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Seed Mucilage Contents in Some Taxa of *Aubrieta* Adans. Genus (Brassicaceae) and Their Systematic Importance

Aubrieta Adans. Cinsinin Bazı Taksonlarındaki Tohum Musilaj İçerikleri ve Onların Sistematik Önemi

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Abstract

In this study, mucilage characterization and their systematic importance in the seeds of the 3 *Aubrieta* taxa, which are *A. deltoidea*, *A. canescens* subsp. *canescens* and *A. canescens* subsp. *cilicica* have discussed. In the examined taxa have found mucilage cells on the seed surface, and they have formed a slippery liquid in contact with water. The mucilage in the studied taxa are made up of the pectin or cellulose structures. Furthermore, there were variations in columellae figures in the examined *Aubrieta* taxa, which are in reduced, prominent, or flattened figures. Also, soil adhesion volumes of the studied taxa varied between 83 mg and 175 mg. The occurrence of mucilage may provide an important role in seed scattering and colonization in terms of the new habitation in *Aubrieta* taxa.

Keywords: *Aubrieta*, cellulose, morphology, mucilage, myxospermy, pectin

Öz

Bu çalışmada, 3 *Aubrieta* taksonunun (*A. deltoidea*, *A. canescens* subsp. *canescens* ve *A. canescens* subsp. *cilicica*) tohumlarındaki musilaj karakterizasyonu ve onların sistematik önemi tartışılmıştır. İncelenilen taksonlarda tohumların yüzeyinde su ile temas halinde kaygan bir sıvı üreten musilaj hücreleri bulunmuştur. Çalışılan taksonlardaki musilaj pektin veya selüloz yapıdadır. Dahası, incelenilen taksonlardaki kolumela şekillerinde belirgin, indirgenmiş ve yassılaşmış şekillerde varyasyonlar vardır. Ayrıca, çalışılan taksonların toprağa yapışma kapasiteleri 83 mg ve 175 mg arasında değişmiştir. Musilaj oluşumu *Aubrieta* taksonlarında yeni habitasyon açısından tohum dağılımı ve kolonizasyonda önemli bir rol sağlayabilir.

Anahtar Kelimeler: *Aubrieta*, selüloz, morfoloji, musilaj, miksospermi, pektin

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1. Introduction

Brassicaceae family has about 365 genera and 3250 species in the world, and it is known as a great family having economic significance (Simpson 2006; Tekin et al. 2013). Turkey with approximately 653 species is one of the most diverse centers of family (Al Shehbaz et al. 2007; Guner et al. 2012). The *Aubrieta* Adans. genus occurs from perennial herbaceous plants from Middle Asia to South Europe (Gustavsson 1986; Phitos 2002; Karaismailoğlu 2016). It is a small-sized genus represented by about 20 species and has taxonomical problems. Turkey has 11 *Aubrieta* taxa, of which 6 are endemic (Guner et al. 2012; Yüzbaşıoğlu et al. 2015). High endemism ratio (as 54%) shows that Turkey is one of the gene centers of genus (Karaismailoğlu 2016).

Mucilage is placed in distinguished epidermal cells during hydration. Moreover, the layer of these cells is thought to be active with regarding propagation, dispersion, and adherence to soil in terms of colonization (Ryding 2001; Western 2012). The production of mucilage in seeds of the flowering plants varies extensively between Asteraceae and Brassicaceae (Greubert 1974; Ryding 2001; Kreitschitz et al. 2009; Western 2012). Earlier performed many studies showed that many taxa in family Brassicaceae include mucilaginous cells in their seed coats (Harper and Benton 1966; Gutterman and Shem-Tov 1997; Lu et al. 2010).

The mucilage content in seeds of the examined *Aubrieta* taxa, which are *A. deltoidea*, *A. canescens* subsp. *canescens* and *A. canescens* subsp. *cilicica*, has not been examined until now. The target of this paper has been to study the mucilage contents and soil binding capacity of the seeds, and question systematical importance of the mucilage in the examined *Aubrieta* seeds.

2. Material and Methods

The examined taxa were collected from wild populations in Turkey. The collector and origin data of the examined taxa were presented in Table 1. The specimens of the plants were stored in M.C. KARAISMAILOGLU collection.
The variations on wetted seeds was observed, and assessments on ability to hydrate were made. Wetted analysis with distilled water were done at room temperature for 12 min. Methylene blue and safranin stains were used to define the mucilage form (Kreitschitz et al. 2009; Inceer 2011).

Uncontaminated sea sand was used for determining of the soil binding capacity of seeds of examined taxa. Firstly, the 20 seeds were placed on wetted sea sand in a petri dishes, and allowed for mucilage production during 12 min. Later, the petri dishes were relocated to 50°C for 24 h. The seeds were sensibly detached from petri dishes and the final weights were recorded. The soil binding capacity of the seeds has evaluated with comparing of the first and final weights of the seed (Huang et al. 2000).
Mucilage features were noticed with utilizing Olympus CX21FS1 microscope and Kameram Imaging Software.

Table 1. The studied taxa and their locations

Taxa	Location	Voucher
Aubrieta deltoidea D.C.	Antalya, Cigdemler-Sogut mountain, Cataltepe, 1750 m, 12.7.2016	Karaismailoglu 324
**A. canescens* subsp. *canescens* Bornm.	Kastamonu, Ilgaz, Musa village, roadsides, stone slopes, 1154 m, 03.5.2015	Karaismailoglu 145
**A. canescens* subsp. *cilicica* Cullen	Nigde, Camardi, Yelatan village hills, 2083 m, 12.6.2016	Karaismailoglu 269

*=endemic taxon

3. Results and Discussion

The wetted seed analysis show that there are particular cells of producing mucilage in seed surfaces in the examined taxa. The cellulosic structure mucilage displayed a heterogenous form. The seeds dyed with methylene blue or safranin signalize that *Aubrieta* mucilage is formed from pectin background and cellulosic edge (Fig. 1). Methylene blue coated by a blue or violet cover around seeds, as safranin showed orange staining of mucilage (Fig. 1).

Stain indicated that the mucilage of the examined *Aubrieta* taxa contains cellulosic form, having cellulose and pectin. This work is the first report on the mucilage structure of the genus *Aubrieta*. The gained outcomes are compatible with prior works, containing many genera as *Brassica, Arabidopsis, Plantago, Anthemis* and *Matricaria* (Gerlach 1972; Braune et al. 1975; Western et al. 2000; Kreitschitz et al. 2009; Inceer 2011, Table 3).

Table 2. Columellae structures of the mucilage cells in the studied taxa and soil binding capacities

Taxa	Columellae structure	Soil binding capacity of seeds		
		First weight (mg)	Final weight (mg)	Net (Final-First w.) (mg)
Aubrieta deltoidea	reduced	21	166	145
A. canescens subsp. *canescens*	flattened	16	191	175
A. canescens subsp. *cilicica*	prominent	10	93	83

Table 3. Mucilage dyeing and literature information

Staining	Target	Obtained Color	Literature data	Earlier works
Safranin	Pectin	Orange	Orange, Orange-Red	Gerlach 1972, Kreitschitz and Valles 2007, Kreitschitz et al. 2009, Inceer 2011
	Cellulose	Orange	Orange, Orange-Red, Red	
Methylene Blue	Pectin	Blue, Violet-Blue	Blue	Gerlach 1972, Kreitschitz and Valles 2007, Kreitschitz et al. 2009, Inceer 2011
	Cellulose	Blue	Violet-Blue	

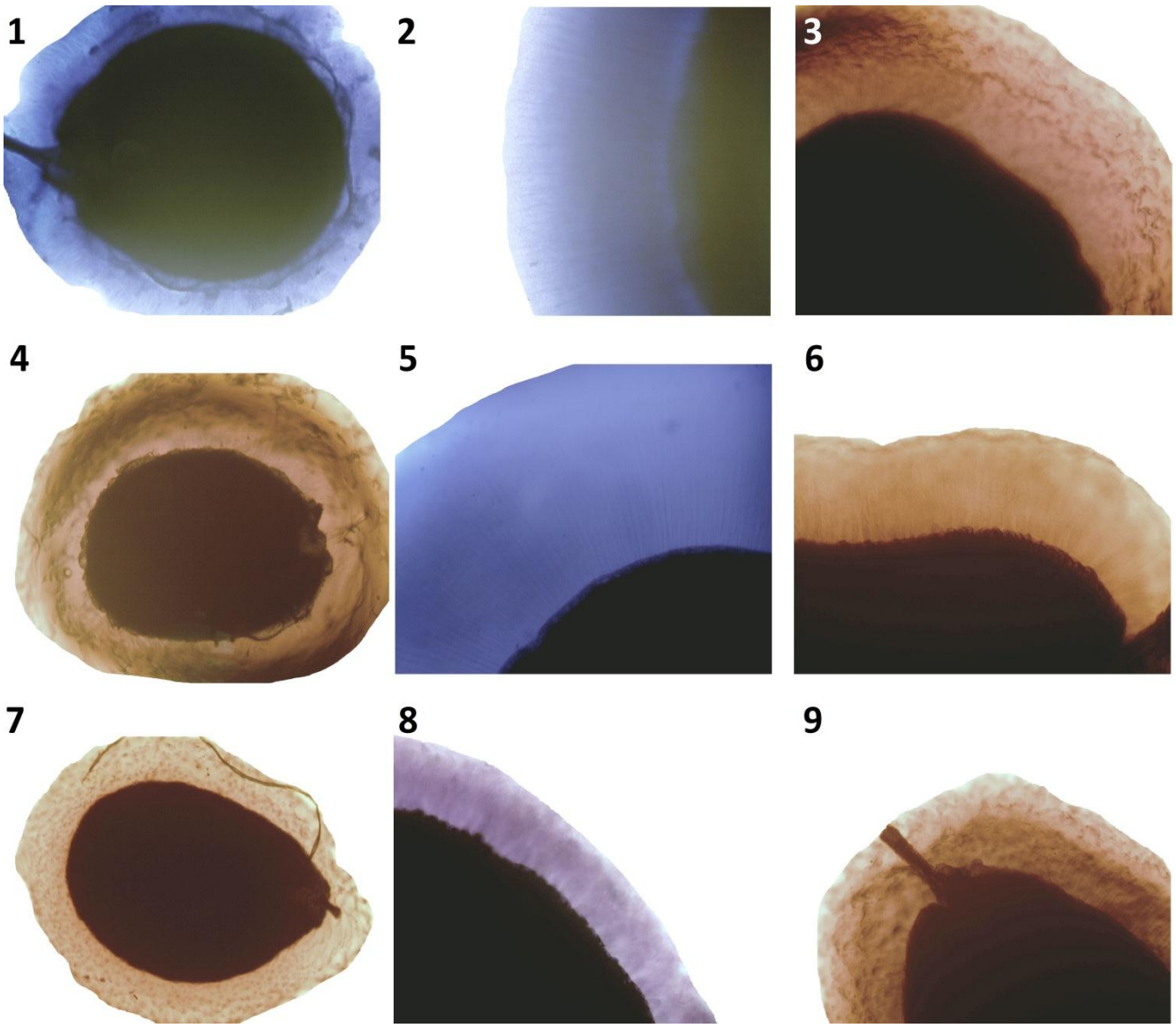

Figure 1. The mucilage layer in the examined taxa; *A. deltoidea*: 1-2= Methylene blue, 3=Safranin, *A. canescens* subsp *canescens*: 4, 6=Safranin, 5= Methylene blue, *A. canescens* subsp *cilicica*: 7, 9: Safranin, 8: Methylene blue.

The quantity of the produced mucilage has displayed variations in examined *Aubrieta* taxa (Table 2). It was the highest at *A. canescens* subsp. *canescens*; however, it is the lowest at *A. canescens* subsp. *cilicica* (Table 2). Differences in mucilage structures can consist of the variations in habitats of taxa. This status has been pronounced in some genera in Lamiaceae and Asteraceae families (Mosquero et al. 2004; Kreitschitz et al. 2009; Inceer 2011). The seeds of *A. canescens* subsp. *canescens* and *A. deltoidea* dispersion in widely thirsty and stone regions form more mucilage than *A. canescens* subsp. *cilicica*. They are adhesive to soil surface as a consequence of mucilage (Gutterman and Shem-Tov 1997). Alike adaptation condition has been also reported in some plants, as *Arabidopsis thaliana* (Western et al. 2000; Western 2006) and *Matricaria chamomilla* (Inceer 2011).

The importance of mucilage in seeds has been stated with many investigations. It includes an important role in prevention of germination in inappropriate terms, generally in plants grown in arid areas as a result of easing water intake (Kreitschitz et al. 2009).

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