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Morphological characterization of *Onobrychis* sect. *Heliobrychis* (Fabaceae) in Iran

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ABSTRACT

The characteristics of pod were investigated in 29 taxa of Onobrychis Miller sect. Heliobrychis Bunge from Iran. Results showed that some of characters, such as figure of pod, number of seed per pod, number of loculus and curvature of pod represent considerable variations within the Heliobrychis section. According to cluster analysis of pod characters, three groups were distinguished within the section.

Keywords: *Heliobrychis*, *Onobrychis*, pod characters.

INTRODUCTION

The genus *Onobrychis* Miller (Hedysareae, Fabaceae), represented by 130 perennial and annual species in the world, is densely distributed in the north temperate regions, but centers of diversity are in the eastern Mediterranean area and western Asia especially Iran and Anatolia [1,4]. The genus is subdivided into two subgenera, namely, *Onobrychis*with four sections (*Onobrychis*, *Dendrobrychis*, *Lophobrychis* and *Laxiflorae*) and *Sisyrosema*with five sections (*Heliobrychis*, *Hymenobrychis*, *Afghanicae*, *Anthyllium* and *Insignes*) [5].

The section *Heliobrychis* Bunge (subgenus *Sisyrosema*), is the biggest section of genus *Onobrychis* in Iran with about 21 species [5]. The majority of species are endemic and important as forage legumes [3, 5, 7]. Section *Heliobrychis* was described as plants perennial or annual, pods crestless covered with pinnate bristles, orbicular, stipitate, along with a curved suture bearing seeds [3]. This section seems to be the most problematic and the boundary of species is not completely clear due to the polymorphism in morphological characters.

In this study, the characteristics of pod of the section *Heliobrychis* were analyzed to identify interspecific relationships among species that can be used in systematic studies.

MATERIALS AND METHODS

Samples of *Onobrychis* sect.*Heliobrychis* were obtained from collections in the Herbarium Research Center of Khorasan-e-Razavi Agricultural and Natural Resources Center (MRCH), Mashhad, Iran, the Herbarium of National Plant GeneBank of Iran (NPGBI) and the Herbarium of the Research Institute of Forests and Rangelands (TARI) (Table 1). Thirteen morphological traits related to reproductive organ (pod) were studied in 29 taxa of the *Heliobrychis* section (Table 2). Cluster analysis was performed using MVSP Vers. 3.2 [8] with Centroid linkage method.

RESULTS AND DISCUSSION

The result of this study showed a few variations within the *Heliobrychis* section based on 13 pod characters. Nevertheless, characters such as; figure of pod, number of seed per pod, number of loculus and curvature of pod are significant. These characters of pod have good taxonomic values and can be useful to evaluate interspecific relationships within the section. Results of cluster analysis based on pod characters showed three clusters (Figure 1).

A. Group 1, includes of *O. heliocarpa* (annual), *O. aucheri* subsp. *aucheri* (O. annual), O. *aucheri* subsp. *teheranica* (annual), *O. aucheri* subsp. *psammophila* (annual) and *O. heterophylla* that have two or three seeds per pod, bilocular or multilocular pod and circinate-incurved curvature.
B. Group 2, consists of *O. sylvatica*, *O. melanotricha* var. *villosa*, *O. subacualis* (annual), *O. psoraleifolia* var. *psoraleifolia*, *O. sojakii*, *O. iranshahrii*, *O. kermanensis*, *O. oxyptera*, *O. mozaffarianii*, *O. andalanica*, *O. aurea* and *O. gaubae* that the shape of the pod in species is suborbicular-semiorbicular.
C. Group 3, contains *O. melanotricha* var. *melanotricha*, *O. gypsicola*, *O. lunata*, *O. haussknechtii*, *O. depauperata* var. *depauperata*, *O. scrobiculata*, *O. atropatana*,

Table 1. Voucher specimens of *Onobrychis* sect. *Heliobrychis* used in this study

Taxa	locality	Voucher number
*O. aurea*Ranjbar, Amirabadizadeh&Ghahremani	Eastern Azarbayjan: Tabriz, Khajeh, Abkhandari Research Center, 1450 m.	MRCH 10037
*O. sojakii*Rech. F.	Kohkiloyeh and Boyerahmad: 45 Km from Khosravi towards Mamsani, 1800 m.	MRCH 5996
O. kermanensis (Sirj. &Rech. F.) Rech. F.	Kerman: Sirjan	NPGBI 6236
O. psoraleifolia var. *psoraleifolia*Boiss.	Esfahan: Ghomishloo, Baghak, 2000 m.	MRCH 1610
*O. andalanica*Bornm.	Sanandaj: Abidar park	NPGBI 6143
O. sylvatica	Khorasan: Mashhad	MRCH 5993
*O. szovitsii*Boiss.	Azarbayjan: 23 Km southeast of Khoy, SeyedHajin village, 1400-1450 m.	MRCH 6037
O. buhseana Bung ex Boiss.	Eastern Azarbayjan: Boostanabad towards Sarab, 1800 M.	NPGBI 3875
O. melanotricha var. *villosa*Bornm.	Zanjan: Zanjan towards Ghorveh, Babarishani village, 1971 m.	NPGBI 6144
O. melanotricha var. *melanotricha*Boiss.	Hamedan: Nahavand, 1954 m.	NPGBI 6042
*O. oxyptera*Boiss.	Fars: 15 Km from Saadatshahr towards Arsanjan, 1800 m.	TAR I87626
*O. gypsicola*Rech. F.	Khozestan: 16 Km from BagheMalak towards Ramhormoz, 900 m.	MRCH 7757
*O. plantago*Bornm.	Kerman: Chopar mountain, 2600 m.	NPGBI 6237
*O. scrobiculata*Boiss.	Gharachaman	NPGBI 2823
*O. lunata*Boiss.	Hamedan: Malayer, 1994 m.	NPGBI 6041
*O. iranshahrii*Rech. F.	Kerman	MRCH 8265
O. depauperata var. *depauperata*Boiss.	Eastern Azarbayjan: Marand towards Tabriz, Payam village, Mishoodagh hills	MRCH 8184
O. marandensis	Eastern Azarbayjan: Marand towards Tabriz, Payam village, Mishoodagh hills, 1900 m.	MRCH 10052
*O. haussknechtii*Boiss.	Kermanshah	NPGBI 6145
O. *gaubae*Bornm.	Tehran: the first of Damavand road, 20 Km from Bomhen, 1700 m.	NPGBI 6146

Table 1. Continued

O.*mozaffarianii*Amirabadi-zadeh	Esfahan: Semirum, Hanna, between Maurak and Khina to Khafr, 1900 m.	TARI 71263
*O. atropatana*Boiss.	Eastern Azarbayjan: Marand towards Zanooz, 1500 m.	NPGBI 3880
*O. argyrea*Boiss.	Azarbayjan: 2-12 Km west of Zenooz, 1500-1700 m.	NPGBI 10026
O. aucheri subsp. *aucheri*Boiss.	Ardabil: 15 Km Mianeh towards Ardabil, opposite of Ghazal-Ozan river, 110 m.	NPGBI 6147
O. aucheri subsp. *psammophila* (Bornm.) Rech. F.	Khorasan: TorbatHeydarieh, Kashmar, Baharieh, 1211 m.	NPGBI 6148
O. aucheri subsp. *teheranica* (Bornm.) Rech. F.	Khorasan: Neishaboor towards Sabzevar, after Baghjar	NPGBI 6149
*O. subacaulis*Boiss.	Eastern Azarbayjan: 8 Km Zenooz, Kanglomaraei, 1380 m.	MRCH 8478
O.*heliocarpa*Bioss.	East Azarbayjan: Marand, Zenooz village	NPGBI 6163
O. heterophylla C. A. Mey.	East Azarbayjan: Varzaghan towards Ahar, 20 Km remained to Satarkhan dam, 1721 m.	NPGB 6151

MRCH: Mashhad Research Center Herbarium.
NPGBI: National Plant Gene Bank of Iran.
TARI: Herbarium of the Research Institute of Forests and Rangelands.

Table 2.List of pod characters and related numerical codes used in morphological studies

No.	characters	Numerical code
1	Size of pod	0= small; 1= large
2	Figure of pod	0= suborbicular-semiorbicular; 1= lunate; 2= reniform; 3= orbicular; 4= linear or oblong
3	Appearance of pod	0= compressed; 1= convex
4	Presence of hair	0= glabrous or pubescence; 1= with bristle and plumose; 2= denselylanate; 3= cottony-woven together
5	Presence of stipe	0= non stipitate; 1= stipitate; 2= cuneate-winged
6	Presence of crest	0= without crest; 1= crestes
7	State of margin	0= without teeth; 1= with teeth
8	Number of seed	0= 1; 1= 1-2; 2= 2 or 3
9	State of dorsal suture of pod	0= erect-suberect; 1= curved
10	State of surface of disc	0= without spines; 1= spinous; 2= with or without spines; 3= with bristle
11	Number of loculus	0= unilocular; 1= bilocular; 2= multilocular
12	Shape of loculus at surface of disc	0= pitted; 1= foveolate and areolate; 2= smooth
13	curvature	0= circinate-incurved; 1= incurved; 2= without curvature

O. argyrea,*O. marandensis*, *O. plantago*, *O. buhseana* and *O. szovitsii* that the shape of the pod in species is lunate except *O. buhseana* (suborbicular-semiorbicular).

Sirjaev[2] divided *Onobrychis* sect. *Heliobrychis* into three subsections, namely *Szovitsianae*, *Boissierianae* and *Persicae*. The two prior subsections are perennials, but the last mentioned contains annual species. According to sirjaev[2] opinion, the subsection *Szovitsianae* contains the lonely species of *O. szovitsii*, which is differentiated easily by its glabrous habit. The remaining perennial species of the section situated in the *Boissierianae* subsection. According to our results, *Szovitsianae* cannot be contemplated as a distinguishing subsection and maybe included in the subsection *Boissierianae*. This is supported well by results from pollen morphology [6] and anatomical findings of the *Onobrychis* sect. *Heliobrychis* [7].

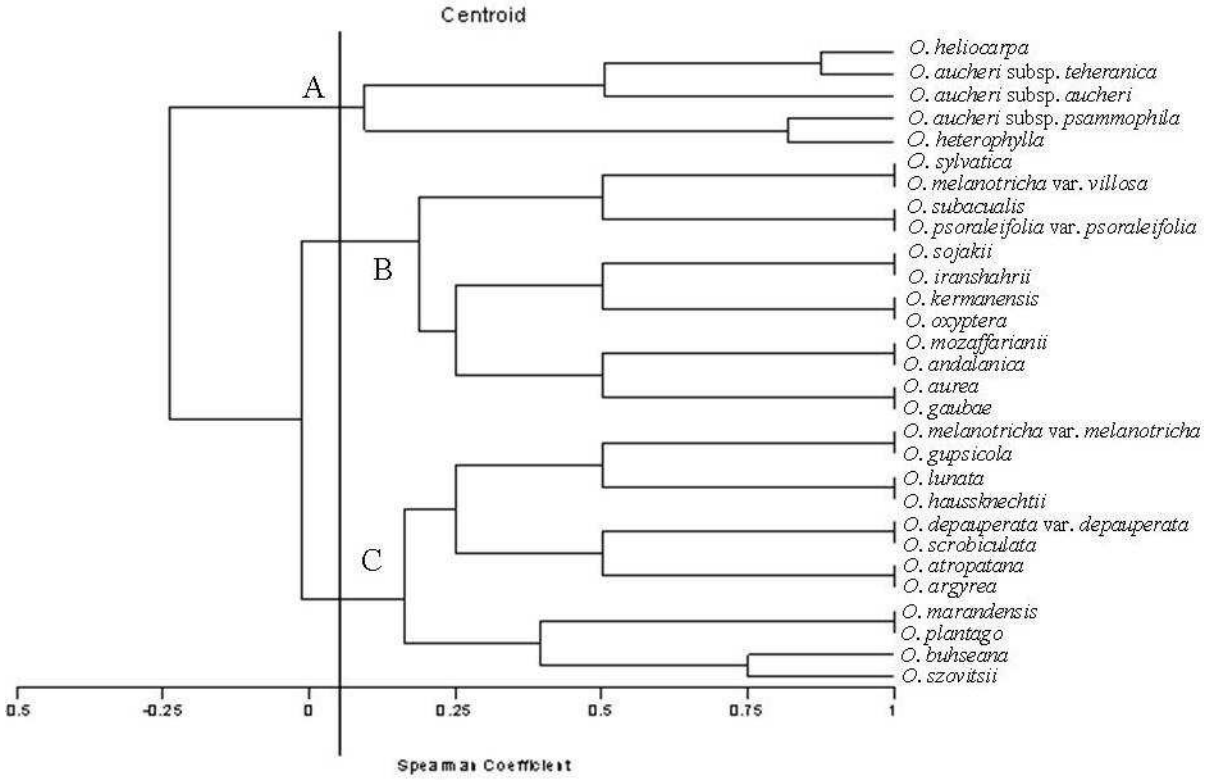

Figure 1. Centroid linkage phenogram based on analyzing pod characters of 29 taxa of *Onobrychis* sect. *Heliobrychis*

CONCLUSION

Species of the section *Heliobrychis*were divided into three groups based on pod characters. Group A includes annual species (except *O. subacualis*) and *O. heterophylla* with two or three seeds per pod, bilocular or multilocular pod

and circinate-incurved curvature, in contrast, groups B and C include the species that have one seed per pod, unilocular pod and incurved or without curvature.

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