Cirujano, 1993). However, this character is especially variable in T. boveana (see species description below), and clear assignation to any of those disc types is sometimes extremely difficult.

The number of petals and sepals is an important character to note. T. boveana and T. africana have been considered quite stable in the number of sepals and petals (tetramerous...
**KEY TO THE STUDIED SPECIES**

1. All flowers in the racemes pentamerous, or exceptionally with only a few tetramerous ............................................... **T. africana**

2. Racemes 2-4(6) cm long and 4.5-5.5(7) mm wide. Bracts 1.25-2.25(3) mm long, usually slightly shorter than the calyx .............. **T. boveana**

The following descriptions are included to facilitate further identification of taxa. They are based on our observations of many specimens of the three species, including type materials of both **T. dalmatica** and **T. boveana**.
Tamarix dalmatica Baum

Leaves 1.5-3(4) mm long, narrowly triangular, acute, with narrow decurrent base, the larger slightly auriculate. Inflorescence composed of racemes arranged in unbranched spike-like panicles. Racemes 20-40(60) × 4.5-5.5(7) mm, with a short peduncle (2-3 mm) covered by scarios bracts. Rachis glabrous. Bracts 1.25-2.25(3) mm long, shorter to equalling the calyx, rarely longer, broadly triangular to obtuse, patent, slightly concave, with the apex sometimes scarios and incurved, base decurrent and narrow. Pedicels ca. 0.5 mm. Sepals 4 (sometimes 5), 1.2-1.7(2) × 1.1-1.4 mm, broadly ovate to elliptic, with a hyaline irregular and finely denticulate margin; the 2 external from obtuse to acute, sometimes with prominent central nerve, the 2(3) internal ones obtuse. Petals 4 (5), 2.5-3.25(3.5) × 1.2-1.5 mm, oblong-elliptical with a central nerve, the 2(3) internal ones obtuse. Filaments 4(5), inserted on the top of disc lobes, the lobes short and filament insertion truncate (abrupt). Anthers not apiculate. Ovary with 4 styles, rarely 3.

Tamarix boveana Bunge

Leaves 2-4(7) mm long, narrowly lanceolate acute, the longer triangular with wide base at flowering time, markedly auriculate in late summer and autumn shoots. Inflorescence composed of racemes arranged in unbranched spike-like panicles. Racemes 40-120(150) × 7-13 mm, very large, with a peduncle up to 1 cm long, with some long and wide oblong bracts. Rachis from papillose to almost glabrous. Bracts 4-6(7.5) × 0.5-1 mm, oblong-obtuse, sometimes with scarios incurved apex, base decurrent, divaricate to recurved at fruit stage, with papillose margin and surface, longer to much longer than calyx; exceptionally 1-3 extra bracts* can be found on the pedicels of flowers at the base of racemes, these bracts being triangular linear and usually shorter than 2 mm. Pedicels 0.5-1 mm, sometimes slightly recurved. Sepals 4 (rarely 5, exceptionally 6), (1.8)2-3.5(4) × 1.25-2.5 mm, ovate-oblong, sub-equalling to slightly longer than calyx, broadly triangular to oblong, sometimes with scarios incurved apex, usually obtuse, with papillose margin, base narrow decurrent to calcate, sometimes with 2 small auricles that are also decurrent. Pedicels ca. 0.5 mm. Sepals 5 (rarely 4, exceptionally 6), broadly ovate to oblong, obtuse, with a narrow hyaline margin entire or finely denticulate; the 2 external (1.1)2.5-2.2(5) mm long, mostly with prominent central nerve, the 2 internal 0.8-1.5 mm long. Petals 5 (rarely 4, exceptionally 6), 2-3(4)* × 0.9-1.5(2) mm, ovate to elliptic (or oblong-cuneate to oblong-unigulate)**. Filaments 5 (rarely 6-8, and exceptionally 4), inserted on the top of the disc lobes, the insertion cuneate (when extra filaments are present, inserted between lobes). Anthers mostly not apiculate. Ovary always with 3 styles.

*In var. fluminensis Maire the bracts, sepals and petals have the largest values for the species.

**Only in var. fluminensis Maire.

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REFERENCES


Tamarix dalmatica in Spain


APPENDIX 1

Studied specimens

Tamaricaceae

Tamarix dalmatica


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