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REVIEW

# Systematic studies on the Zygophyllaceae of Saudi Arabia: A new variety and new variety combination in *Tetraena*

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**Abstract** During 2013–2014, fresh material of *Tetraena alba* was collected from two localities in Saudi Arabia. Detailed morphological examination of these specimens revealed that there is a new variety of this species, for which the name *T. alba* var. *arabica* is proposed. Fresh material of *Zygophyllum amblyocarpum* was also collected from a different locality, and based on its characteristics is transferred to *Tetraena* with the new combination *T. alba* var. *amblyocarpa*. *T. alba* and its varieties are illustrated and morphological characters supplied to differentiate among them.


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## 1. Introduction

Zygophyllaceae is a large cosmopolitan family and currently including five subfamilies, namely Zygophylloideae, Tribuloideae, Seetzenioideae, Larreoideae and Morkillioideae (Sheahan and Chase, 2000; Beier et al., 2003; Bellstedt et al., 2008). Zygophylloideae is the largest subfamily and currently consists of six genera, namely *Zygophyllum*, *Fagonia*, *Augea*, *Roepera*, *Tetraena* and *Melocarpum* (Beier et al., 2003; Bellstedt et al., 2008).

Until recently, *Tetraena* was a monotypic genus, and its only species, *Tetraena mongolica*, is a restricted-range species confined to western Inner Mongolia in China. Based on the combined analyses of morphological and molecular data, Beier et al. (2003) transferred 35 species from *Zygophyllum* to *Tetraena* as new combinations; these species are from Africa and Asia. Subsequently, many authors (e.g. Norton et al., 2009; Sakkir et al., 2012; Louhaichi et al., 2011; Mosti et al., 2012; Azevedo, 2014; Ghazanfar and Osborn, 2015) followed the new classification proposed by Beier et al. (2003). Thus, *Tetraena*, as currently circumscribed, is widespread in China, as well as in the arid and semi-arid parts of tropical and subtropical Africa and Asia. Currently, ten species of *Tetraena* are known from Saudi Arabia (El-Hadidi, 1977; Migahid, 1978; Hosny, 1988; Beier et al., 2003; Ghazanfar and Osborn, 2015).

In the present work, which is based on the detailed morphological study of fresh and herbarium specimens, *Tetraena alba* is described from Saudi Arabia. However, in one location named Umluj, Saudi Arabia (Fig. 1), a plant was found growing in the same area with *T. alba* (L.f.) Beier and Thulin, both sharing some morphological characters, but differing in others, including length of leaflet petiole, flower size, capsule shape and size, and the capsule pedicel length. This entity is here described as a new variety, named *T. alba* var. *arabica*. In addition, *Zygophyllum amblyocarpum* is transferred to *Tetraena* as a new variety combination, namely *T. alba* var. *amblyocarpa*.

## 2. Materials and methods

During 2013–2014, plant material was collected from Umluj and Shuaibah in Saudi Arabia (Fig. 1). Several duplicate herbarium specimens were made and additional samples were preserved in 70% ethanol. For each taxon herbarium specimens from different herbaria were examined: Saudi Arabia National Herbarium, Riyadh (RIY); King Saud University Herbarium, Riyadh (KSU); Herbarium of Flora and Phytotaxonomy, Research Agricultural Museum, Dokki, Cairo, Egypt (CAIM); Royal Botanic Gardens, England, Kew (K); and Royal Botanic Garden, Edinburgh (E). Material was studied with the aid of a Novex AP-20 stereo microscope and ×10-hand lens. The average measurements for ten mature leaves, flowers and fruits were taken for each sample. Measurements for leaves, flowers and fruits of dried herbarium specimens were supplemented by rehydrating material in boiling water. Measurements are given in millimetres, except where indicated. Conservation threat assessments follow the International Union for Conservation of Nature (IUCN, 2014). Voucher specimens are deposited in KAUH.

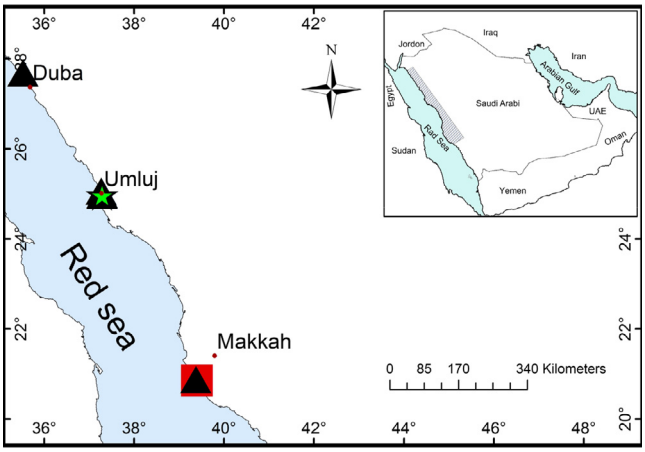


**Figure 1** Distribution of *Tetraena* varieties in Saudi Arabia: ▲ *T. alba* var. *alba*, ★ *T. alba* var. *arabica*, ■ *T. alba* var. *amblyocarpa*.

## 3. Taxonomy

### 3.1. *Tetraena alba*

Perennial shrubs, green or greenish grey, 50–60 cm high, 40 cm wide. Stems pubescent, with unicellular simple trichomes. Leaves: 2-foliolate, 7–12 mm long, 3–5.5 mm wide, cylindrical or elliptic, apex acute, fleshy; petiole 10–18 long; stipules triangular, herbaceous, 1 × 1.5 mm, pubescent. Flowers arranged in clusters (sometimes solitary), bisexual, white, 4–5.5 × 3–5 mm; pedicel 1–2 mm long. Sepals 5, rounded-obtuse at the apex, herbaceous, yellowish green, obovate, 3–4 × 2–3 mm, pubescent, aestivation imbricate. Petals 5, white, spatulate, 3.5–6 × 1–2 mm, aestivation open. Stamens 10, 3–4 mm long; staminal appendages undivided, 2–2.5 mm long, 1 mm wide; anthers 2-lobed, yellow, dorsifixed, longitudinally dehiscent; disc smooth. Ovary 5-locular, pubescent; style single, 1 mm long. Capsules a schizocarp, obconical or oblong-obconical, star-shaped or obconical-acute, with keeled lobes 8–13 × 7–12 mm, pubescent, endo- and exocarp extending as wings, pedicel 2–6 mm long, pubescent.

*Key to the varieties*

(1) Leaflets petiole up to 15 mm long; flowers 4–4.5 × 3–4.5 mm; capsules obconical star-shaped, with thick broad lobes 8–10 × 7–10 mm; pedicel up to 3 mm long..... **var.*alba*.**

(2) Leaflets petiole up to 18 mm long; flowers 5.5 × 5 mm; capsules oblong obconical star-shaped, with slightly narrow lobes 11–13 × 8–10 mm; pedicel up to 6 mm long ..... **var.*arabica*.**

(3) Leaflets petiole up to 10 mm long; flowers 4 × 4 mm; capsules obconical-acute, with keeled lobes 9–13 × 8–12 mm; pedicel up to 6 mm long .....**var. *amblyocarpa*.**