

ANATOMY-TAXONOMY OF THE GENUS ZIZIPHUS IN IRAN

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Anatomy-taxonomy of *Ziziphus* species in Iran were studied under light microscope. The different anatomical characters on *Ziziphus spina-christi*, *Z. nummularia*, *Z. jujuba* indicated the adaptation of this species to various ecological conditions.

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مطالعه تشریحی - تاکسونومی جنس کنار در ایران

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ساختار تشریحی برگ و ساقه در گونه های جنس کنار که شامل *Z. nummularia* و *Z. spina-christi*, *Z. jujuba* مربوط به مناطق مختلف ایران می باشد از نظر ریخت شناسی و تشریحی مورد مطالعه قرار گرفت. شرح کامل مشخصات در هر گونه به همراه کلید شناسایی نیز برای تفکیک گونه ها ارائه می گردد.

INTRODUCTION

Ziziphus is a multipurpose tree or shrub. Belonging to *Rhamnaceae* family. There are about 50 species in the tropical Asia, Africa and America and the temperate regions of both hemispheres (Townsend & Guest, 1980). In Flora Iranica 5 species were listed for Iranian Plateau namely *Z. spina-christi*, *Z. nummularia*, *Z. jujuba*, *Z. mauritiana* and *Z. oxyphylla* (Rechinger, 1977). *Z. aucheri* from Bushehr was reported by Boissier in 1843 while Rechinger was regarded it as a synonym of *Z. spina-christi*, later on Qaiser and Nazimuddin (1981) reported it as a variety of *Z. spina-christi*. Anatomical characters of different species of *Ziziphus* distributing in Iran were studied to determine not only for characteristic features but also for research on adaptive characters of leaves.

MATERIAL AND METHODS

Materials were fixed in FAA and transversal sections of leaf prepared by hand cutting. Sections were cleared with sodium hypochlorite, dehydrated and stained with methyl green and carmine vest and mounted in gelatin. The results were observed using a light microscope. The species for this study are labeled as follows:

Ziziphus nummularia (Burm. f.) Wight & Arn. -Ilam, Shush to Dehloran, 55 km to Dehloran, 200 m, Dinarvand & Mohammady, 5999.

Ziziphus jujuba Miller. -Golestan, Kalaleh, 450 m, Dinarvand, Dorry & Arazy, 6447.

Ziziphus spina-christi (L.) Willd.

Var. *spina-christi* -Khuzestan, Masjed Soleyman, Lali, 600 m, Dinarvand & Howzeih, 6530.

Var. *aucheri* -Bushehr, Poshtkuh, Bushkan region, near Imamzadeh village, 650 m, Dinarvand, Howzeih & Sadeghy, 5429.

OBSERVATIONS AND RESULTS

***Ziziphus* Miller.**

Tree or shrub, evergreen or deciduous; two thorns one straight and another curved. Leaves alternate, ovate; elliptic or oblong. Inflorescence small racyme, glabrous or pubescent. Calyx to 3 mm, deltoid. Corolla yellow, green or white. Stamens 5. Style bifid. Drupe elliptic or spherical.

Identification key to species:

1- Inflorescence glabrous. branches verticillate

Z. jujuba

- Inflorescence pubescent. Verticillate branches absent
- 2- Leaves deciduous, pubescent in both surfaces specially on lower surface *Z. nummularia*
- Leaves evergreen, glabrous or pubescent on lower surface *Z. spina-christi*

Z. jujuba Miller.

Shrub to 2 m high, branches verticillate, with two thorns one straight and the other curved. Leaves alternate, oblong-ovate, to 5 cm long and 3 cm wide, glabrous. Inflorescence glabrous raceme. Calyx 2-3 mm long, deltoid. Corolla green or yellow, 2 mm long, spatulate. Stamens 5. Style bifid. Drupe elliptic, red or dark brown.

Z. nummularia (Burm.f.) Wight & Arn.

Deciduous shrub, 1-3 m high; branches numerous, hardly curved and pubescent with two thorns one straight and the other curved. Leaves alternate, ovate-roundish, 5-15 or rarely 30 mm long, 5-20 mm wide, pubescent in both surfaces especially on lower surfaces. Inflorescence pubescent raceme. Calyx 3 mm long. Corolla yellow, 3 mm long. Stamens 5. Style bifid. Drupe spheric, red or dark brown.

Z. spina-christi (L.) Willd.

Evergreen tree or shrub, 3-8 m high, branches straight or curved; pubescent on young branches, with two thorns one straight and the other curved. Leaves alternate, ovate- spheric or elliptic; 1-3.5 cm long, 1-3.5 wide; glabrous or pubescent on lower surfaces. Inflorescence pubescent raceme. Calyx 3 mm long. Corolla white, 2 mm long. Stamens 5. Style bifid. Drupe round, red or dark brown yellow or green.

Identification key to the varieties of Ziziphus spina-christi

- 1- Leaves glabrous or shortly pilose on the nervation of the lower surface *var. spina-christi*
- Leaves pilose on lower surface and sometimes on upper *var. aucheri*

Anatomical characters

Z. jujuba (Fig. 1, A-C)

Epidermis consists of one layer of large cells. Stomata are anisocytic and sunken in cross-section. Papilla is observed on abaxial surface of midrib. Isobilateral mesophyll includes 3-4 layers of long palisade cells adaxially and 2-3 layers of short cells on abaxial surface. Vascular bundles are collateral and surrounded by parenchymatous bundle sheaths.

Ziziphus nummularia (Fig. 2, A-E)

Both leaf surfaces are pubescent with simple short trichome. Epidermis includes one layer of polygonal

cells with thick outer wall and thick cuticle on both surfaces. Stoma is sunken and takes place in crypts. Papilla is observed on both surfaces more frequently on abaxial surface. Mesophyll is isobilateral with 3-4 layers of long palisade cells adaxially and 2-3 layers of short palisade cells abaxially. Vascular bundles are collateral and surrounded by bundle sheaths with thin cell wall. Stem shape in cross section is spherical and has secondary development. It is also covered by unicellular trichomes with thin wall. Single epidermis includes polygonal cells with thick outer wall and brown contain. Cortex includes layers of sub epidermal collenchyma and sclerenchyma cells. In vascular cylindrical, secondary development is important and surrounded by periphloematic fibre. The pith is small and includes parenchymatous cells in center of stem (Fig 2, D, E).

Z. spina-christi var. spina-christi (Fig. 3, A, C)

Epidermis is glabrous and consists of one layer of isodiametric cells with thick wall. Stomata are sunken. Mesophyll is isobilateral. Vascular bundles are collateral and surrounded by bundle sheaths with thin cell wall.

Z. spina-christi var. aucheri (Fig. 3, B, D, E)

Abaxial surface is pubescent. Cuticle is thick on both surfaces. Epidermis includes one layer of cells with thick wall adaxially. Papilla with high frequently is present abaxially. Mesophyll is isobilateral. Vascular bundles are collateral and surrounded by bundle sheaths. Shape of stem in cross section is spherical and has secondary development. Stem is glabrous and single epidermis includes isodiametric cells with thick outer wall. Cortex includes 3-4 layers of sub epidermal collenchyma and large canal. In vascular cylindrical secondary development is notable and surrounded by periphloematic fibre. The pith is amply and includes parenchymatous cells in center of stem (Fig. 3, D, E).

DISCUSSION

Z. nummularia and *Z. spina-christi* are native in tropical and dry regions i. e. Saharo-Sindian. They show anatomical characters of xerophyte plants such as high frequently of papilla on both surfaces, epidermis with thick outer wall and thick cuticle and stomata are observed in crypts (Zarinkamar 1993, 1997). *Z. spina-christi var. spina-christi* is occurring more in west of Nubo-Sindian province of Saharo-Sindian and beside the constant or seasonal rivers which present less xerophyte characters including glabrous epidermis on both surfaces. *Z. spina-christi var. aucheri* occurs more in east of Nudo-Sindian that is drier than west in Iran.

In this species the epidermis with thick cell wall adaxially, thick cuticle on both surfaces and simple papilla with high frequently abaxially is observed. *Z. jujuba* occurs in drier part of Hyrcanian province of Euro-Siberian region with the temperate climate. It has different characters such as superficial stomata and simple papilla which is rarely observed on the midrib of abaxial surface of leaf. Comparative cross section of stem in *Z. nummularia* and *Z. spina-christi* shows that *Z. nummularia* is more xerophytes than *Z. spina-christi*. It is because of pubescent stem in *Z. nummularia* and its cortex has several layers of collenchyma and sclerenchyma tissue and its pith is small with parenchymatous cells and thick cell wall while in *Z. spina-christi* stem is glabrous and its cortex has three to four layers of sub epidermal collenchyma and its pith is large with parenchymatous cells in center of stem.

This study also proves that the anatomical characteristics of stem in these species go along with their leaves' characteristics.

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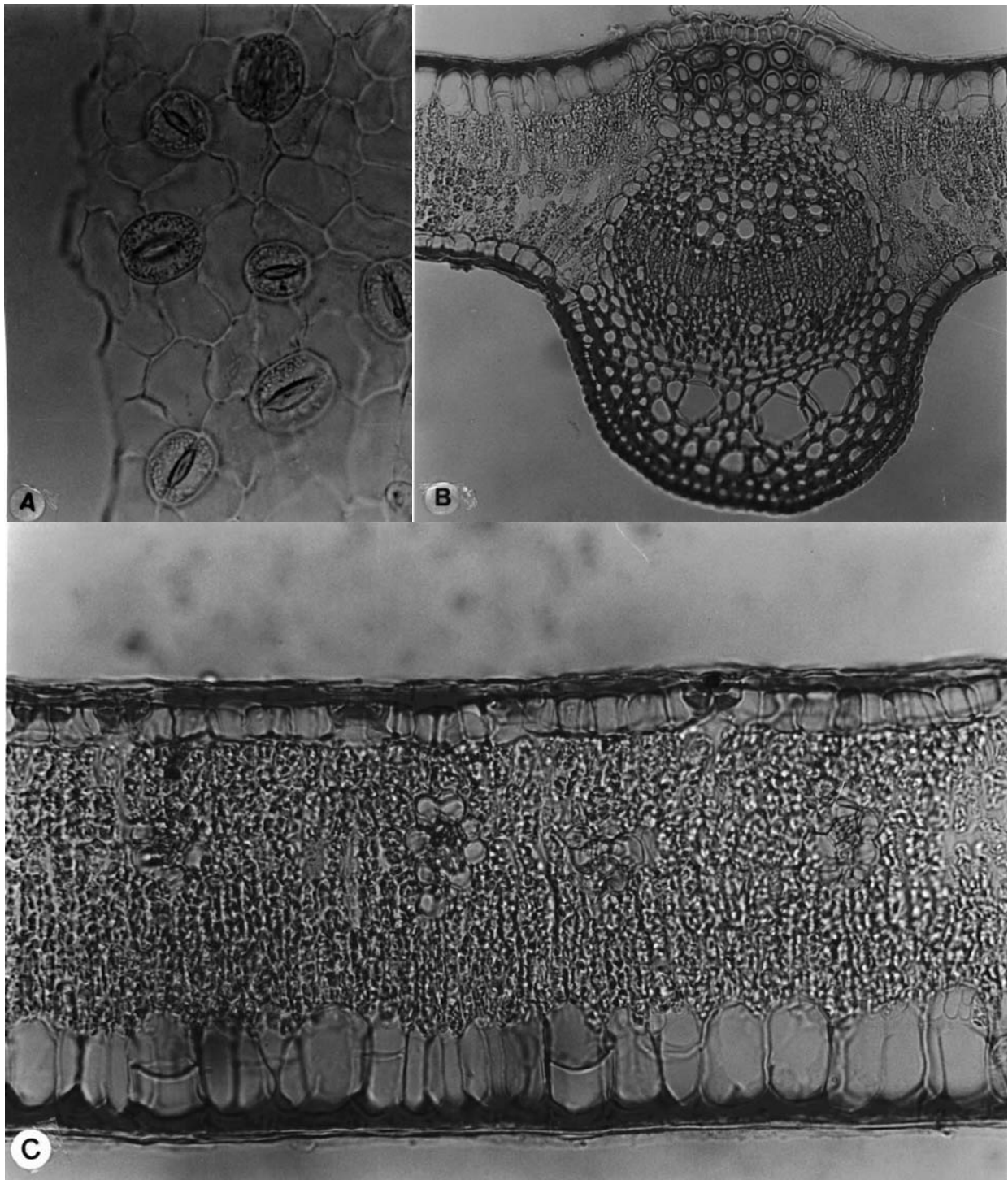


Fig. 1: A-C, leaf of *Z. jujuba*; A, epidermis in superficial view; B, C, transversal section; B, central vein; C, details of mesophyll; A, C ($\times 120$); B ($\times 60$).

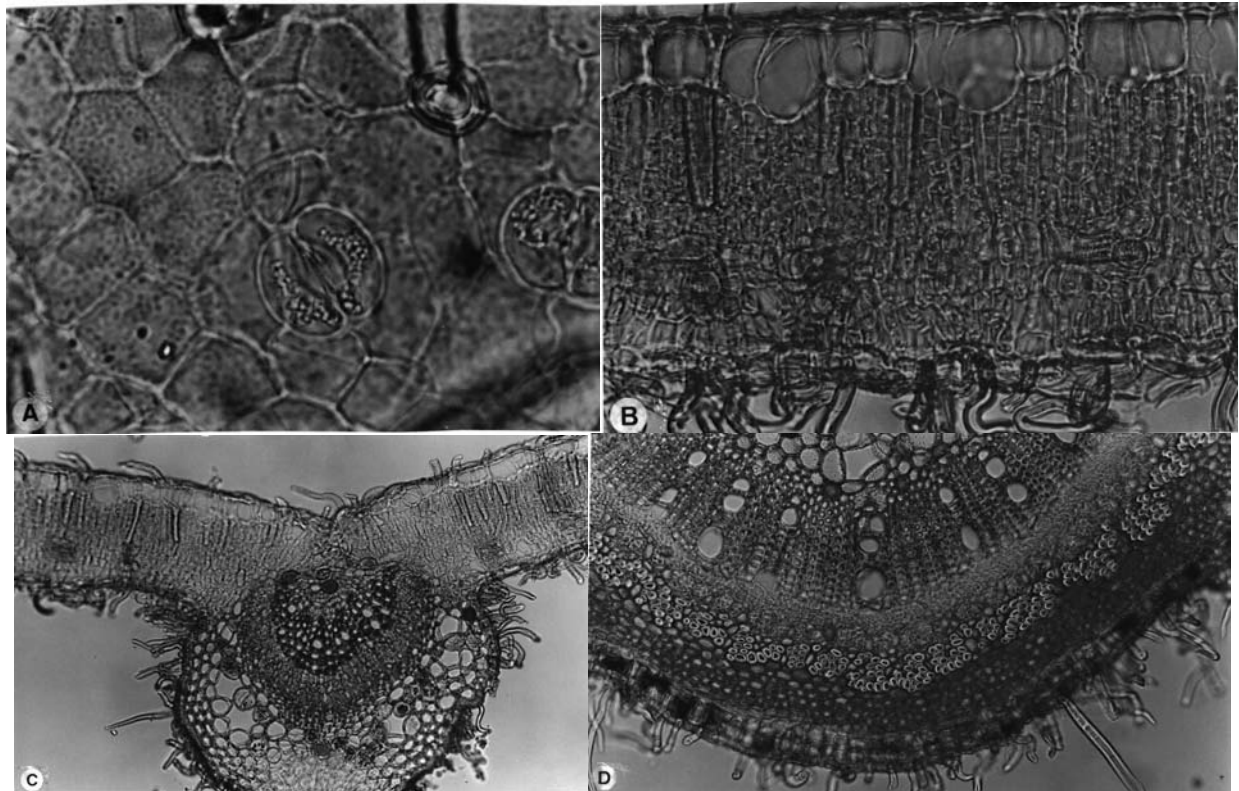


Fig. 2: A-D, *Z. nummularia*; A, epidermis in superficial view; B, C, leaf in transversal section; B, details of mesophyll; C, general aspect; D, stem; A, B, D ($\times 120$); C ($\times 60$).

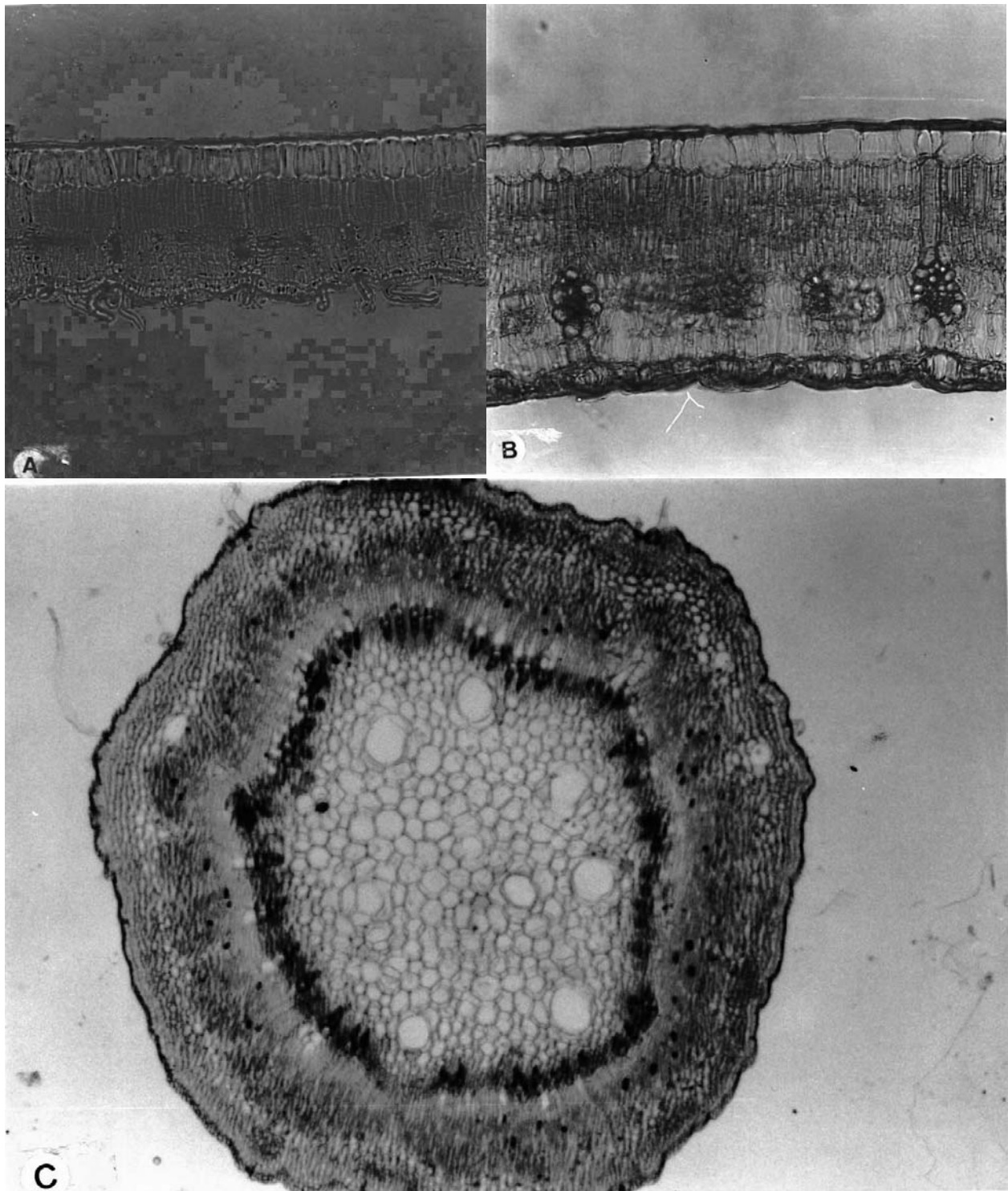


Fig. 3: A, *Ziziphus spina-christi*; A, B, var. *spina-christi*; C, var. *aucheri*; A, B, leaf in transversal section; C, stem; A, ($\times 120$); B, C ($\times 60$).