SERİ / SERIES / SERIE / SÉRIE	A	CİLT / VOLUME / BAND / TOME	56	SAYI / NUMBER / HEFT / FASCICULE	2	2006

İSTANBUL ÜNİVERSİTESİ

ORMAN FAKÜLTESİ

DERGİSİ

REVIEW OF THE FACULTY OF FORESTRY,
UNIVERSITY OF ISTANBUL

ZEITSCHRIFT DER FORSTLICHEN FAKULTÄT
DER UNIVERSITÄT ISTANBUL

REVUE DE LA FACULTÉ FORESTIÈRE
DEL 'UNIVERSITÉ D'ISTANBUL

MICROMORPHOLOGICAL OBSERVATIONS ON THE SEED SURFACES OF SOME *ONOBRYCHIS* ADANS. (LEGUMINOSAE) TAXA FROM TURKEY

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Abstract

This study was initiated to discriminate some *Onobrychis* taxa having great diversity in Anatolia from their seed-coat sculptures with SEM (Scanning Electron Microscopy). Diagnostic differences in high magnifications were observed on the seed surfaces of eleven taxa examined. The patterns found in close related species may also be useful as additional parameters to the delineations but no any general characteristics examplified on the section level were identified.

Key words: *Onobrychis*, seed, SEM, surface patterns, taxonomy, testa sculpture

1. INTRODUCTION

Onobrychis Adans. comprising about 170 species distributed mainly in temperate Europe and Asia (CRONQUIST 1981; ZOHARY 1987) has great importance from both the large number of species with high ratio of endemism in Turkey and being a taxonomically problematic genus. From 46 species recorded in Flora of Turkey, 23 (50 %) are endemic at species level. The number of endemic taxa can be increased with including lower taxonomic categories such as subspecies and varieties. In addition to the 46 species covered in the 3rd volume of Flora of Turkey (Hedge 1970), new taxa and new records were increasingly reported (DAVIS *et al.* 1988; DUMAN / VURAL 1990; VURAL 2000; AKTOKLU 2001). Anatolia is the most important origin centre of this genus which is widely distributed and have been also used as forage plants. The revision of the genus *Onobrychis* in Flora of Turkey is generally based on a limited number of specimens, and it is recommended for a better delimination of taxa to examine large numbers which are collected from different localities in order to determine the range of diversity and character variation within taxa.. It was reported that *Onobrychis* having numerous taxonomical problems throughout the genus await solution and field studies are much needed. Particular attention was recommended to given the indumentum, leaflet size and shape, peduncle length, corolla size, colour, proportions of standarts, wings and keels, and fruit size, shape and degree of toothing on crest and disc (HEDGE 1970). Many of the species dealt with in the Flora of Turkey were reported to be not defined or keyed out satisfactorily. It is usually too difficult to delimitate the close related taxa strictly with only the keys based upon morphological descriptions in such genus which have large variations. Detailed and reliable parameters are needed to elucidate phylogenetic

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Yayın Komisyonuna sunulduğu Tarih: 30. 09. 2005

relations and taxonomical problems in addition to morphological descriptions. Detailed investigations on generative characteristics which are not so much affected from environmental conditions can yield more reliable results among closely related taxa. Fruit morphology is therefore a very important key character in the identification of *Onobrychis* species but not sufficient in delineations for the species having large variations and sometimes for close related ones. On the other hand, no any study on the structural characteristics of the seeds as constant and reliable parameters which may be useful for solution of some taxonomical problem in *Onobrychis* was reported. Apart from the morphological descriptions, among the studies carried out on Turkish *Onobrychis*, SAYI (1950) investigated some xerophytic natures of *Onobrychis argyrea* Boiss. without determining subspecies as a steppe plant in the ligth of anatomical structures of the leaves and stem. ÖZYURT / KARGIOĞLU (1996) examined the ecological and morphological characteristics and the anatomical features of the vegetative organs of *Onobrychis pisidica* Boiss., endemic for Turkey adapted to steppe conditions. SEM technics in taxonomy provide facility to observe differences among related taxonomical groups as detailed criterion in generative organs like fruits and seeds especially. A high number of studies using SEM from taxonomical aspects were carried out on Leguminosae seeds (BRISSON/PETERSON 1976; BUTLER 1988; GUNN 1982; DITSCH *et al.* 1995; HUSAIN *et al.* 1994; GÜNEŞ 2000) and taxonomical importance of the microstructural features of testa in addition to morphological characteristics such as the size, general shape of seeds, shape of the hilum and its location was reported. KISLEV and HOPF (1985) in their SEM examinations of micromorphological features of the testa could discriminate *Lathyrus cicera* from *L. sativus*, which have morphologically similar seeds with the specimens belonged to 11th century. SEM observations of the surface features of testa in addition to other morphological characteristics of the seeds in 99 taxa belonging 4 genera of the Tribus *Vicieae* as diagnostic characters were examined by CHERNOFF *et al.* (1992) and the greatest diversity of testa surface patterns in *Lathyrus* was reported. This study was supported by the findings on testa ornamentations in SEM provided from 19 *Lathyrus* species in Turkey and observed species-spesific differences (GÜNEŞ 2000). It is obvious that microstructural features of the testa have great variations among different systematic categories in Leguminosae. But it was not reported any result on surface patterns of the seeds and its utility in delimitation of *Onobrychis* taxa. Ten species and one subspecies from four different sections including related species and endemic four taxa were examined in order to investigate diagnostic value of micromorphological surface features in the delineations at species and section level and taxonomical utility as an additional parameter in *Onobrychis*.

2. MATERIAL AND METHODS

The material were obtained from the specimens deposited in Istanbul University Faculty of Science (ISTF) herbarium, namely *O. aequidentata* (Sibth.& Sm.) d'Urv., *O. armena* Boiss.& Huet, *O. oxyodonta* Boiss., *O. altissima* Grossh., *O. argyrea* Boiss. subsp. *isaurica* Hedge & Hub.-Mor., *O. atropatana* Boiss., *O. huetiana* Boiss., *O. subacaulis* Boiss., *O. hypargyrea* Boiss., *O. galegifolia* Boiss., *O. nitida* Boiss.. ISTF numbers of the voucher specimens checked the identifications were given in the results. The general locations of the collected specimens were demonstrated in the map. Mature and uncontaminated 7-8 seed samples taken from each one individual of eleven species were mounted on a stub using double-sided adhesive tape and coated with 100-200 Å thick layer of gold in Bio-Rad SC502 rotating and tilting vacuum coating apparatus for two minutes, and was scanned with the JEOL JSM-5200 SEM at 20-25 KV accelerating voltage. Before taking the photographes, all seed samples for each species were scanned as three dimentional and observed on monitor. Photographs were taken from the monitor

with two different magnifications of 1500x and 3500x showing general characteristics of seed samples. The pictures obtained with all surface scannings of the seed specimens reflect the general surface characteristics of each individual taxon. General surface patterns of each seeds were observed according to literature (STEARN 1973; CHAKRABARTY / MUKHERJEE 1986: BARTHLOTT *et al.* 1998).

3. RESULTS

***Onobrychis aequidentata* (Sibth.& Sm.) d'Urv.**: In ruminate-reticulate surface sculpture, irregular elevations and depressions giving an eroded appearance make up partly network-like sculpture. ISTF 36980. (Figs 1-2).

***O. armena* Boiss.& Huet**: Rugose-reticulate surface pattern make up sharply angled conspicuous ribs presenting reticulatovenosus appearance give secondary branches into each interspace. ISTF 15559. (Figs 3-4).

***O. oxyodonta* Boiss.**: Rugose-favulariate surface characteristic consists of discontinuously branched ribs giving close texture. ISTF 13551. (Figs 5-6).

***O. altissima* Grossh.**: Favulariate surface pattern has finely wrinkles irregularly. ISTF 21473. (Figs 7-8).

***O. argyrea* Boiss. subsp. *isaurica* Hedge & Hub.-Mor.**: Pattern favulariate type. Finely close foldings arrange irregularly. ISTF 10576. (Figs 9-10).

***O. atropatana* Boiss.**: Rugose structure flexuose and bearing veinlets-like wrinkles. ISTF 16194. (Figs 11-12).

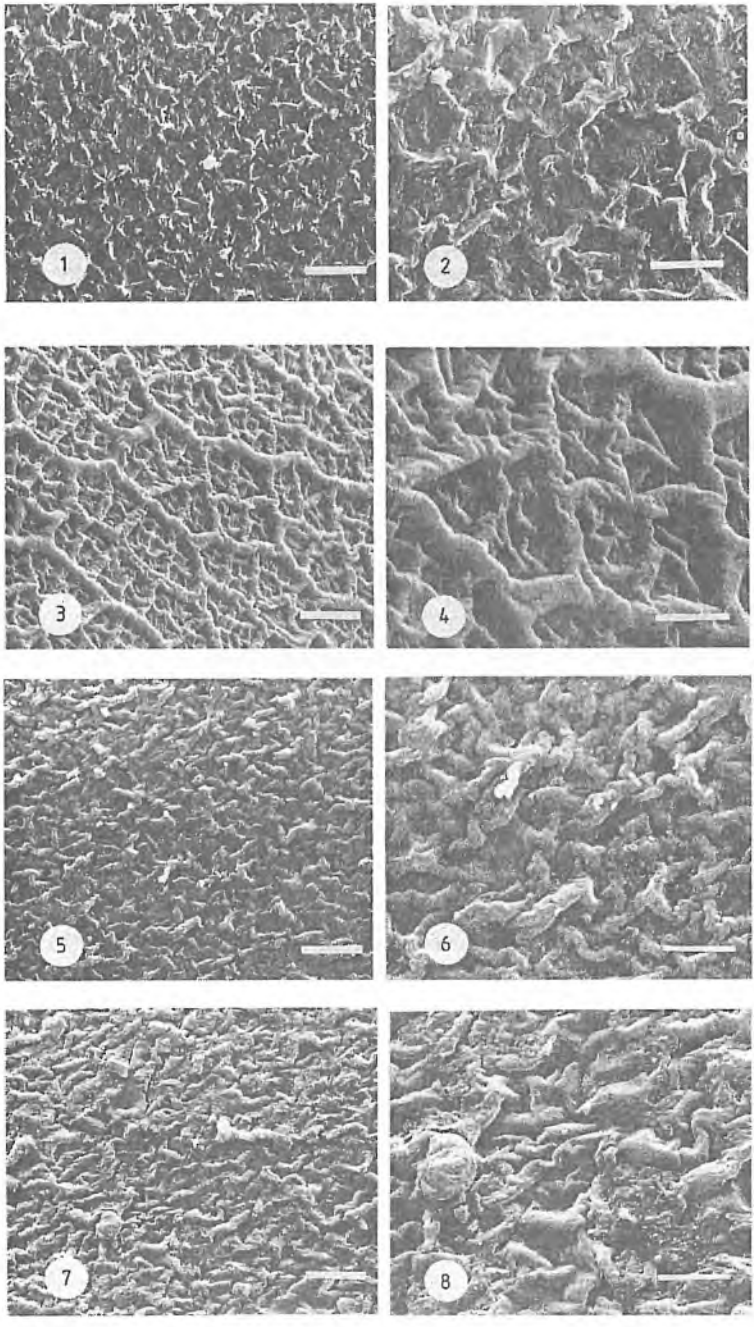
***O. huetiana* Boiss.**: Favulariate type sculpture has close finely wrinkles forming densely woven texture. ISTF 21516. (Figs 13-14).

***O. subacaulis* Boiss.**: Inconspicuous ruga and secondarily elevations forming reticulate sculpture present closely woven features. ISTF 16065. (Figs 15-16).

***O. hypargyrea* Boiss.**: Reticulate-rugose type pattern make up raised network of sharply angled foldings with branched ribs conspicuously. ISTF 5470. (Figs 17-18).

***O. galegifolia* Boiss.**: Favulariate type pattern consists of closely incompleted foldings in one directions. ISTF 21342. (Figs 19-20).

***O. nitida* Boiss.**: Pattern rugose-favulariate type. Hardcopiously irregular elevations form rib like wrinkles. ISTF 4285. (Figs 21-22).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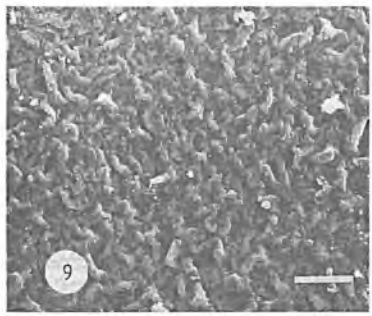
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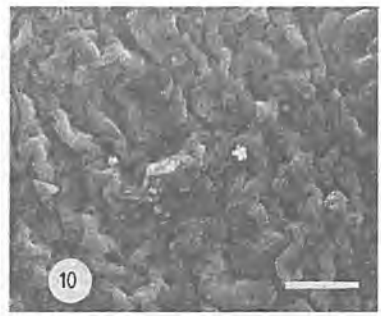
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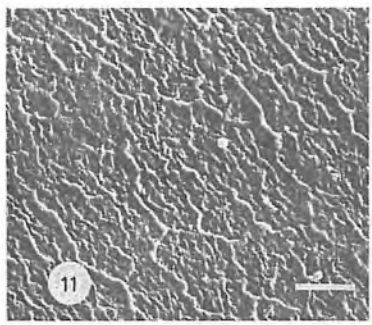
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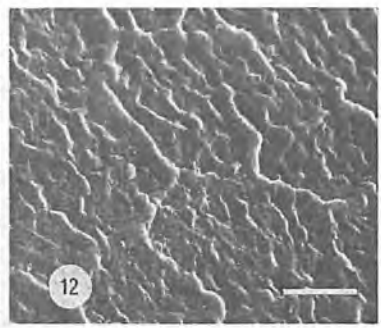
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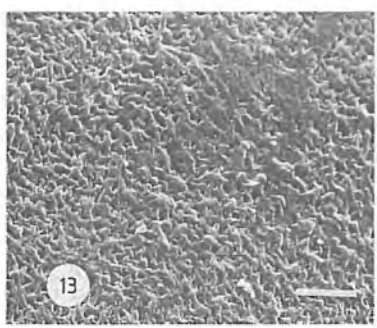
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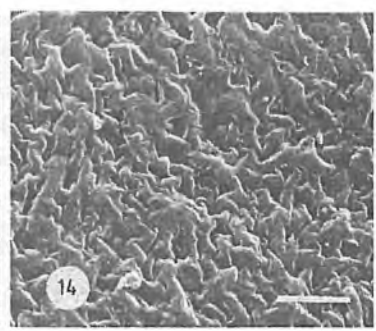
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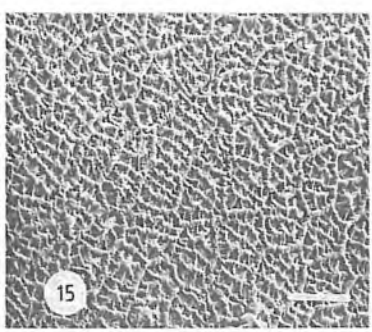
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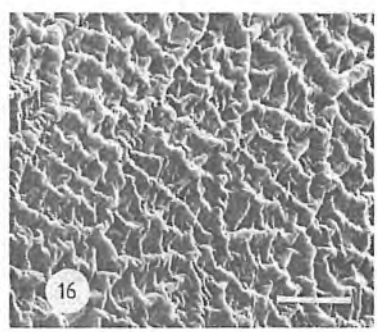
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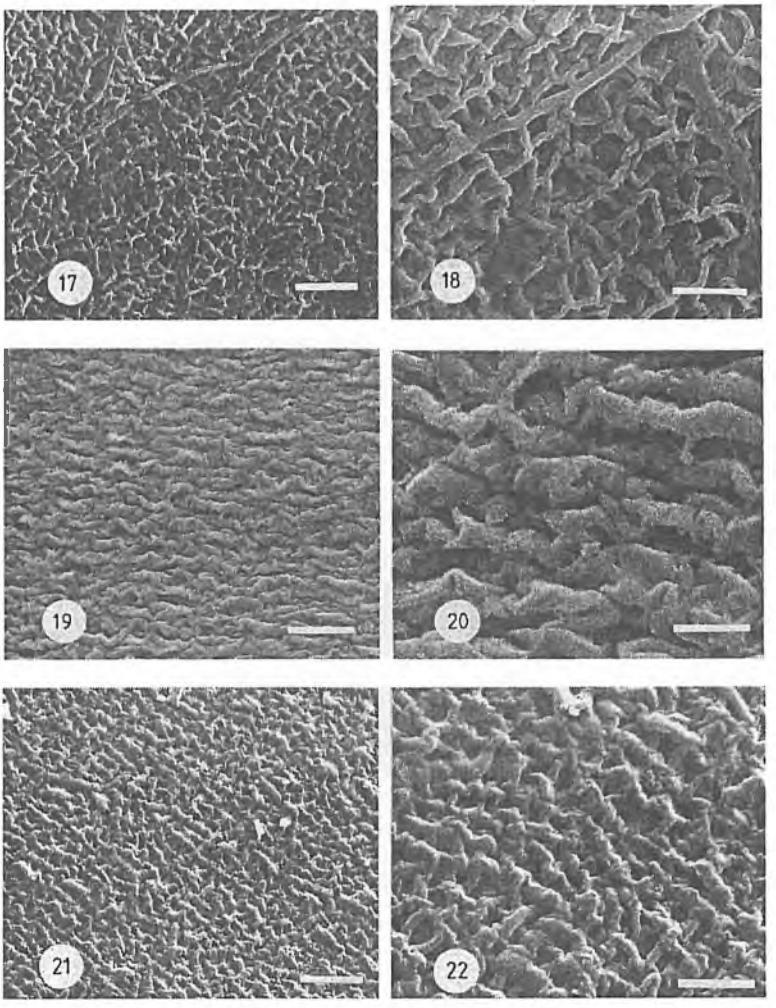

Figure 1-22. Seed surfaces of the species from two different magnifications. Scale bars=10 μm on the left, 5 μm on the rigth. Figs 1,2:*O. aequidentata*, Figs 3,4:*O. armena*, Figs 5,6:*O. oxyodonta*, Figs 7,8:*O. altissima*, Figs 9,10:*O. argyrea* subsp. *isaurica*, Figs 11,12:*O. atropatana*, Figs 13,14:*O. huetiana*, Figs 15,16:*O. subacaulis*, Figs 17,18:*O. hypargyrea*, Figs 19,20:*O. galegifolia*, Figs 21,22 :*O. nitida*

Şekil 1-22. Türlerin iki farklı büyütmedeki tohum yüzeyleri. Sol resimlerdeki ölçek çubukları 10 μm, sağ resimlerdeki ölçek çubukları 5 μm. Şekil 1,2:*O. aequidentata*, Şekil 3,4:*O. armena*, Şekil 5,6:*O. oxyodonta*, Şekil 7,8:*O. altissima*, Şekil 9,10:*O. argyrea* subsp. *isaurica*, Şekil 11,12:*O. atropatana*, Şekil 13,14: *O. huetiana*, Şekil 15,16: *O. subacaulis*, Şekil 17,18:*O. hypargyrea*, Şekil 19,20:*O. galegifolia*, Şekil 21,22 :*O. nitida*

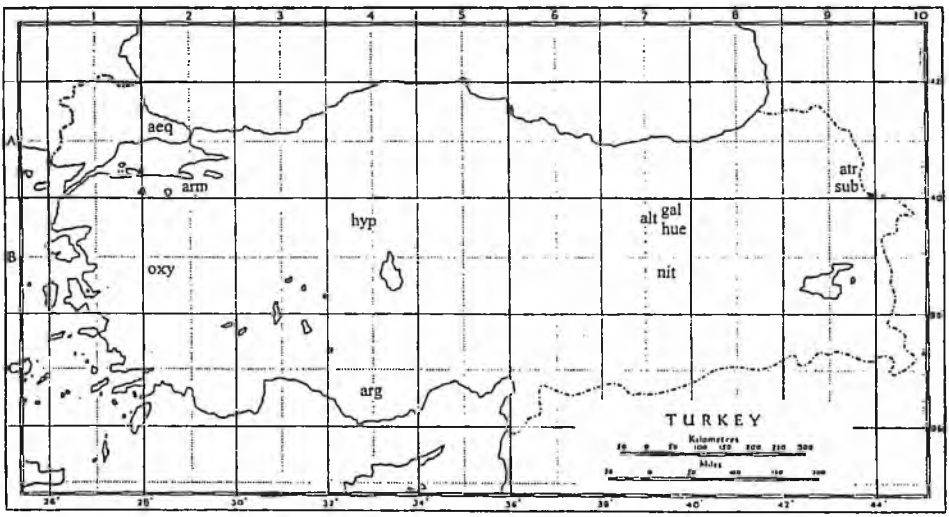

Figure 23. Localities of the examined species in Turkey. aeq:*O. aequidentata*, arm:*O. armena*, oxy:*O. oxyodonta*, alt:*O. altissima*, arg:*O. argyrea* subsp. *isaurica*, atr:*O. atropatana*, hue:*O. huetiana*, sub:*O. subacaulis*, hyp:*O. hypargyrea*, gal:*O. galegifolia*, nit:*O. nitida*

Şekil 23. İncelenen türlerin Türkiye'den toplandığı yerler. aeq:*O. aequidentata*, arm:*O. armena*, oxy:*O. oxyodonta*, alt:*O. altissima*, arg:*O. argyrea* subsp. *isaurica*, atr:*O. atropatana*, hue:*O. huetiana*, sub:*O. subacaulis*, hyp:*O. hypargyrea*, gal:*O. galegifolia*, nit:*O. nitida*

4. DISCUSSION

Morphology and micromorphology of seeds are a source of important informations for the classification of angiosperm taxa as having highly complex structures exhibiting a vast diversity of taxonomically applicable characters (BARTHLOTT 1984). Apart from the importance of fruit morphology in delineations of *Onobrychis* species having great variations, the microstructurel surface characteristics of the seeds presenting detailed informations were evaluated in this study for the first time and their utility as good and additional diagnostic characters in delimitation of *Onobrychis* which is taxonomically an extremely difficult genus with many of the worst problems in Anatolia (HEDGE 1970). Determinative differences in the surface pattern among close related species especially were observed. *O. armena* and *O. oxyodonta* from Section *Onobrychis*, which are reported as close related species differ from each others in surface ornamentations of the seeds. While *O. armena* which is very common, widespread and most variable species distinguished from the latter by the short fruiting peduncles (HEDGE 1970) presents reticulatovenosus appearance, *O. oxyodonta* has however irregular ribs forming close texture. It was reported that cuticular "folds" show a high micromorphological diversity and are an angiosperm characteristics (BARTHLOTT/EHLER 1977). Generally, cuticular ornamentations may serve as good diagnostic characters, but their systematic significance is, with some exceptions, rather limited. On the other hand, secondary wall thickenings occuring usually in the

form of reticulations or striations are always of high taxonomic significance (BARTHLOTT 1984). The striking differences in surface features between two species may be usable as a stable and diagnostic character. But subspesific status was also reported to be preferable for above two species (HEDGE 1970). It is nessesary to determine the margin of the variation of surface patterns with using the specimens having intermediate nature and growing different habitats. *O. altissima* from the same section which is related with cultivated sainfoin, *O. sativa*, and reported that may be progenitor of it (HEDGE 1970) resembles *O. oxyodonta* in surface characteristics of the seed, though not related species with it from morphological characteristics. *O. hypargyrea* and *O. nitida* from Section *Hymenobrychis* have similar patterns generally, but it is easy to distinguish *O. hypargyrea* with reticulate-rugose structure from *O. nitida* having rugose-favulariate pattern with close texture. It was reported that these two species have the closest relation with *O. tournefortii* but distinct from it on the indumentum characteristics according to Flora of Turkey. *O. galegifolia* from the same section is however completely different in surface pattern as described morphologically in the Flora. It was observed that *O. argyrea* subsp. *isaurica* and *O. huetiana* forming densely woven texture with finely wrinkles from Section *Heliobrychis* have very similar surface ornamentations. But it is possible to delimitate them with sligthly different patterns in SEM images. These species are also related with *O. bornmuelleri* and distinguished from this species with some minor and unsatisfactory morphological characters given in the key. *O. huetiana* and *O. bornmuelleri* were reported to be intermediate forms and subspesfic status would be more appropriate (HEDGE 1970). Similarity of surface characteristics of the seeds in *O. argyrea* subsp. *isaurica* and *O. huetiana* having similar fruit morphology also imply that concerning three species stem from common ancestral stock. However, other two species from section *Heliobrychis*, *O. atropatana* and *O. subacaulis* have different surface patterns. It wasn't observed common characteristics in seed surface among species from the same section. It is the most probable that seed surface sculpture is valuable parameter in species level but not for higher taxonomic categories in *Onobrychis* species. The specimens collected from different localities for the species growing in a great variety of habitats, showing large variations and intermediate nature such as *O. aequidentata*, *O. armena*, *O. oxyodonta*, *O. subacaulis*, *O. hypargyrea* are needed to be examined in order to categorize in subspesific level with using seed surface ornamentation characteristics as an additional parameters which are probably stable in low level grouping especially. On the other side, epicuticular secretions classified as "tertiary sculpture" having particular taxonomic and systematic significance on seeds are not usually exhibited in contrast to surfaces of leaves, stems and fruits (BARTHLOTT 1984; ÖZCAN, 2002; ÖZCAN 2004). Different epicuticular wax types representing all major groups of seed plants were classified with SEM analysis providing a terminology necessary as a standart for comparative descriptions (BARTHLOTT *et* al. 1998; DITSCH *et al.* 1995). Eleven species examined here have no tertiary sculpture on their seed surfaces. All of the specimens have heavily sculptured surface ornamentations as seen in higher magnifications. Heavily ornamented ridged surfaces (reticulations or captor ridges) were reported to compensate by increasing the capture of ligth (KAY / STIRTON 1981). This may serve the adsorption of the light and increasing surface temparature for germination of these species growing in mountain steppe generally.

Apart from fruit, morphologies of the seeds in *Onobrychis* don't provide sufficient information in delimitation of the species. Surface patterns of the seeds detected with SEM, which have more diversity and spesific structures than the fruits as stable and reliable parameters may be however useful as additional taxonomic criterion for the identification of the problematic or related taxa such as spesific and infra-spesific level in the situations in which fruit and other morphological characteristics are not sufficient. Considerable differences were observed in

studied species, but it is needed to determine the margin of variation of the seed surface characteristics for the species collected from different localities and having largely distributions. It is possible to demonstrate intraspesific variations of seed- coat sculpture with SEM observations providing new insight to the differences. The analysis of these characteristics may serve to make new groupings in lower categories for some variable species of *Onobrychis*. This parameter with using large samplings is most probably to be utilised as a "fingerprint of species" but no common characteristics were observed here in section level. Broad scanning of entire genus is needed for higher groupings than species. On the other hand, surface characteristics of the seeds of *Onobrychis* which have a number of species and endemics in Anatolia can provide valuable archaebotanical informations.

TÜRKİYE'DEKİ BAZI *ONOBRYCHIS* ADANS. (LEGUMINOSAE) TAKSONLARININ TOHUM YÜZEYLERİNDE MİKROMORFOLOJİK GÖZLEMLER

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Kısa Özet

Bu çalışmada Anadolu'da geniş çeşitlilik gösteren *Onobrychis* türlerinin tohum örtüsü yüzey karakterlerinden, tarayıcı elektron mikroskobu (SEM) kullanılarak tür düzeyinde ayırıma gidilmesi amaçlanmıştır. İncelenen 11 taksonun tohum yüzeylerinin yüksek büyütmelerde teşhise yönelik farklılıklar taşıdığı gözlenmiştir. Sözkonusu yüzey-yapısal özellikler aynı zamanda, yakın ilişkili türlerin taksonomik olarak sınırlandırılmasında kullanışlı ilave veriler olarak değerlendirilebilir. Fakat, tür üstü taksonomik kategori olarak seksiyon düzeyinde genel karakteristiği temsil eden ayırtedici ortak bir yüzey yapılanması tespit edilmemiştir.

Anahtar kelimeler: ***Onobrychis*, tohum, SEM, yüzey özellikleri, taksonomi, testa yüzey yapısı**

1.GİRİŞ

Avrupa ve Asya'nın ılıman iklim kuşağında yaklaşık 170 türle temsil edilen *Onobrychis* Adans., Türkiye'de gerek yüksek endemizm oranı gerekse taksonomik açıdan problemli bir cins olması dolayısı ile dikkat çekmektedir. Türkiye Florasında kayıt altına alınmış 46 türün 23 adedi (%50) tür düzeyinde endemik olup, alttür ve varyete düzeylerinde ise bu oran daha yukarılara çıkmaktadır. Floranın 3. cildinde bildirilen 46 türe ilave olarak listeye yeni taksonlar da ilave edilmektedir (DAVIS *et al.* 1988; DUMAN / VURAL 1990; VURAL 2000; AKTOKLU 2001). Türkiye florası eserinde *Onobrychis*'in revizyonu genellikle sınırlı sayıda örneğin incelenmesine dayanmakta olup, çok sayıda ve farklı bölgelerden toplanmış örneklerle çalışılmasının, çeşitliliğin daha iyi anlaşılıp taksonlar arasında daha net sınırlandırmaların yapılabilmesine olanak tanıyacağı belirtilmiştir. Geniş varyasyona sahip olan bu cinsin özellikle yakın ilişkili türleri arasında sadece dışyapısal özelliklere dayanan teşhis anahtarlarının kullanımıyla kesin ayırıma gitmek her zaman kolay olmamaktadır. *Onobrychis*'te gerek filogenetik ilişkilerin aydınlatılması, gerekse taksonomik problemlerin çözümünde morfolojik özelliklerin yanısıra ayrıntılı veriler sunan, güvenilir ve sabit ilave parametrelere gereksinim duyulmaktadır. Özellikle çevresel koşullardan çok fazla etkilenmeyen generatif karakterler yakın ilişkili taksonların sınırlandırılmasında kullanılabilmektedir. Diğer yandan meyva morfolojisi, *Onobrychis* türlerinin teşhisinde önemli bir anahtar karakter olmakla birlikte, geniş varyasyon gösteren türler ile yakın ilişkili taksonlar arasında belirgin bir ayırım sağlamamaktadır. Testanın mikroyapısal özelliklerinin Leguminosae familyasının farklı sistematik kategorilerinde çok geniş bir varyasyon gösterdiği bilinmektedir (BRISSON/PETERSON 1976; GUNN 1982; BUTLER 1988; CHERNOFF *et al.* 1992; HUSAIN *et al.* 1994; DITSCH *et al.* 1995; GÜNEŞ 2000). Bu çalışmada 4 farklı sesiyondan ve içlerinde yakın ilişkili türler ile endemik 3 tür ve bir alttürün bulunduğu toplam 11 taksonun tohum

yüzeyleri, özgün yapısal özelliklere sahip kalıtsal karakterler olarak *Onobrychis*'in taksonomisindeki kullanımı ve teşhise yönelik değerleri açısından araştırılmıştır.

2. MATERYAL VE YÖNTEM

Çalışma kapsamında incelenen türler, çeşitli araştırıcılar tarafından toplanmış olan ve ISTF herbaryumunda bulunan kayıtlı örneklere dayanmaktadır. İncelenen örneklerin teşhisleri kontrol edilip doğrulanmış, ISTF numaraları da sonuçlar kısmında verilmiştir. Araştırma materyalinin toplandığı noktalar genel olarak harita üzerinde gösterilmiştir. Herbir taksondan temin edilen 7-8 adet olgun tohum örneği Bio-Rad SC502 vakumlu kaplama cihazında iki dakika süreyle 100-200 Å kalınlığında bir altın tabakası ile kaplanmıştır. Daha sonra JEOL JSM-5200 SEM mikroskobunda, 20-25 KV voltaj altında tohumların çeşitli yüzeylerinden mikromorfolojik yüzey taraması yapılarak taksonun genel karakteristiğini yansıtan bir alandan herbir örnek için x1500 ve x3500 büyütmelerde iki farklı görüntü kaydedilmiştir. Mikromorfolojik yüzey karakterlerine ilişkin gözlemler ilgili literatürdeki standart terminoloji kullanılarak ifade edilmiştir (STEARN 1973; CHAKRABARTY / MUKHERJEE 1986; BARTHLOTT *et al.* 1998).

3. SONUÇLAR VE TARTIŞMA

Bu çalışmada, *Onobrychis'* in taksonomisinde kullanılan vejetatif ve generatif organların morfolojik özelliklerinin dışında, Türkiye'de yaşayan türler için ilk defa olmak üzere tohumların mikroyapısal yüzey karakterleri incelenmiş, elde edilen bulguların türler arasında teşhise yönelik ilave veriler olarak kullanılabileceği gözlenmiştir. Tohumların morfolojik ve mikroyapısal özelliklerinin, geniş çeşitlilik gösteren Angiosperm'lerin sınıflandırılmasında önemli taksonomik veriler sunduğu (BARTHLOTT 1984), yüzeydeki kutikular katlanmaların oldukça zengin mikromorfolojik çeşitlilik gösterdiği ifade edilmiştir (BARTHLOTT / EHLER 1977). İncelediğimiz türler arasında aynı seksiyondan (Sect. Onobrychis) ve yakın ilişkili *O. armena* ve *O. oxyodonta* türlerinin tohum yüzey özelliklerinin teşhise yönelik önemli farklara sahip oldukları gözlenmiştir. Diğer yandan morfolojik açıdan belirgin farklar göstermekle birlikte *O. altissima*'nın mikromorfolojik yüzey karakteri açısından *O. oxyodonta* ile çarpıcı benzerlikler sergilediği gözlenmiştir. Hymenobrychis seksiyonundan *O. hypargyrea* ve *O. nitida* türleri de çok benzer yüzey yapısına sahip olmakla birlikte *O. hypargyrea*, ağsı ve damarlı yapısı ile *O. nitida*' dan kolayca ayrılabilmektedir. *O. galegifolia* aynı seksiyondan olmakla birlikte Türkiye Florası eserinde morfolojik özellikleri açısından belirtildiği gibi tohumun yüzey mikromorfolojisi bakımından da tamamen farklı bir profil sergilemektedir. Diğer bir seksiyondan olan (sect. Heliobrycis) *O. argyrea* subsp. *isaurica* ve *O. huetiana* taksonları da çok benzer bir yüzey yapısına sahip olmakla birlikte SEM görüntülerindeki ince farklarla birbirlerinden ayrılabilmektedir. Flora'da bu iki türün aynı zamanda *O. bornmuelleri* ile morfolojik olarak çok yakın benzerlik gösterdiği belirtilmiştir. Benzer meyva morfolojisi ve gözlenen tohum yüzey özellikleri, sözkonusu bu üç türün ortak filogenetik bir sürece sahip olabileceklerine kısmen ışık tutmaktadır. Diğer yandan aynı seksiyondan olan *O. atropatana* ve *O. subacaulis* türleri ise oldukça farklı yüzey oluşumlarına sahiptir. Mevcut gözlemlerimizde, tohumlardaki mikroyapısal yüzey oluşumları tür düzeyinde ayırtedici olmakla birlikte, daha üst taksonomik gruplandırmalarda genel karakteristiği yansıtmamaktadır. Çeşitli habitatlarda yayılış alanı bulan, yapısal varyasyon ve geçiş formları gösteren *O. aequidentata*, *O. armena*, *O. oxyodonta*, *O. subacaulis*, *O. hypargyrea* türlerinde geniş örneklemeler yapılarak, tohum yüzey mikromorfolojisi analizleri ile tür altı kategoriler tanımlanabilir. Benzer şekilde aynı türün farklı

bölgelerden toplanmış örnekleri de incelenerek tohumlardaki yüzey mikromorfolojisinin sabitliğinin de denetlenmesine gereksinim vardır. *Onobrychis*'in taksonomisinde meyva ve tohumun genel morfolojisinin yeterli olmadığı durumlarda, geniş çeşitlilik ve özgün yapılar sergileyen tohum mikromorfolojisi, ilave kalıtsal taksonomik parametreler olarak, türlerin ve tür altı kategorilerin sınırlandırılmasında ve taksonlar arası ilişkilere ilave bir pencereden veriler sunarak yeni gruplandırmalara gidilebilmesine olanak tanıyabilir.

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