Morphological comparison and key to *Juniperus deltoides* and *J. oxycedrus*

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ABSTRACT

The morphologies of *J. deltoides* and *J. oxycedrus* are discussed. The species are distinguished by their leaf base shapes (deltoid, tapered), stomatal bands (not sunken, sunken), scale cone tips (protruding, absent), scale cone tip bloom (present, absent), and tree crown shape (pyramidal, rounded). A key is presented to aid in their identification. Published on-line **www.phytologia.org** *Phytologia 96(2): 58-62 (April 1, 2014).* ISSN 030319430

KEY WORDS: *Juniperus deltoides, J. oxycedrus,* morphology, key, taxonomy.

Although recent studies (Adams, 2004; Adams et al., 2010, 2011, Adams, et al., 2005) utilizing nrDNA sequencing, RAPDs, leaf terpenoids and morphology, clearly demonstrate that *J. oxycedrus* (*sensu stricto*) is restricted to the western Mediterranean; whereas, another, morphologically similar species, *J. deltoides* R. P. Adams occupies the eastern Mediterranean region, the taxa are difficult to recognize.

Adams (2014) recognized both *J. deltoides* and *J. oxycedrus* in his monograph of *Juniperus*. At present the distributions of *J. oxycedrus* and *J. deltoides* are shown in Figs. 1 and 2. Rajcevic et al. (2013) documented *J. deltoides* in Croatia and Serbia by leaf terpenes. The exact distribution of these taxa in Italy is not known. It is likely that they are sympatric in western Italy and other places. The purpose of this paper is to present a summary of morphological differences and a key to aid their identification.

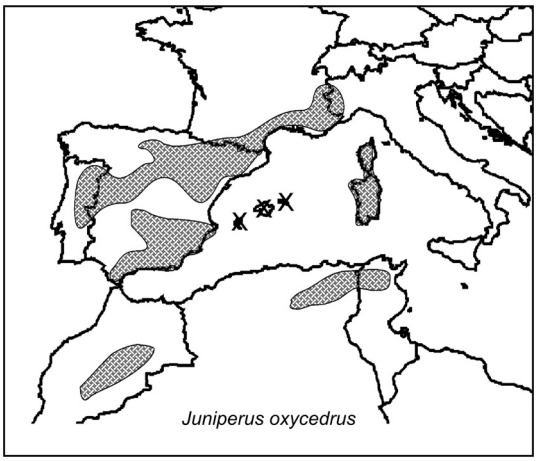


Figure 1. Distribution of *J. oxycedrus.*

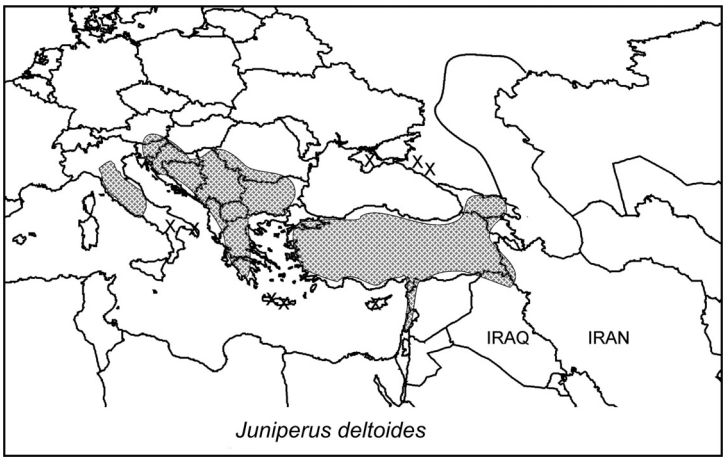


Figure 2. Distribution of *J. deltoides.*

DISCUSSION

Table 1 presents a summary of morphological differences between *J. deltoides* and *J. oxycedrus* (adapted from Adams et al., 2005). The leaves of *J. oxycedrus* tend to be longer and narrower than *J. deltoides* (Table 1). A key character separating the species is the seed cone morphology. The cone scales are visible on seed cones of *J. deltoides* and the tips of the cone scales generally protrude (Fig. 3), usually

covered with a glaucous powder (bloom). In contrast, the seed cones of *J. oxycedrus* are smooth with just a hint of the 3 fused cone scales on the distal end and the cone scales are not visible on the sides of the seed cones (Fig. 4). A second key character is the shape of the leaves where the blade is joined to the sheath (base). In *J. deltoides*, the leaf sides are parallel or obtuse, giving the leaves a triangular or deltoid appearance (Fig. 5). But, in *J. oxycedrus*, the leaves taper near the base where the blade is connected to the sheath (Fig. 6).

Table 1. Morphological differences between *J. deltoides* and *J. oxycedrus* from herbarium vouchers from Morocco eastward to Turkey. protube. = protuberances (cone scale tips protruding). bloom refers the whitish-blue glaucous material on the cone-scale tips. MO = Morocco, PO = Portugal, SP = Spain, FR = France, IT (east) = eastern Italy, GR = Greece, TK = Turkey.

	western Mediterreanea				eastern Mediterreanea		
Character	MO	PO	SP	FR	IT(east)	GR	TK
leaf length(mm)	15.0	14.7	14.4	14.5	13.0	11.5	11.7
leaf width (mm)	1.7	1.43	1.28	1.70	2.10	1.80	1.80
leaf shape at base	tapered	tapered	tapered	tapered	delta	delta	delta
stomatal bands	sunken	sunken	sunken	sunken	flat	flat	flat
seed cone, distal-end							
cone scale tips	smooth	smooth	smooth	smooth	protube.	protube.	protube.
cone scale tips: bloom	none	none	none	none	bloom	bloom	bloom
tree crown shape	rounded	rounded	rounded	rounded	pyramidal	pyramidal	pyramidal

Figure 3. *J. deltoides*, seed cones (right most photo is an immature, yellow-brown seed cone with cone scales very pronounced). Notice glaucousness on cone scale tips in the left and center-right cones.

Figure 4. *J. oxycedrus*. Note the line where the 3 cones scales are fused on the distal end and the lack of protuberances on the seed cones. Cones in the right-most photo are not fully mature, thus yellow color.

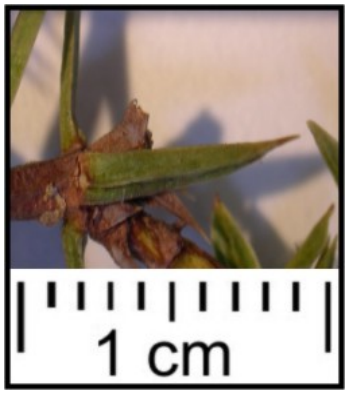


Figure 5. *J. deltoides* leaf. Notice the broad (delta shaped) leaf base where the blade is joined to the sheath.

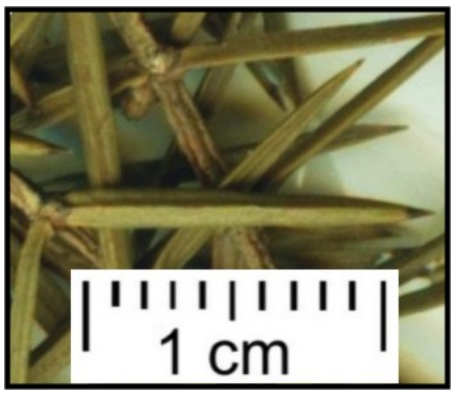


Figure 6. *J. oxycedrus* leaf. The leaves taper at the base where the leaf blade is joined to the sheath.

A third character is the position of the stomatal bands on the leaves. In *J. deltoides*, the two white, stomatal bands are not sunken, but smooth to the leaf surface (Fig. 7). In contrast, the stomatal bands of *J. oxycedrus* are sunken into the leaf (Fig. 7).

In addition the volatile leaf oil of *J. deltoides* differs from that of *J. oxycedrus* (Adams et al., 2005, Adams and Tashev, 2012). The leaf oil of *J. deltoides* is lower in α-pinene and higher in limonene compared to *J. oxycedrus*. The oil of *J. deltoides* contains several compounds not present in *J. oxycedrus*: trans-p-mentha-2,8-dien-1-ol, cis-p-mentha-2,8-dien-1-ol, cis-carveol, carvone, (2E)-decenal, ar-curcumene, α-copaen-11-ol, a-calacorene, β-calacorene and cadalene.

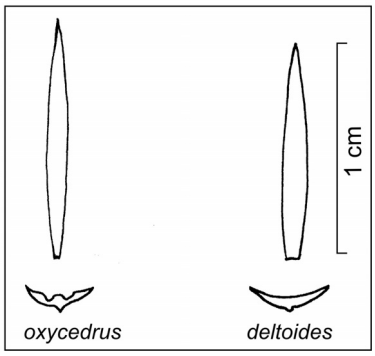
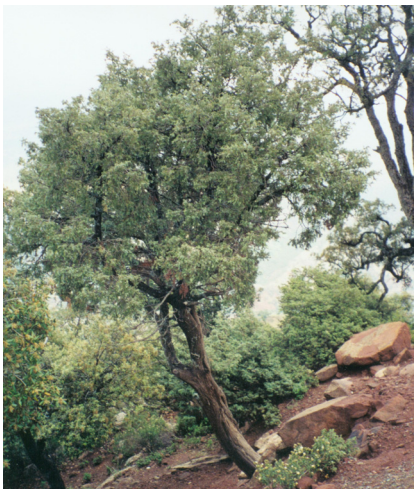


Figure 7. Leaf shapes of *J. oxycedrus* and *J. deltoides*.

The crown shape of *J. oxycedrus* is generally more rounded (Fig. 8) than the more pyramidal crowns of *J. deltoides* (Fig. 9).

Fig. 8 (left) *J. oxycedrus,* Ruidera, Spain. *Adams 9053*



(right) *J. oxycedrus,* Morocco. *Adams 9406*

Fig. 9 (left) Archova, Greece, *Adams 9436* (right) 30 km n. of Eskisehir, Turkey. *Adams 9430*

It might be noted that Passal (Inform. Bot. Ital. 41(1):141, 2009), published the new combination *J. oxycedrus* subsp. *deltoides* (R. P. Adams) N. G. Passal, but the combined morphology, terpenes data, and DNA sequencing clearly supports *J. oxycedrus* and *J. deltoides* as distinct lineages and species (Adams et al. 2005, Adams, 2014).

The following key is presented to aid the identification of these taxa.

Key to *J. deltoides* and *J. oxycedrus*

1a. Leaves narrowing at the base of attachment, stomatal bands sunken; seed cones without bloom (glaucous) on cone scale tips, seed cones without raised cone scale tips, seed cones globose, shrubs and trees with round crowns; France, Spain, Portugal, Algeria, Morocco....***J. oxycedrus***

1b. Leaves with base of attachment nearly as wide or wider than the blade (mid-point), stomatal bands flat to surface to scarcely sunken; seed cones without bloom (glaucous) on cone scale tips, seed cones with raised cone scale tips, with shrub and trees with pyramidal crown, Italy, Greece, Turkey and eastward.....***J. deltoides***

ACKNOWLEDGEMENTS

This research was supported in part with funds from Baylor University. Thanks to Tonya Yanke for lab assistance.

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