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A morphometric study on *Draba cappadocica* Boiss. & Balansa and *Draba rosularis* Boiss.*

Nasip DEMİRKUŞ[1], Metin ARMAĞAN[2], Mehmet Kazım KARA[3]**
[1]*Van Yüzüncü Yıl University, Faculty of Education, Department of Science and Mathematics, Van, Turkey*
[2]*Adnan Menderes University, Buharkent Vocational School, Medicinal and Aromatic Plants Program, Aydın, Turkey*
[3]*IğdırUniversity, Faculty of Agriculture, Department of Zootechnics, Iğdır, Turkey*
***nasip@hotmail.com*

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Draba cappadocica Boiss. & Balansa ve *Draba rosularis* Boiss. türleri üzerine morfometrik bir çalışma

Abstract: *Draba cappadocica* Boiss. & Balansa and *Draba rosularis* Boiss. samples were collected from the around of Van (Turkey) province, between 1997 and 2001, after performing population observations. Numerical data were obtained minimun about 10 dry samples collected from each locality and evaluated by SPSS. Special and common characteristics of the taxa were determined and detailed and reliable knowledge were gathered about the little-known properties of them. As a result of the statistical analyzes, depending on their range of variation, the new descriptions were obtained.

Key words: *Draba rosularis*, *Draba cappadocica*, morphometry, Van

Özet: Van (Türkiye) çevresinde 1997-2001 yılları arasında *Draba cappadocica* Boiss. & Balansa ve *Draba rosularis* Boiss. türlerine ait populasyon gözlemleri yapılarak, örnekler toplanmış ve her lokaliteden en az 10 kuru bitki örneğine ait numerik veriler derlenerek SPSS paket programı ile değerlendirilmiştir. Taksonların özgün ve ortak özellikleri saptanarak, literatürde az bilinen özellikleri hakkında daha ayrıntılı ve sağlıklı bilgi derlenmiştir. İstatistik analizleri sonucunda, karakterlerin değişim aralıklarına bağlı olarak yeni betimler ortaya konmuştur.

Anahtar Kelimeler: *Draba rosularis*, *Draba cappadocica*, morfometri, Van

1. Introduction

Draba L., the largest genus in the family Brassicaceae (Al-Shehbaz et al., 2006; Bailey et al., 2006; Koch et al., 2007), comprises more than 370 species in the world (Warwick et al., 2006). It has been spread in arctic, subarctic, alpine, and mountainous regions of the world. Members of *Draba* are annuals, biennials or perennials. Some molecular studies (Koch and Al-Shehbaz, 2002; Beilstein and Windham, 2003) showed that most of the sections of *Draba* are polyphyletic (*Drabella, Tylodraba, Calodraba, Adenodraba, Phyllodraba* etc.).

The computer has made it possible to consider large numbers of characteristics in classifying many phenomena, notably living organisms, fossil organisms and even imaginary organisms (Sokal, 1966). We chose *Draba rosularis* Boiss. and *Draba cappadocica* Boiss. & Balansa species in an attempt to fill the gap in the literature caused by their description which is based on fewer materials in terms of quantitative and qualitative properties, and to emphasize the importance of numerical taxonomy, though simple in this field.

The present basic information about these two species is bounded with the information provided by the first articles published by the Flora of Turkey (Coode and Cullen, 1965). However, information about the morphological characteristics and habitat-spreading habits of species is inadequate or incomplete (Vural and Aytaç, 2005; Adıgüzel et al., 2006; Kandemir and Türkmen, 2008; Jordan-Thaden and Koch, 2008; Başköse and Dural, 2011; Karaer, 2012; Yetişen et al., 2014; Moradkhani and Milan, 2015). Considering the current status of the taxa in the literature, this study was carried.

The study aims to make a contributionthe Flora of Turkey by obtaining and presenting much more reliable characteristics for the determinetion of the two *Draba* species.

2. Materials and Method

Field studies were carried out between the years 1997-2001, especially during 4th, 5th and 6th months, and minimum 10 plant specimens were collected for each species from different localities, 7 times for *D. rosularis*, and 2 times for *D. cappadocica* (Demirkuş et al., 2000). *D. rosularis* samples were collected from the localities around the fountain in Güzeldere Pass (Başkale-Van) for 6 times, and the end of Keşiş Lake, around Güvelek Village for 1.

Photographs of collected fresh and dry materials were taken, and they were scanned by using Işık Kutusu (Light Box) (Demirkuş et al., 2005). During field studies, observations related to the populations, flowering time, and the characteristics of the spreading areas of these species were also carried out.

Ten dry plant specimens were used for each locality to obtain numerical data. Firstly they were numbered from 1 to 10 and placed in small envelopes. Then stem (plant) size, number of flowers, stem leaves width and height

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(sub, middle and upper part), sepals width and height (sub, middle and upper branches), petals width and height (sub, middle and upper branches), pedicels width and height (sub, middle and upper branches), fruit width and height (sub, middle and upper branches), width × height ratio and stylus (sub, middle and upper branches) length measurements were carried out. Under a 10X, 20X, 80X magnification Lup-Microscope, measurement datapedicel length, sub-middle-upper rosette leaves length, base leaves width × height, width of sub-middle-upper sepals in inflorescence × height, width of sub-middle-upper petals in inflorescence × height, width of fruit in inflorescence × height, stylus and flowers were obtained.

SPSS demo version was used for evaluating the data, and reliability ratings, variation and change analyses of the numerical properties of each species were evaluated. By sorting the variants according to the ratio of variance coefficients of the analysed data from the most to the least variant characteristics, we drew graphs. Following the original English descriptions of the two specimens in the Flora of Turkey, we provided new descriptions based on the data obtained out of our research.

The samples (*ND5163*, *ND5336*, *ND5654*, *ND7130*, *ND7184*, *ND7184A*, *ND7697*, *MA1103*, and *MK230408*) are stored in VANF herbarium (ND= Nasip Demirkuş, MA= Metin Akpınar, MK= Mehmet Koyuncu).

3. Results

Population sample 1 (D. cappadocica): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, over the Fountain, 2650 m, 21.04.2000, ND7184A. We collected and named this population sample on the same date and in the same locality as Number 5 Population of *D. cappadocica* species, which was collected from Güzeldere Fountain.

Population sample 2 (D. cappadocica): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, Fedai Taşı surroundings, rocky slope, 2900 m, 27.06.1997, ND5654. We collected and diagnosed the fruited sample of this population on Fedai Taşı hill (rocky hill) which is located opposite Güzeldere Hill in the accompaniment of Prof. Dr. M. Koyuncu, and evaluated it as original *D. cappadocica* species.

Population sample 3 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, 2750 m. 24.05.1997. ND5163. Quantitative and qualitative characteristics of this population's specimens, pertaining to mature flowering time, generally overlaps with the limited definition in The Flora of Turkey.

Population sample 4 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, over the fountain, 2660 m. 21.04.2000, MK230408. Quantitative and qualitative characteristics of this population's specimens, which were collected in early flowering time, generally overlaps with the limited definition in The Flora of Turkey.

Population sample 5 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, 2750 m. 24.05.1997, ND7184. Quantitative and qualitative characteristics of this populations' specimens, which were collected in early flowering time, show many variations. As some plant specimens we collected in this area overlapped with *D. cappadocica* taxon (ND7184A), we evaluated them as population number 1 under the name of *D. cappadocica*, as for the other specimens (7184), however, we evaluated them as *D. rosularis* (population number 5). It generally overlaps with the limited definition in The Flora of Turkey.

Population sample 6 (D. rosularis): B9 Van; the end of Keşiş Lake (upper foothill of Erek mountain) Güvelek Village and surroundings, 2000 m, 19.05.1999, ND7697. Quantitative and qualitative characteristics of this population' specimens belonging to mature flowering time originally overlaps with the limited definition in The Flora of Turkey.

Draba rosularis samples were collected from the localities around the fountain in Güzeldere Pass (Başkale-Van) for 6 times, and the end of Keşiş Lake, around Güvelek Village for 1.

Population sample 7 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, rocky slopes, 2700 m. 19.05.2001. MA1103. Quantitative and qualitative characteristics of this population's specimens of mature flowering time generally overlaps with the limited definition in The Flora of Turkey.

Population sample 8 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, over the Fountain, 2680 m, 28.05.2000, ND7130. This population sample belonging to mature flowering time collected from this locality is different from the other 6 samples of the same locality. Quantitative and qualitative characteristics of this population's specimens generally overlaps with the limited definition in The Flora of Turkey.

Population sample 9 (D. rosularis): B9 Van; between Hoşap (Güzelsu) and Başkale, Güzeldere Pass, 2750 m, 13.06.1997, ND5336. Quantitative and qualitative characteristics of this population' specimens pertaining to mature flowering time, generally overlaps with the limited definition in The Flora of Turkey.

The descriptions of population samples;1 and 2 pertaining to *D. cappadocica*, and 3, 4, 5, 6,7, 8, 9 belonging to *D. rosularis* species. The 7th, 8th, and 9th population belongs to *D. rosularis*. Because of the data in these three populations are insufficient, they have not been evaluated.

Among the measured characteristics of the two species; descriptive characteristics used in Flora of Turkey (for them to show parallelism with ours in comparison) were preferred.

All studied descriptive characters and measurements results of them are given in Table 1.

4. Discussionand Conclusions

It seems to be more reliable to make a decision about the status of *D. cappadocica* species in Van basin after collecting specimens from B5 Kayseri: Erciyes Mountain, 2400 m, and B9Van: Ispiriz Mountain, 3400 m, D. 23685 localities again and compiling them with the current data.

Draba cappadocica Boiss. & Balansa in Boiss., Diagn. ser. 2(6): 14 (1859). Syn: *D. calycosa* Boiss. & Balansa in Boiss., Fl. Or. 1:299 (1867), excl. var. *aucheri* Boiss.

Table 1. Descriptive averages and limit values of population samples' numerical data pertaining to *Draba cappadocica* and *Draba rosularis* (The significant data pertaining to *D. cappadocica* were given bold and in red; those of *D. rosularis* were given bold)

Measured Plant Organ	Evaluated Taxa	Specimen Number	Mean	Standard Deviation	Minimum	Maximum
Stem (plant size) (cm)	1. *D. cappadocica*	64	**5,1**	**1,22**	**2,9**	**8**
	2. *D. rosularis*	231	**6,14**	**3,03**	**1,5**	**16,5**
	3. Total	295	5,92	2,77	1,5	16,5
Number of flowers	1. *D. cappadocica*	64	**8,34**	3,28	**1**	**19**
	2. *D. rosularis*	219	**9,42**	4,71	**1**	**28**
	3. Total	283	9,18	4,45	1	28
Sub-rossette leaves length (mm)	1. *D. cappadocica*	20	**8,33**	2,37	**4**	12
	2. *D. rosularis*	59	**11,82**	4,96	**4**	**30**
	3. Total	79	10,94	4,69	4	30
Middle-rosette leaves length (mm)	1. *D. cappadocica*	20	8,38	3,31	4	**15**
	2. *D. rosularis*	59	10,97	4,64	5	28
	3. Total	79	10,32	4,47	4	28
Upper-rosette leaves length (mm)	1. *D. cappadocica*	20	7,8	2,91	4	13
	2. *D. rosularis*	59	10,58	4,27	4	25
	3. Total	79	9,87	4,13	4	25
Sub-rosette leaves width (mm)	1. *D. cappadocica*	20	1,62	0,38	1	2,2
	2. *D. rosularis*	59	1,66	0,42	1	**2,8**
	3. Total	79	1,65	0,41	1	2,8
Middle-rosette leaves width (mm)	1. *D. cappadocica*	20	1,82	0,5	1,1	3,5
	2. *D. rosularis*	59	1,6	0,49	**0,75**	3
	3. Total	79	1,67	0,5	0,75	3,5
Upper rosette leaves width (mm)	1. *D. cappadocica*	20	1,8	0,44	**1**	**3**
	2. *D. rosularis*	59	1,5	0,45	0,5	2,2
	3. Total	79	1,58	0,46	0,5	3
Sub-branch sepals length (mm)	1. *D. cappadocica*	14	**2,82**	0,36	2	3
	2. *D. rosularis*	60	**2,54**	0,51	1,5	3,5
	3. Total	74	2,59	0,49	1,5	**3,5**
Middle-branch sepals length (mm)	1. *D. cappadocica*	14	2,85	0,29	2	3
	2. *D. rosularis*	60	2,49	0,48	1,5	3,2
	3. Total	74	2,56	0,47	**1,5**	3,2
Upper-branch sepals length (mm)	1. *D. cappadocica*	11	2,86	0,78	**2**	**5**
	2. *D. rosularis*	59	2,38	0,45	1,3	3,1
	3. Total	70	2,45	0,54	1,3	5
Sub-branch sepals width (mm)	1. *D. cappadocica*	14	1,61	0,39	1,2	2,5
	2. *D. rosularis*	60	1,43	0,28	1	**2**
	3. Total	74	1,46	0,31	1	2,5
Middle-branch sepals width (mm)	1. *D. cappadocica*	14	1,59	0,29	**1,2**	2
	2. *D. rosularis*	60	1,45	0,32	**0,8**	2
	3. Total	74	1,48	0,32	0,8	2
Upper-branch sepals width (mm)	1. *D. cappadocica*	11	1,66	0,51	1,2	**3**
	2. *D. rosularis*	59	1,39	0,33	0,7	2,8
	3. Total	70	1,44	0,37	0,7	3
Sub-branch petals length (mm)	1. *D. cappadocica*	13	**5,35**	**0,56**	4,5	6
	2. *D. rosularis*	58	**5,01**	**0,76**	3,5	**7**
	3. Total	71	5,07	0,73	3,5	7
Middle-branch petals length (mm)	1. *D. cappadocica*	14	5,2	0,71	4	6
	2. *D. rosularis*	58	4,82	0,9	3	7
	3. Total	72	4,89	0,88	3	7
Upper-branch petals length (mm)	1. *D. cappadocica*	11	4,45	0,78	**3**	**6**
	2. *D. rosularis*	56	4,48	0,77	**2,3**	6
	3. Total	67	4,47	**0,78**	2,3	6

Sub-branch petals width (mm)	1. *D. cappadocica*	13	2,82	0,4	2	3,3
	2. *D. rosularis*	58	2,26	0,37	1,5	3
	3. Total	71	2,37	0,43	1,5	3,3
Middle-branch petals width (mm)	1. *D. cappadocica*	14	2,69	0,61	1,8	**4**
	2. *D. rosularis*	58	2,25	0,34	1,7	3
	3. Total	72	2,33	0,44	1,7	4
Upper-branch petals width (mm)	1. *D. cappadocica*	11	2,41	0,58	**1,4**	3
	2. *D. rosularis*	56	2,16	0,35	**1,3**	**3**
	3. Total	67	2,2	0,4	1,3	3
Sub-branch pedicel length (mm)	1. *D. cappadocica*	20	**6,99**	**2,02**	4,2	**12**
	2. *D. rosularis*	60	**7,1**	**2,54**	2,5	**15**
	3. Total	80	7,07	2,41	2,5	15
Middle-branch pedicel length (mm)	1. *D. cappadocica*	20	5,63	1,32	4	10
	2. *D. rosularis*	60	5,79	2,33	2	12
	3. Total	80	5,75	2,11	2	12
Upper-branch pedicel length (mm)	1. *D. cappadocica*	17	4,64	1,07	**3**	7
	2. *D. rosularis*	59	4,99	1,94	**1**	10
	3. Total	76	4,92	1,78	1	10
Sub-branch fruit length (mm)	1. *D. cappadocica*	6	3,75	0,88	**2,5**	**5**
	2. *D. rosularis*	2	6	0	6	6
	3. Total	8	4,31	1,28	2,5	6
Middle-branch fruit length (mm)	1. *D. cappadocica*	6	**3,67**	**0,61**	3	4,5
	2. *D. rosularis*	2	**6**	**1,41**	**5**	**7**
	3. Total	8	4,25	1,31	3	7
Upper-branch fruit length (mm)	1. *D. cappadocica*	6	3,42	0,66	3	4,5
	2. *D. rosularis*	2	5	0	5	5
	3. Total	8	3,81	0,92	3	5
Sub-branch fruit width (mm)	1. *D. cappadocica*	6	3,33	0,82	**2**	**4**
	2. *D. rosularis*	2	4,25	**0,35**	4	**4,5**
	3. Total	8	3,56	0,82	2	4,5
Middle-branch fruit width (mm)	1. *D. cappadocica*	6	3,17	0,52	2,5	4
	2. *D. rosularis*	2	3,75	0,35	3,5	4
	3. Total	8	3,31	0,53	2,5	4
Upper-branch fruit width (mm)	1. *D. cappadocica*	6	2,77	0,54	2	3,5
	2. *D. rosularis*	2	3,5	0,71	**3**	4
	3. Total	8	2,95	0,63	2	4

The original description in the Flora of Turkey;

Perennial herb, forming rounded tufts. Caudiculi leafy only near the top. Scapes up to 2 cm, villous. Leaves linear to linear-obovate, soft, overlapping, canescent with stellate hairs. Petals yellow, c. 4 mm. Ovary with 16-24 ovules. Siliculae ovoid, as long as broad. Fl. 6. Rock crevices, slopes, 2400-2900 m.

The new description in respect of this study

Perennial plant, forming rounded tufts. Caudiculi leafy only near the top. Scapes 2.9-8 cm, villous. Leaves linear to linear-obovate; 4-15 × 1-3 mm, soft, overlapping, canescent with stellate hairs. Flowers 1-19. Pedicel 3-12 mm. Sepals, 2-5 × 1.2-3 mm. Petals yellow, 3-6 × 1.4-4 mm. Ovary with 16-24 ovules. Siliculae ovoid, as long as broad, 2-2.5 × 2-4 mm. Fl. 6. Rock crevices, slopes, 2400-2900 m.

Draba rosularis Boiss. in Ann. Sci. Nat. 17: 165 (1842). Syn: *D. calycosa* Boiss. & Balansa var. *aucheri* Boiss., Fl.Or.1:299(1867).

The original description in the Flora of Turkey;

Caespitose perennial. Scapes ascending-erect, up to 10 cm, pubescent. Leaves narrowly elliptic, soft, canescent with stellate hairs, 8-20 mm long. Petals yellow, 4-5 mm. Ovary with (12-)16-32 ovules. Siliculae ovoid-ellipsoid, inflated, with an indumentum of stellate hairs. Fl. 4-7. Rocks, up to 3200 m.

The new description in respect of this study;

Caespitose perennial, soft, stellate and branching hairy. Scapes ascending-erect, 1.5-17.5 cm, pubescent. Rosette leaves narrowly elliptic, oblong-lanceolate to linear, acute and acuminate at the apex soft, canescent with stellate and branching long hairy; 4-30 × 0.75-2.8 mm. Flowers 1-28. Pedicel 1-15 mm. Sepals 1.5-3.5 × 0.8-2 mm, with soft; stellate and branching hairy. Petals yellow, 2.3-7 × 1.3-3 mm. Ovary with (12-)16-32 ovules. Silicula ovoid-ellipsoid, inflated, 5-7 × 3-4.5 mm, with an indumentum of short stellate hairs. Fl. 4-7. Rocky slopes, 2400- 3200 m.

We obtained the following results based on this study;

1. We gave more detailed and reliable information about morphological characteristics, flowering time and spreadaltitude of *D. cappadocica* and *D. rosularis* species, known to Turkey alone, not the literature and the world.

2. We determined the statistical analysis and coefficient of variation of the two species studied in terms of stem (plant) size, leaf size / width, sepals' length / width, petals length / width, fruit length / width, and some other characteristics. We determined that the most reliable (the least changing) characteristics, according to these data, are the numerical data of fruits, petals, sepals, stem leaves and stem (plant) size respectively (Figure 1, 2).

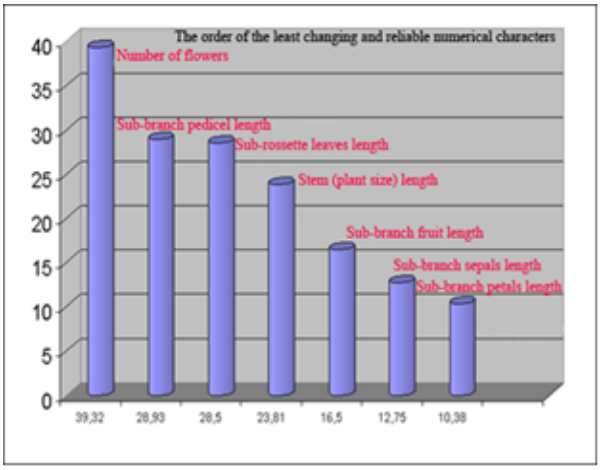

Figure 1. Variation coefficient ratios of *Draba cappadocica* characters.

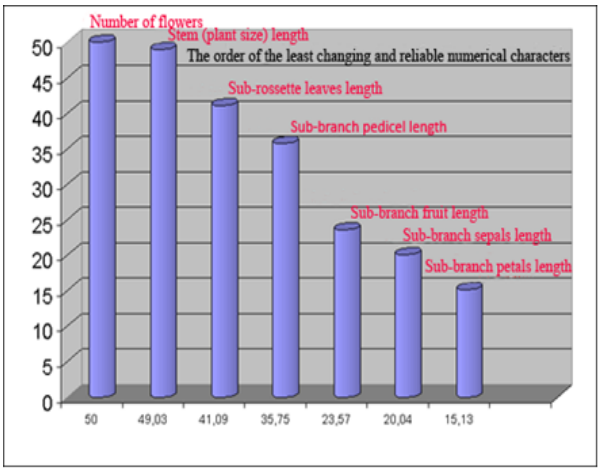

Figure 2. Variation coefficient ratios of *Draba rosularis* characters.

3. Based on numerical data, we gave substantial information about the method followed and the programmes used in determining-using similar, transitive and original characteristics of two close taxa.

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