



ANATOMICAL FINDINGS OF *Onobrychis* (*Fabaceae*) IN IRAN AND THEIR TAXONOMIC IMPLICATIONS

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Abstract. Peduncle anatomy was investigated in 8 species of *Onobrychis* from Iran by light microscopy. Ten quantitative and qualitative characters were studied in the peduncle cross sections. Results showed that qualitative characters represent considerable variations within the section, some of which such as outline shape of the peduncle cross section, density of papillae on hair surface, and position of cavities in peduncles are taxonomically important characters to differ annual species from perennials in the section. Four groups were distinguished within the perennial species according to peduncle anatomical characters. In addition, a key is provided for the taxa based on these characters.

Keyword: Anatomical characters, cross section, *Leguminosae*, *Onobrychis*.

Introduction

The genus *Onobrychis* Miller (*Hedysareae*, *Fabaceae*), with about 170 species in 2 subgenera and 9 sections, includes annual or perennial herbs or shrubs.

The genus is mainly distributed in northern temperate regions; however, centres of its genetic diversity are in the eastern Mediterranean area and south-west Asia [LOCK and SIMPSON, 1991, RECHINGER, 1984].

The genus *Onobrychis* Miller have with nearly 170 species mainly distributed in centres of its diversity are in the eastern Mediterranean area and south-West Asia; a few taxa are cultivated as fodder or ornament *Onobrychis* sect with nearly 60 species is the biggest section *Fabaceae* in Iran.

This type of plants often is used as grass for animals due to its nutritional values. *Onobrychis* sect. *Onobrychis* represents 15 species in Iran.

Its majority species are endemic and important as forage legumes [RANJBAR *et al.*, 2010b, AMIRABADIZADEH *et al.*, 2007, RANJBAR *et al.*, 2004, AKTOKLU, 2001, RECHINGER, 1984].

Due to the high polymorphism in morphological characters, the section is taxonomically the most problematic group and the boundaries of its species are not completely clear.

Several studies have been made to evaluate interspecific relationships within the genus *Onobrychis* in Iran using morphological, palynological, and karyological characters [RANJBAR *et al.*, 2010b, KARAMIAN *et al.*, 2010, KARAMIAN *et al.*, 2009, RANJBAR *et al.*, 2009].

However, there is no report on anatomy of the genus.

Anatomical characters are not always as useful as morphological characters for plant identifications; however, they are well-established criteria and can offer significant assistance in plant taxonomy [GÜVENÇ and DUMAN, 2010, RANJBAR *et al.*, 2010a, GÜVENÇ *et al.*, 2011].

In the present study, peduncle anatomy is used to assess interspecific relationships within *Onobrychis* sect.

Material and methods

Samples of *Onobrychis* were prepared from fresh materials collected in the field.

Voucher specimens (Table 1) were deposited in the herbaria BASU and TARI.

Since some acaulescent species present in the section, cross sections were made only from peduncles. Mature peduncles from dried specimens were chosen and softened in a mixture of distilled water/glycerine/ethanol 70%



(1:1:1) for 2 weeks [BUTNARIU and CORADINI, 2012, PETRACHE, et al., 2014, BUTNARIU, et al., 2012].

Cross sections were made from the middle part of peduncles using commercial razor blades.

The sections were stained with methyl blue and carmine and mounted on

the slides using Canada balsam. Then, they were examined using an Olympus BX-41 photomicroscope at 40–400× magnifications and photographed by an Olympus digital camera.

Table 1.

Voucher specimens of *Onobrychis sect. Onobrychis* used in this study

Taxa	Locality	Collector name and number
1 <i>Onobrychis persica</i> Sirj. & Rech. F	Iran .Zanjan.Gavazang	Hassan Ghasempour; IAUH9988
2 <i>Onobrychis sintenissii</i> Bornm	Iran .Zanjan.Gavazang	Hassan Ghasempour; IAUH9950
3 <i>Onobrychis viciifolia</i> Scop	Iran .Zanjan.Gavazang	Hassan Ghasempour; IAUH9987
4 <i>Onobrychis altissima</i> Grossh	Iran .Zanjan.Gavazang	Hassan Ghasempour; IAUH9982
5 <i>Onobrychis. caput-galli</i> Boiss	Iran.Zanjan.Taham.Chavarzagh	Hassan Ghasempour; IAUH9992
6 <i>Onobrychis cornuta</i> (L.) Desv	Iran.Zanjan.Tatom of 10 (km) to zanjan.	Hassan Ghasempour; IAUH9991
7 <i>Onobrychis major</i> (Boiss.) Hand	Iran.Zanjan.Taham.Chavarzagh	Hassan Ghasempour; IAUH9998
8 <i>Onobrychis michauxii</i> DC	Iran.Zanjan.Tatom of 60 (km) to zanjan.	Hassan Ghasempour; IAUH9990

Anatomical characters, which were selected and quantified here, included outline shape of the peduncle cross section, the shape of epidermal cells, hair surface, the number of collenchyma layers, the number of parenchyma layers in cortex, the shape of endodermis cells, the number of vascular bundles, the number of pericyclic fibre layers, the shape of parenchymatous cells in pith, and the position of cavities [MEHRABIAN et al., 2007, HASSAN and HENEIDAK, 2006, FAHN, 1990].

Results and discussion

Outline shape of the peduncle cross section in studied taxa is circular, elliptic, triangle, or hexagonal with a reticular or smooth border [BUTNARIU, et al., 2006, RODINO, et al., 2014, BUTNARIU, et al., 2005, BUTU, et al., 2014].

The epidermis consists of a single layer of triangle sub-circular to sub-rectangular cells covered sparsely with hairs smooth (*Onobrychis altissima*).

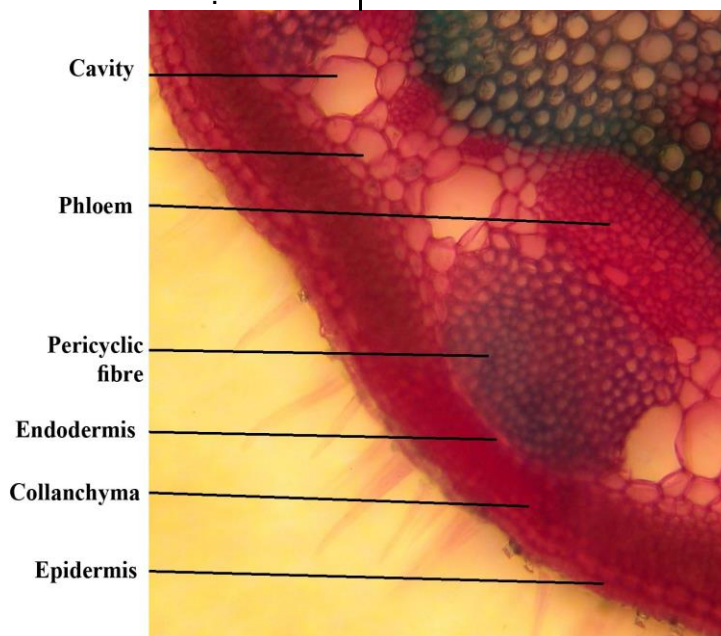


Figure 1. Peduncle cross section of *Onobrychis* showing quantified characters.

There is a continuous ring composed of 6 layers of tangential collenchymatous cells below the epidermis that are discontinued by cortex parenchyma. The cortex is

composed of 4 layers of sub-circular to sub-rectangular parenchymatous cells [BUTNARIU and GIUCHICI, 2011, IANCULOV, et al., 2004, BUTNARIU, 2014, BUTU, et al., 2014].



A single continuous endodermis exists at the end of the inner cortex. The central vascular cylinder consists of 5–13 discrete collateral primary bundles individually distinct arranged in an elliptic ring around the pith.

These bundles are separated by narrow medullar rays.

Pericyclic fibres occur in 7 layers in pile above the vascular bundles. The pith is more or less circular and composed of polygonal or large isodiametric cells with conspicuous intercellular spaces.

There are some cavities around pericyclicfibres and also within the cortex parenchyma (Figure 2, Table 2).

Table 2.

Differential characters related to the peduncle cross section in *Onobrychis* sect. *Heliobrychis*.

Species	Outline shape of the peduncle cross section	Hair surface	Number of collenchyma layer	Number of cortex parenchyma layer	Number of vascular bundle	Number of Pericyclic fibre layer	Number of cavity position
Perennial species							
Group A							
<i>Onobrychis altissima</i>	triangle	smooth	6	4	7	7	1–2
Group B							
<i>Onobrychis persica</i>	hexagonal	reticular	6	6	8	12	0–1
Group C							
<i>Onobrychis viciifolia</i>	± elliptic	reticular	6	5	12	6	2
<i>Onobrychis cornuta</i>	± elliptic	reticular	1	6	5	11	2
<i>Onobrychis sintenissii</i>	± elliptic	smooth	4	7	13	20	3
Group D							
<i>Onobrychis atropa</i>	circular	smooth	9	10	9	8	3
<i>Onobrychis miichuxi</i>	circular	smooth	6	4	9	15	2
<i>Onobrychis major</i>	circular	smooth	7	6	7	6	1

A. Group 1 consists of *Onobrychis altissima* represents a triangle shape in peduncle outlines covered with hairs, on their surfaces smooth (Figures 2).

B. Group 2 consists of *Onobrychis persica*, shows hexagonal shape in peduncle outlines covered with hairs, and are reticular their surfaces (Figures 3).

C. Group 3 consists of *Onobrychis viciifolia*, *Onobrychis cornuta*, *Onobrychis sintenissii* shows elliptic shape in peduncle outlines covered with hairs reticular or smooth on their surfaces (Figure 4).

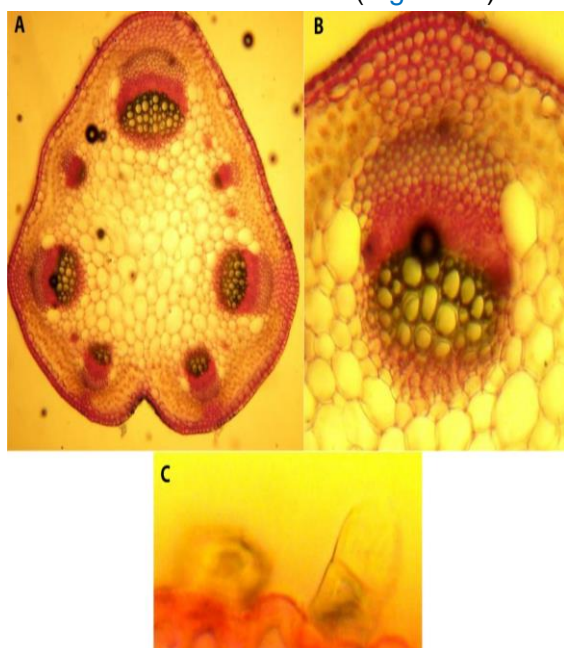


Figure 2. Photomicrographs of the peduncle cross sections *Onobrychis altissima*. A– entire section. B–enlargement

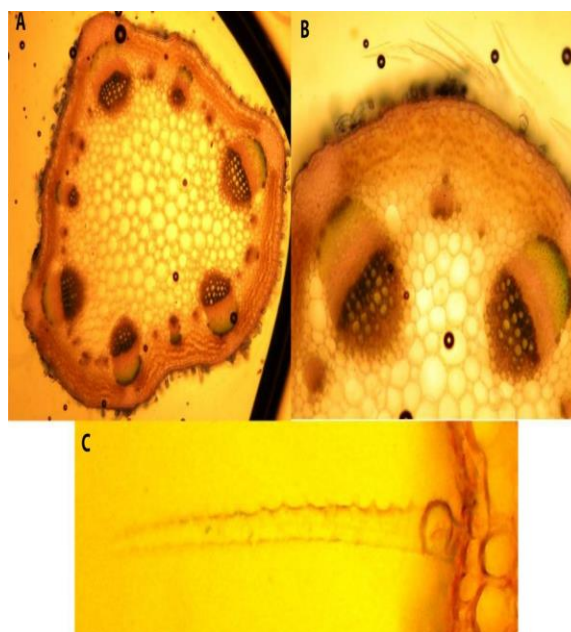


Figure 3. Photomicrographs of the peduncle cross sections *Onobrychis persica*. A–entire section. B–enlargement



showing internal structure. C–hair

showing internal structure. C–hair

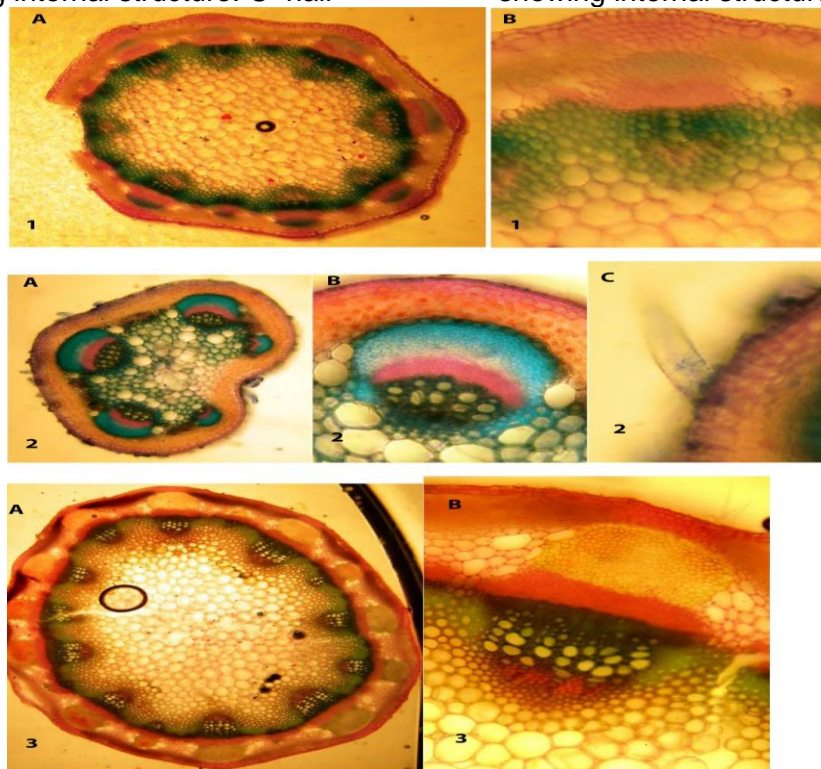


Figure 4. Photomicrographs of the peduncle cross sections *Onobrychis*.
1) *Onobrychis viciifoli*, 2) *Onobrychis cornuta*, 3) *Onobrychis sinterissii*
A–entire section. B–enlargement showing internal structure. C–hair

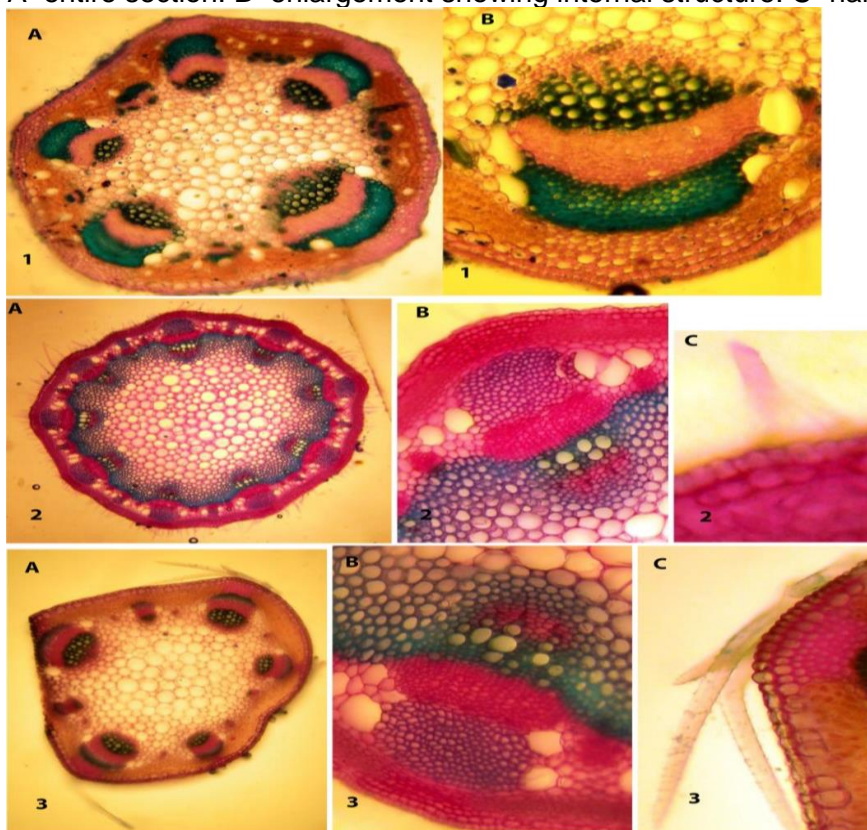


Figure 5. Photomicrographs of the peduncle cross sections *Onobrychis*.
1) *Onobrychis atropa*, 2) *Onobrychis miichuxi*, 3) *Onobrychis major*



A– entire section. B–enlargement showing internal structure. C–hair

The results of this study revealed that quantitative characters show a few variations by a continuous range and are stable within the section.

However, qualitative characters, such as outline shape of the peduncle cross section, density of papillae on the hair surface and the number of cavities, are significant. These characters have good taxonomic values and can be useful to evaluate inter specific relationships within the section [BUTNARIU, *et al.*, 2011, BARBAT, *et al.*, 2013, BUTNARIU, 2012, BUTU, *et al.*, 2015].

Results are summarised as follows: Perennial species develop metaxylem elements in the xylem tissue. Some cavities were observed within cortex parenchyma and also around pericyclicfibres. They can be divided into 4 groups based on anatomical characters.

Grouping is in agreement with the results from morphology (unpublished data). Group A includes the species with predominantly well–developed stems. In contrast, groups B and C include the species that are predominantly acaulescent. Group D includes.

The perennial and annual species of *Onobrychis* sect. *Onobrychis* were separated well by anatomical characters related to peduncle. This is supported well by results from pollen morphology of the *Onobrychis* sect. *Heliobrychis* [AMIRABADIZADEH *et al.*, 2007].

The species show disjunctive distribution in north west Iran at an altitude range of 1500–2700 m, unlike The remaining members. The other interesting anatomical character in *Onobrychis* sect. *Heliobrychis* is the presence of papillae on hair surface.

This character has been reported as an ancestral state against smooth surface occurring in some species of legumes, such as thorny *Astragal* [ZARRE, 2003].

The members of the section are predominantly papillose on the hair surfaces, but are rarely smooth. In addition, based on the density of papillae, 2 character states can be distinguished [BUTNARIU, *et al.*, 2015a, CAUNII, *et al.*, 2015, BUTNARIU, *et al.*, 2016, BUTNARIU, *et al.*, 2015b].

Thus, 3 character states can be considered, e.g., smooth, loosely papillose, and densely papillose for the hair surfaces. However, the significance of the characters related to hairs can be assessed exactly for taxonomy and phylogenetic reconstruction of the section, when they have been investigated precisely by scanning electron microscopy.

Conclusions

Four groups were distinguished within the perennial species according to peduncle anatomical characters. In addition, a key is provided for the taxa based on these characters.

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