



## Comparative morphological studies on three endemic *Ononis* L. (Leguminosae) species growing in Turkey

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### Abstract

In this study, the morphological characteristics of three endemic *Ononis* L. (Leguminosae) species (*O. sessilifolia* Bornm., *O. basiadnata* Hub.&Mor. and *O. macrosperma* Hub.&Mor.) which are native to Turkey were examined to determine the relevance of these properties in the establishment of similarities and differences in these taxa. The morphological characters of the plants, such as leaf, stem and flower properties, were described in detail. As a result, the trichomes and branching of the stem, corolla and peduncle properties, seed surface, and type of stamen like this properties were analyzed to help in morphological differences in the between the *Ononis* species. Also, as a result of the fieldworks done, if the necessary measures are not taken, especially for *O. sessilifolia* and *O. macrosperma*, these species could be seriously threatened in the future.

**Key words:** *Ononis*, morphology, endemic, Leguminosae, Turkey

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### Türkiye’de yetişen üç endemik *Ononis* L. türü üzerinde karşılaştırmalı morfolojik çalışmalar

### Özet

Bu çalışmada, Türkiye’de doğal olarak yetişen üç endemik *Ononis* L. (Leguminosae) türünün (*O. sessilifolia* Bornm., *O. basiadnata* Hub.&Mor. ve *O. macrosperma* Hub.&Mor.) morfolojik özellikleri bu taksonlar arasındaki benzerlik ve farklılıkları temel alınarak bu özelliklerin ilişkisi tanımlanarak araştırılmıştır. Bitkilerin morfolojik özellikleri örneğin yaprak, gövde ve çiçekleri detaylı olarak tanımlanmıştır. Sonuç olarak, tüyler, gövde dallanması, korolla, pedunkul, tohum yüzeyi ve stamen tipleri gibi özelliklerin, *Ononis* türleri arasındaki morfolojik farklılıkların tespitine yardımcı olabileceği analiz edilmiştir. Ayrıca, yapılan arazi çalışmaları neticesinde, şayet gerekli önlemler alınmazsa, özellikle *O. sessilifolia* ve *O. macrosperma* türlerinin gelecekte yüksek tehdit altında olabileceği düşünülmüştür.

**Anahtar kelimeler:** *Ononis*, morfoloji, endemik, Leguminosae, Türkiye

### 1. Introduction

The legume family is second only to the grass family in terms of its importance to humans. Almost every major civilization since the development of agriculture has had legumes as well as grain as part of its support system. This family is the source of a wide range of products, such as foods and medicines, although fewer than 50 legume species provide 90 % of the world’s current requirements (Simpson and Ogarzaly, 2001; Cunha et al. 2012).

The species of *Ononis* L., which belong to the family Leguminosae, are called “Kayışkiran”, “Sabankiran”, “Demirdelen”, “Kayık çiçeği”, “Yandak”, “Şırbık”, “Koca örsele” or “Yaltakdiken” in Turkey. The genetic source of the genus *Ononis* L., which is represented by 75 species in the world, is the Mediterranean (Evans, 2002). This genus has 17 species of which 4 taxons are endemic in Turkey (Davis, 1970; Güner, 2012).

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In this study, the morphological properties of three endemic *Ononis* species (*O. sessilifolia* Bornm., *O. basiadnata* Hub.-Mor. and *O. macrosperma* Hub.-Mor.) were studied comparatively. According to the IUCN Red Data Book (Ekim et al., 2000) in Turkey, while *O. basiadnata* and *O. macrosperma* are at lower risk, *O. sessilifolia* has been recorded as vulnerable. In different regions of our country, the various species of *Ononis* have been used for their diuretic, antiseptic and antimicrobial effects (Baytop, 1999).

Members of the genus have been reported to possess pharmacological activities due to their aperient, antiedemic, antiscorbutic, antiseptic, cardiogenic, depurative, diuretic, estrogenic, hemolytic, litholytic, antibacterial, analgesic, anti-inflammatory, antiviral, cytotoxic, antioxidant (Erdemgil et al. 2002; Duke et al. 2002; Deliorman et al. 2012), antifungal (Altuner, 2010), antiproliferative (Talib, 2010), antilipase (Bustanji et al. 2011), antitumor (Talib, 2012) and wound healing effects (Altuner et al. 2010; Süntar et al. 2011). In addition, the aerial part of *O. arvensis* has been used in traditional medicine to treat urinary tract infections and skin diseases. In the literature, there are a few anatomical and morphological investigations on some species of *Ononis* (Langer et al.1995; Duke et al. 2002; Taia, 2004; Baldemir et al. 2009; Agullo, 2013). Leaf epidermal studies are useful in determining their different morphological and anatomical characteristics, thus helping in the assessment of a taxonomic relationship (identification, classification) between species (Ogie-Odia et al. 2010).

In the present investigation, new and extended findings on three species of *Ononis* were revealed in comparison with the morphological definitions given in the Flora of Turkey (volume 3) (Davis, 1970).

## 2. Materials and methods

### 1.1. Plant materials

Plant materials were gathered from the localities indicated in Table 1. Voucher specimens are deposited in the Herbarium of the Faculty of Pharmacy at the University of Ankara, Turkey (AEF).

Table 1. Locations and herbarium numbers of the studied *Ononis* species.

Species	Locations	Herbarium number
<i>O. sessilifolia</i>	C5 Niğde: Çamardı, Demirkazık mountains, Narpızlı plateau, channel around, rocky slopes, s.l. 2073 m, 13.06.2007, Ayşe and Şükrü Baldemir	(AEF 23979)
<i>O. basiadnata</i>	C4 İçel: Gülnar-Mut road, exit of Gülnar, fields, among maquis, s.l. 1140 m. 08.06.2007, Ayşe and Şükrü Baldemir	(AEF 23968)
<i>O. macrosperma</i>	C2 Antalya: Elmalı, Çıglıkara, entrance of Sinekçibeli, rocky slopes, <i>Cedrus libani</i> forest, s.l. 1684 m. 29.5.2008, Ayşe and Şükrü Baldemir	(AEF 24698)

### 1.2. Morphological studies

For morphological studies, three species of *Ononis* were analyzed in detail in terms of parameters such as size, shape, surface, and other properties of the leaf, flower, stem and fruit. We generally used herbarium specimens and sometimes benefited from material deposited in 70% alcohol. The microphotographs and drawings were carried out with a Leica Stereo microscope.

## 3. Results

During morphological studies, the herbarium materials and plant materials deposited in 70% alcohol were used.

### 3.1. *O. sessilifolia* Bornm. In Feddes Rep. 50: 133, t. 337 (1941).

Type: Described from Turkey C5 Niğde, Ellenberg 108.

Perennial, dwarf undershrub with depressed short stems. Detailed morphological characteristics of *O. sessilifolia* are given in Table 2 (Figures 2, 3).

Flowering time: June-August. The plant's natural habitat is Alpine slopes, at altitudes between 2400-2800 m. Endemic, Ir.-Tur. Element (Davis, 1970).

Category of danger: Lower risk (LR-cd) (Ekim et al. 2000)



Figure 1. Photographs of herbarium samples H1- *O. sessilifolia*, H2- *O. basiadnata*, H3- *O. macrosperma*

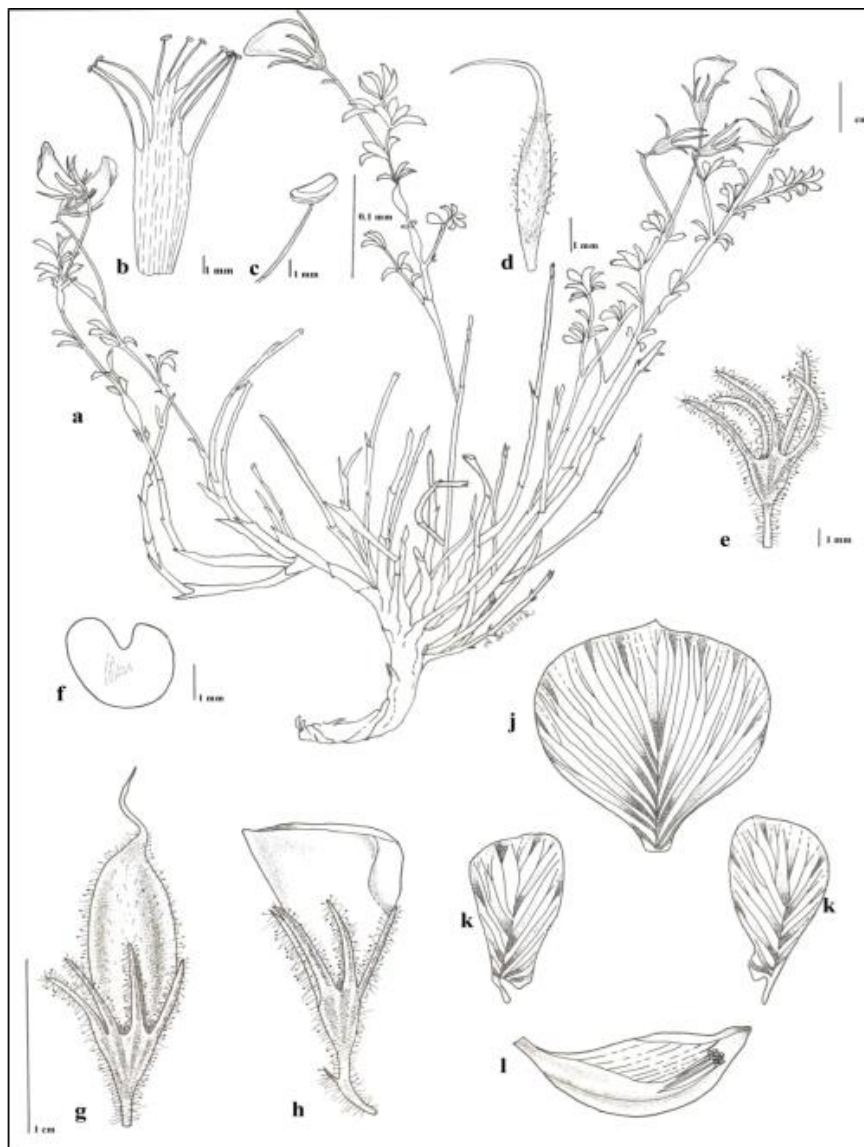


Figure 2. Morphological drawing of *O. sessilifolia*  
 a. general view of plant, b. stamens monodelphous (10), c. stamen, d. ovary, e. calyx, f. seed, g. legume, h. flower, j. vexillum (standard), k. wing, l. carina

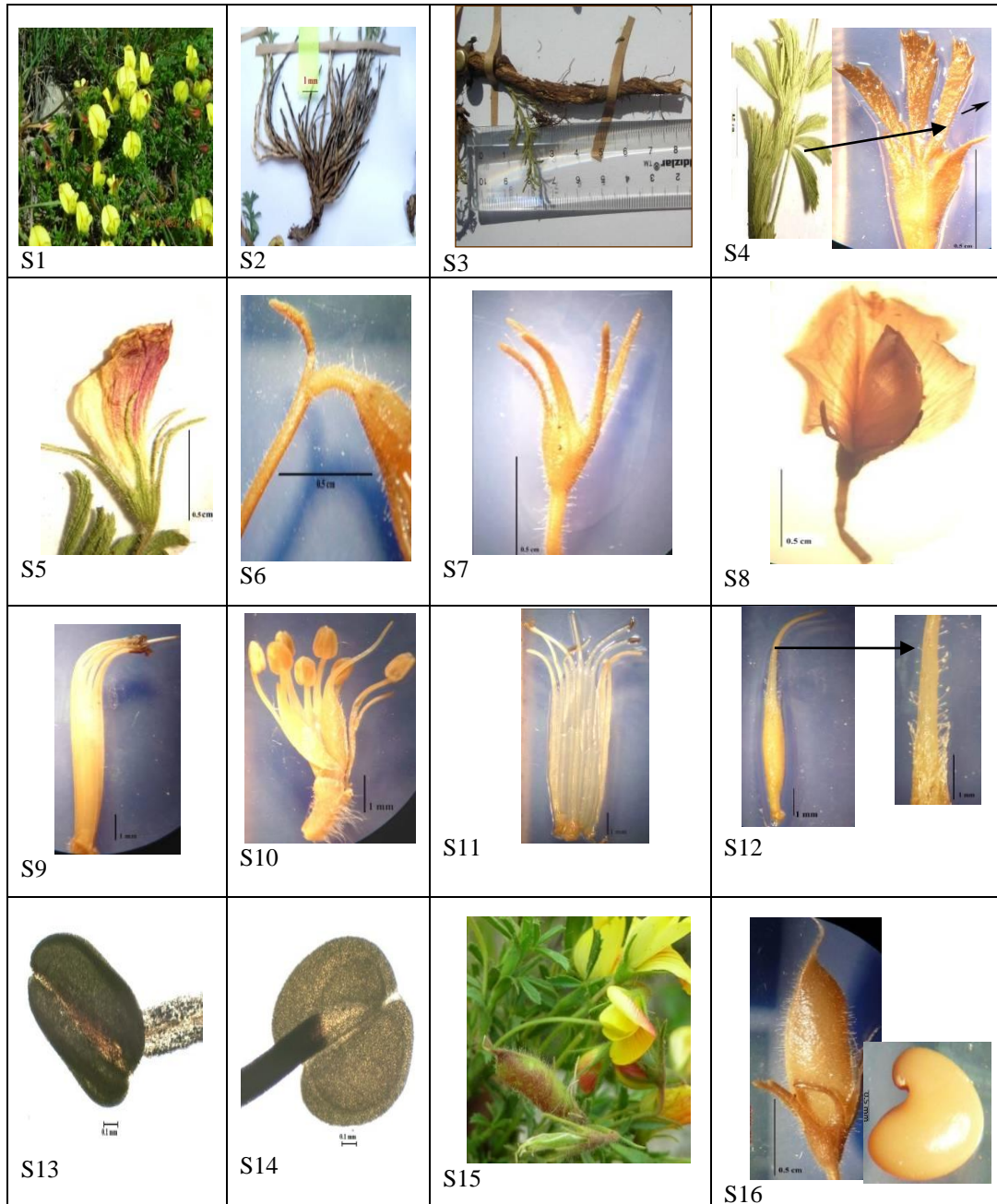


Figure 3. *O. sessilifolia*- S1- general view of plant in nature, S2- the stem residue from the previous year, S3- root, S4- leaves trifoliate and leaflike stipula, S5- flower, S6- awn, S7- calyx, S8- corolla, S9- androecium, S10- androecium and gynoecium, S11- stamens monodelphous (10), S12- ovary, S13- front view of stamen, S14- rear view of stamen, S15- view of the legume in nature, S16- legume and seed.

**3.2. *O. basiadnata* Hub.-Mor.** In *Bauhinia* 2 (3): 298, t. 3, 324 (1965).

Type: Described from Turkey C4 İçel, Huber-Morath 9533.

Annual to perennial, densely glandular villous, many-branched with ascending stems. Morphological properties of *O. basiadnata* are given in detail (Table 2) (Figures 4, 5).

Flowering time: June-July. It grows naturally on stony slopes, limestone rocks and *Quercus macchie* at altitudes between 600-1350 m.

Endemic, East Mediterranean element (Davis, 1970).

Category of danger: Vulnerable (VU) (Ekim et al. 2000).

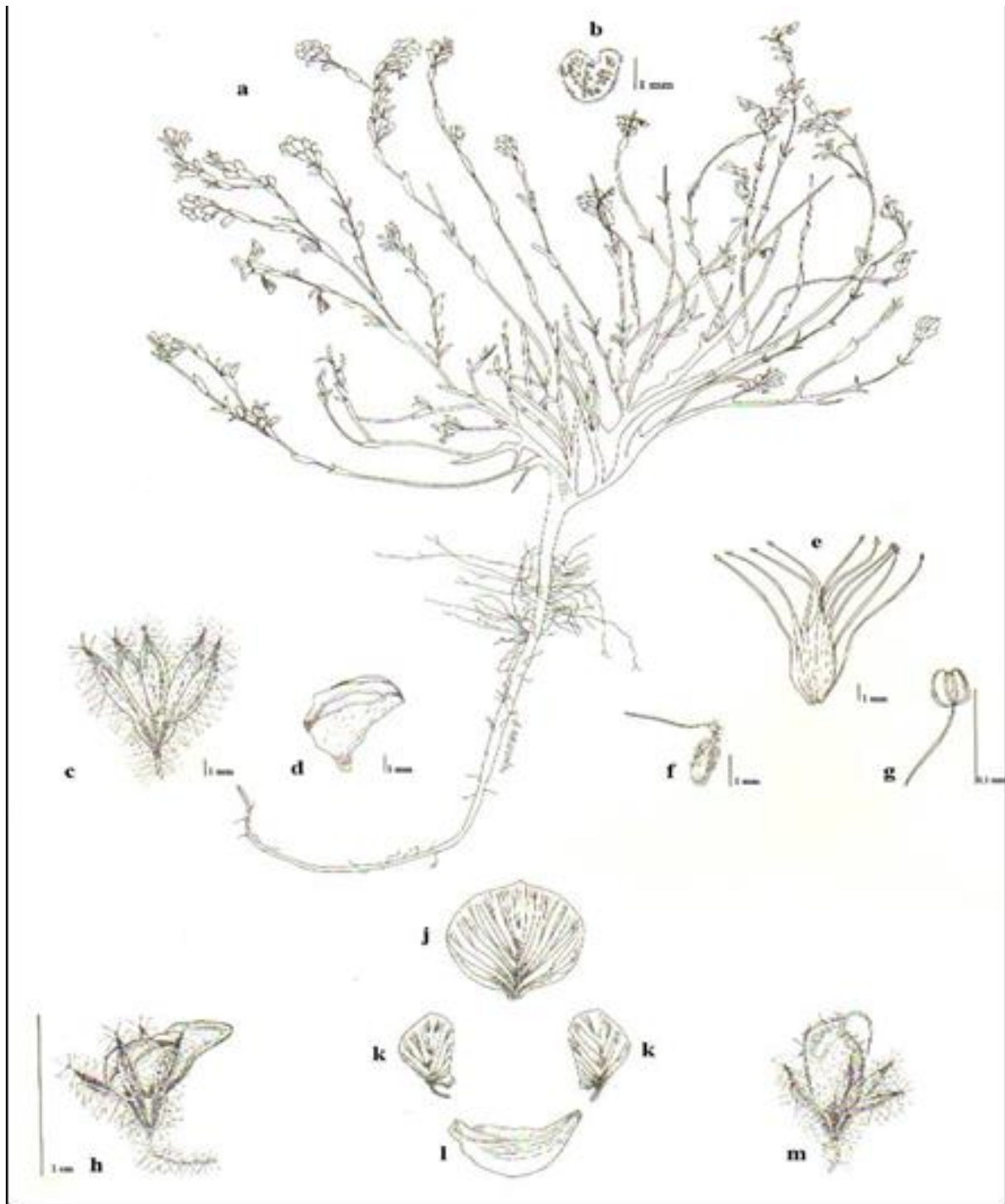


Figure 4. Morphological drawing of *O. basiadnata* **a.** general view of plant, **b.** seed, **c.** calyx, **d.** corolla, **e.** stamens diadelphous (9+1), **f.** ovary, **g.** stamen, **h.** flower, **j.** vexillum (standard), **k.** wing, **l.** carina, **m.** legume

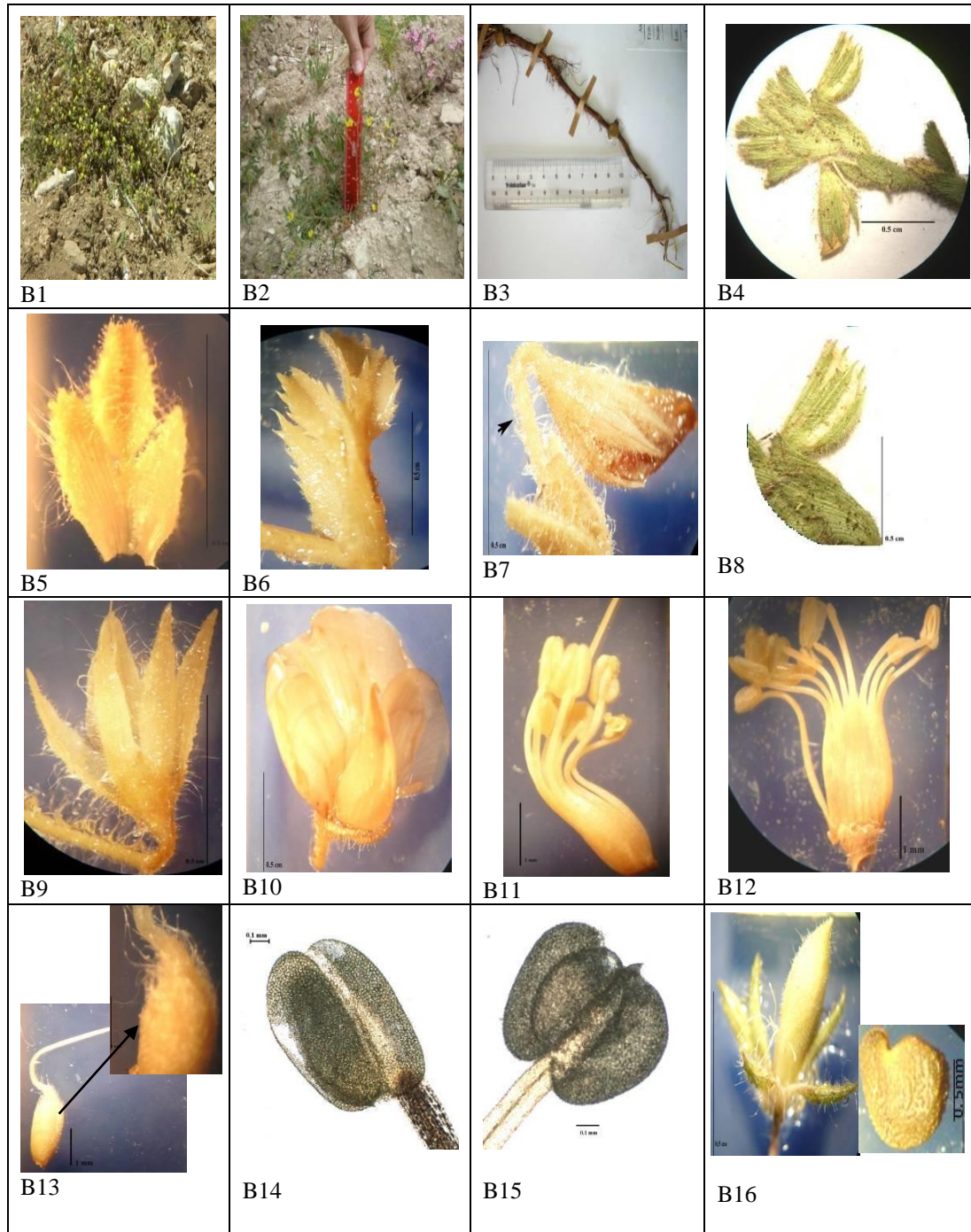


Figure 5. *O. basiadnata*- B1, B2- general view of plant in nature, B3- root, B4- flowers, B5- leaves unifoliate and leaflike stipula, B6- leaflike stipula, B7, B8- flower, B9- calyx, B10- corolla, B11- androecium, B12- stamens diadelphous (9+1), B13- ovary, B14- front view of stamen, B15- rear view of stamen, B16- legume and seed.

### 3.3. *O. macrosperma* Hub.-Mor. In *Bauhinia* 3 (2): 313 (1967).

Type: Described from Turkey C2 Antalya, Friederike Sorger 63-36-25.

Annual, branched from base, glandular-villous. Morphological properties of *O. macrosperma* are described in more detail (Table 2; Figures 6, 7).

Flowering time: May-July. Its natural habitat is *Juniperus excelsa* forests at altitudes between 1100-1500 m.

Endemic, East Mediterranean element (Davis, 1970).

Category of danger: Vulnerable (VU) (Ekim et al. 2000).

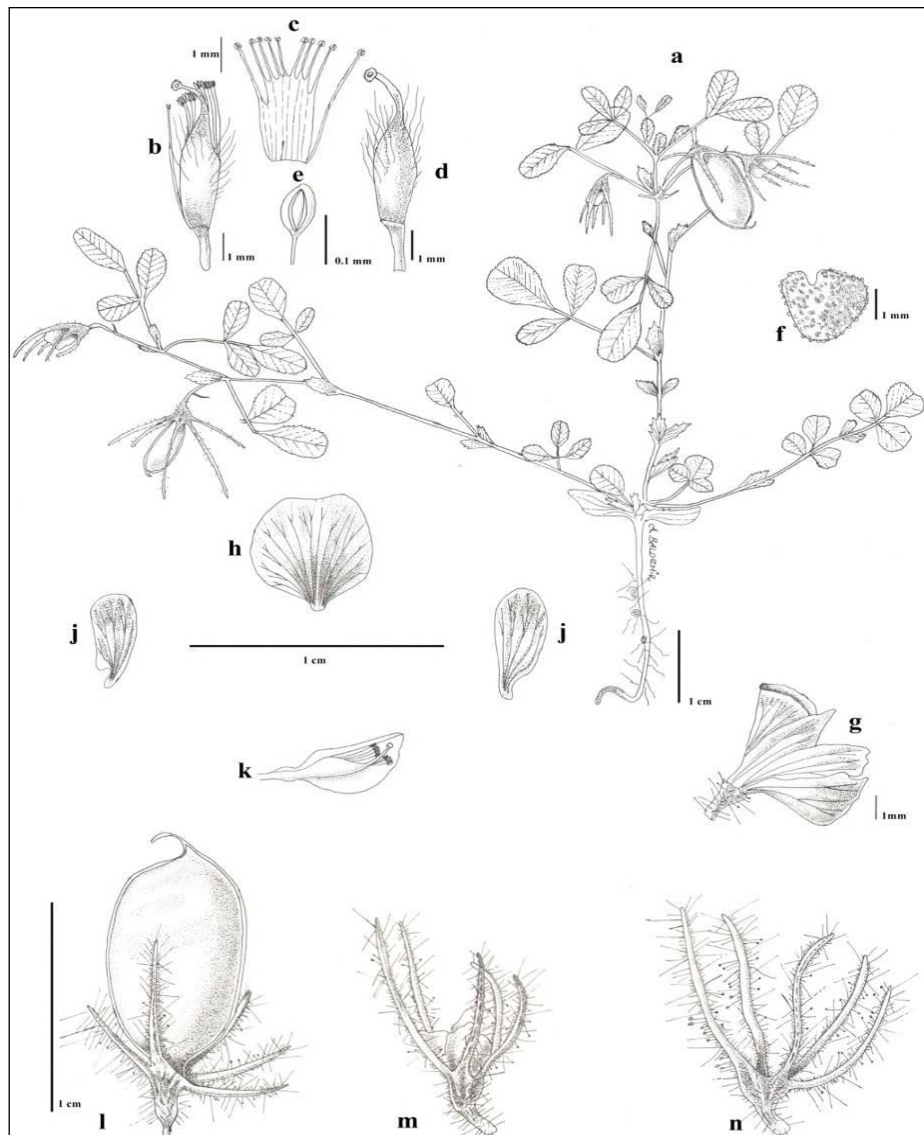


Figure 6. Morphological drawing of *O. macrosperma* **a.** general view of plant, **b.** androecium and gynoecium, **c.** diadelphous stamen (9+1), **d.** ovary, **e.** stamen, **f.** seed, **g.** corolla, **h.** vexillum (standard), **j.** wing, **k.** carina, **l.** fruit (legumen), **m.** flower, **n.** calyx.

#### 4. Conclusions and discussion

In this study, the morphological properties of three endemic *Ononis* species were investigated. Our morphological findings were compared with the results from the *Flora of Turkey* and similarities and differences between the species were detected. For instance, the corolla color of *O. macrosperma* in the *Flora of Turkey* is listed as white. However, we observed that the corolla is yellow in this species (Figure 7). According to the *Flora of Turkey* (Davis, 1970), *Ononis* species have a monodelphous stamen. Our study showed that *Ononis* species can have both monodelphous or diadelphous stamens (Figures 2-7). In addition, some morphological features not detailed in the *Flora of Turkey* for the *Ononis* species were revealed in our study (Table 1). Previous outcomes showed that the pollen and seed ornamentations of the three species were different from each other (Baldemir et al. 2009).

In the literature, there are very few studies about the morphological features of *Ononis* genus (Taia, 2004; Turini, 2010; Agullo et al, 2013). Taia (2004) reported that *Ononis* leaf characters were divided into two groups: the *O. pubescens* type that has simple lanceolate leaves with a smooth margin and acute apices, covered by multicellular glandular hairs; and the second group, taxa with trifoliate leaves, leaflets with different shapes, for example lanceolate, ovate, trilete or obovate with smooth or dentate margins and emarginated, acute or apiculate apices, and leaflets enriched with multicellular, smooth walled glandular hairs. According to our leaf findings, *O. sessilifolia* and *O.*

*macrosperma* have trifoliolate, while *O. basiadnata* has mainly unifoliolate, but sometimes trifoliolate. The other common specifications in the groups are nearly consistent with our findings (Table 1). Turini et al. (2010) studied 69 *Ononis* species which were analyzed using plastid trnL-F and nuclear ITS DNA sequences. In another study, *O. tridentata* samples growing in Morocco generally showed the largest medium values against other taxa, and the most outstanding features are the inflorescence peduncle length ( $13.09 \pm 1.67$  mm vs. up to 6.47 mm), the calyx teeth length ( $5.46 \pm 0.64$  mm vs. up to 4.31 mm) and the stipule width ( $1.55 \pm 0.38$  mm vs. up to 1.13 mm). As a result, Agullo et al. (2013) developed a key according to the features of the leaflets, sepals and inflorescence among *O. tridentata* subspecies.

This study is original, in that, similar and different morphological features of the three endemic *Ononis* species growing in Turkey are revealed in detail. However, morphologic studies should be supported by molecular, chemical and anatomical studies. It was found that the distribution areas of *O. sessilifolia* and *O. macrosperma*, in particular, have narrowed. In addition, the habitats of all three species were identified as grazing areas. If the necessary measures are not taken, these species could be seriously threatened in the future. Previously, culture studies with different plants were performed and substantially successful results were obtained (Uzunhisacıklı and Vural, 2009). Also, the seeds should be stored in gene banks.

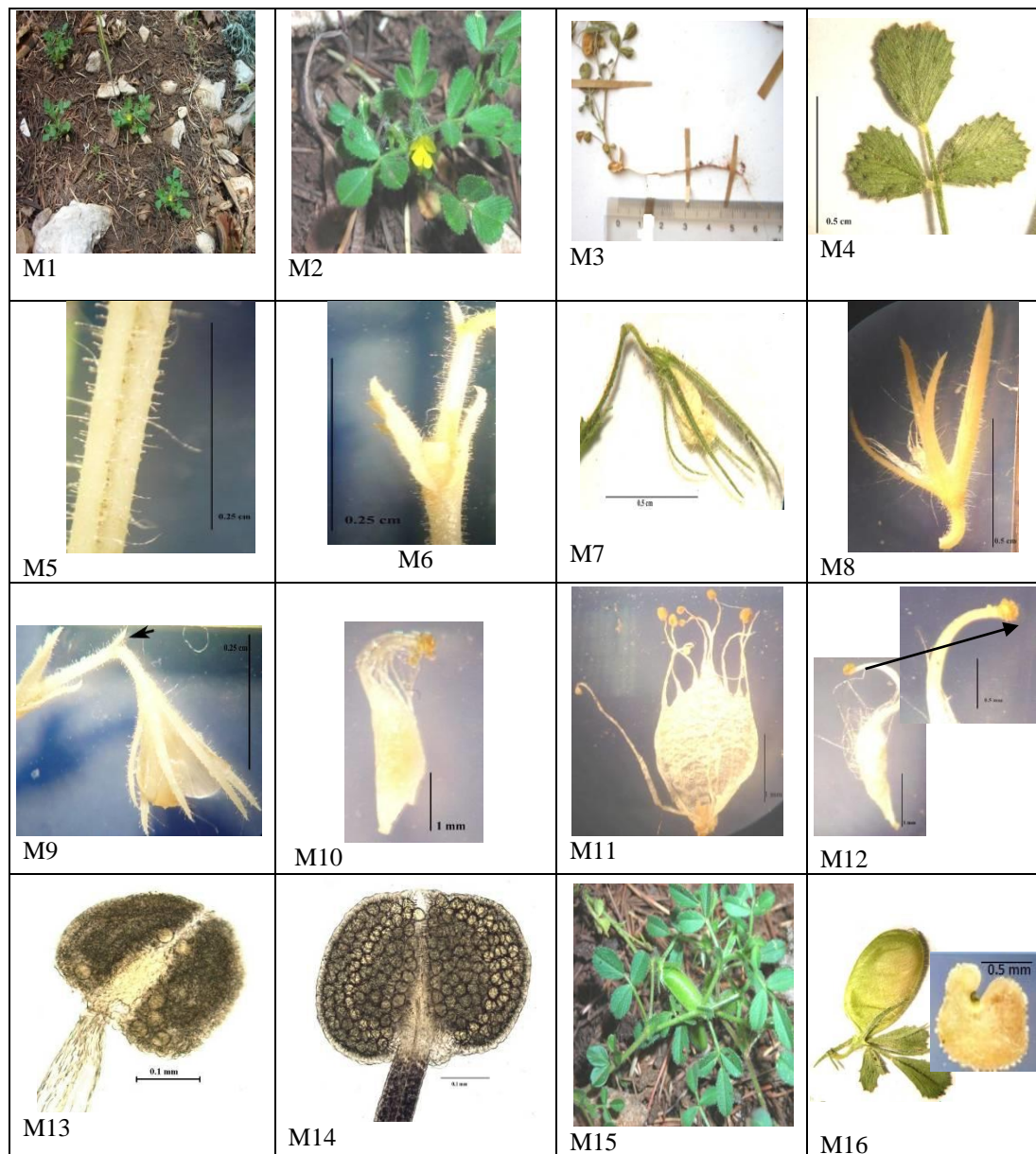


Figure 7. *O. basiadnata*- M1, M2- general view of plant in nature, M3- root, M4- leaves trifoliolate, M5- hairy petiole, M6- leaflike stipule, M7- flower, M8- calyx, M9- awn, corolla, M10- androecium, M11- stamens diadelphous (9+1), M12- ovary papillate, M13- front view of stamen, M14- rear view of stamen, M15- view of legume in nature, M16- legume and seed.



Table 2. Comparison of morphological properties of three endemic *Ononis* taxa growing in Turkey.

Parts of plants	<i>O. sessilifolia</i>	<i>O. basiadnata</i>	<i>O. macrosperma</i>
Leaf	Leaves minute, trifoliolate, sessile; leaflets sessile, linear-oblong (2-) 3-6 (-7) mm, denticle; unijugate leaflike stipules at the base of leaf, leaflets often folded and densely glandular pilose (Figs. 2, 3).	Leaves mainly unifoliolate, sometimes trifoliolate; leaflets oblanceolate-cuneate, often folded, denticulate, 2-5 x (1.5) 2-3 (-4) mm, densely glandular hairs, petiole 3-7 (-8) mm and unijugate leaflike stipules adnate to petiole (Figs. 4, 5).	Leaves trifoliolate, leaflets broad obovate-cuneate to oblanceolate, shortly denticulate, 4-6 (-7) x (2-) 3-5 mm, hairy, unijugate leaflike stipules at the parts connected to the branch of leaf (Figs. 6, 7).
Stem	Dwarf undershrub with depressed short stems, 3-(5) 6.5 cm and glandular hairy, previous year's stem residues clearly seen (Fig. 3).	Many branched with ascending stems, (7-) 8-20 (-23) cm, densely glandular-villous (Figs. 4, 5).	Stem is branched from base, (3.5-) 4-6.5 (-8) cm, glandular-villous (Fig. 7).
Flower	<p>Peduncle long-exserted, (13-) 17- 27 mm, 1-flowered, with a 1-1.5 mm (Fig. 3).</p> <p>Calyx campanulate, (4.5-) 5-5.5 (-6) mm, parted to 2/3 : 3/4 into linear subulate, 1- nerved; calyx tube (1.5) 2-2.5 mm, and has glandular and eglandular hairs (Fig. 3).</p> <p>Corolla yellow, vexillum (standard) often striped with red, 10-13 (-14) x (9-) 10-12 (-13) mm; wing 7-10 x 4.5-5 (-6) mm; carina (7-) 9-10 x 4-5.5 mm (Fig. 3).</p> <p>Androecium monodelphous (10), anthers versatile, filaments connected from center to anther and easily moving, stamens 7-10 mm.</p> <p>Ovary superior 7-12 mm, densely glandular hairy, style coiled up as a hook in one direction (Fig. 3).</p>	<p>Peduncle 3-8 mm, 1-flowered, generally not or indistinctly awned (Fig. 5).</p> <p>Calyx campanulate, linear-lanceolate, calyx lobes (3-) 3.5-4 (-4.5) mm, cleft to 3/4 linear-lanceolate, at least at base 5-nerved lobes, calyx tubes (1.25-) 1-1.5 mm, densely eglandular hairs and rarely glandular hairs (Fig. 5).</p> <p>Corolla yellow, vexillum often striped with red 6-8 x (5-) 6-7.5 mm; wing 5-6 x 2-3 mm; carina 5-7 x 2.5-3.5 mm (Figs. 4, 5).</p> <p>Androecium diadelphous (9+1), vexillar stamen inserted near base of staminal tube, 5-7 (-7.5) mm (Fig. 5).</p> <p>Ovary superior, 6-7.5 (-8.5), ovate, hairy, style characteristically rolled and extended in the same direction (Fig. 5).</p>	<p>Peduncle (4-) 5- 7 (-10) mm, 1- flowered, shortly awned 0.5-1.5 (-2.5) mm (Fig. 7).</p> <p>Calyx campanulate-subulate, lobes somewhat unequal (4-) 5- 7 (-8) mm, calyx tubes 1-1.5 mm, 1- nerved, hairy (Fig. 7).</p> <p>Corolla yellow, vexillum 3-4 x 1.5-3 mm; wings have different dimensions 3-4 x 0.75-1.25 mm; carina 3.5-4 (-4.5) x 1,5-2 mm (Figs. 6, 7).</p> <p>Androecium diadelphous (9+1), vexillar stamen inserted near base of staminal tube, (2-) 3.5-4 (-5) mm (Fig. 7).</p> <p>Ovary superior (1.5-) 2-4.5 (-5) mm, longitudinal slightly elongated, quite hairy and stigma papillose (Fig. 7).</p>
Fruit (legume)	Linear-oblong (9-) 11-13 (-14) x (2-) 3-4 mm, densely trichome (Figure 3). Seeds cordate-ellipsoid, 0.95- 1.1 mm long, 0.92-1.04 mm wide, ornamentation reticulata (Baldemir et. al, 2009).	Oblong (8-) 7-6 x 2.5-3 mm, densely trichome (Figure 5). Seeds cordate-ellipsoid, 1.2-2 mm long, 1-1.80 mm wide, ornamentation gemmate-retipilate (Baldemir et. al, 2009).	Oblong (5-) 6-10 (-11) x 3-4.5 mm, densely trichome (Figure 7). Seeds cordate-ellipsoid, 1,90-3 mm long 1.8-3 mm wide, ornamentation baculate-rugulate (Baldemir et. al, 2009).

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