ISSN 1308-5301 Print
ISSN 1308-8084 Online

Biological Diversity and Conservation

CİLT / *VOLUME* **6** SAYI / *NUMBER* **1** NİSAN / *APRIL* **2013**

Biyolojik Çeşitlilik ve Koruma Üzerine Yayın Yapan Hakemli Uluslararası Bir Dergidir
An International Journal is About Biological Diversity and Conservation With Refree

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Cilt / *Volume* **6**, Sayı / *Number* **1**, Nisan/*April* 2013

Editör / *Editor-in-Chief:* Ersin YÜCEL

ISSN 1308-5301 Print
ISSN 1308-8084 Online

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Dergiyi tarayan veri tabanları / *Abstracted-Indexed in*

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Biyolojik Çeşitlilik ve Koruma/*Biological Diversity and Conservation ;* *Cilt / Volume **6**, Sayı / Number **1**, Nisan/April 2013*
ISSN 1308-5301 Print; ISSN 1308-8084 Online

Sahibi / *Publisher* : Ersin YÜCEL
Bu dergi yılda üç sayı yayınlanır. Yayınlanma yeri Eskişehir/Türkiye'dir. / *This journal is published three numbers in a year. Printed in* Eskişehir/*Turkey.*
Dergide yayınlanan makalelerin her türlü sorumluluğu yazarlarına aittir / *All sorts of responsibilities of the articles published in this journal are belonging to the authors*

Editörlük Ofisi/*Editorial Office*; Alper YARGIÇ, Hilal ERSOY, Mine YÜCEL;
Kapak Resmi/ *Cover Image*: . Ersin YÜCEL, Dilge YÜCEL**;**
Baskı/*Printing Press*; Cetemenler Dijital, Eskişehir/Turkey;
Kapak Düzeni/ *Cover Layout*; Mine YÜCEL
Dizgi/Compositor; Mine YÜCEL
Web Consultant ; Alper YARGIÇ

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 1-7

Research article/Araştırma makalesi

Population trend of corn leaf aphid (*Rhopalosiphum maidis.*) with different chemical doses in three maize varieties

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Abstract

Field experiment was conducted to find out the comparative efficacy of different commercial insecticides for the control of aphids, *Rhopalosiphum maidis* Fitch (Homoptera: Aphididae) and to study the resistance level of the newly released maize variety (Jalal) to the farmers for general cultivation in comparison with the two commonly grown corn cultivars (Azam and Sarhad white). Experiment was laid down in a randomized complete block design with three replications. The treatments included; seed dresser (*Imidacloprid*^{TM}), granular application (*Carbofuran*^{TM}) and foliar spray (*Methamidophos*^{TM}), each in recommended and half of the recommended doses. Aphid's population data were recorded on weekly intervals for each treatment upon the varieties. Seed dresser, granules application and foliar spray significantly reduced aphid infestation from 1st week to 4th week as compared to control. Recommended dose of all of the insecticides significantly minimized the aphid's population as compared to half doses. The newly released cultivar 'Jalal' showed comparatively more resistance to the aphid's infestation as compared to 'Azam' and 'Sarhad White' suggested that the old cultivars have almost lost their resistance against the available strains of aphids. Similarly recommended dose of seed dressing resulted in maximum grain yield (2841 kg ha^{-1}) followed by the recommended dose of foliar spray, whereas; minimum grain yield (2678 kg ha^{-1}) was recorded in control plots. Maize variety 'Jalal' produced higher grain yield (2857 kg ha^{-1}) followed by 'Azam' (2818 kg ha^{-1}). Outcome of the experiment suggested that 'Jalal' is not only a productive variety but also proven tolerant to aphids compared to the existing two corn varieties (Azam and Sarhad White). Thus these findings provided a tool to focus on the use of recommended doses of *Imidacloprid*^{TM} as seed dresser with low toxicity and environmental safety for early protection, good plant vigor and greater yield. The same variety can be used in the development of potential hybrid or varieties breeding.

Key words: Aphids infestation, Pesticide application, Corn cultivars

1. Introduction

Corn (*Zea mays* L.) is vulnerable to the attack of a number of insect pests including aphid, which is a known serious pest. The corn leaf aphid, (*Rhopalosiphum maidis.* Fitch) (Aphididae: Homoptera) is a cosmopolitan specie that has been recorded on many species of graminae of which corn is a preferred host (Bing *et al*., 1990). The specie is parthinogenic and entirely viviparous. *R. maidis* damage occurs when large population builds up in corn whorl before anthesis. Large *R. maidis* population have been associated with the yield loss, particularly in drought stressed corn (Everly, 1960). Resistance to *R. maidis* in corn was first reported in the F_1, of a cross between yellow dent corn and teosinte (Gerner, 1971). Since then resistance in corn has often been documented (Diske & Guthire, 1998). Resistance to corn leaf aphid's resulting from several factors including plant morphology, soil structure, climatic aberrations and physio-chemical characteristics of the host pest (Coon *et al.*, 1948). The factors involved in conditioning resistant to the corn leaf aphid, however the mechanism is still poorly understood (Bing et al., 1990). *R. maidis* is found in corn, barley and occasionally in wheat. However, it has been reported that the most common host for this particular strain is Jhonson grass; a wild cereal specie (Stray *et al*., 1994; Apablaza & Tiska, 1973). Both Jhonson grass and *R. maidis* are mainly

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associated to orchards and cereal fields in northern and central Chile, showing quite similarity for distribution pattern (Mattheri, 1950; Artigas, 1994).

Corn leaf aphids are very common in whorl stage, but rarely cause economic losses. Infestation becomes apparent when tassels begin to emerge revealing colonies of aphids. Infestations are even more severe in late-planted corn. If the population is beyond the threshold level, especially three-weeks prior tasselling, a physiological damage correlating with yield loss may be observed. However, infestation usually occurs close to the tassel emergence, and despite large numbers, the aphids, do not cause economic losses (Bessin, 2004). This infestation and losses due to the attack of corn leaf aphid is also a known major problem for the maize industry of Pakistan. The *R. maidis* is often kept in check naturally by the predator *M. sexmaculata* in the absence of pesticide application (Pirzada *et al*., 1996). *R. maidis* has a wide host range in the Graminae, including more than 30 genera and most of the cereal crops, especially barley, corn and sorghum. *R. maidis* feeding on cereal may cause direct yield loss (Kieckhefer & Kantack, 1980). It is also a vector of several other plant viruses affecting cereal crops and soybean for mosaic disease (Blackman & Eastop, 1984). Population of *R. maidis* has been reported in barley during spring in the Northern planes of USA. Flight activity to other crop is probably related to population increase in barley and subsequent dispersal (Kieckhefer & Lytle, 1976). Earlier studies addressed many other factors including temperature influencing *R. maidis* biology (El-Ibrashy *et al*., 1972; Singh & Painter, 1964; Carter, 1957). Population density of aphid plant^{-1} on corn has variable values ranging from 3.42 to 42.17 depending on the weather conditions (Fareed, 1991). In areas with mild summer, the pest could be a threat to the early as well as late corn plantation (Mashwani & Kareemullah, 1990). Khalil et al., (2010) applied the powder inoculum for the control of maize leaf diseases.

Keeping in view the importance of corn industry for the production of poultry feeds, this study was initiated to: (i) work on the population trend of aphid association with *R. maidis* in the summer corn crop, (ii) evaluate the resistance level of 'Jalal' variety in comparison with two other cultivars (Azam and Srahad white) for yield loss, and (iii) address recommendations for these pesticides.

2. Materials and methods

Field Experiment was conducted to find out the comparative efficacy of different insecticides for the management of *R. maidis* in maize crop and to study the performance in terms of resistance of the newly released variety (Jalal) in comparison with the two commonly cultivated corn varieties (Azam & Sarhad white). The experiment was started on 6th July 2010, continued up to 3rd week of October at the Agricultural farm of The Agricultural University, Peshawar Pakistan. Experiment was designed in a randomized manner to assess the performance of the three insecticides (*Imidacloprid*, *Carbofuron* & *Methamidophos*) on the three corn cultivars viz. Jalal, Azam and Sarhad white (Table 1). Plot size was 5×3m^2 with three replications of each treatment along with control. There were six treatments along with a check plot with four rows plot^{-1} having row-to-row distance of 75cm and plant-to-plant distance of 30cm. The treatments included seed dressing, granular application and foliar spray, each in recommended and half of the recommended doses. Seeds were treated with *Imidacloprid* prior sowing at two levels. Treatments were assigned as T_2 recommended dose (5 gmkg^{-1} of seed) and T_3 half of the recommended dose (2.5 gmkg^{-1} of seed). As granular application, '*Carbofuron*' was applied on 12th August @ 20 kgha^{-1} as a recommended dose (T_4) and 10 kgha^{-1} as half of recommended dose (T_5). '*Methamidophos*' was applied as foliar spray on 16th September @ 1000 mlha^{-1} as a recommended dose (T_6) and 500 mlha^{-1} as half of recommended dose (T_7). Agronomic practices were kept constant for all treatments of the corn. The relative performance of corn varieties/cultivars and insecticides efficacy were studied to find out the population density of *R. maidis* on each cultivar upon weekly interval, starting from two-leaf stage till the crop maturity. Data were collected on yield and its components viz., number of cobs plant^{-1}, number of grains cob^{-1}, 1000-grain weight and grain yield plant^{-1} converted to hectare. Aphid's density was determined by visual counting and collecting total number of aphids available on the newly unfolded randomly selected 3rd leaf in each replication. Their means were determined following data analyses using M-STAT C package. ANOVA was performed for data analysis and means were separated through LSD test as proposed by (Steel & Torrie, 1980).

Table 1. List of pesticides used in the study to count aphid's population with recommended and half of the recommended dose.

S.No	Common name	Trade name	Dose applied
1.	Imidacloprid 70WS	Confidor	5 gmkg^{-1} seed (Full)
2.	Imidacloprid 70WS	Confidor	2.5 gmkg^{-1} seed (Half)
3.	Carbofuran 3G	Carbofuran 3G	20 kgha^{-1} (Full)
4.	Carbofuran 3G	Carbofuran 3G	10 kgha^{-1} (Half)
5.	Methamidophos	Methamidophos	1000 mlha^{-1} (Full)
6.	Methamidophos	Methamidophos	500 mlha^{-1} (Half)

3. Results and discussion

3.1 Effect of seed dresser on aphid's population

Analysis of variance showed that the three maize cultivars were affected by the aphid's population significantly using different application of the pesticides through different ways on weekly interval basis (Table 2). Mean aphid's population was significantly lower on the newly released maize cultivar 'Jalal' during all weeks. Similarly, the full dose of *Imidacloprid* was found effective for the control of aphid's population in maize cultivars. Maximum mean aphid's population (22.96 aphids plant^{-1}) were observed in Sarhad white (SW), followed by Azam (18.14 aphids plant^{-1}), whereas minimum aphids population (12.83 aphids plant^{-1}) was recorded in corn cultivar Jalal (Table 2). An increase was observed in all the cultivars for aphid's population from 1st to 7th week, which drastically reduced in the 9th week. Interaction between weeks and cultivar's exhibited that aphid's population differed at different weeks for all the three cultivars, with maximum variation in 'Azam'. Seed dressing with recommended dose of *'Imidacloprid 70WS'* either in full or half significantly reduced aphid's population compared to the control (Table 2).

Using *Carbofuran* both in full and half dose to measure the population density of aphid it was observed from the mean data (Table 3) that all the three maize cultivars responded differently to the application of *Carbofuran*. As stated earlier, the infestation raised in the subsequent weeks with the passage of time until 7th week of data recorded. Interaction among variety, week and seed dressing indicated that higher number of aphid's infestation (43.81) was recorded by SW followed by 'Jalal' in 6th week. However, the mean data reveled that the minimum infestation of 11.29 was recorded in 'Jalal' followed by 'Azam' (17.03). The response of *Carbofuran* was also significant on the mean basis.

Table 4. The effect of *Methamidophos* also had significant effect on the aphid's population responsible for the cause of blights in maize cultivars. The minimum population density for aphid's (22.16) was recorded in 'Jalal' followed by 'Azam' (29.14), however, the rate of infestation was much higher in SW (35.28). Similarly, the use of *Methamidophos* was found effective with full dose as recommended, however the control made was also enough through half dose application of *Methamidophos* (Table 4). Interaction of varieties with weekly infestation revealed that the aphid's population drastically fell down in the 3rd week.

Table 2. Interaction effect of varieties and treatments with time intervals on the mean number of corn leaf aphid's plant^{-1} of maize with Imidacloprid

Time intervals (weeks)	Varieties				Treatments			
	Jalal	S. white	Azam	Mean	Imidacloprid $_{(Full\ dose)}$	Imidacloprid $_{(Half\ dose)}$	Control	Mean
W_1	0.59	2.48	0.92	**1.33**	0.00	0.07	3.92	**1.33**
W_2	1.15	4.59	3.00	**2.9**	0.22	0.18	8.33	**2.91**
W_3	2.11	12.07	7.55	**7.25**	1.26	1.77	18.70	**7.25**
W_4	6.11	18.00	11.70	**11.93**	4.18	5.66	25.96	**11.93**
W_5	13.52	26.00	17.85	**19.12**	5.07	10.48	41.81	**19.12**
W_6	26.03	43.74	35.03	**34.94**	23.29	28.44	53.07	**34.94**
W_7	36.00	58.07	50.78	**48.28**	31.62	37.96	75.26	**48.28**
W_8	26.18	31.48	28.81	**28.82**	26.85	28.81	30.81	**28.82**
W_9	3.81	10.22	7.63	**7.22**	7.22	7.78	6.66	**7.22**
Mean	**12.83**	**22.96**	**18.14**	--	**11.08**	**13.46**	**29.39**	--
$LSD_{(0.005)}$ for varieties				0.745	$LSD_{(0.005)}$ for treatments			0.745
$LSD_{(0.005)}$ for weeks				0.745	$LSD_{(0.005)}$ for interaction effect			2.236
$LSD_{(0.005)}$ for interaction				2.236				

Table 3. Interaction effect of varieties and treatments with time intervals on the mean number of corn leaf aphid's plant^{-1} of maize with granular pesticide (carbofuran)

Time intervals (weeks)	Varieties				Treatments			
	Jalal	S. white	Azam	Mean	Carbofuran $_{(Full\ dose)}$	Carbofuran $_{(Half\ dose)}$	Control	Mean
W_1	4.48	14.07	9.70	**9.42**	9.07	9.14	10.03	**9.42**
W_2	2.48	11.48	8.15	**7.37**	0.29	1.85	19.96	**7.37**
W_3	4.66	16.74	11.37	**10.92**	0.89	3.85	28.04	**10.92**
W_4	11.14	25.29	17.04	**17.82**	2.55	5.03	45.89	**17.82**
W_5	21.11	35.63	30.85	**29.19**	12.29	16.26	59.04	**29.19**
W_6	31.44	43.81	26.37	**33.87**	21.59	27.15	52.89	**33.87**
W_7	3.74	8.70	6.63	**6.35**	5.26	4.29	9.51	**6.35**
Mean	**11.29**	**22.24**	**17.03**	--	7.42	9.65	32.19	--
$LSD_{(0.005)}$ for varieties				0.806	$LSD_{(0.005)}$ for treatments			0.806
$LSD_{(0.005)}$ for weeks				1.232	$LSD_{(0.005)}$ for weeks			1.232
$LSD_{(0.005)}$ for interaction				2.134	$LSD_{(0.005)}$ for interaction effect			2.134

Table 4. Interaction effect of varieties × time interval on the mean number of leaf aphid's plant^{-1} in maize with methamidophos

Time intervals (weeks)	Varieties				Treatments			
	Jalal	S. white	Azam	Mean	Methamidophos (Full dose)	Methamidophos (Half dose)	Control	Mean
W_1	53.56	88.00	72.11	**71.22**	62.67	68.33	82.67	**71.22**
W_2	11.07	13.63	12.37	**12.36**	0.48	1.26	35.33	**12.36**
W_3	1.78	4.22	2.93	**2.93**	0.33	1.15	7.44	**2.98**
Mean	**22.16**	**35.28**	**29.14**	--	21.16	23.58	41.81	--
$LSD_{(0.005)}$ for varieties				2.102	$LSD_{(0.005)}$ for treatments			2.102
$LSD_{(0.005)}$ for weeks				1.214	$LSD_{(0.005)}$ for weeks			1.214
$LSD_{(0.005)}$ for interaction				1.214	$LSD_{(0.005)}$ for interaction effect			1.214

Corn or maize leaf aphid (*R. maidis*) is a serious pest of wheat in many countries including Pakistan (Bing *et al.,* 1990). 'Jalal' cultivar was developed by Cereal Crops Research Institute, Pakistan and was released for general cultivation in 2003. Granular application for the control of insect pest of corn is a common practice among the corn growers in Pakistan. Usually extension services of entomologists of Pakistan are recommending *Imidaclopridclopard* against the entire pest complex of maize. Seed dressing is one of the effective mean to protect the crop from early pests including shoot fly, cutworm, jassid and early attack of borer. So *Imidacloprid* was proven effective than the foliar application of *Methamidophos.* 'Jalal' proved to be comparatively resistant to the infestation of the corn leaf aphid. Low infestation of aphid's have been reported in 'Jalal' (Kiramat, 2003). Controlling the aphid's population in different cultivars through seed dressing of *Imidacloprid* has been reported by many scientists (Gray *et al*., 1996; Fareed, 1991; Mashwani & Kareemullah, 1990). Instead of controlling aphid's population through chemical way its better to change the sowing time (Straub & Boothrod, 1980). Aphid's infestation is a serious problem and by evaluating plant resistance it can be easily overcome at 4-5 leaf stage with the combined strategy of antibiosis and antixenosis (Rabichuk, 1985).

3.2. Response of maize cultivars to different treatments based on aphid's population and their interaction effect with weeks

Data concerning aphid's population as affected by different treatments of pesticides (full & half dose) varied significantly for all the three cultivars (Table 5). Using half dose of *Imidacloprid* the interaction effect (T×V) was significantly low for all the three cultivars, however it was acceptable for 'Jalal' than the other two cultivars. Using *Carbofuran* as pesticide for studying the aphid's population with full dose as recommended was found significant than the half dose of the said pesticide for controlling the aphid's population in all three maize cultivars. However, the interaction effect was much more effective in 'Jalal' than the rest of the two cultivars (Table 5). As stated for *Imidacloprid* and *Carbofuran* the control was also good using *Methamidophos* granules. On the basis of mean aphid's population *Imidaclopridclopard* was found effective in 'Jalal' in the 1st week followed by *Carbofuran* in 6th week and *Methamidophos* in 3rd week. Infestation of aphid's was high (107.4) in the 4th week using *Imidacloprid,* low (33.87) in 6th week using *Carbofuran* and moderate (71.22) using *Methamidophos* in 1st week (Table 5).

Though *Imidacloprid* was proven effective however, the half dose had prolonged results with yield loss. Foliar spray of *Methamidophos* proved ineffective to provide any protection against the pest. The reason for the low performance of the foliar spray may be attributed to the fact that the insecticide was applied late in season when the pest was already established. Aphid's population directly had least significant effect on the yield traits (Wilde & Ohiagu, 1976). Fereres (2000) concluded that use of barrier crops could be an effective crop management strategy to protect against vectors that are the causing agents for virus infection, but only under specific circumstances.

3.3. Effect of seed dressing, granular and foliar spray on the yield & yield components of maize cultivars

Data pertaining to treatments application of seed dressing (full & half), granules (full & half) and foliar spray (full & half) revealed that the mean number of cobs plant^{-1} were significantly higher (1.00) using pesticide as seed dressing (full dose). On mean basis 'Jalal' had more number of cobs plant^{-1} (0.90) followed by 'Azam' (0.87). Number of grains cob^{-1} was also significantly affected with different treatments (Table 6). Maximum combine mean grains cob^{-1} of all the three maize cultivars (283.81) was recorded using pesticide as seed dressing (full dose). Of the three maize cultivars, 'Jalal' excelled in performance than the other maize cultivars with 285.8 grains cob^{-1}. 1000-grain weight in maize is a direct primary yield component. Data regarding 100-grain weight as influenced by different treatments was also significant on the mean basis. Maximum 1000-grain weight of 211.41 g for all the genotypes was recorded using seed dressing as full dose. Similarly, 'Jalal' produced more 1000-grain weight of 213.3 g under all treatment applications. Aphid's population reduces yield directly as they are the responsible vector for dissemination of blight disease. Mean grain yield was high (2841.07 kg ha^{-1}) in all the three genotypes using pesticide as seed dressing in full-recommended dose.

Table 5. Interaction effect of varieties with treatments and time interval on the mean number of corn leaf aphid's plant^{-1} of three maize cultivars

Varieties	**Time intervals (weeks)**										
	Treatments	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8	W_9	T×V
Jalal	$Imidacloprid_{(F)}$	0.00	0.33	0.45	2.55	5.00	18.89	28.99	25.11	3.88	9.46
	$Imidacloprid_{(H)}$	0.00	0.11	0.55	5.00	7.78	23.88	32.55	26.88	4.66	11.26
	Control	1.77	3.00	5.33	10.77	27.78	35.33	46.44	26.55	2.88	17.76
S. white	$Imidacloprid_{(F)}$	0.00	0.22	1.67	5.66	5.55	25.66	33.77	28.99	10.66	12.46
	$Imidacloprid_{(H)}$	0.11	0.22	2.55	6.55	13.00	32.22	42.44	31.33	9.78	15.35
	Control	7.33	13.33	32.00	41.77	59.44	73.33	98.00	34.11	10.22	41.05
Azam	$Imidacloprid_{(F)}$	0.00	0.11	1.66	4.33	4.66	25.33	32.11	26.44	7.11	11.30
	$Imidacloprid_{(H)}$	0.11	0.22	2.22	5.44	10.66	29.22	38.89	28.22	8.89	13.76
	Control	2.66	8.67	18.78	25.33	38.22	50.55	81.33	31.78	6.89	29.35
Mean		**1.33**	**2.91**	**7.24**	**107.4**	**19.12**	**34.93**	**48.28**	**28.82**	**7.21**	--
$LSD_{(0.05)}$ LSD for interaction											3.873
$LSD_{(0.05)}$ LSD for T×V											0.745
$LSD_{(0.05)}$ LSD for weeks											1.29
Jalal	$Carbofuran_{(F)}$	4.22	0.00	0.67	1.67	8.22	23.00	4.00	--	--	**5.96**
	$Carbofuran_{(H)}$	4.22	1.11	2.11	3.44	12.00	23.00	3.88	--	--	**7.10**
	Control	5.00	6.33	11.22	28.33	43.11	48.33	3.33	--	--	**20.80**
S. white	$Carbofuran_{(F)}$	13.00	0.66	1.33	4.33	15.55	23.11	6.44	--	--	**9.20**
	$Carbofuran_{(H)}$	13.77	2.55	6.55	7.88	20.00	36.33	4.00	--	--	**13.01**
	Control	15.44	31.22	42.33	63.67	71.33	72.00	15.66	--	--	**44.52**
Azam	$Carbofuran_{(F)}$	10.00	0.22	0.67	1.67	13.11	28.66	5.33	--	--	**8.52**
	$Carbofuran_{(H)}$	9.44	1.89	2.88	3.77	16.77	22.11	5.00	--	--	**8.83**
	Control	9.66	22.33	30.55	45.67	62.67	38.33	9.55	--	--	**31.25**
Mean		**9.42**	**7.37**	**10.92**	**17.82**	**29.19**	**33.87**	**6.35**	--	--	--
$LSD_{(0.05)}$ LSD for interaction											3.696
$LSD_{(0.05)}$ LSD for T×V											1.397
$LSD_{(0.05)}$ LSD for weeks											1.232
Jalal	$Methamidophos_{(F)}$	45.67	0.33	0.33	--	--	--	--	--	--	**15.44**
	$Methamidophos_{(H)}$	60.00	0.55	1.00	--	--	--	--	--	--	**20.51**
	Control	55.00	32.33	4.00	--	--	--	--	--	--	**30.44**
S. white	$Methamidophos_{(F)}$	80.00	0.78	0.00	--	--	--	--	--	--	**26.92**
	$Methamidophos_{(H)}$	81.33	1.77	1.33	--	--	--	--	--	--	**28.14**
	Control	102.67	38.33	11.33	--	--	--	--	--	--	**50.77**
Azam	$Methamidophos_{(F)}$	62.33	0.33	0.67	--	--	--	--	--	--	**21.11**
	$Methamidophos_{(H)}$	63.67	1.44	1.11	--	--	--	--	--	--	**22.07**
	Control	90.33	35.33	7.00	--	--	--	--	--	--	**44.22**
Mean		**71.22**	**12.35**	**2.97**	--	--	--	--	--	--	--
$LSD_{(0.05)}$ LSD for interaction											3.642
$LSD_{(0.05)}$ LSD for T×V											1.214
$LSD_{(0.05)}$ LSD for weeks											1.214

Of the three maize cultivars, 'Jalal' gave maximum grain yield of 2857.9 kg ha^{-1} under different methods of pesticide applications (Table 6). The use of *Methamidophos* as foliar spray for the control of aphid's population and their interaction with yield and yield components was found ineffective for number of cobs plant^{-1}, grains cob^{-1} and 1000-grain weight. Minimum number of cobs plant^{-1}, grains, weight and grain yield was recorded for all the three cultivars in control. Thus, the newly developed maize cultivar was proven resistant to the attack of aphid's infestation. Our findings are fully supported by Kiramat (2003) who reported moderate insect resistant in Jalal to the insect attack and recorded 6.97 tons of yield as compared to the 3.56 tons ha^{-1} yield of Azam. Similarly, Ullah et al (2005) obtained a maximum grain yield of 6.83 t ha^{-1} from different sets of maize cultivars with the application granular pesticide. To get maximum yield through pesticide control is effective and safe for environment with low LD_{50} to be used for aphid's count and eradication (Gray *et al.*, 1996). Yield loss in maize due to the infestation of aphids can be controlled if proper management of the crop is done through aphids survey and studying environmental factors (Everly, 1960). Oil extracts with optimum rate reduced the aphids infestation and enhanced grain yield, however the diluted and low concentration of oil were ineffective to control the aphid's colonies (Ferro *et al*., 1980).

Table 6. Effect of different treatments over the yield and associated traits of three maize cultivars

Treatments	Cobs plant^{-1}				Grains cob^{-1}				1000-grain weight				Grain yield			
	Jalal	SW	Azam	Mean	Jalal	SW	Azam	Mean	Jalal	SW	Azam	Mean	Jalal	SW	Azam	Mean
Seed Dressing (F)	1.11	0.89	1.00	1.00a	296.11	273.33	282.00	283.81a	215.89	187.67	230.67	211.41a	2919.44	2745.7	2807.11	2841.07a
Seed Dressing (H)	1.00	0.78	0.89	0.89c	291.67	270.67	279.67	280.67 b	223.89	185.00	201.78	203.56b	2867.22	2784.9	2871.11	2824.07 d
Granules (F)	0.89	0.89	1.00	0.92b	288.22	273.67	277.33	279.74c	213.56	180.33	203.22	199.04b c	2822.00	2713.6	2873.33	2802.96 g
Granules (H)	0.89	0.78	0.89	0.85d	287.00	270.00	276.11	277.70 d	212.44	176.67	200.11	196.41c	2867.78	2701.8	2872.44	2814.00e
Foliar Spray (F)	1.00	0.78	0.89	0.89c	283.33	267.22	273.22	274.59e	211.11	183.00	197.56	197.22c	2898.22	2775.6	2839.11	2837.63 b
Foliar Spray (H)	0.77	0.78	0.89	0.81e	281.33	266.44	274.22	274.00e	209.22	179.00	194.56	194.26c	2861.00	2745.0	2870.00	2825.33c
Control	0.67	0.89	0.55	0.70f	273.00	265.33	266.33	268.22f	206.67	179.67	202.00	196.11c	2769.67	2669.8	2596.00	2678.48f
Mean	0.90a	0.83 c	0.87b	--	285.8a	269.52 c	275.56 b	--	213.3a	181.6c	204.3 b	--	2857.9a	2733.7 c	2818.44 b	--
LSD for treatments				0.071	LSD for treatments			1.49	LSD for treatments			6.074	LSD for treatments			1.187
LSD for (cobs plant^{-1})				0.003	LSD for (grains cobs^{-1})			3.04	LSD for 1000-grain weight			3.214	LSD for grain yield			4.786

4. Conclusions

'Jalal' maize cultivar had proven to be more productive as well as found resistant to the attack of aphid's and could be incorporated in the breeding program to develop pesticide resistant genotypes and ensure the food safety in the future. Moreover, The full dose of *Imidacloprid* as seed treatment is recommended as it provided early protection and good plant vigor with greater yield.

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(Received for publication 21 October, 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 8-12

Research article/Araştırma makalesi

Calcium oxalate crystals in generative organs of *Astragalus hamosus* and *Astragalus glycyphyllos*

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Abstract

In this study, distribution of Calcium oxalate (CaOx) crystal types within generative organs of Astragalus hamosus L. and Astragalus glycyphyllos L. and crystal types of them were examined using light microscopy (LM). During cytoembryological studies on A. glycyphyllos, CaOx crystals have been observed in generative organs. Prismatic and druse type crystals were determined in different regions of flowers of A. glycyphyllos while were not observed in A. hamosus. This study represents additional data on the presence of CaOx crystals in examined Astragalus species.

Key words: Astragalus, Crystal, Generative organs

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Astragalus hamosus ve *Astragalus glycyphyllos* generatif organlarındaki kalsiyum okzalat kristalleri

Özet

Bu çalışmada, *Astragalus hamosus* L. and *Astragalus glycyphyllos* L. un generatif organlarındaki kalsiyum okzalat kristal tiplerinin dağılımı ışık mikroskobu kullanılarak incelenmiştir. *A. glycyphyllos* taki sitoembryolojik çalışmalar boyunca generatif organlarda CaOx kristalleri gözlenmiştir. *A. hamosus* ta gözlenmediği halde *A. glycyphyllos* un çiçeklerinin farklı bölgelerinde prizmatik ve druz tip kristaller gözlenmiştir. Bu çalışma incelenen *Astragalus* türlerinde CaOx kristallerinin varlığını göstermektedir.

Anahtar kelimeler: Astragalus, Generatif organlar, Kristal

1. Introduction

Astragalus L. (Fabaceae, Leguminosae) contains an estimated 2500 annual and perennial species and about 250 sections worldwide (Lock and Simpson, 1991; Podlech, 1998). *Astragalus* L. species are very old and well known curative plants with immunostimulant, hepatoprotective, antiperspirant, diuretic, and tonic properties (Tang and Eisenbrand, 1992). It is the largest genus of the family Leguminosae with more than 2000 species and also the largest genus with 450 species in flora in Turkey. About 48% of the Turkish species (218) are endemic (Akan et al., 2008; Pınar et al., 2009).

In Turkey, *Astragalus* spp. are often used for the production of gum tragacanth which has significant commercial value (Çalış and Sticher, 1996) and also for curative purposes (Bedir et al., 2001). Given the fact that the farmers usually have to use limited lands to produce products such as grain, industrial crops and fruits, the production of forage scrops are very limited. In addition to this, several species of *Astragalus* are used in folk medicine due to their hepatoprotective, antioxidative biological activities and their antiviral properties (Ríos and Waterman, 1997).

In Turkish folk medicine, the roots of *Astragalus* species are used for the treatment of leukemia and for the healing of open wounds (Yeşilada et al., 2005). Some *Astragalus* products, such as gum tragacanth, are widely used as the base product for certain pharmaceuticals and as thickening agents in certain foods (Zarre, 2000). Gođevac et al. (2008) investigated the antioxidant activity of methanol extract from the aerial part of *A. glycyphyllos* L. Although

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 BioDiCon. 300-0113

there are many systematic, anatomic, karyological and palynological studies on the *Astragalus* species, some taxonomic problems concerning this genus have not been resolved yet (Wojciechowski et al., 1999; Dane et al., 2007).

In recent years, there has been a significant increase in the number of anatomical studies (Khatun et al., 2011) and the studies of formation mechanisms of CaOx crystals and their taxonomic importance have been increased. CaOx crystals which are found in the structure of druse and raphide type are inclusions that are often seen in higher plants (Akan et al., 2008; Ekici and Dane, 2009). They can be observed in specific tissues of various plants. In significant amounts Ca-oxalate crystals are usually used as a taxonomical tool (Lernsten and Horner, 2000). However, their functional significance remains unclear, although various functions have been attributed to them (Dormer, 1961; Horner, 1977; Lersten and Horner, 2000; Franceschi and Nakata, 2005; Kuo-Huang et al., 2007).

In this study, *A. hamosus* and *A. glycyphyllos* species have been investigated for crystals in ovary, anther, filament, styles, corolla and calyx. This is the first report on these species based on *A. hamosus* and *A. glycyphyllos* for cryrstal types in European Turkey.

2. Materials and methods

The specimens of *A. hamosus* and *A. glycyphyllos* were collected from a natural population in Edirne in European Turkey. Voucher specimens were deposited in the Herbarium of Trakya University (EDTU).

Examined specimens are given as follows:

***Asragalus hamosus* L. ,** A1 (E) Edirne: Center, around Gullapoğlu Campus, 20.05.2002, coll. *F. Dane*, EDTU (8515) (Table 1, Figures 1b).

***Astragalus glycyphyllos* L.** A1 (E) Edirne: Center, Söğütlük forest, 10.08.1989, coll. *F. Dane*, EDTU (3826)!; Center, Izzet Arseven Forest, 20.07.2002, coll. *O. Dalgic*, EDTU (8516)! (Table 1, Figures 1a, 2 - 4)

For LM, materials were fixed in ethyl alcohol and glacial acetic acid (3:1 v/v) at room temperature overnight and transferred to 70% ethyl alcohol. Hand-sections were made from fixed calyx, corolla, filament and ovary. Anthers were hydrolyzed with 1 N HCl for 15 min. at 60^{o}C in an oven. They were stained with Feulgen reagent for 2 hours in darkness at 25^{o}C. Anthers were squashed and counterstained with aceto orcein. The slides were examined under an Olympus Photomicroscope and photographs were taken with the same microscope.

3. Results

In this study, CaOx crystals were investigated and their morphology and distribution determined by light microscopy in organs of *Astragalus glycyphyllos* and *Astragalus hamosus*. In recent years, studies of formation mechanisms of CaOx crystals and their taxanomic importance have been increased. During cytoembryologic studies on *Astragalus glycyphyllus*, CaOx crystals have been observed in generative organs. Both solitary and druse crystals were observed. Solitary crystals were type of prismatic. Taxa, crystal types and crystal's location were given in Table 1.

Table 1.

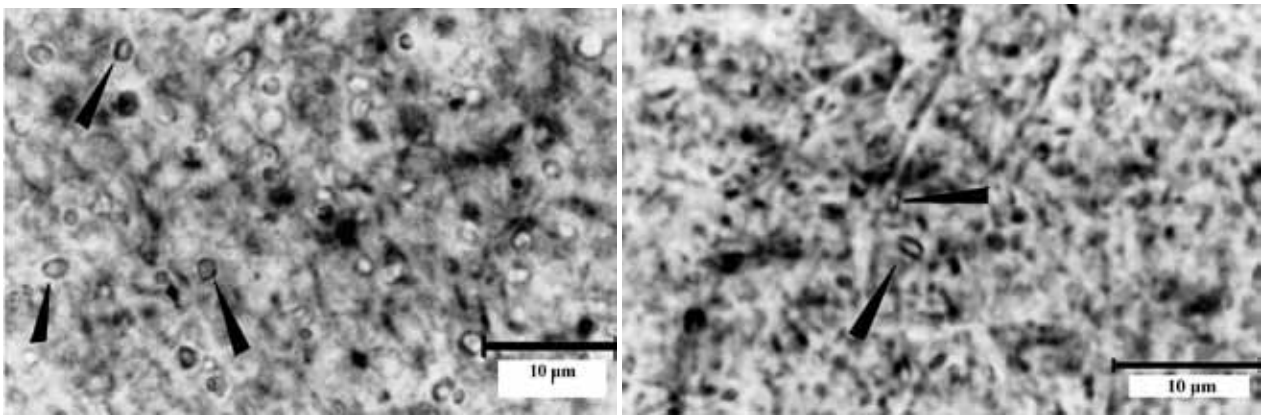
Location	**Taxa**	
	Astragalus hamosus	***Astragalus glycyphyllos***
Calyx	None	Druse (dense)
Corolla	None	prismatic (dense)
Anther tapetal cells	None	prismatic
Filament	None	None
Ovary	prismatic (few)	Prismatic (dense)
Style	None	prismatic (few)
Stigma	None	None

4. Conclusions

Druses were observed in calyx cells in *A. glycophyllos***.** However, no druse crystal was found in *A. hamosus*. The crystals were determined as prismatic in the ovaries of *A. glycophyllos* and *A. hamosus*. No crystals were found in stigma, style, filament and calyx in *A. hamosus* while few prismatic crystals were found in style of *A. glycyphyllos*. There were prismatic crytals found in tapetal cells of anthers of *A. glycophyllos.*

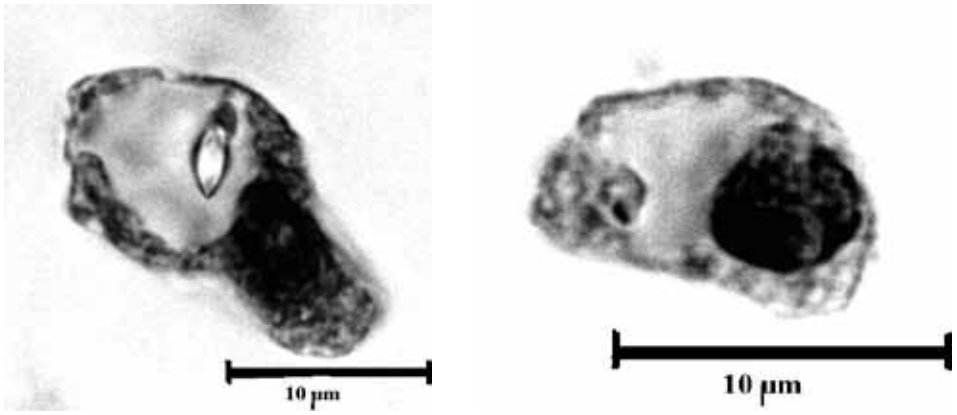
Meric studied CaOx crystals in Asteraceae. She thought that the presence of crystals in transitory floral organs such as the filament, anther and style was interesting. The function of crystals in those organs devoid of supporting

tissues might be to provide strength to the tissues of these floral organs, which were critical to pollination and fertilization for sexual reproduction (Meric, 2009).



a. **b.**

Figure 1. CaOx crystals in ovarium : a. *A. glycophyllos*; b. *A. hamosus*



a. **b.**

Figure 2. a. b. CaOx crystals are shown in tapetal cells of anthers in *A. glycophyllos*

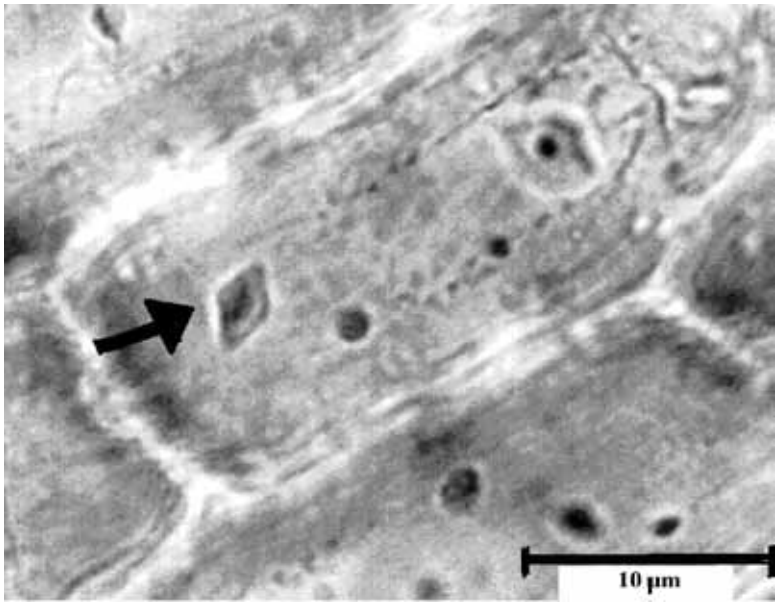
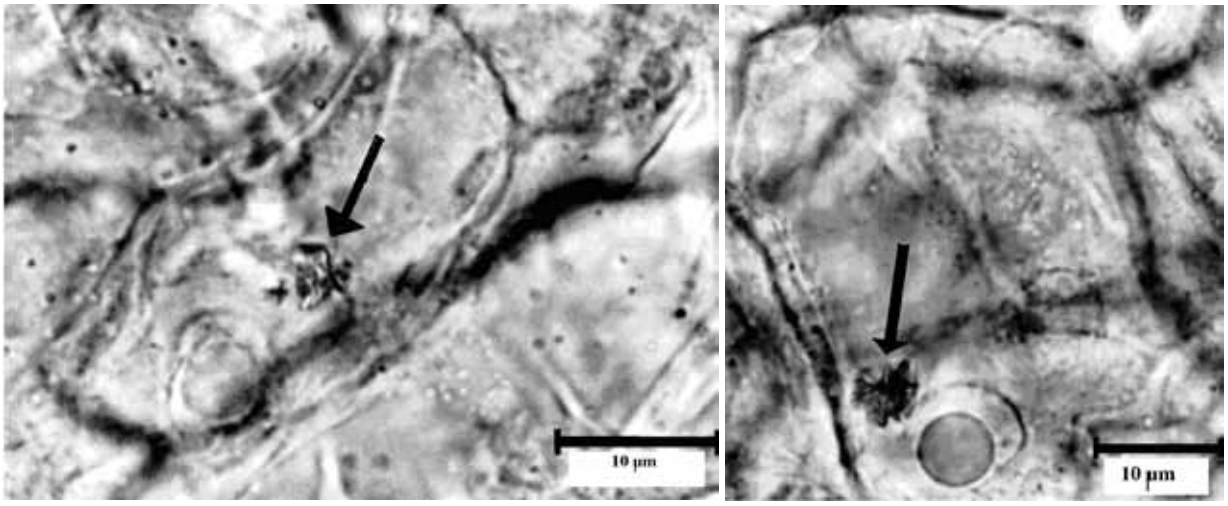


Figure 3. CaOx crystals shown in corolla of *A. glycophyllos*



a. **b.**

Figure 4. a. b. CaOx crystals shown in calyx of *A. glycophyllos*

Several studies have described about CaOx crystals (Dormer, 1961; Horner, 1977; Lersten and Horner, 2000; Kuo-Huang et al., 2007; Meric, 2009). CaOx crystals are found at all taxonomic levels in photosynthetic organisms, from small algae to higher plants (Franceschi and Nakata, 2005). The morphology and distribution of crystals is constant within a species. Because of that their presence was thought to be under genetic control (Ilarslan et al., 2001; Franceschi and Nakata, 2005).

Acknowledgements

The crystals are formed from endogenously synthesized oxalic acid and Ca taken from the environment, and they are produced and accumulated in species-specific morphologies. Thus the constancy of crystal type and distribution may be considered a taxonomic character for classification of species (Franceschi and Nakata, 2005).

In order to solve the taxonomic problems in *Astragalus* L. crystal types of *A. glycophyllos* and *A. hamosus* were determined.

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(Received for publication January 01, 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 13-17

Research article/Araştırma makalesi

Erythrocyte deformations in *Rutilus rutilus* provided from Porsuk dam lake

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Abstract

Normally cell structures of erythrocytes in fishes are smooth, symmetrical and ellipsoid shaped. However, some significant deformations occur in cell membranes of erythrocytes, as a result of environmental pollutants and the primary reason of these deformations on cell membranes are toxic metals. The aim of this study is to determine the deformations occurring in the erythrocyte cells of *Rutilus Rutilus* (Linnaeus, 1758) provided from Porsuk Dam Lake in April 2011 by frontal blood preparation method. According to data observed, fusiform, spherical and degenerated erythrocytes and also echinosit cell membrane types were observed. It can be clearly understood that, pollution of Porsuk Dam Lake has reached critical levels as much as to cause significant erythrocytes deformations in *R. rutilus*.

Key words: *Rutilus rutilus*, Porsuk Dam Lake, Erythrocytes deformations

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Porsuk baraj gölü'ndeki *Rutilus rutilus* türünün kirliliğe bağlı eritrosit şekli deformasyonları

Özet

Balıkların eritrositleri düzgün, simetrik ve elipsoit şekilli hücre yapısındadır. Ancak çevresel kirleticilerin etkileri sonucu eritrosit hücrelerinin elipsoit yapıları ve hücre zarı şekilleri deformasyona uğramaktadır ve balık eritrosit hücrelerinde bu deformasyonlara sebep olan çevresel kirleticilerin başında toksik metaller gelmektedir. Bu çalışmada, Nisan 2011'de Porsuk Baraj Gölü'nden temin edilen *Rutilus rutilus* (Linnaeus, 1758) (kızılgöz) türünün eritrosit hücrelerinde meydana gelen deformasyonların, hazırlanan frontal kan preparatları ile incelenmesi amaçlanmıştır. Yapılan preparatlarda fusiform şekilli, sferik şekilli, dejenere olmuş eritrositler ile hücre zarının dikensi bir yapı gösterdiği ekinosit (spiküllü) şekilli eritrositler gözlenmiştir. Sonuç olarak Porsuk Baraj Gölü'ndeki kirliliğin, bu ekosistemde son 5 yıldır önemli miktarlarda popülasyon oluşturan *R. rutilus* türünün eritrositlerinde ciddi deformasyonlar oluşturacak seviyelere ulaştığı tespit edilmiştir.

Anahtar kelimeler: *Rutilus rutilus,* Porsuk Baraj Gölü, Eritrosit deformasyonları

1. Giriş

Artan nüfus yoğunluğuna bağlı olarak çoğalan endüstriyel ve tarımsal faaliyetler sonucu oluşan kirleticiler iç sularımızı ve denizlerimizi gün geçtikçe daha fazla kirletmektedir. Bu kirliliğin belirlenmesi ve izlenmesi için son yıllarda birçok çalışma yapılmıştır. Özellikle suya giren toksik metaller hem su kimyası adına hemde sulak alanda yaşayan canlılar adına ciddi riskler oluştururlar. Metallerin oluşturdukları bu riskler suda ve organizmada birikim

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 BioDiCon. 243-0412

seviyeleriyle ve metalin toksik özelliğiyle yakından ilişkilidir. Sucul ortamlarda ki bu metal kirliliğinden en çok etkilenen organizmaların başında balıklar gelir.

Metale maruz kalan balıklarda osmotic ve iyon düzenlenmesi problemleri, enzim aktivitelerinde düzensizlik, lipit metabolizması ve immün sistem sorunları ve kondisyon faktörü düşüşleri gibi çeşitli bozukluklar meydana gelir (Grosell vd., 2002; Bervoets ve Blust, 2003; Chowdhury ve Wood, 2007; Reynders vd., 2008). Balıklarda, özellikle toksik metal kirliliğine bağlı olarak bazı fizyolojik düzensizlikler ve kan parametrelerinde deformasyonlar meydana gelebilir (Çelik, 2006). Bu nedenle hematolojik teknikler kirleticilerin subletal etkilerini belirlemek amacıyla sık başvurulan yöntemlerden biridir (Katalay ve Parlak 2004).

Porsuk Baraj Gölü, Eskişehir ilinin taşkınlardan korunması, Eskişehir ve Alpu ovalarının sulanması ve Eskişehir ilinin içme ve kullanma suyu temini amacıyla 1972 yılında Porsuk Çayı üzerinde (39°33−39°40K, 30°05−30°16D) inşa edilmiştir (Şekil 1).

Porsuk Çayı üzerinde inşa edilmiş olan Porsuk Baraj Göleti, endüstriyel ve tarımsal faaliyetler sonucu önemli miktarda kirleticiye maruz kalmaktadır. Bu kirleticilerin önemli miktarını da özellikle endüstriyel ve tarımsal faaliyetler sonucu ortaya çıkan metaller oluşturmaktadır. Porsuk Çayı'nda ve Porsuk Baraj Gölü'nde çok sayıda belirleme ve izleme çalışması yapılarak sudaki, sedimentteki ve organizmalardaki metal miktarları çeşitli araştırmacılar tarafından belirlenmiştir (Çiçek ve Koparal, 2001; Muhammetoğlu vd., 2005; Canbek vd., 2007; Uysal, 2011).

Bu çalışmada, Porsuk Baraj Gölü'nde yaşayan *Rutilus rutilus* (Linnaeus, 1758) (kızılgöz) balığında kirliliğe bağlı olarak eritrosit hücrelerinde meydana gelen yapısal değişiklikler incelenmiştir.

2. Materyal ve yöntem

Nisan 2011 tarihinde 22 mm göz açıklığına sahip galsama ağı yardımıyla yakalanan kızılgöz örneklerinin herbirinden enjektör kullanılarak intrakardiyak kan örnekleri alındı ve temiz lamlar üzerine yayma preparat yapıldı. Oda sıcaklığında ve havada kurutulan kan yaymaları metanol ile tespit edildikten sonra Harris Haematoxylin kullanılarak sitolojik boyama yapıldı. Hazırlanan tüm kan preparatları Olympus CX31 marka ve model ışık mikroskobunda incelendi. Elde edilen bulgular Olympus Camedia marka, C-5060 model compact dijital kamera kullanılarak 4.0.6 versiyon Spot advanced program yardımıyla fotoğraflandırıldı.

Şekil 1. Porsuk Çayı ve Porsuk Baraj Gölü
Figure 1. Porsuk Stream and Porsuk Dam Lake

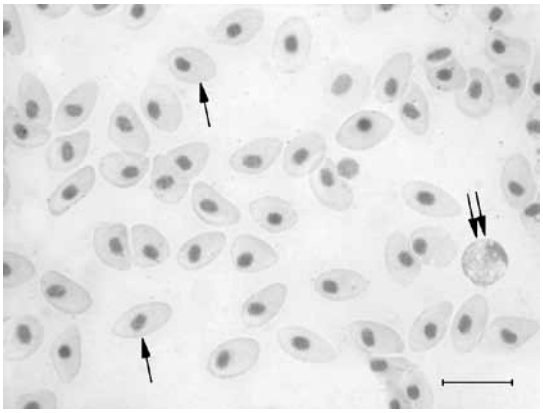
3. Bulgular

Porsuk Baraj Gölü'nde, 2011 yılı ilkbahar mevsiminde tespit edilen bazı fizikokimyasal parametreler Tablo 1'de verilmiştir.

Tablo 1. Porsuk Baraj Gölü'nde tespit edilen fizikomyasal veriler
Table1. Physochemical parameters detected in Porsuk Dam Lake

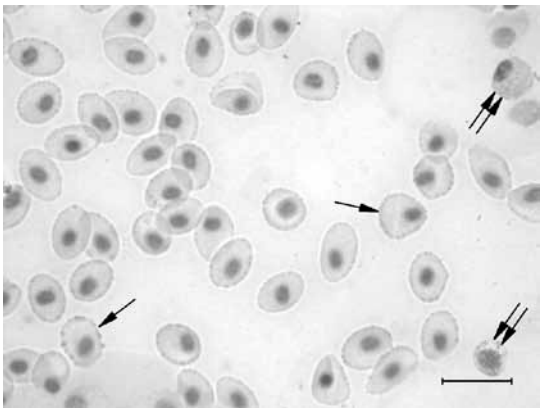
Parametreler	**Birim**	**Değer**
Su sıcaklığı	^{o}C	19,528
pH		8,686
Çözünmüş Oksijen	mg O_2/L	4,204
Elektriksel İletkenlik	µs/cm	2174
Tuzluluk	‰	0,278

Porsuk Baraj Gölü'nde yaşayan kızılgöz balıklarından alınan kan örnekleri incelendiğinde, kirliliğe bağlı olarak eritrosit hücrelerinde şekilsel deformasyonlar gözlenmiştir. Özellikle bazı bireylerde eritrosit hücre zarı yapısındaki değişiklikler ve ekinositler'in (spiküllü eritrosit) varlığı çekilen fotoğraflarda tespit edilmiştir. İncelenen preparatlarda çok sayıda eritrosit hücresinin dış hücre zarlarının dikensi yapı kazanarak deforme olduğu ve ekinosit denen yapıyı kazandığı görülmüştür. Deformasyona uğramış ve normal şekilli eritrosit hücrelerinin görüntüleri Şekil 2, Şekil 3 ve Şekil 4'te verilmiştir.



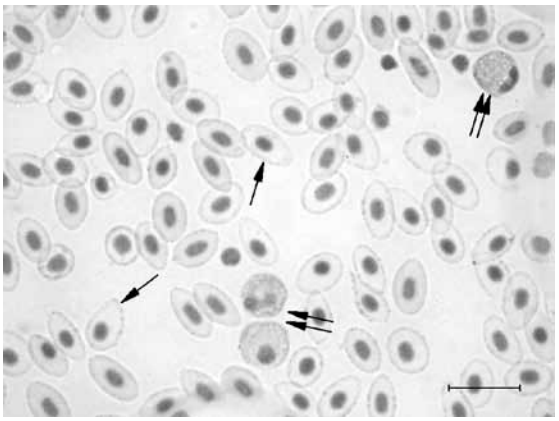
Şekil 2. *R. rutilus* türünün kan örneklerinde hücre çeperi normal görünümlü eritrosit (↗) ve lökositler (⇗) (Ölçü barı 10 µm)

Figure 2. Erythrocytes with normal cell walls of blood samples in *R. Rutilus* species (↗) and leukocytes (⇗) (Size bar is 10 µm)



Şekil 3. *R. rutilus* türünün kan örneklerinde hücre zar yapısı; değişime uğramış ekinositler (spiküllü eritrosit) (↗) ve normal görünümlü lökositler (⇗) (Ölçü barı 10 µm)

Figure 3. Cell membrane structure of blood samples in *R. Rutilus* species; modified echinocytes (↗) and normal appearing leukocytes (⇗) (Size bar is 10 µm)



Şekil 4. *R. rutilus* türünün kan örneklerinde hücre zar yapısı; değişime uğramış ekinositler (spiküllü eritrosit) (↗) ve normal görünümlü lökositler (⇗) (Ölçü barı 10 µm)

Figure4. Cell membrane structure of blood samples in *R. Rutilus* species; modified echinocytes (↗) and normal appearing leukocytes (⇗) (Size bar is 10 µm)

4. Sonuçlar ve tartışma

Literatür bilgilerine göre ekinosit oluşumuna en çok tesir eden metalin kadmiyum olduğu ve kadmiyumun özelikle tarımsal alanlarda gübre olarak kullanılan fosfat kayası, fosforik asit ve fosforlu gübrelerde bulunduğu

bildirilmiştir (Katalay ve Parlak, 2004). Yapılan preparat incelemeleri sonucu Kızılgöz balığının çok sayıda eritrosit hücresinin şekillerinde ciddi deformasyonlar meydana geldiği ve eritrosit hücrelerinin dış hücre zarlarının dikensi yapılar kazanarak ekinosit denen yapıyı kazandığı görülmüştür.

Katalay ve Parlak (2004) *Gobius niger* balıklarını kontrollü ortamda 24 gün süreyle 2 mg/L kadmiyum konsantrasyonuna maruz bıraktıklarında kırmızı kan hücrelerinin immatür halde olduklarını ve çok sayıda çeşitli çeper deformasyonları, fusiform şekilli eritrosit, hipokromik anemi ve spiküllü eritrosit oluşumu gözlemlemişlerdir. Ayrıca fusiform şekilli, çekirdeği merkezi konumda olmayan sferik şekilli, hücre çekirdeği belirsiz dağınık kütle şeklinde ve granüllü yapıda dejenere eritrosit sayısında artış olduğunu bildirmişlerdir. Kadmiyum dozu artırıldığında (24 gün süreyle 3 mg/L) eritrositlerde parçalanma, fusiform ve orak şekilli parçalı eritrosit sayısında artışlar, hücre çepellerlerinde yoğun dikensi yapılar ve sitoplazmanın homojen bir dağılım göstermeyip hipokromi gözlendiğini bildirmişlerdir.

Köleli ve Kantar (2005) yaptıkları çalışmada, 6 gübre fabrikasından aldıkları toplam 14 gübre numunesinde Cd seviyelerini araştırmışlardır ve 14 numunenin 10'nunda Cd'nin 8 mg/kg değerinin üzerinde (Cd için sınır değer) olduğunu tespit etmişlerdir. Fosfatlı gübrelerin ana maddesi olan fosfat kayası Türkiye'ye yurt dışından ithal edilmekte ve hem ithal edilen hem Türkiye'de üretilen bu ham madde bileşiminde olması gerekenden çok daha fazla Cd içeriği yer almaktadır. Tarım arazilerinde bilinçsiz olarak gereğinden fazla miktarda fosfatlı gübre kullanımı sonucu toprak üst yüzeyinde biriken özellikle fosfat kayası bileşikleri yağmurlarla derelere, çaylara, baraj ve göllere taşınmakta ve çalışmanın yapıldığı Porsuk Çayı etrafında da önemli miktarda tarım arazisi bulunmaktadır.

Porsuk Çayı Havzası'nda bu güne kadar yapılan birçok çalışmada havzanın önemli bir kirlilik baskısına maruz kaldığı ortaya konulmuştur (Tokatlı vd. 2011; Tokatlı vd. 2012; Köse vd., 2012; Tokatlı, 2013; Yücel vd., 2010). Çiçek ve Koparal (2001) ve Canbek vd. (2007) tarafından Porsuk Baraj Gölü'nde yapılan çalışmalarda, özellikle suda ki Cd miktarının Su Kirliliği Kontrölü Yönetmeliği Kıta İçi Su Kaynaklarının Sınıflarına göre IV sınıf ve EPA ya göre müsaade edilen sınırların çok üstünde olduğunu bildirilmiştir. Daha önceki çalışmalarda bildirilen yüksek Cd seviyelerinin, Porsuk Baraj Gölü'nde yaşayan kızılgöz balığında fizyolojik ve yapısal değişikliklere sebep olduğu düşünülmektedir.

Emilen kadmiyum organizmada iki aşamalı bir yayınım gösterir. İlk aşamada kan ve özellikle karaciğerde düşük molekül ağırlıklı bir protein olan metallotiyoneinle fiske edilir. İkinci aşamada toksisiteden yoksun olan metallotiyonein-kadmiyum kompleksi mobilize olarak kana geçer ve böbrekte alıkonarak yoğunlaşır (Yazkan, 2004). Kadmiyum, metallothionein kompleksleri tarafından tecrit edilir ve bağlanan kadmiyumun hücre içi reseptörlerle etkileşimi kesilmektedir (Kayhan, 2006). Kadmiyum, balıklarda anemik tepki oluşturarak hematokrit ve hemoglobin düzeyleri ile eritrosit sayısında ve serum glukoz düzeyinde önemli düşmeye neden olabilmekte ve su ortamında çok düşük derişimlerde bile balıklarda doku ve omurga bozukluklarına, solunum değişimine ve hatta ölüme bile neden olabilmektedir (Haux ve Larson, 1984; De Smet ve Blust, 2001; Karataş vd, 2005).

Balıklarda ki metal kirliliğini iki farklı yönden incelemek gerekir. İlki balık sağlığı açısından; organizma da biriken metaller balığın metabolizmasını bozabilir, üreme faaliyetlerini azaltabilir hatta fazla birikmesi sonucu balığın ölümüne yol açabilir. İkincisi insan sağlığı açısından; özellikle insan gıdası olarak kullanılan balıklarda biriken metaller besin yolu ile insana geçer ve metabolizma için çeşitli olumsuz durumların oluşmasına sebep olabilir. Normal şartlarda Porsuk Baraj Gölü'ne dökülen Sobran deresinde görülen Kızılgöz balığı, 2000'li yılların başına kadar Porsuk Baraj Gölü'nde oldukça sınırlı populasyon yoğunluğuna sahipken, barajın su kalitesinde ki değişimler ve istilacı bir tür olan *Carassius gibelio* türünün bölgede yoğun populasyon oluşturmasından sonra Porsuk Baraj Gölü'nde ciddi miktarda av gücüne, dolayısıyla populasyon yoğunluğuna ulaşmıştır. Porsuk Baraj Gölü'ndeki bu kirlilik hem ekolojik dengeyi hemde insan sağlığını ciddi anlamda tehdit etmektedir.

Porsuk Baraj Gölü'nde yaşayan kızılgöz balıklarının kan preparatları incelendiğinde özellikle eritrosit hücrelerinin çeperlerinde deformasyonlar meydana geldiği ve çok sayıda ekinosit oluşumu gözlenmiştir. Bölgede daha önce yapılmış çalışmalar ve mevcut çalışmada yapılan eritrosit preparatları, kızılgöz balığının Porsuk Baraj Gölü'nde ciddi miktarda Cd kirliliğine maruz kaldığını göstermektedir. Eritrosit çeper yapısı bozulan balıklarda solungaçlardan dokulara oksijen taşınım kapasitesi düşmekte ve bu durum kızılgöz balığının oksijen toleransını düşürüp, türün bölgedeki populasyonunu tehlike altına sokmaktadır.

Sonuç olarak, denetim olmadan ihraç edilen ham madde ve bu ham maddeden elde edilen fosfatlı gübrelerin fazla kullanımı Porsuk Baraj Gölü'ndeki ekolojik hayatı tehdit edecek seviyeye gelmiştir. Bu sorunun çözümü için tarım arazilerinin toprak analizi yapıldıktan sonra gübrelenmesi yöntemlerinin acilen gerekli miktara çekilmesi hem insan hemde ekosistem sağlığı açısından çok büyük önem arz etmektedir.

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(Received for publication April 07 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 18-21

Research article/Araştırma makalesi

Morphological features and inheritance of a dwarf -growth phenotype in a pea mutant line

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Abstract

A dwarf-growth pea mutant recovered after exposing seeds of *P. sativum* cv Iregi-5 to gamma-irradiation. The main characteristic of the plants was the shortened internode length. The shoot growth of the mutant was less than that of its parent. The line V/4 has shown to have single-gene recessive inheritance, characterized morphologically and for seed production. The early expression of the mutant phenotype makes it desirable characteristic for genetic- and physiological studies of the stem elongation and plant development.

Key words: Peas, *Pisum sativum*, Dwarf mutant, Inheritance, Internode length

1. Introduction

Pea (*Pisum sativum* L.), one of the most important food legume crops, provides excellent dietary components with health-promoting benefits and offers the important ecological advantage of contributing to the development of low input farming systems by fixing atmospheric nitrogen and further minimizing the need for external inputs when used as a break crop. The Institute of Plant Physiology and Genetics, Bulgarian Academy of Sciences, developed a high-quality *P. sativum* mutant collection by mutagenizing a number of pea cultivars with chemical and physical agents. With a view to initiating an improvement program for pea mutant lines assessment, various field and laboratory studies were performed (Naidenova and Vassilevska-Ivanova, 2006; 2008; Vassilevska-Ivanova et al., 2008). During the course of field studies, a unique dwarf-growth mutant line was identified. The details of the mutant line and its inheritance are reported here for the first time.

It is widely accepted that dwarf phenotype in plants can be caused by the malfunction of biosynthesis or signaling pathways of different growth factors (Richards et al., 2001). The most intensively growth factors that modulate vegetative growth of shoots and other developmental processes are the gibberellins (GAs). Mutations blocking synthesis lead to a dwarf GA-responsive phenotype. Numerous such mutations are now known (Reid and Ross, 1993; Reid et al., 1996; Ross et al., 1997). For example, it was established that there are mutations at four loci that block active gibberellins in peas: *le* (Ingram et al., 1984), *na* (Ingram and Reid, 1987), *lh* (Swain et al., 1997) and *ls* (Ait-Ali et al., 1999). Several GA-synthesis mutations have been characterized at the molecular level and all are in structural genes. It is now clear some steps are controlled by gene families with distinct tissue specificity. Researches on auxin mutants are less well understood. Classical plant physiology experiments have indicated that indole-3-acetic acid (IAA) is required for normal stem elongation and for the inhibition of lateral bud outgrowth (Davies, 1995). Reports on developmental mutants with reduced level of IAA are rare, possibly due to the redundancy of IAA biosynthesis pathways (Normanly and Bartel, 1999; Symons et al., 2002), or because auxin deficiency may be lethal (Ngo et al., 2002; Kizil et al., 2010).

The objective of this study was to describe the morphological differences between normal (wild) plants and a dwarf-growth pea mutant, to determine the inheritance of the mutant trait and to evaluate the potential of the trait as a marker in genetic and physiological studies.

Abbreviations: GAs = gibberellins; IAA = indole-3-acetic acid; TSW = thousand seeds weight

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 BioDiCon. 183-0311

2. Materials and methods

Pea mutant V/4 was isolated in M_2 generation after irradiation of dry seeds of cultivar Iregi-5 with 100 Gy γ–rays (Co^{60}-source), at the Institute of Genetics, Bulgarian Academy of Sciences, by Dr. M. Vassileva. The mutant phenotype was verified in M_3 and in the next generations. *P. sativum* cv Iregi-5 is a mid-plant height, mid-season, anthocyaninless commercial variety. Initial cultivar and mutant plants were grown in the field at a rate of 100 plants/m^2. Conventional management practices, including insect control were used. Thirty randomly selected plants, both for mutant and their respective normal plants, were used for recording 20 variables, that characterize the mutant morphologically and also affect its production: days to first open flowers and to maturity (50 %), plant height (cm), plant height to the 1-st pod (cm), number of nodes to first pod, total number of nodes with expanded leaves on the main stem, number of pods (total, fertile and sterile) per plant, stem width at internode 8, petiole length at leaf 8, number and weight (g) of seeds per plant, number of fruitage nodes, pod length and pod width, number of seeds per pod, thousand seeds weight (TSW) (g), lodging resistance and protein content. Crude protein content (N x 6.25) in the seeds was calculated by the standard method. Node counts commenced from the first scale leaf as node 1. Internode 1 lays between nodes 1 and 2. Flowering time was taken as the days from sowing to appearance of the first open flowers.

Genetic behavior of the mutation was studied by making reciprocal crosses between the mutant and the parent genotype. We used chi-square test to determine the goodness -of - fit of the observed ratios to theoretical ratios (Rokitckij, 1967).

3. Results and discussion

Differences in stem growth between V/4 and Iregi-5 were visible soon after emergence and persisted during the entire growth period. The stem of V/4 was much shorter than that of Iregi-5 (Figure 1). The number of nodes was similar during the early stage, but V/4 had slightly fewer nodes than Iregi-5 during the late stage (Table 1).

The mutant V/4 had a pronounced apical dominance as Iregi-5; both, V/4 and Iregi-5 produced secondary shoots or lateral branches at nodes 1 and 2 rarely. Internode lengths at V/4 showed that the major factor accounting for the dwarfness was the short internode length (Figure 2 and 3). In both lines, the first flowers appeared around 74-75 days after planting and at the same nodes, 16 or 17. V/4 produced fewer and smaller pods and seeds than did Iregi-5 (Table 1). V/4 had 3.5 pods/ plant, whereas Iregi-5 bore 5.5 pods. The seed weight per plant and TSW were 2.78 g and 208.2 g for V/4 and 5.19 g and 219.4 g for Iregi-5, respectively. The seeds of V/4 and Iregi-5 were green and smooth, rarely wrinkled, and the cotyledons were green.

Figure 1. Plants of the dwarf-growth mutant line V/4 in the field.

The leaf surface was dull, dark-green and lusterless, and may be covered with a whitish bloom. The mutant plants had strongly reduced petiole length at leaf 8 by 63 %, and reduced stem width at internode 8 by 15 % when compared with the initial cultivar Iregi-5 but nevertheless; reduced tendency of the crop to lodging was not established. Furthermore, the stem tissue structure of the mutant differed from this of the initial cultivar: it is compact and rigid with good standing ability. The stem structure of the initial cultivar has clearly outlined thicker, polylamellate outer walls, arranged differently from those in the inner walls. As a whole, the pea stem is hollow with exception of part between 1 to 3, and the last two internodes, thereby reducing lodging resistance of the plants. It is quite possible, that the changes

are response of the total wall material of the stem to the presence or absence of auxin. Similar changes of epidermal cell wall of pea stems were established during auxin-induced growth (Bret-Harte and Talbott, 1993). The reciprocal crosses between V/4 (dwarf-growth) and Iregi-5 (normal growth) gave F_1 plants with the normal traits only. In cross V/4 x Iregi-5, F_2 populations segregated into 165 normal and 50 dwarf-growth types (χ^2 = 0.35, P >0.50); and in reciprocal cross Iregi-5 x V/4 F_2 segregated in 195:59 (χ^2 = 0.47, P>0.25), respectively, thus fitting a monogenic 3:1 ratio. This indicates that the dwarfness is governed by a single recessive gene.

In the present study, we described a dwarf-growth mutant, which phenotypically was characterized by reduced plant stature. It is clear that the dwarf mutant has a dramatically altered phenotype with changes in a wide range of developmental traits.

Table 1. Morphological and productivity characteristics of a dwarf-growth mutant

Trait	cv Iregi-5	V/4
Days to first open flowers (50 %)	74	75
Days to maturity (50 %)	111	110
Plant height, cm	44.7 ± 0.83	11.4 ± 0.27***
Plant height to the first pod, cm	37.3 ± 0.50	8.9 ± 0.22***
Stem width internode 8, cm	0.47 ± 0.07	0.40 ± 0.06***
Petiole length leaf 8, cm	5.29 ± 0.08	1.93 ± 0.07***
No of nodes to the first pod	16.8 ± 0.17	15.7± 0.19***
Total number of nodes (with expanded leaves on the main stem)	21.0 ± 0.30	20.0 ± 0.22*
No of fruitage nodes	3.3 ± 0.21	2.9 ± 0.13
Pod length, cm	6.47 ± 0.09	6.13 ± 0.09*
Pod width, cm	1.58 ± 0.02	1.65 ± 0.02**
Total number of pods /plant	5.5 ± 0.29	3.5 ± 0.17***
No of fertile pods/plant	5.2 ± 0.22	3.2 ± 0.11***
No of sterile pods/plant	0.33 ± 0.11	0.30 ± 0.08
No of seeds/plant	23.7 ± 0.97	13.4 ± 0.54***
No of seeds/pod	4.51 ± 0.07	4.22 ± 0.12*
Weight of seeds/plant, g	5.19 ± 0.18	2.78 ± 0.11***
Thousand seeds weight (TSW), g	219.4	208.2
Protein content, %	26.95	25.85
Mean lodging score•	5	2-3

•Scale:1 = erect; 5 = prostrate; *P< 0.05, **P< 0.01, ***P< 0.001, based on t-test

Figure 2. 9. 11 internodes of the cv Iregi-5 (left) and dwarf-growth mutant line V/4 (right)

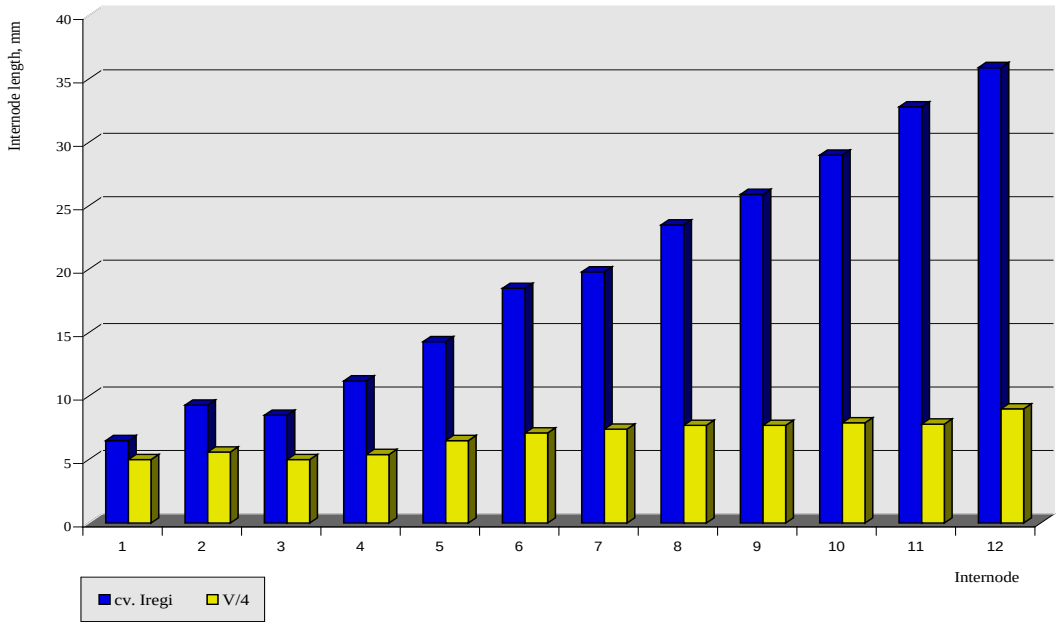

Figure 3. Internode length for the first 12 internodes of cv Iregi-5 and mutant line V/4.

Despite the severity of some of these changes, mutant plants are both viable and fertile, and show surprising vigor and standing ability. Together these characteristics make dwarf-growth V/4 a highly valuable research tool with the potential to provide many insights into the role of auxin and gibberellins in plant growth and development.

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(Received for publication 21 March 2011; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 22-31

Research article/Araştırma makalesi

Flora of Armutluçayır (Kastamonu/Turkey)

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Abstract

The study area is situated in Armutluçayır and its vicinity in Kastamonu. As a results of determination of 600 plant specimens collected from Armutluçayır and its environment, 66 families, 198 genera and 277 taxa at specific and infraspesific rank are found in the area. One taxon is new record for A4 square and nine taxa are endemic to Turkey (3,24 %). Phytogeographical elements of the area are as follow Euro-Siberian 103 (37,18 %), Irano- Turanian 6 (2,16 %), Mediterranean 3 (1,08 %), the poliregionals and unknowns 165 (59,58 %).

Key words: Flora, Armutluçayır, Kastamonu, Turkey

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Armutluçayır (Kastamonu) Florası

Özet

Araştırma alanı, Kastamonu ili sınırları içinde yer alan Armutluçayır çevresidir. Alandan toplanan 600 bitki örneğinin değerlendirilmesi sonucu 66 familyaya ait 198 cins ve 277 tür ve tür altı seviyede takson tespit edilmiştir. Tür ve tür altı seviyede Bir takson A4 karesi için yeni kayıttır. 9 takson endemik olup endemizm oranı % 3,24'dür. Taksonların fitocoğrafik bölgelere dağılımı ise şöyledir: Avrupa-Sibirya 103 (% 37,18), İran-Turan 6 (% 2,16), Akdeniz 3 (% 1,08), ve geniş yayılışlılar ile fitocoğrafik bölgesine karar verilemeyenler ise 165 (% 59,58)'dir.

Anahtar kelimeler: Flora, Armutluçayır, Kastamonu, Türkiye

1. Giriş

1-1. Alanın Coğrafi Konumu ve Özellikleri

Çalışma alanı Kastamonu İli sınırları içinde olup, coğrafi konum itibarıyla 36º 48´-36º 44´ doğu boylamları ve 46º 24´ - 46º 11´ kuzey enlemleri arasında yer almaktadır (Şekil 1). Araştırma alanının güneyinde Ulus, güneybatısında Bartın, kuzeybatısında Kurucaşile, kuzeydoğusunda Cide, güneydoğusunda Pınarbaşı ve Azdavay ilçeleri bulunmaktadır. Güzelyayla Köyü ise çalışma alanı sınırları içindeki yerleşim yeridir. Arazinin yüksekliği 800 m'den başlayıp, 1110 m'ye kadar çıkmaktadır. Alandaki en önemli yükseklik 1107 m ile "Çayır Tepe"sidir. Araştırma alanına ulaşım Cide, Sofular Köyü, Ovacık Köyü ve Güzelyayla Köyü yollarından sağlanmaktadır. Alanın içinden geçen bir dere yatağı mevcut olup, bu derenin su kapasitesi oldukça azdır.

Bitki coğrafyası açısından Avrupa-Sibirya floristik bölgesinde yer alan çalışma alanı, Davis'in kareleme sistemine göre ise A4 karesinde bulunmaktadır (Davis, 1971; Davis ve Hedge, 1975).

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1-2. Jeolojik Yapı ve Toprak Özellikleri

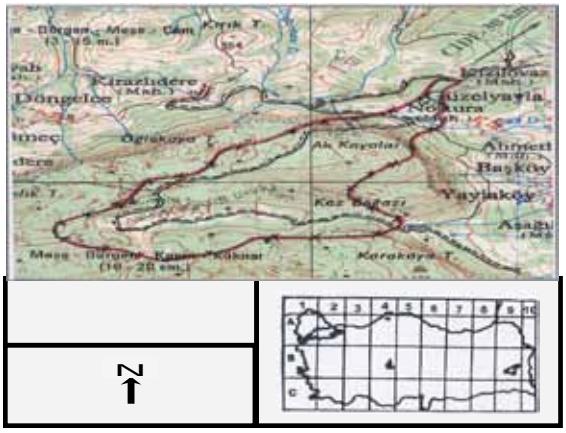
Çalışma alanında yaygın olarak üst Jura-Kretase dönemine ait rastlanan çeşitli formasyonlardan karbonat çimentolu kumtaşı, kumtaşı baskın olmak üzere nadir kiltaşı, silttaşı arabantlarından meydana gelen, yer yer detritik kireçtaşı ara seviyeleri bulunur. (Anonim, 1987). Çalışma alanında hakim toprak grubu Kırmızı Sarı Podzolik topraklardır (Anonim, 1993).

1-3. İklim

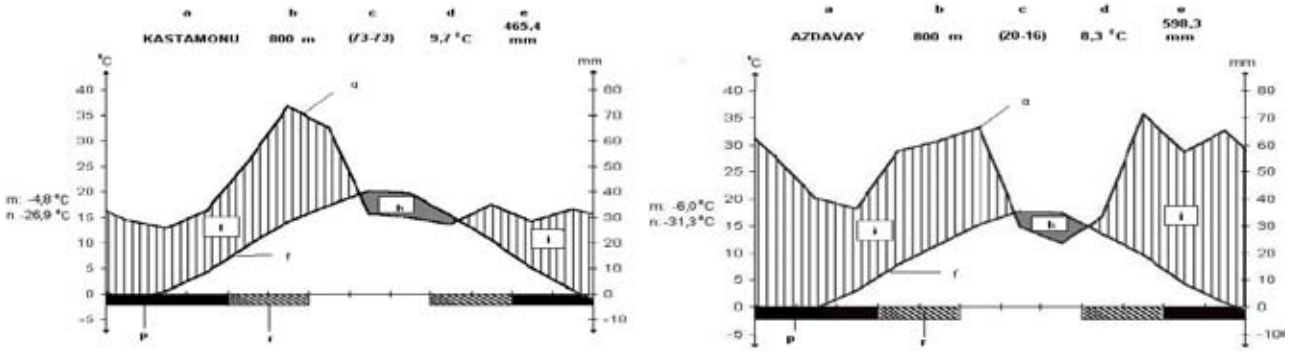
Çalışma alanı Kastamonu ili Cide ilçesi sınırları içerisindedir. Cide rakım olarak deniz seviyesinde olduğundan iklim diyagramı hazırlanırken Azdavay ilçesinin verileri kullanılmıştır (Şekil 2). Kastamonu "Karasal " biyoiklim katında, Azdavay " Az yağışlı, kışı çok soğuk Akdeniz " biyoiklim katında yer almaktadır. Kastamonu'nun ortalama yıllık yağış miktarı 465,4 mm, Azdavay'ın ortalama yıllık yağış miktarı 598,3 mm' dir. Kastamonu IYSK yani "Yarı karasal yağış rejimi I. tipi"ne, Azdavay SKIY yani, "Batı Akdeniz Yağış rejimi tipi" ne sahiptirler (Akman, 1999).

1-4. Alanın Önemi

Alanın tamamı Küre Dağları Milli Parkı "Mutlak Koruma Zonu" içerisinde yer aldığı için koruma altındadır. Anadolu'nun kuzeyindeki Küre Dağları'nın batı bölümünde yer alan Milli Park, Batı Karadeniz Karstik zonu içine girer. Genel olarak batı doğu doğrultusunda uzanan ve kuzeye doğru ekolojik koridorlar ile Karadeniz'e ulaşan park, olağanüstü peyzajları ile bir plato karakteri gösterir. Kastamonu ve Bartın illerinin sınırları içerisinde bulunan Milli Park Cide, Şenpazar, Azdavay, Pınarbaşı, Ulus, Amasra ve Kurucaşile ilçeleri ile çevrilidir. 07.07.2000 tarihinde Milli Park olarak ilan edilen Küre Dağları 37000 hektarlık "Mutlak Koruma Zonu" ile, kırsal yerleşim birimlerini içine alan 80.000 hektarlık "Tampon Zon" olarak ayrılmıştır. Küre Dağları Milli Parkı tampon zonla birlikte 117.000 hektarlık bir alana sahiptir. Çalışma alanımız ise Milli Parkın kuzeybatısında yer almaktadır (Kalem, 2002).



Şekil 1. Çalışma alanının coğrafi haritası
Figure 1. Geographic map of the study area



Şekil 2. Kastamonu ve Azdavay'ın İklim Diyagramları
Figure 2. Ombro-termic climate diagrams of Kastamonu and Azdavay

(**a:** Meteoroloji İstasyonu, **b:** Meteoroloji İstasyonu Yüksekliği (m.), **c:** Sıcaklık ve yağış rasat yılı, **d:** Ortalama yıllık sıcaklık (^{0}C), **e:** Ortalama yıllık yağış (mm.), **f:** Sıcaklık eğrisi, **g:** Yağış eğrisi, **h:** Kurak mevsim, **i:** Nemli mevsim, **m:** En soğuk ayın en düşük sıcaklık ortalaması (^{0}C), **n:** Mutlak minimum sıcaklık (^{0}C), **p:** Mutlak donlu aylar, **r:** Muhtemel donlu aylar)

2. Materyal ve yöntem

Araştırma alanına 2002 ve 2003 yıllarında gidilmiş ve 600 bitki örneği toplanmıştır. Bunların teşhisi sonucunda tür ve türaltı seviyede olmak üzere 277 takson tespit edilmiştir. Toplanan örnekler GAZI herbaryumunda saklanmaktadır. Örneklerin büyük bir kısmı ‘‘Türkiye ve Ege Adaları Florası Cilt 1-11’’ (P.H.Davis, 1965-1985; P.H. Davis ve ark., 1988; Güner ve ark., 2000), teşhislerinde şüpheye düşülen bitkilerde ‘‘Avrupa Florası Cilt 1-5’’ (Tutin ve ark., 1964-1980), ‘‘İran Florası Cilt. 1’’ (Rechinger, 1975), ‘‘Rusya Florası Cilt. 1-30’’ (Komarov, 1933-1964), ‘‘İtalya Florası Cilt. 1-3’’ (Pignatti, 1982) ve ‘‘Filistin Florası Cilt. 1-4’’ (Zohary, 1966-1986) gibi çevre ülke floraları ile İngilizce-Türkçe Botanik Kılavuzu’’ (Baytop, 1998) ve ‘‘Botanik Latincesi’’ (Stearn, 1973) gibi eserlerden yararlanılmıştır. Ayrıca teşhis edilen bitkilerin otörlerinin doğru ismi ilgili kaynaktan kontrol edilmiştir (Brummit ve Powell, 1999).

Alanın jeolojisi ve toprak yapısına ait bilgiler ilgili yayınlarından yararlanılarak hazırlanmıştır (Anonim, 1987; Anonim, 1993). Kastamonu’nun iklimi ile ilgili meteorolojik veriler Devlet Meteoroloji Genel Müdürlüğü’nden alınmıştır (Anonim, 1994). İklim ile ilgili verilerin yorumlanmasında ‘‘İklim ve Biyoiklim’’ kitabından yararlanılmşıtır (Akman, 1999).

Bitki listesi verilirken Türkiye Florası esas alınmıştır. Makalede bitki toplanan istasyonların lokaliteleri liste halinde verilmiştir. Tür ve tür altı taksonlarla ilgili bilgiler verilirken taksonun toplandığı yer (istasyon numarası), tarih, toplayıcı ve numarası, endemik olup olmadığı, biliniyorsa fitocoğrafik bölgesi sıralanmıştır. Toplama yeri verilirken ‘‘A4 Kastamonu: Cide, Armutluçayırı’’ kısmı tekrarlanmamıştır. Endemiklerin tehlike kategorileri ‘‘Türkiye Bitkileri Kırmızı Kitabı’’ (Ekim ve ark., 2000) taranarak belirtilmiştir. Taksonların tehlike kategorileri IUCN 2001 kriterlerine göre yeniden düzenlenmiştir (IUCN, 2001). A4 karesi için yeni olan taksonların belirlenmesi ilgili kaynaklar kullanılarak gerçekleştirilmiştir (Donner, 1990; Dönmez, 1998; Yıldırımlı, 1994; Yıldırımlı, 1997; Yıldırımlı, 1999; Yıldırımlı, 2000; Özbek ve Vural, 2010).

Bitki Toplanan İstasyonlar
Bitkilerin tamamı A4 Kastamonu: Cide, Armutluçayırın’dan toplanmıştır.
1- Çayır Tepe- Kez Boğazı, orman açıklığı, yol kenarı, 950-1050 m.
2- Çayır Tepe- Kez boğazı, orman içi, yangın şeriti, yol kenarı, 1100 m.
3- Çayır Tepe- Kez boğazı, çayırlık alanlar, 1000 m.
4- Çayır Tepe, orman içi, 950-1100 m.
5- Çayır Tepe, orman açıklığı, yol kenarı, 1000-1050 m.
6- Kez Boğazı, yol kenarı, 950 m.
7- Ak Kayalar, kayalık alanlar, 1050-1100 m.
8- Ak Kayalar civarı, yol kenarı, 1000 m.
9- Çayır Tepe-Ak Kayalar arası yol kenarı, nemli yerler, 950-1050 m.
10- Çayır Tepe-Ak Kayalar, çayırlık ve taşlık alanlar, 1000 m.
11- Çayır Tepe-Ak Kayalar, kayalık alan, dağ yamacı, 1000 m.
12- Çayır Tepe- Ak Kayalar, orman altı, yol kenarı, 1000 m.
13- Çayır Tepe-Ak Kayalar orman açıklığı , yol kenarı, 1000 m.
14- Ak Kayalar- Güzelyayla Köyü, yol kenarı, 950 m.
15- Güzelyayla köyü yolu üzeri, yol kenarı, 950 m.

Kısaltmalar	**Açıklama**
Akd.	Akdeniz elementi
Avr.-Sib.	Avrupa-Sibirya elementi
İr.Tur.	İran-Turan elementi
End.	Endemik
GAZI	Gazi Üniversitesi Herbaryumu
IUCN	Dünya Koruma Birliği
EN	Tehlikede
LC	En az tehdit altında
m	Metre
mm	Milimetre
MD	Münevver Demirbaş
subsp.	Alttür
var.	Varyete.

3. Bulgular

Bitki Listesi

PTERIDOPHYTA

EQUISETACEAE
Equisetum hyemale L., 1, 12.04.2003, MD 1185.
E. ramosissimum Desf., 1, 27.06.2003, MD 1212.
E. arvense L., 1, 12.04.2003, MD 1189.

ASPIDIACEAE
Dryopteris filix-mas (L.) Schoot, 9, 08.08.2002, MD 1124.

GYMNOSPERMAE

PINACEAE
Abies nordmanniana (Stev.) Spach subsp. **bornmuelleriana** (Mattf.) Coode & Cullen, 2, 09.08.2002, MD 1148. **End., LC,** Avr.- Sib.

Pinus nigra J.F.Arnold. subsp. **nigra** var. **caramanica** (Loudon) Rehder, 4, 14.07.2003, MD 1303.
P. sylvestris L., 4, 28.06.2003, MD 1303. Av.-Sib. El.
TAXACEAE
Taxus baccata L., 4, 14.07.2003, MD 1305.

CUPRESSACEAE
Juniperus oxycedrus L. subsp. **oxycedrus**, 4, 14.07.2003, MD 1304.

ANGIOSPERMAE

DICOTYLEDONAE

RANUNCULACEAE
Hellaborus orientalis Lam., 2, 09.05.2003, MD 1190, Avr.-Sib.
Anemone blanda Schott & Kotschy, 7, 12.04.2003, MD 1184.
Clematis vitalba L., 13, 14.07.2003, MD 1320.
Thalictrum foetidum L., 11, 27.06.2003, MD 1258, Avr.-Sib.
T. lucidum L.,2, 07.10.2002, MD 1162.
Ranunculus cappadocicus Willd.,3, 30.06.2002, MD 1087.
R. villosus DC. subsp. **constantinopolitanus** (DC.) Elenevsky 3, 09.05.2003, MD 1174.
R. ficaria L. subsp. **calthifolius** (Reichb.) Arc., 10, 09.05.2003, MD 1193.

BERBERIDACEAE
Berberis vulgaris L., 1, 14.07.2003, MD 1326.
B. crataegina DC. , 2, 08.08.2002, MD 1112.
Epimedium pubigerum (DC.) Moren et Decaisne, 4, 29.06.2002, MD 1066.

PAPAVERACEAE
Corydalis integra Barbey & Major 4, 09.05.2003, MD 1197.

CRUCIFERAE (BRASSICACEAE)
Conringia orientalis (L.) Andrz., 3, 30.06.2002, MD 1090.
Lepidium campestre (L.) R. Br., 13, 28.06.2002, MD 1035.
Cardaria draba (L.) Desv. subsp. **draba**, 3, 28.06.2002, MD 1039.
Thlaspi perfoliatum L., 3, 28.06.2002, MD 1010.
Capsella bursa- pastoris (L.) Medik., 1, 28.06.2002, MD 1005.
Alyssum repens Baumg. var. **stenophyllum** Hal., 13, 28.06.2002, MD 1046.
A. murale Waldst. & Kit. subsp. **murale** var. **murale**, 13, 28.06.2002, MD 1017.
Erophila verna (L.) Chavall. subsp. **verna**, 13, 28.06.2002, MD 1024.
Arabis caucasica Willd. subsp. **caucasica**, 13, 28.06.2002, MD 1033.
Turritis glabra L., 3, 08.08.2002, MD 1143.
Aethionema oppositifolium (Pers.) Hedge,3, 09.05.2003, MD 1192.
Cardamine quinquefolia (Bieb.) Schmalh.,8, 09.05.2003, MD 1194, Avr.- Sib.
C. graeca L.,5, 28.06.2002, MD 1009.
Alliaria petiolata (Bieb.) Cavara & Grande, 13, 28.06.2002, MD 1034.
Descurainia sophia (L.) Webb ex Prantl, 3, 30.06.2002, MD 1078.

CISTACEAE
Helianthemum nummularium (L.) Miller subsp. **nummularium**, 8, 27.06.2003, MD 1229.

VIOLACEAE
Viola odorata L., 13, 07.10.2002, MD 1177.

POLYGALACEAE
Polygala supina Schreb., 3, 31.06.2002, MD 1094.
P. anatolica Boiss. & Heldr., 8, 27.06.2003, MD 1229.

CARYOPHYLLACEAE
Minuartia anatolica (Boiss.) Woron. var. **polymorpha** McNeill,7, 27.06.2003, MD 1274.
Cerastium anomalum Waldst. & Kit., 8, 27.06.2003, MD 1224.
Dianthus calocephalus Boiss., 5, 15.07.2003, MD 1333.
Silene italica (L.) Pers., 3, 27.06.2003, MD 1230.
S. vulgaris (Moench) Garcke var. **vulgaris**, 7, 27.06.2003, MD 1253.

POLYGONACEAE
Rumex acetosella L.,1, 28.06.2003 MD 1292.
R. crispus L., 7, 28.06.2002 MD 1020.
R. obtusifolius L. subsp. **subalpinus** (Schur) Celak., 5, 27.06.2003 MD 1214.

CLUSIACEAE (GUTTIFERAE)
Hypericum androsaemum L.,7, 28.06.2003, MD 1289, Avr.- Sib.
H. bithynium Boiss., 7, 27.06.2003, MD 1262, Avr.- Sib.
H. perforatum L., 13, 30.06.2002, MD 1081.

MALVACEAE
Malva alcea L.,5, 27.06.2003, MD 1221.

LINACEAE
Linum flavum L. subsp. **scabrinerve** (P.H.Davis) P.H.Davis, 13, 08.08.2002, MD 1113, **End., LC**

GERANIACEAE
Geranium purpureum Vill.,3, 29.06.2002, MD 1053.
G. divaricatum Ehrh.,6, 31.06.2002, MD 1093.
G. pyrenaicum Burm. fil., 5, 30.06.2002, MD 1085.
Erodium cicutarium (L.) L' Herit subsp. **cicutarium**, 3, 09.05.2003, MD 1190a.

RUTACEAE
Dictamnus albus L., 4, 27.06.2003, MD 1277.

ACERACEAE
Acer platonoides L.,5, 27.06.2003, MD 1280, Avr.- Sib.
A. campestre L. subsp. **campestre**, 4, 27.06.2003, MD 1278.

STAPHYLLACEAE
Staphyllea pinnata L., 13, 07.08.2003, MD 1114.

RHAMNACEAE
Paliurus spina-christii Miller, 13, 08.08.2002, MD 1144, Avr.- Sib.

AQUIFOLIACEAE
Ilex colchica Poj., 5, 30.06.2002, MD 1086Avr.- Sib.

FABACEAE (LEGUMINOSAE)

Genista tinctoria L., 1, 15.07.2003, MD 1350, Avr.- Sib.
Galega officinalis L., 5, 29.06.2002, MD 1068,Avr.- Sib.

Astragalus glycyphyllos L. subsp. **glycyphyllos,** 3, 27.06.2003, MD 1247.
Vicia cracca L. subsp. **stenophylla** Vel., 3, 27.06.2002, MD 1234.
V. truncatula Fischer ex Bieb., 5, 28.06.2003, MD 1298, Avr.- Sib.
Lathyrus pratensis L., 6, 27.06.2003, MD 1215, Avr.- Sib.
Ononis spinosa L. subsp. **leiosperma** (Boiss.) Sirj., 6, 12.04.2003, MD 1191.
Trifolium repens L. var. **repens**, 7, 29.06.2002, MD 1061.
T. campestre Schreb, 3, 30.06.2002, MD 1029.
T. pratense L. var. **pratense,** 10, 08.08.2002, MD 1133.
Melilotus officinalis (L.) Desr., 3, 31.06.2002, MD 1100.
Medicago sativa L. subsp. **sativa,** 3, 27.06.2003, MD 1281.
Dorycnium graecum (L.) Ser., 3, 08.08.2002, MD 1109, Avr.- Sib.
D. pentaphyllum Scop. subsp. **anatolicum** (Boiss.) Gams, 5, 30.06.2002, MD 1072.
D. pentaphyllum Scop. subsp. **herbaceum** (Vill.)Rouy,7, 27.06.2003, MD 1252.
Lotus corniculatus L. var. **corniculatus**,10, 28.06.2002, MD 1004.
Coronilla varia L. subsp. **varia**, 7, 27.06.2003, MD 1267.

ROSACEAE
Laurocerasus officinalis Roemer,2, 09.05.2003, MD 1207.
Prunus divericata Ledeb. subsp. **divericata**, 1, 07.10.2002, MD 1150.
Filipendula vulgaris Moench., 1, 28.06.2002, MD 1036, Avr.- Sib.
Rubus hirtus L., 15, 27.06.2003, MD 1302, Avr.- Sib.
Potentilla argentea L.,11, 27.06.2003, MD 1264.
P. recta L. *Grup B.*, 1, 28.06.2002, MD 1030.
P. reptans L., 14, 07.10.2002, MD 1163.
Fragaria vesca L., 11, 27.06.2003, MD 1250.
Geum urbanum L., 8, 28.06.2003, MD 1291, Avr.- Sib.
Agrimonia eupatoria L., 5, 28.06.2002, MD 1028.
Sangiosorba minor Scop. subsp. **muricata** (Spach) Briq., 10, 27.06.2003, MD 1244.
Alchemilla monticola Opiz,14, 27.06.2003, MD 1243, Avr.- Sib.
Rosa foetida J. Herrm.,1, 30.06.2002, MD 1075.
R. canina L., 5, 30.06.2002, MD 1077.
Mespilus germanica L., 14, 27.06.2003, MD 1286, Avr.- Sib.
Pyracantha coccinea Roemer, 3, 28.06.2002, MD 1019.
Crataegus pentagyna Waldst. & Kit., 5, 12.04.2003, MD 1183, Avr.- Sib.
C. monogyna Jacq. subsp. **monogyna,** 5, 31.06.2002, MD 1102.
Cydonia oblonga Miller, 14, 08.08.2002, MD 1136.
Pyrus elaeagnifolia Pallas subsp. **elaeagnifolia**, 15, 08.08.2003, MD 1132.

ONOGRACEAE
Epilobium angustifolium L., 3, 30.06.2002, MD 1084, Avr.- Sib.
E. hirsutum L., 1, 08.08.2002, MD 1108.

CRASSULACEAE
Sedum acre L., 7, 27.06.2003, MD 1261.
Sedum pallidum Bieb.var. **pallidum,** 7, 27.06.2003, MD 1255.
S. pallidum Bieb. var. **bithynicum** (Boiss.) Chamberlain, 7, 31.06.2002, MD 1096, Avr.- Sib.

SAXIFRAGACEAE
Saxifraga rotundifolia L., 5, 27.06.2003, MD 1273, Avr.- Sib.

APIACEAE (UMBELLIFERAE)
Sanicula europaea L., 1, 27.06.2003, MD 1239, Avr.- Sib.
Eryngium campestre L. var. **virens** L., 6, 15.07.2003, MD 1356.
Anthriscus nemorosa (Bieb.) Sprengel, 11, 27.06.2003, MD 1251.
Scandix pecten- veneris L., 3, 28.06.2003, MD 1296.
Sium sisarum L. var. **lancifolium** (Bieb.) Thell., 9, 08.08.2002, MD 1123.
Pastinaca sativa L. subsp. **urens** (Req. ex Godron) Celak., 5, 08.08.2002, MD 1118.
Heracleum platytaenium Boiss., 2, 08.08.2002, MD 1115, **End., LC,** Avr.- Sib.
Daucus carota L., 2, 08.08.2002, MD 1121.

CORNACEAE
Cornus sanguinea L. subsp. **australis** (C. A. Meyer) Jav., 13, 28.06.2003, MD 1297, Avr.- Sib.

CAPRIFOLIACEAE
Sambucus nigra L., 7, 28.06.2002, MD 1040, Avr.- Sib.
Viburnum lantana L., 5, 07.10.2002, MD 1158, Avr.- Sib.
Lonicera caucasica Pallas subsp. **orientalis** (Lam.) Chamb. & Long., 7, 27.06.2003, MD 1246, **End., LC**

RUBIACEAE
Asperula involucrata Wahlenb.,7, 28.06.2003, MD 1260, Avr.- Sib.
Galium rotundifolium L., 5, 28.06.2003, MD 1275, Avr.- Sib.
G. verum L., subsp. **verum**, 9, 07.10.2002, MD 1160, Avr.- Sib.
Cruciata laevipes Opiz., 7, 28.06.2002, MD 1032, Avr.- Sib.

VALERIANACEAE
Valeriana alliariifolia Adams, 5, 31.06.2002, MD 1101.

DIPSACACEAE
Dipsacus laciniatus L., 15, 29.06.2002, MD 1067.

ASTERACEAE (COMPOSITAE)
Inula vulgaris (Lam.) Trevisan, 13, 28.07.2003, MD 1382, Avr.- Sib.
Pulicaria dysenterica (L.) Bernh., 2, 08.08.2002, MD 1119.
Erigeron acer L. subsp. **pycnotrichus** (Viert.) Grierson, 3, 08.08.2002, MD 1116, Avr.- Sib.
Helichrysum graveolens L. (Bieb.) Sweet,10, 28.06.2002, MD 1001.
Conyza bonariensis (L.) Cronquist, 1, 08.08.2002, MD 1141.
Bellis perennis L., 10, 09.05.2003, MD 1180, Avr.- Sib.
Doronicum orientale Hoffm., 4, 28.06.2003, MD 1283.
Senecio vernalis Waldts. & Kit., 3, 27.06.2003, MD 1235.
Tussilago farfara L., 8, 29.06.2002, MD 1059, Avr.- Sib.
Petasites albus (L.) Gaertner, 9, 09.05.2003, MD 1202.
P. hybridus (L.) Gaertner, 12, 27.06.2003, MD 1270, Avr.- Sib.
Eupatorium cannabinum L., 5, 08.08.2002, MD 1106, Avr.- Sib.
Anthemis tinctoria L. var. **pallida** DC., 10, 29.06.2002, MD 1065.
A. tinctoria L. var. **tinctoria** DC., 3, 28.07.2003, MD 1390.
Achillea setacea Waldst. & Kit., 13, 17.07.2003, MD 1322, Avr.- Sib.

Tanacetum parthenium (L.) Schultz Bip., 5, 30.06.2002, MD 1092.
Tripleurospermum oreades (Boiss.) Rech. fil var. **oreades**, 5, 27.06.2003, MD 1200.
Arctium minus (Hill) Bernh. subsp. **pubens** (Babington) Arènes, 13, 08.08.2002, MD 1105.
Cirsium lappaceum (Bieb.) Fischer subsp. **lappaceum,**13, 08.08.2002, MD 1110.
C. vulgare (Savi) Ten., 10, 08.08.2002, MD 1107.
C. hypoleucum DC., 12, 30.06.2002, MD 1098, Avr.- Sib.
C. arvense (L.) Scop. subsp. **vestitum** (Wimmer & Grab.) Petrak, 7, 28.06.2000, MD 1027.
Carduus nutans L.subsp. **nutans** sensu lato, 13, 08.08.2002, MD 1120.
Centaurea salisifolia Bieb. ex Willd. subsp. **salisifolia,** 13, 09.08.2002, MD 1125.
C. solsitialis L. subsp. **solsitialis**, 3, 15.07.2003, MD 1340.
C. iberica Trev. ex Sprengel, 1, 08.08.2002, MD 1051.
C. urvillei DC. subsp. **stepposa** Wagenitz, 3, 14.07.2003, MD 1312, İr.-Tur.
Xeranthemum cylindraceum Sm., 3, 28.07.2003, MD 1391.
Cichorium intybus L., 3, 28.07.2003, MD 1384.
Leonthodon crispus Vill. subsp. **asper** (Waldst. & Kit.) Rohl. var. **asper**, 2, 27.06.2003, MD 1266.
Pilosella hoppeana (Schultes) C. H. & F. W. Schultz subsp. **testimonialis** (Naegli ex Peter) Sell & West, 7, 27.07.2003, MD 1242, Avr.-Sib.
P. piloselloides (Vill.) Sojak subsp. **megalomastix** (NP.) Sell & West, 10, 28.06.2002, MD 1002.
Lapsana communis L. subsp. **alpina** (Boiss. & Bal.) Sell., 17, 27.06.2002, MUÖ 1134, Avr.-Sib.
Taraxacum microcephaloides Van Soest,3, 29.06.2002, MD 1058.
T. serotinum (Waldst. & Kit.) Poiret, 13, 07.10.2002, MD 1157.

CAMPANULACEAE
Campanula latifolia L., 4, 05.05.2002, 30.06.2002, MD 1076, Avr.-Sib.
C. rapunculoides L. subsp. **rapunculoides**, 2, 07.10.2002, MD 1161, Avr.-Sib.
C. glomerata L. subsp. **hispida** (Witasek) Hayek, 5, 27.06.2003, MD 1222, Avr.-Sib.
C. latiloba A. DC. subsp. **latiloba**, 1, 28.06.2002, MD 1050, **End., LC,** Avr.-Sib.

ERICACEAE
Rhododendron luteum Sweet., 4, 09.05.2003, MD 1203, Avr.-Sib.
R. ponticum L. subsp. **ponticum**, 2, 09.05.2003, MD 1206, Avr.-Sib.
Vaccinium arctostaphylos L., 5, 28.06.2003, MD 1295, Avr.-Sib.

PRIMULACEAE
Primula vulgaris Hudson subsp. **sibthorpii** (Hoffmanns.) W.W.Sm.& Forrest,3, 09.05.2003, MD 1198.
Lysimachia verticillaris Sprengel, 3, 29.06.2002, MD 1064, Avr.-Sib.

OLEACEAE
Fraxinus excelsior L. subsp. **excelsior**, 4, 07.10.2002, MD 1164, Avr.-Sib.
F. angustifolia Vahl. subsp. **angustifolia**, 4, 15.07.2003, MD 1353.

GENTIANACEAE
Gentiana cruciata L., 9, 28.06.2002, MD 1014.

CONVOLVULACEAE
Convolvulus arvensis L., 13, 28.06.2002, MD 1038.
Calystegia silvatica (Kit.) Griseb., 13, 28.06.2002, MD 1049.

BORAGINACEAE
Myosotis ramosissima Rochel ex Schultes subsp. **ramosissima**, 7, 28.06.2002, MD 1007.
M. alpestris F.W. Schmidt subsp. **alpestris**, 7, 27.06.2003, MD 1225.
Cynoglossum officinale L., 5, 28.06.2003, MD 1276, Avr.-Sib.
C. montanum L., 8, 28.06.2003, MD 1282, Avr.- Sib.
Lithospermum officinale L., 7, 29.06.2002, MD 1060, Avr.- Sib.
Echium vulgare L., 7, 28.06.2002, MD 1023, Avr.- Sib.
Symphytum orientale L., 8, 14.07.2003, MD 1327, Avr.-Sib.
Trachystemon orientalis (L.) G. Don., 7, 28.06.2002, MD 1195, Avr.- Sib.
Anchusa leptophylla Roemer & Schultes subsp. **leptophylla**, 25, 27.06.2003, MD 1236.
SOLANACEAE
Solanum dulcamara L., 2, 28.07.2003, MD 1392, Avr.- Sib.
Atropa bella-donna L., 5, 28.06.2003, MD 1293, Avr.- Sib.

SCROPHULARIACEAE
Verbascum ponticum (Boiss.) O. Kuntze, 7, 28.06.2003, MD 1300, **End., EN,** Avr.- Sib.
V. oreophilum C. Koch var. **oreophilum**, 3, 28.06.2003, MD 1288, İr.-Tur.
V. spectabile Bieb. var. **isandrum** Hub.- Mor., 10, 27.06.2003, MD 1227, **End., EN,** Avr.- Sib.
V. cheiranthifolium Boiss. var. **cheiranthifolium**, 7, 28.06.2003, MD 1299.
Scrophularia scopolii [Hoppe ex] Pers. var. **scopolii,** 1, 29.06.2002, MD 1056.
Digitalis ferruginea L. subsp. **ferruginea**, 4, 07.10.2002, MD 1149, Avr.- Sib.
Veronica persica Poiret., 13, 09.05.2003, MD 1176.
V. anagallis-aquatica L., sensu lato, 1, 28.06.2002, MD 1042.
V. chamaedrys L.,2, 28.06.2002, MD 1047, Avr.- Sib.
V. officinalis L.,7, 28.06.2002, MD 1021, Avr.- Sib.
Euphrasia pectinata Ten.,5, 09.05.2003, MD 1199.

OROBANCHACEAE
Orobanche caryophyllacea Smith, 12, 14.07.2003, MD 1351.

GLOBULARIACEAE
Globularia trichosantha Fisch. & Mey., 3, 14.07.2003, MD 1306.

LABIATAE (LAMIACEAE)
Ajuga reptans L., 5, 20.04.2002, 27.06.2003, MD 1233, Avr.- Sib.
A. chamapitys (L.) Schreber subsp**. chia** (Schreber) Murb. var. **chia,** 2, 07.08.2002, MUÖ 1290
Teucrium chamaedrys L. subsp. **chamaedrys**, 3, 28.07.2003, MD 1401, Avr.- Sib.
T. polium L., 13, 14.07.2003, MD 1308.
Lamium garganicum L. subsp. **reniforme** (Montbret & Aucher ex Bentham) R.Mill, 7, 28.06.2003, MD 1257.

L. purpureum L. var. **purpureum,** 3, 09.05.2003, MD 1173, Avr.- Sib.
Sideritis germanicopolitana Bornm. subsp. **viridis** Hauuskn. ex Bornm., 11, 28.07.2003, MD 1397, **End., LC**
Stachys thirkei C. Koch., 3, 31.06.2002, MD 1131.
S. sylvatica L., 3, 30.06.2002, MD 1091, Avr.- Sib.
S. officinalis (L.) Trevisan subsp. **officinalis**, 9**,** 08.08.2002, MD 1142, Avr.- Sib.
S. annua (L.) L. subsp. **annua** var. **annua**, 7, 25.06.2003, MD 1335.
Prunella vulgaris L., 7, 30.06.2002, MD 1071, Avr.- Sib.
P. laciniata (L.) L.,7, 28.06.2002, MD 1008, Avr.- Sib.
Calamintha grandiflora (L.) Moench, 1, 31.06.2002, MD 1095, Avr.- Sib.
Clinopodium vulgare L. subsp. **vulgare**, 3, 31.06.2002, MD 1139, Avr.- Sib.
Mentha longifolia (L.) Hudson subsp. **typhoides** (Briq.) Harley var. **typhoides**, 3, 31.06.2002, MD 1122
Salvia forskahlei L., 1, 28.06.2002, MD 1015, Avr.- Sib.
S. verbeneca L.,10, 31.06.2002, MD 1127.
S. virgata Jacq., 13, 28.07.2003, MD 1400.
S. verticillata L. subsp. **amasiaca** (Freyn & Bornm.) Bornm., 10, 27.06.2003, MD 1287, Ir.- Tur.

PLANTAGINACEAE
Plantago major L. subsp. **major**, 15, 29.06.2002, MD 1062.

THYMELAEACEAE
Daphne pontica L., 12, 09.05.2003, MD 1205, Avr.- Sib.

LAURACEAE
Laurus nobilis L., 5, 09.05.2003, MD 1204, Akd.

EUPHORBIACEAE
Euphorbia stricta L., 8, 29.06.2002, MD 1052, Avr.- Sib.
E. macroclada Boiss., 7, 28.06.2003, MD 1259.
E. amygdaloides L. var. **amygdaloides**, 15, 09.05.2003, MD 1208, Avr.- Sib.

URTICACEAE
Urtica dioica L., 15, 27.06.2003, MD 1279, Avr.- Sib.
JUGLANDACEAE
Juglans regia L., 15, 29.07.2003, MD 1410.

PLATANACEAE
Platanus orientalis L., 15, 29.07.2003, MD 1408.

FAGACEAE
Fagus orientalis Lipsky, 15, 07.10.2002, MD 1153, Avr.- Sib.
Castanea sativa Miller, 15, 07.10.2002, MD 1170, Avr.- Sib.
Quercus robur L. subsp. **robur**, 4, 28.06.2003, MD 1301, Avr.- Sib.
Q. pubescens Willd., 15, 07.10.2002, MD 1166.

CORYLACEAE
Carpinus betulus L., 15, 07.10.2002, MD 1171, Avr.- Sib.
Corylus colurna L., 16, 07.10.2002, MD 1168, Avr.- Sib.

BETULACEAE
Alnus glutinosa (L.) Gaertner subsp. **glutinosa**, 15, 07.10.2002, MD 1167, Avr.- Sib.

CORNACEAE
Cornus sanguinea L. subsp. **australis** (C. A. Meyer) Jáv.,15, 07.10.2002, MD 1169, Avr.- Sib.

SALICACEAE
Salix alba L., 14, 15.07.2003, MD 1360, Avr.- Sib.
Populus tremula L., 14, 15.07.2003, MD 1357, Avr.- Sib.
P. nigra L. subsp. **nigra**, 14, 15.07.2003, MD 1361

MONOCOTYLEDONAE

LILIACEAE
Smilax excelsa L., 07.10.2002, MD 1165, Avr.- Sib.
Polygonatum multiflorum (L.) All., 5, 27.06.2003, MD 1240.
Scilla bithynica Boiss., 4, 09.05.2003, MD 1196, Avr.- Sib.
Ornithogalum narbonense L.,1, 27.06.2003, MD 1217, Doğu Akd.
O. fimbriatum Willd., 1, 12.04.2003, MD 1181, Doğu Akd.
Muscari armeniacum Leichtlin ex Baker , 7, 12.04.2003, MD 1188, İr.-Tur.
M. neglectum Guss.,10, 09.05.2003, MD 1201.
Lilium martogon L., 5, 09.05.2003, MD 1209, Avr.- Sib.
Colchicum szovitsii Fisch. & Mey., 1, 12.04.2003, MD 1182, İr.-Tur.

AMARYLLIDACEAE
Galanthus plicatus Bieb. subsp. **byzantinus** (Baker) D. A. Webb., 1, 27.06.2003, MD 1210, Avr.- Sib.

IRIDACEAE
Iris sintenisii Janka, 1, 31.06.2002, MD 1099, Avr.- Sib.
Crocus ancyrensis (Herbert) Maw, 1, 12.04.2003, MD 1187, **End., LC,** İr.-Tur.
C. speciousus Bieb. subsp. **speciousus,**1, 07.10.2002, MD 1151.

ORCHIDACEAE
Orchis palustris Jacq., 5, 27.06.2003, MD 1232.
Dactylorhiza urvilleana (Steudel) Baumann & Kürkele, 3, 14.07.2003, MD 1318, Avr.- Sib.

JUNCACEAE
Juncus inflexus L., 2, 26.06.2003, 08.08.2002, MD 1216.

CYPERACEAE
Cyperus glaber L., 5, 26.06.2003, MD 1237.
Carex divulsa Stokes subsp. **divulsa**, 1, 28.06.2002, MD 1011, Avr.- Sib.
C. acutiformis Ehrh., 4, 30.06.2002, MD 1089, Avr.- Sib.
C. pendula Hudson, 1, 08.08.2002, MD 1130, Avr.- Sib.

GRAMINEAE (POACEAE)
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Elymus repens (L.) Gould subsp. **repens**, 10, 28.06.2003, MD 1271.
Hordeum bulbosum L., 5, 27.06.2003, MD 1037.
Bromus arvensis L., 3, 12.08.2003, MD 1470.
Koeleria cristata (L.) Pers., 13, 12.08.2003, MD 1505.
Phleum alpinum L., 13, 12.08.2003, MD 1510, Avr.- Sib.
Festuca drymeja Mertens & Koch, 3, 12.08.2003, MD 1490, Avr.- Sib.
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Calamagrostis pseudophragmites (Haller fil.) Koeler, 1, 08.08.2002, MD 1135, Avr.- Sib.
Lolium perenne L., 5, 28.06.2002, MD 1025, Avr.- Sib.
L. rigidum Gaudin var. **rigidum**, 5, 29.06.2002, MD 1057.
Poa trivialis L., 5, 27.06.2003, MD 1213.
P. pratensis L., 5, 27.06.2003, MD 1026.
P. angustifolia L., 1, 29.06.2002, MD 1063, Avr.- Sib.

P. bulbosa L., 13, 12.08.2003, MD 1499.
P. nemoralis L., 1, 27.06.2003, MD 1083.
Dactylis glomerata L. subsp. **hispanica** (Roth.) Nyman, 2, 28.06.2002, MD 1022.
Cynosurus cristatus L., 13, 12.08.2003, MD 1504, Avr.-Sib.
Briza media L., 13, 27.06.2003, MD 1218.
Melica ciliata L., subsp. **ciliata,** 1, 28.06.2003, MD 1254.

4. Sonuçlar ve tartışma

Çalışma alanında orman, çalı, çayır ve kaya vejetasyonu yaygındır. Özellikle orman vejetasyonu baskındır ve alanın büyük bir kısmında hakimdir. 2002-2003 yılları arasında alanda yapılan arazi çalışmaları sırasında 600 bitki örneği toplanmıştır. Toplanan örneklerin değerlendirilmesi sonucunda 66 familya, 198 cins, tür ve tür altı seviyede 277 takson tespit edilmiştir. 277 taksonun 4 tanesi *Pteridophyta* ve 273 tanesi *Spermatophyta*'ya dahildir. *Gymnospermae*'ler 5 takson ile temsil edilirken, *Angiospermae'*ler ise 268 taksona sahiptir. Çalışma alanından 9 tane endemik takson tespit edilmiş olmakla birlikte endemizm oranı %3,24'dür. Araştırma alanı ve yakın alanların endemizm oranları Tablo1'de verilmiştir.

Tablo 1. Çalışma alanı ile alana yakın diğer çalışma alanlarının endemizm oranları (%)
Table 1. The endemism ratio of studied area and its around

	Araştırma Alanları				
	1	2	3	4	5
Endemizm Oranları (%)	3,24	7,71	7,17	10,67	5,94
Endemik Takson Sayısı	9	33	44	67	30
Toplam Takson Sayısı	277	428	613	628	505

1. *M. Demirbaş*- Armutluçayır Florası (Kastamonu)
2. *M. U. Özbek*- Kurtgirmez Dağı ve Çatak Kanyonu (Kastamonu) Florası
3. *O. Ketenoğlu*- Batı Küre Dağları (Kastamonu-İnebolu-Cide) Florasına Katkılar
4. *S. Aslan*- Kıbrıs Köyü Vadisi (Mamak-Ankara) Florası
5. *C. Türe*- Yirce-Bürmece-Kömürsu ve Muratdere (Bilecik-Bursa) Orman Serilerinin Florası

Endemizm oranı en fazla S. Aslan' da (%10,67), M.U. Özbek'de (%7,71) ve O. Ketenoğlu ile K. Güney'de (%7,17) görülmüştür. En düşük endemizm oranı alanımızda görülmüştür. Bu oranın düşük olmasının en önemli sebebi, çalışma alanının dahil olduğu Avrupa-Sibirya Fitocoğrafik bölgesinin ülkemizde bulunan diğer fitocoğrafik bölgelere oranla daha az endemik bitki türü bulundurmasındandır. Ayrıca çalışma alanında diğer alanlarda görülen farklı habitat tiplerinin olmaması da etkendir.

Araştırma alanından tesbit edilen taksonların fitocoğrafik bölgelere dağılımı şöyledir: 103'ü Avrupa-Sibirya (%37,18), 6'sı İran-Turan (%2,16), 3'ü Akdeniz (%1,08). Euxin ve Hirkano Öksin Avrupa-Sibirya' ya, Doğu Akdeniz elementleri ise Akdeniz elementleri içine dahil edilmiştir. Diğerleri (%59,58) ya geniş yayılışlı ya da yayılış alanları belirsizdir (Tablo 2). Çalışma alanından toplanan endemik bitkilerin tehlike kategorileri Türkiye bitkileri Kırmızı Kitabı ve IUCN kriterleri göz önünde bulundurularak değerlendirilmiştir (Tablo 3) (Ekim ve ark., 2000; IUCN, 2001).

Tablo 2. Çalışma alanına ait fitocoğrafik bölge elementlerinin yakın bölgedeki çalışmalar ile karşılaştırılması (%).
Table 2. A comparison of the phytogeographical elements between studied area and neighbouring areas

	Araştırma Alanları				
Bitki Coğrafyası Bölgeleri	1	2	3	4	5
Avrupa-Sibirya	37,18	31,55	41,8	10,5	15,7
İran-Turan	2,16	5,33	8	19,74	7,3
Akdeniz	1,08	3,71	14,3	8,12	10,5
Belirlenemeyenler veya çok bölgeli olanlar	59,58	59,41	35,9	61,64	66,5

Tablo 3. Alandaki endemik taksonların tehlike sınıflarına göre dağılımı
Table 3. According to risk categories, the distribution of endemic taxa

Takson	**IUCN Kategorisi**
Verbascum spectabile var. *isandrum*	EN
Verbascum ponticum	EN
Abies nordmanniana subsp. *bornmuelleriana*	LC
Linum flavum subsp. *scabrinerve*	LC
Heracleum platytaenium	LC
Lonicera caucasica subsp. *orientalis*	LC
Campanula latiloba subsp. *latiloba*	LC
Sideritis germanicopolitana subsp. *viridis*	LC
Crocus ancyrensis	LC

Çalışma alanında en çok cins içeren familyalar; *Compositae*, *Rosaceae*, *Gramineae*, *Cruciferae* ve *Leguminosae* 'dür (Tablo 4).

Tablo 4. En çok cins içeren familyalar ve oranları (%)
Table 4. The families containing the highest number of genus and its rate (%)

Familya	Cins Sayısı	Toplam Cins Sayısına Oranı (%)
Compositae	25	12,62
Rosaceae	16	8,08
Gramineae	14	7,07
Cruciferae	13	6,56
Leguminosae	12	6,06

Çalışma alanında en fazla tür içeren familyalar; *Compositae*, *Rosaceae*, *Labiatae*, *Gramineae*, *Leguminosae*' dür (Tablo 5).

Tablo 5. En çok tür içeren familyalar ve oranları (%)
Table 5. The families containing the highest number of species and its rate (%)

Familya	Tür Sayısı	Toplam Tür Sayısına Oranı (%)
Compositae	35	12,63
Rosaceae	20	7,22
Labiatae	20	7,22
Gramineae	20	7,22
Leguminosae	17	6,13

Poa, Verbascum, Veronica, Stachys, Cirsium, Centaurea, Campanula, Salvia, Ranunculus, Trifolium, Rumex, Euphorbia, Hypericum, Geranium, Dorycnium, Potentilla, Sedum ve *Carex* araştırma alanında en fazla türe sahip cinslerdir (Tablo 6).

Tablo 6. En çok tür içeren cinsler ve oranları (%)
Table 6. The genera containing the highest number of species and its rate (%)

Cins	Tür Sayısı	Toplam Tür Sayısına Oranı (%)
Poa	5	2,52
Verbascum	4	2,02
Veronica	4	2,02
Stachys	4	2,02
Cirsium	4	2,02
Centaurea	4	2,02
Campanula	4	2,02
Salvia	4	2,02
Ranunculus	3	1,51
Trifolium	3	1,51
Rumex	3	1,51
Euphorbia	3	1,51
Hypericum	3	1,51
Geranium	3	1,51
Dorycnium	3	1,51
Potentilla	3	1,51
Sedum	3	1,51
Carex	3	1,51

Çalışma alanından toplanan bazı türler Türkiye'deki genel yayılışları, bulundukları habitatlar, flora da belirtilen özelliklerle olan farklılıkları açısından ilginçtir. Bu türler ve özellikleri şunlardır:

Stachys officinalis (L.) Trevisan subsp. *officinalis* türünün alanımızda toplanan bireylerinin yaprak eninin daha uzun olması ile farklılık göstermiştir. Florada türün yaprak eninin 4-5 cm olması gerekirken, bizim örneğimizin 5,5-6 cm olduğu ve Avrupa florasına bakınca bu farklılığın çok önemli olmadığı gözlenmiştir. Türün diğer morfolojik özelliklerinde bir farklılık yoktur.

Alandan tespit edilen ve Türkiye Florasında endemik olan *Verbascum oreophilum* C. Koch var. *oreophilum* taksonu Rusya Florası'nda (41) bulunduğundan çalışmamızda endemik olarak değerlendirilmemiştir. (Schischkin ve Bobrov, 1955-1959). *Arctium minus* (Hill) Bernh. subsp. *pubens* (Babington) Arènes taksonu A4 karesi için yeni kayıttır.

Sonuç olarak, Batı Karadeniz Bölgesindeki endemizm oranı diğer bölgelere oranla düşüktür. Tehlike kategorilerine bakıldığında endemik olan bazı türlerin gelecekte nesillerinin tehlikede olduğu açıktır. Fakat araştırma alanının Küre Dağları Milli Parkı içerisinde ve "Mutlak Koruma Zonu" nda yer alması sevindiricidir. Flora ve fauna elemanları tamamiyle koruma altındadır. Sadece bilimsel çalışmalarda araziye girme izni verilmektedir.

Teşekkür

Bazı bitkilerin teşhisinde yardımcı olan Prof. Dr. Hayri Duman, Prof. Dr. Zeki Aytaç, Prof. Dr. Murat Ekici, Yard. Doç. Dr. Mehtap Tekşen, Yard. Doç. Dr. Mehmet Erkan Uzunhisarcıklı ve Yard. Doç. Dr. Faik Karavelioğulları'na, çalışma alanına ulaşmamıza verdikleri desteklerinden dolayı T.C. Orman ve Su İşleri Bakanlığı, Doğa Koruma ve Milli Parklar Genel Müdürlüğü'ne ve Dr. İsmail Menteş'e teşekkür ederiz.

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(Received for publication 12 April 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 32-34

Research article/Araştırma makalesi

A new *Peziza* record for Turkish Mycobiota

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Abstract

In the current study, *Peziza ammophila* Durieu & Lév was reported for the first time from Turkey. A short description, ecology, distribution and photographs related to macro and micromorphologies of the taxon are provided.

Key words: *Peziza ammophila*, *Ascomycota*, New record, Turkey

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Türkiye Mikobiyotası için yeni bir *Peziza* kaydı

Özet

Mevcut çalışmada, *Peziza ammophila* Durieu & Lév Türkiye'den ilk defa rapor edilmiştir. Taksonun kısa deskripsiyonu, ekolojisi, yayılışı, makro ve mikromorfolojilerine ait fotoğrafları verilmiştir.

Anahtar kelimeler: *Peziza ammophila*, *Ascomycota*, Yeni kayıt, Türkiye

1. Introduction

Peziza Fr. is the largest genus of the family *Pezizaceae* Dumort with 104 confirmed species (Kirk et al., 2008). The members of the genus produce sessile or stipitate, cup-shaped, cupulate, turbinate, pulvinate, epigeous or semi-hypogeous to hypogeous apothecia in a range of several millimetres to more than 10 centimetres in diameter, cylindrical, operculate and 8 spored asci, elliptical or rounded, smooth or ornamented ascospores. Most of the members are saprotrophs while only a few species are claimed to be ectomycorrhizal (Akata & Kaya 2012; Barseghyan & Wasser, 2011; Hansen & Knudsen, 2000).

During our routine field trips, a deeply cup shaped and brown *Peziza* sp. was collected and identified as *Peziza ammophila* Durieu & Lév. According to current literature on macromycota of Turkey (Solak et al., 2007; Sesli & Denchev, 2008, Akata, 2012; Akata & Kaya, 2012a,b; Akata et al., 2012; Allı et al., 2011; Doğan et al., 2012; Kaya et al., 2012), it has not yet been recorded from Turkey.

This study aims to make a contribution to the macromycota of Turkey.

2. Materials and methods

Peziza samples were collected from Silifke (Mersin) during the field trip on 27 January 2013. Necessary morphological and ecological characteristics of the samples were noted and photographed in their natural habitats. Thereafter the samples were taken to the herbarium for further investigations. Microphotographs were taken under a light microscope (Leica DM 1000). Reagents such as Melzer reagent, 5 % KOH, congo red and cotton blue were used. Identification of the samples were conducted according to their ecologic, macroscopic and microscopic features and performed with the aid of literature (Jordan 2004; Hansen and Knudsen 2000). The identified fungi specimens were deposited at Ankara University Herbarium (ANK).

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 BioDiCon. 304-0213

3. Results

A short description, ecology and distribution, locality, collection date, photographs of apothecia and microphotographs of asci, ascospores and paraphyses of the taxon were given. The systematics of the taxon is in accordance with Mycobank (http://www.mycobank.org/: accessed 1 February 2013).

Ascomycota R.H. Whittaker
Pezizomycetes O.E. Erikss. & Winka
Pezizomycetidae Locq
Pezizales J. Schröt.
Pezizaceae Dumort.
Peziza ammophila Durieu & Lév. (1848)

Syn. *Geopyxis ammophila* Sacc. (1889), *Sarcosphaera ammophila* (Sacc.) Moesz (1912), *Tarzetta ammophila* (Sacc.) Theodor (1936).

Macroscopic and microscopic features:

Apothecia 3-5 cm broad, 4-5 cm tall, stipitate, deeply cup shaped, margin often splitting in to irregular rays, hymenial surface smooth, brownish, yellowish toward the margin, outher surface more pallid, typically covered by sand grains (Figure1.a,b,c). **Flesh** 2-2.5 mm thick, fragile, brittle and brownish. Stem bulb shaped, dusted with sand grains. **Asci** 170-190 × 13-14 µm, cylidrical, eight spored. **Paraphyses** cylindrical (Figure1.d,e). **Ascospores** 15-16 × 8-10 µm, hyaline, smooth, ellipsoid, without guttules, uniseriate (Figure1.f,g).

Ecology: September to October, in small trooping groups in littoral sand dunes, uncommon. (Kutorga & Kataržytė, 2008; Jordan 2004; Hansen & Knudsen 2000).

Specimen examined: TURKEY— Mersin, Silifke, Arkum, in coastal sand dune, sea level, 36°21'33" N, 34°04' 41" E, 27.01.2013, A.E. Yaprak 2013-007.

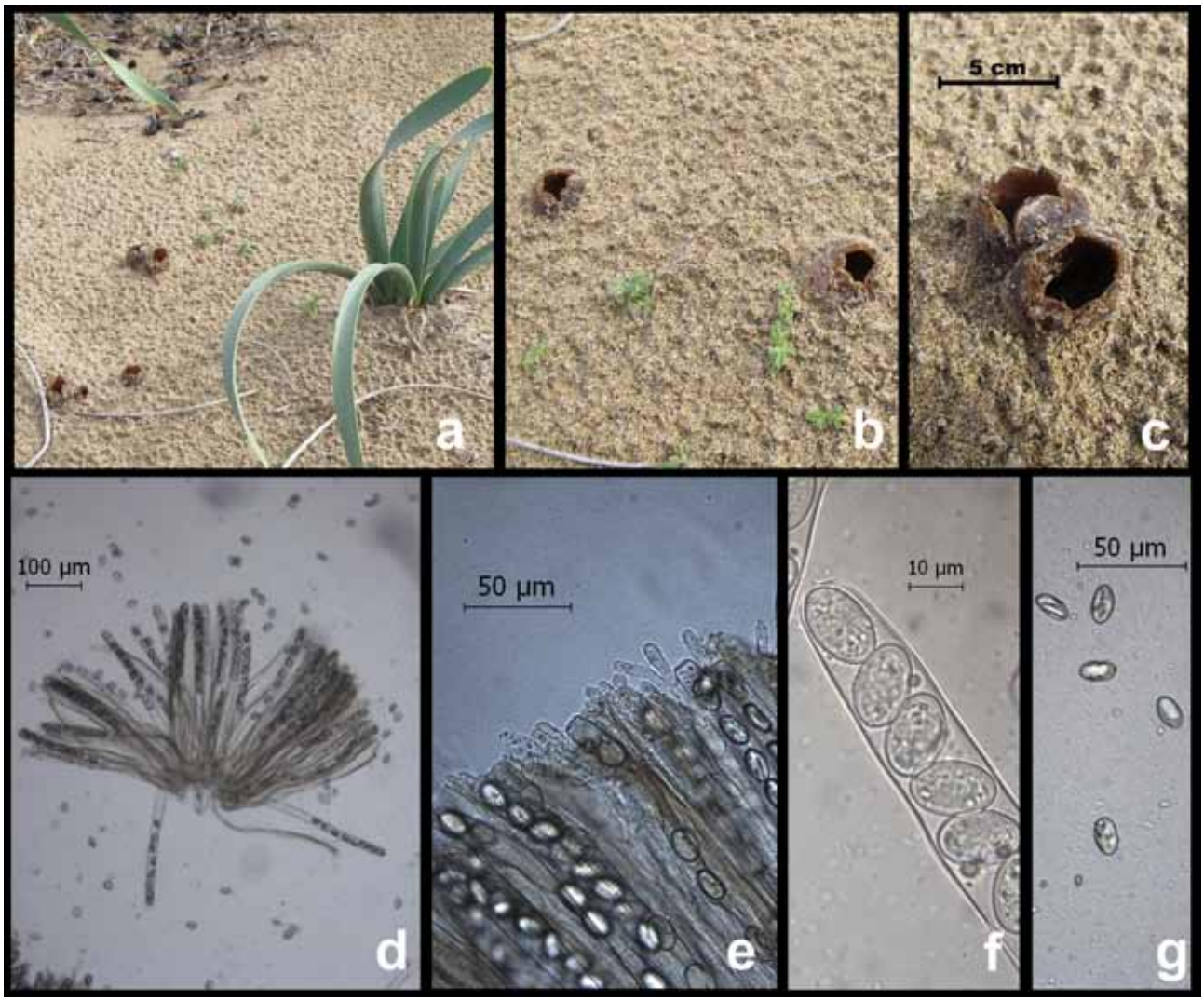

Figure1. *Peziza ammophila*: **a,b,c.** apothecia, **d,e.** asci and paraphyses, **f,g.** ascospores

4. Conclusions

Peziza is an interesting and complicated systematic group. Sometimes it could be very difficult to find clear diagnostic characteristics to define species. Therefore, many *Peziza* members have a rich synonmy because different authors placed some species in different genera. The members of the genus can be separated from each other mainly on the basis of their micromorphology such as ascospore shape, ornamentation, colour, and guttulation; biochemical reaction of the asci; pigmentation of the paraphyses (Akata & Kaya 2012; Barseghyan & Wasser 2011).

Peziza ammophila resembles *Sarcosphaera coronaria* (Jacq.) J. Schröt. macroscopically but the latter species has pinkish, lilac or brown violet hymenium and larger apothecia which grow on soil, under broadleaved and coniferous trees (Arora, 1986; Breitenbach & Kränzlin, 1984). Although it is not easy to identify it in the field due to its hypogeous apotecia, it can easily be distinguished from other *Peziza* species by its brownish, deeply cup shaped apotecia developing underground with only the mouth at ground level and growing in sand, sandy soil or sand dunes (Arora, 1986).

According to the present checklists (Solak et al., 2007; Sesli & Denchev, 2008) and the recent data on Turkish macromycota (Akata, 2012; Akata & Kaya, 2012a,b; Akata et al., 2012; Allı et al., 2011; Doğan et al., 2012; Kaya et al., 2012) 21 *Peziza* species (*P. ampelina* Pass., *P. amphora* Quél., *P. applanata* (Hedw.) Fr., *P. arenaria* Osbeck, *P. arvernensis* Roze & Boud., *P. badia* Pers., *P. cerea* Sowerby : Fr., *P. depressa* Pers., *P. domiciliana* Cooke, *P. erucaeformis* Batsch, *P. granulosa* Schumach., *P. michelii* (Boud.) Dennis, *P. micropus* Pers., *P. moravecii* (Svrček) Svrček, *P. phyllogena* Cooke, *P. repanda* Wahlenb., *P. saniosa* Schrad., *P. succosa* Berk., *P. varia* (Hedw.) Alb. & Schwein., *P. vesiculosa* Bull., *P. violacea* Pers.) have so far been reported from Turkey.

With the current study, *Peziza ammophila* Durieu & Lév. is reported for the first time from Turkey and it will be the twenty second species of Turkish *Peziza*.

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(Received for publication 06 February 2013; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 35-56

Research article/Araştırma makalesi

The Flora of the area located between Salkaya Creek and Dambuyuk Lowland (Elazıg /Turkey)

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Abstract

This research was carried out to determine the flora of district between Salkaya creek and Dambüyük lowland (Elazig Northwest). 3283 plant specimens were collected from the research area, between 2009-2012 years. After identification of the plant samples which were collected in research area, 84 families and 374 genera which belonged to these families and totally 798 taxa were determined as species, subspecies and variety levels. From these, 3 taxa belongs to Pteridophyta, 795 taxa belongs to Spermatophyta division. Coniferophyta and Magnoliophyta subdivisions in Spermatophyta division, include 6 and 789 taxa, respectively. In Magnoliophyta subdivision, 686 taxa were determined in Magnoliopsida and 103 taxa were determined in Liliopsida class. Totally 85 taxa are endemic for Turkey. The endemism ratio of the research area is 10.6 %. 15 taxa were determined as new record for square B7. The distibution of phytogeographic elements are: Irano-Turanian 306 (38.5%), Mediterranean 36 (4.5%) and Euro-Siberian 34 (4.1%).

Key words: Flora, Turkey, Elazig, Endemic, Dambüyük Lowland

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Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Sahanın (Elazığ /Turkey) Florası

Özet

Bu çalışma, Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Sahanın (Elazığ Kuzeybatısı) florasını tespit etmek amacıyla yapılmıştır. 2009-2012 yılları arasında çalışma alanından 3283 bitki örneği toplanmıştır. Alandan toplanan bitki örneklerinin teşhisinden sonra 84 familya ve bu familyalara ait 374 cins ve bu cinslere ait tür, alttür ve varyete seviyesinde toplam 798 takson saptanmıştır. Bu taksonlardan 3 tanesi Pteridophyta, 795 tanesi Spermatophyta bölümlerine aittir. Spermatophyta bölümünde bulunan, Coniferophyta ve Magnoliophyta alt bölümleri ise sırasıyla 6 ve 789 takson içermektedir. Magnoliophyta alt bölümüne ait 789 taksonun, 686'sı Magnoliopsida, 103'ü ise Liliopsida sınıfına ait olduğu tespit edilmiştir. Toplam 85 takson Türkiye için endemiktir. Endemizm oranı %10.6'tür. 15 takson ise B7 karesi için yeni kayıt olarak saptanmıştır. Taksonların bitki coğrafyası bölgelerine göre dağılımı şöyledir: İran-Turan 306 (%38.5), Akdeniz 36 (%4.5) ve Avrupa-Sibirya 34 (%4.1).

Anahtar kelimeler: Flora, Türkiye, Elazığ, Endemik, Dambüyük Ovası

1. Giriş

Ülkemiz, coğrafi konumu, jeolojik yapısı, farklı topoğrafik yapılara ve toprak gruplarına sahip oluşu, değişik iklim tiplerinin etkisi altında kalması, üç farklı bitki coğrafyası bölgesinin birleştiği yerde olması ve bazı bitki cinslerinin gen merkezi olması gibi ekolojik ve floristik sebeplerle zengin bir flora ile çok değişik vejetasyon tiplerine sahiptir (Davis ve Hedge, 1975).

1.1. Alanın Coğrafi Konumu

Çalışma alanı Elazığ ili sınırları içerisinde olup, batıda Dambüyük Ovası ile Salkaya Deresi, 38^0 41' 21''- 38^0 47' 52'' kuzey enlemleri ile 39^0 00' 15''- 39^0 12' 45'' doğu boylamları arasında yer almaktadır. Alanın sınırları batıda

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Dambüyük, Koruk ve Esenkent köylerini, güneyde Körpe köyünün alt tarafını ve doğuda ise Aydıncık Köyü'nü alacak şekilde sınırlandırılmıştır. Bu yerleşim alanlarının yanı sıra çalışma sahasında Çatalharman, Üçtepe, Altınkuşak, Alatarla gibi köyler de bulunmaktadır. Çalışma alanının kapladığı alan yaklaşık 105 km^2'dir. Çevresi ise yaklaşık 47 km' dir. Alanın uzunluğu 17.5 km, genişliği ise 10 km arasında değişmektedir. Çalışma alanı P.H. Davis'in grid sistemine göre B7 karesi içerisinde yer almaktadır. Alanın en alçak yeri 810 m olan su kotudur. En yüksek yeri ise Alatarla'nın kuzey doğusunda 1238 m yüksekliğinde olan tepelerdir (Şekil 1).

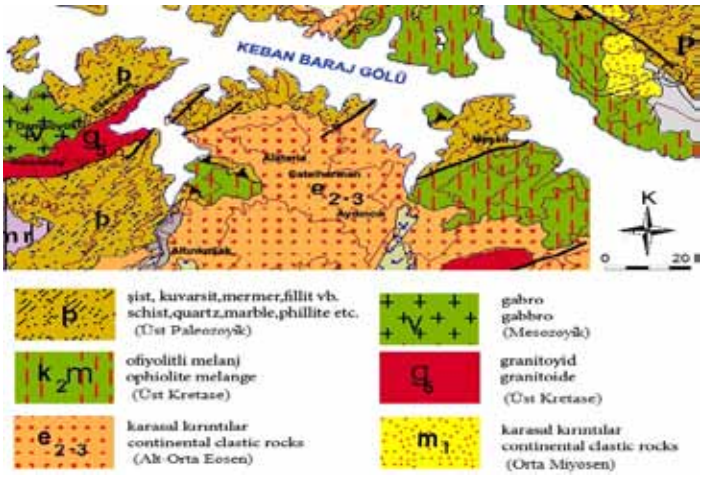
Şekil 1. Çalışma alanının sınırlarını gösteren uydu görüntüsü (www.earth.google.com).

1.2. Alanın Jeoloji ve Jeomorfolojisi

Elazığ yöresi, özellikle de araştırma alanı, jeomorfolojik ve yapısal özellikleri açısından ülkemizin az bilinen bir bölümünü oluşturur. Araştırma alanı Türkiye'nin en yüksek ve dağlık bölgesi olan Doğu Anadolu Bölgesi'nde bulunmaktadır. Bölgenin jeomorfolojik özelliği 'yükseltileri batıdan doğuya doğru artan, birbirine paralel dağlar ile bunlar arasına sıkışmış ve birbirlerinden belirgin eşiklerle ayrılmış ovalar şeklinde karakterize edilebilir. Ayrıca ana hatlarıyla ele alındığında, araştırma alanının bulunduğu Elazığ'ın kuzey batısı, güneydoğu Torosların kuzey kenarındaki alçak alan şeridi boyunca uzanan ve Elbistan'dan başlayarak doğuda Havasor ve Gevar havzalarıyla devam eden depresyon dizinlerinden oluşmaktadır. 700-1000 m yükseklikte batıda Malatya ile, 800-1000 m'ler arasında uzanan doğudaki Uluova depresyonları arasında bir eşik alana da karşılık gelmektedir. İnceleme alanı arızalı bir görünüme sahip olmakla birlikte yükseltisi 800-1500 m civarındadır. İnceleme alanının doğal yapısı içinde dağlık alanlar, havzalar ve plato alanlarından oluşan morfolojik ana birimler ayırt edilebilmektedir (Tonbul, 1985). Araştırma alanının jeomorfoloji haritası ise Şekil 2.'de görülmektedir.

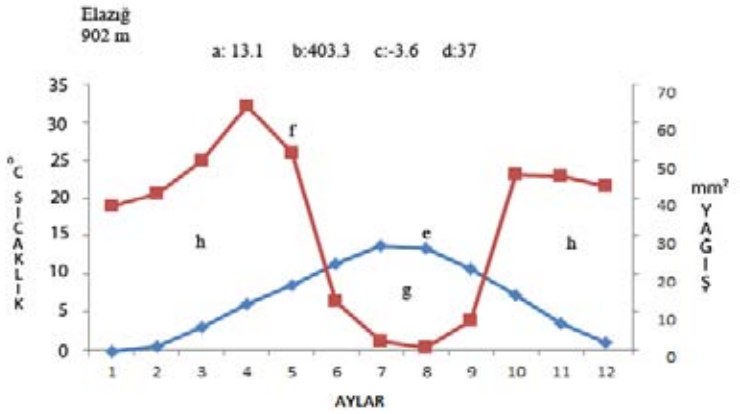
1.3. Alanın İklimi

Çalışma alanında oldukça değişik bir iklim tipi kendini göstermektedir. Yazları oldukça kurak ve sıcak, kışları Doğu Anadolu Bölgesi koşullarına oranla oldukça ılıman ve yağışlı geçen bu iklim, Akdeniz iklimine büyük ölçüde benzer. Bununla birlikte araştırma alanı Doğu Anadolu makroklimaası sınırları içinde olmakla beraber daha elverişli iklim şartlarına sahiptir. Yani karasal Doğu Anadolu iklimi ile Akdeniz ikliminin birbirini etkilediği bir geçiş sahasında yer aldığı için kendine özgü iklim koşullarıyla dikkat çekmektedir.



Şekil 2. Araştırma Alanının Jeoloji Haritası (MTA, 2002).

Araştırma alanının iklimi ile ilgili veriler alanın bağlı olduğu Elazığ Merkez Devlet Meteoroloji İşleri Genel Müdürlüğü'nden elde edilmiştir. Son 37 yıla ait aylık ve yıllık ortalama sıcaklık verileri, aylar içerisinde en düşük ve en yüksek sıcaklık verileri, toplam yağış verileri, nisbi nem verileri, ortalama rüzgar yönü ve hızı ile ilgili veriler dikkate alınmıştır. Aylık ortalama sıcaklık değerleri ile aylık ortalama yağış verileri kullanılarak araştırma alanının ombrotermik (yağış-sıcaklık) diyagramı çizilmiştir (Şekil 3).



Şekil 3. Elazığ İline ait Ombro-Termik Diyagram

Elazığ iline ait yıllık yağış verileri karşılaştırılacak olursa, iklim sınıflandırılması '*yarı kurak'* olarak nitelendirilir. Yıllık yağış rejiminin aylara ve mevsimlere dağılış şekline 'yağış rejimi' denir. Yağış rejimi hakkındaki veri ve bilgiler biyolojik açıdan son derece önemlidir. Bitkiler için ise yıllık yağış miktarı kadar, yağışın mevsimlere göre dağılışı da çok önemlidir. Çünkü vejetasyon, yağışın mevsimlere göre dağılışından veya kurak bir mevsimin bulunup bulunmamasından etkilenir. Türkiye'deki yağış rejimi tipleri azalan yağış miktarlarına göre 4 mevsimin baş harfleri kullanılarak oluşturulur. Buna göre K (Kış), İ (İlkbahar), Y(Yaz) ve S (Sonbahar) şeklinde gösterilir (Akman, 1999).

Elazığ merkez meteroloji istasyonunun verilerine göre, en sıcak ayın maksimum sıcaklık ortalaması Elazığ için M = 34.3 C^0, en soğuk ayın minimum sıcaklık ortalaması m= -3.6 C^0, yıllık yağış miktarı P =403.3 mm ve yağış-sıcaklık emsali Q = 36.8 bulunmuştur. Emberger'in formülü Elazığ için uygulandığında; Q = 36.8 ve m= -3.6 ^{0}C olarak bulunur. Dolayısıyla biyoiklim katı Elazığ istasyonu için yarı kurak üst, Akdeniz iklimli ve kışı çok soğuk olduğu sonucuna varılır (Tablo 1).

Tablo 1. Biyoiklimsel Sentez (DMO, 2010).

Meteoroloji istasyonları	P (mm)	M	m	Q	PE (mm)	S (PE/M)	Yağış Rejimi	İklim Tipi
Elazığ	392.4	34.3	-3.6	36.8	15.3	0.44	İ. K. S. Y. (Doğu Akdeniz 2. Tip)	Yarı kurak, üst, çok soğuk Akdeniz iklimi.

1.4. Alanın Önemi

Salkaya Deresi ile Dambüyük Ovası arasında kalan sahayı araştırma alanı olarak seçmemizin nedenlerini şöyle sıralayabiliriz;

1. Araştırma alanına özgü yapılmış bir floristik araştırmanın olmaması,
2. Araştırma alanı jeomorfolojik açıdan Türkiye'nin karakteristik bir sahasıdır. Nitekim bu sahada monoklinal bir yapı mevcuttur. Kuesta denilen özel jeomorfolojik şekillerin birkaç sıra halinde uzanması ve bu sırtların asimetrik yapıları bitki üzerinde bakı ve eğim şartlarının kısa mesafede farklılaşması ve bu farklılaşmanın bitki çeşitliliğini ve değişimini etkilemesi,
3. Alanın çevresinde çok sayıda yerleşim yerinin bulunması sebebiyle, bunların flora üzerindeki etkilerinin ortaya çıkarılması,
4. Alanın değişik habitat şartlarına sahip olması,
5. Alanın çevresinde hayvancılığın yaygın oluşundan dolayı bitki örtüsündeki tahribatın ortaya çıkarılması,
6. Deniz seviyesi, ova ve yüksek dağlık bölgeleri içine alan farklı yükseltilerdeki habitatlara sahip olması,
7. Karasal iklim görülmesine rağmen Keban Baraj Gölü'nün iklim üzerindeki yumuşatıcı etkisinin taksonların yayılışını nasıl etkilediğini belirleyebilme düşüncesi,
8. Alanın farklı toprak tiplerini içermesi (büyük çoğunluğu kahverengi, az da olsa litosolik ve alüviyal topraklar),
9. Anadolu diyagonaline yakın olması ve diyagonalin doğusunda kalması,
10. İnceleme alanının 800-1250 m. yükselti ortalaması ile bölgenin diğer bölümlerine oranla daha düşük bir yükselti ortalamasına sahip olması,
11. Keban Baraj Gölü' nün bölge üzerindeki etkisi.

2. Materyal ve yöntem

Araştırma alanında 2009-2012 tarihleri arasında farklı vejetasyon dönemlerinde 3283 bitki örneği toplanmıştır. Bitkilerin teşhisinde temel kaynak olarak "Flora of Turkey and the East Aegean Islands" Vol. 1-9 (Davis, 1965), Flora of Turkey and Aegean Islands (supl. 1) Vol. 10 (Davis vd., 1988), Flora of Turkey and Aegean Islands (suupl. 2) Vol. 11 (Güner vd., 2000) kaynaklarından yararlanıldı. Bundan başka teşhis çalışmalarında çeşitli revizyon çalışmalarından da yararlanılmıştır (Aytaç, 1997; Dadandı, 2002; Dalcı, 1986; Çelik ve Yıldız, 1989; Baytop, 1998). Teşhis işlemlerinden sonra, uygun bitki örnekleri herbaryum materyaline dönüştürülerek Fırat Üniversitesi Herbaryumu (FUH)'nda muhafaza edilmiştir. Makalede bitki toplanan istasyonların lokaliteleri liste halinde verilmiştir. Taksonlarla ilgili bilgi verilirken, taksonun lokalitesi, tarihi, toplayıcı adı ve numarası, endemik olup-olmadığı, biliniyorsa fitocoğrafik bölgesi verilmiştir.

Elazığ iklimi ile ilgili meteorolojik veriler 'Elazığ Merkez Devlet Meteoroloji İşleri 13. Bölge Müdürlüğü'nden alınmıştır (DMO, 2010). Çalışma alanının çevresindeki Elazığ ili rasat istasyonlarına ait iklim diyagramları Gaussen metoduna göre çizilmiştir. Çalışma alanının iklimsel değerlendirilmesi için Emberger'in Akdeniz iklim katları ve kuraklık dereceleri için geliştirdiği formüllerden yararlanılmıştır. İklim ile ilgili verilerin yorumlanmasında 'İklim ve Biyoiklim' kitabından yararlanılmıştır (Akman, 1999).

Morfolojik terimlerin öğrenilmesinde 'İngilizce-Türkçe Botanik Kılavuzu' isimli eser kullanılmıştır (Baytop, 1998). Bitki otör isimlerinin doğru yazılması için Brummit ve Powel'in 'Author of Plant Names' adlı eserinden yararlanılmıştır (Brummitt ve Powell, 2001). Endemik taksonların tehlike kategorileri Türkiye Bitkileri Kırmızı Kitabı (Ekim, 2000)'na göre bir tablo halinde hazırlanarak tartışma-sonuç bölümünde verilmiştir. Taksonların tehlike kategorileri, IUCN 2001 kriterlerine göre yeniden düzenlenmiştir (IUCN, 2001). Çalışma alanına yakın yerleşim yerinde ve alan içinde halka ait tarla, bağ ve bahçe gibi yerler bulunduğundan bazı bitkilerin kültür oldukları belirtilmiştir. Bitkilerin yaşam formları Raunkiaer'e (Raunkiaer, 1934) göre verilmiştir. Grid sistemine göre B7 karesi için yeni olan kayıtlar * işaretiyle tür adının ön kısmında belirtilmiştir. 'Flora of Turkey 1-9' (Davis, 1974), 'Flora of Turkey and the East Aegean Islands' adlı eserlerin, 10. (Davis vd., 1988), 11. ciltleri (Güner vd., 2000) ve diğer yeni kare kayıtları ile çalışmalar tarandıktan sonra B7 karesi için 15 yeni kayıt olduğu tespit edilmiştir.

Bitki Toplama İstasyonları

1. B7 Elazığ: Aydıncık Köyü girişi yamaçlar, 850-900 m.,
2. B7 Elazığ: Aydıncık Köyü Gurusor mevkii, yamaçlar, 850-900 m.,
3. B7 Elazığ: Aydıncık Köyü çevresi, yamaçlar, 850-900 m.,
4. B7 Elazığ: Aydıncık Köyü Tanrıvermiş Kalesi çevresi, yamaçlar, 900-950 m.,
5. B7 Elazığ: Aydıncık Köyü Tanrıvermiş Kalesi doğusu, yamaçlar, 900-950 m.,
6. B7 Elazığ: Aydıncık Köyü Tanrıvermiş Kalesi güneyi, yamaçlar, 900-950 m.,
7. B7 Elazığ: Aydıncık Köyü Çakıl mezrası, yamaçlar, 900-950 m.,
8. B7 Elazığ: Aydıncık Köyü Har mezrası, dere kenarı, 850-900 m.,
9. B7 Elazığ: Mastar Çiftliği çevresi, ormanlık alan, 850-900 m.,
10. B7 Elazığ: Çatalharman Köyü çevresi, yamaçlar, 950-1000 m.,
11. B7 Elazığ: Alatarla Köyü mezarlıklar arkası, dere kenarı, 950-1000 m.,
12. B7 Elazığ: Alatarla Köyü suya inen yol, tarla kenarı, 950-1000 m.,
13. B7 Elazığ: Alatarla Köyü Ağmani yolu, meşe topluluğu, 1100-1200 m.,
14. B7 Elazığ: Alatarla Köyü mezarlıklar arkası, kayalıklar, 950-1050 m.,
15. B7 Elazığ: Altınkuşak Köyü Ağdaş çeşmesi, nemli alan, 950-1000 m.,
16. B7 Elazığ: Altınkuşak Köyü çevresi, yamaçlar, 900-950 m.,
17. B7 Elazığ: Altınkuşak Köyü alt kesimler, ağaçlık alan, 850-900 m.,
18. B7 Elazığ: Altınkuşak Köyü girişi taş ocakları karşısı, sulak alan, 900-950 m.,
19. B7 Elazığ: Üçtepe Köyü tabelası üst kesimler, yamaçlar, 900-950 m.,
20. B7 Elazığ: Üçtepe Köyü Çardaklı çeşmesi önü kanal boyu, yol kenarı, 900-950 m.,
21. B7 Elazığ: Körpe Köyü çıkışı, yol kenarı-yamaçlar, 1100-1200 m.,
22. B7 Elazığ: Körpe Köyü çevresi çeşmenin üst tarafı, yamaçlar, 1050-1100 m.,
23. B7 Elazığ: Körpe Köyü' ne 3 km. kala yolun sağı, yamaçlar, 1100-1150 m.,
24. B7 Elazığ: Koruk Köyü girişi köprünün alt tarafı, yamaçlar, 900-950 m.,
25. B7 Elazığ: Koruk Köyü mezarlıklar altı Aşağıpınar mevkii, yamaçlar, 900-950 m.,
26. B7 Elazığ: Koruk Köyü kanal boyu Çalıbağı mevkii, yamaçlar, 900-950 m.,
27. B7 Elazığ: Koruk Köyü köy binasının arka tarafları, yamaçlar, 950-1000 m., meşelikler
28. B7 Elazığ: Koruk Köyü su deposunun çevresi, yamaçlar, 950-1000 m.,
29. B7 Elazığ: Esenkent Köyü şarap fabrikasının alt tarafı, yamaçlar, 950-1000 m.,
30. B7 Elazığ: Esenkent Köyü üst kesimler, yamaçlar, 1000-1050 m.,
31. B7 Elazığ: Esenkent Köyü alt kesimler, dere kenarı, 800-850 m.,
32. B7 Elazığ: Esenkent Köyü hayrat çeşmesinin üst tarafı, yamaçlar, 900-950 m.,
33. B7 Elazığ: Esenkent Köyü girişi, yamaçlar, 950-1000 m.,
34. B7 Elazığ: Dambüyük Köyü Kabasakal mevkii, yamaçlar, 900-950 m.,
35. B7 Elazığ: Dambüyük Köyü Tapanlar mezrası, yamaçlar, 950-1000 m.,
36. B7 Elazığ: Dambüyük Köyü Deliktaş mevkii, yamaçlar, 950-1000 m.,
37. B7 Elazığ: Dambüyük Köyü Karamanlar mevkii, yamaçlar, 1000-1050 m.,
38. B7 Elazığ: Dambüyük Köyü alt kesimler İncesu mevkii, yamaçlar, 850-900 m.,
39. B7 Elazığ: Dambüyük Köyü girişi, yamaçlar, 900-950 m.,

Kısaltmalar: Akd.: Akdeniz elementi; Av.-Sib.: Avrupa-Sibirya elementi; Ir.-Tur: İran-Turan elementi; End.: Endemik; ŞH: Şükrü HAYTA.

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Adonis aestivalis L. subsp. *aestivalis*, 33, 14.04.2010, ŞH 1570.
A. aestivalis L. subsp. *parviflora* (Fisch. ex DC.) Busch., 7, 14.04.2010, ŞH 1571.
A. eriocalycina Boiss., 26, 28.04.2010, ŞH 1607. İr.-Tur.
A. flammea Jacq., 16, 15.05.2010, ŞH 1698.
**Ranunculus dissectus* M.Bieb. subsp. *huetii* (Boiss.)P.H.Davis, 18, 05.06.2010,ŞH 2035. End. İr.-Tur.
R. repens L., 22, 16.04.2011, ŞH 2699.
R. constantinopolitanus (DC.) d'Urv., 15, 14.03.2009, ŞH 1015.
R. cuneatus Boiss., 25, 14.04.2010, ŞH 1572.
R. sintenisii Freyn, 36, 26.05.2012, ŞH 3750.
R. isthmicus Boiss. subsp. *stepporum* P.H.Davis, 32, 28.03.2009, ŞH 1062.
R. cornutus DC., 37, 16.04.2010, ŞH 1273.
R. arvensis L., 8, 16.05.2009, ŞH 1106.
R. kochii Ledeb., 18, 14.03.2009, ŞH 1004. İr.-Tur.
Ceratocephalus falcatus (L.) Pers., 34, 16.04.2011, ŞH 2697.
Thalictrum isopyroides C.A.Mey., 25, 25.04.2012, ŞH 3409.
BERBERIDACEAE
Berberis vulgaris L., 14, 05.06.2010, ŞH 2036.
Leontice leontopetalum L. subsp. *leontopetalum*, 19, 25.03.2012, ŞH 3411.
Bongardia chrysogonum (L.) Spach, 38, 14.03.2009, ŞH 1020. İr.-Tur.
PAPAVERACEAE
Glaucium corniculatum (L.)Rud. subsp. *refractum* (Nab.) Cullen, 29, 06.05.2012, ŞH 3496. İr.-Tur.
G. leiocarpum Boiss., 37, 09.06.2010, ŞH 2180.
G. acutidentatum Hausskn. & Bornm., 10, 12.06.2011, ŞH 3123. End. İr.-Tur.
G. cappadocicum Boiss., 23, 06.05.2012, ŞH 3518.
Roemeria hybrida (L.) DC. subsp. *hybrida*, 25, 22.05.2010, ŞH 1806.
Papaver triniifolium Boiss., 26, 26.06.2011, ŞH 3221. End. İr.-Tur.
P. rhoeas L., 30, 28.04.2009, ŞH 1077.
P. lacerum Popov, 21, 16.04.2011, ŞH 2701.
P.dubium L., 29, 28.03.2009, ŞH 1046.
P. clavatum Boiss. & Hausskn ex Boiss., 16, 28.06.2010, ŞH 1331. End.
P. argemone L., 12, 27.05.2011, ŞH 3002.
Hypecoum imberbe Sibth. & Sm., 26, 31.03.2010, ŞH 1528.
Corydalis rutifolia (Sibth. & Sm) DC. subsp. *erdelii* (Zucc) Cullen & P.H.Davis., 14, 22.05.2010,ŞH 1728.
Fumaria parviflora Lam., 17, 02.05.2011, ŞH 2753.
F. asepala Boiss., 15, 17.05.2012, ŞH 3630. İr.-Tur.
BRASSICACEAE
Brassica elongata Ehrh., 3, 14.06.2009, ŞH 2410.
Sinapis arvensis L., 29, 04.06.2010, ŞH 1218.
Hirschfeldia incana (L.) Lag. & Foss., 39, 03.06.2012, ŞH 3847.
Eruca sativa Miller, Gard. Dict. Ed., 36, 27.05.2011, ŞH 3004.
Raphanus raphanistrum L., 17, 10.09.2010, ŞH 2637.
Rapistrum rugosum L. 28, 26.05.2012, ŞH 3755.
Conringia orientalis (L.) Andrz., 10, 09.06.2010, ŞH 2186.
C. perfoliata (C.A.Mey.) N.Busch, 21, 28.03.2009, ŞH 1044.
Lepidium perfoliatum L., 34, 15.05.2010, ŞH 1509.
L. latifolium L., 15, 12.06.2011, ŞH 3125.
Cardaria draba (L.) Desv. subsp. *chalepensis* (L.) O.E.Schultz, 19, 22.05.2010, ŞH 1814.
Isatis condolleana Boiss., 31, 28.04.2010, ŞH 1613. End. İr.-Tur.
I. glauca Aucher ex Boiss. subsp. *glauca*, 34, 12.06.2011, ŞH 3126. İr.-Tur.
Coluteocarpus vesicaria (L.) Holmboe subsp. *vesicaria*, 36, 15.05.2010, ŞH 1702. İr.-Tur.
Aethionema carneum (Banks & Sol.) Fedtsch., 24, 22.05.2010, ŞH 1816. İr.-Tur.
Ae. arabicum (L.) Andrz. ex DC., 10, 05.06.2010, ŞH 2042.
Ae. iberideum Boiss., 1, 13.05.2012, ŞH 3589.
Ae. grandiflorum Boiss. & Hohen., 25, 02.05.2011, ŞH 2758. İr.-Tur.
Ae. armenum Boiss., 11, 28.06.2009, ŞH 1333. İr.-Tur.
Thlaspi perfoliatum L., 17, 28.04.2010, ŞH 1614.
Capsella bursa-pastoris (L.) Medik., 18, 09.06.2010, ŞH 2189.
Boreava orientalis Jaub. & Spach, 32, 03.06.2012, ŞH 3848.
N. apiculata Fisch. & C.A.Mey. & Ave-Lall., 7, 14.06.2009, ŞH 1219.
Tchihatchewia isatidea Boiss., 36, 12.06.2011, ŞH 3127. End. İr.-Tur.
Fibigia clypeata (L.) Medik., 29, 07.06.2009, ŞH 1144.
F. macrocarpa (Boiss.) Boiss., 27, 22.05.2010, ŞH 1896.
F. eriocarpa (D.C) Boiss., 23, 22.05.2010, ŞH 1823.
Alyssum linifolium Stephan ex Willd. var. *linifolium*, 2, 14.04.2010, ŞH 1541.
A. aureum (Fenzl) Boiss., 4, 22.05.2010, ŞH 1725. İr.-Tur.
A. desertorum Stapf var. *desertorum*, 25, 23.05.2009, ŞH 1130.
A. minutum Schlecht ex. DC. 7, 27.05.2011, ŞH 3006.
A. szowitsianum Fisch. & C.A.Mey., 38, 06.05.2012, ŞH 3503.
A. strigosum Banks & Sol. subsp. *strigosum*, 26, 28.03.2009, ŞH 1086.
A. praecox Boiss. & Balansa var. *praecox*, 36, 23.05.2012, ŞH 3733. End.
A. pateri Nyar subsp. *pateri*, 6, 10.05.2011, ŞH 2831. End. İr.-Tur.
A. filiforme Nyar, 33, 28.05.2010, ŞH 1947. End. İr.-Tur.
A. murale Waldst. & Kit. var. *murale*, 5, 09.06.2010, ŞH 2196.
Clypeola aspera (Grauer) Turrill, 11, 15.05.2010, ŞH 1615. İr.-Tur.
Draba bruniifolia Stev. subsp. *bruniifolia*, 29,16.04.2011, ŞH 2708.
E. verna (L.) Chevall. subsp. *praecox* (Stev.) Walters, 7, 06.05.2012, ŞH 3518.
Erophila verna (L.) Chevall. subsp. *verna*, 2, 14.03.2009, ŞH 1038.
Arabis caucasica Willd. subsp. *caucasica*, 4, 09.06.2010, ŞH 2197.
Nasturtium officinale R.Br., 11, 22.05.2010, ŞH 1828.
Barbarea vulgaris R. Br., 15, 16.04.2011, ŞH 2709.
**B. verna* (Mill.) Aschers, 31, 14.04.2010, ŞH 1132.
B. plantaginea DC., 10, 07.06.2009, ŞH 1146.
Drabopsis nuda (Bel.) Stapf., 29, 28.05.2010, ŞH 1948. İr.-Tur.
**Chorispora syriaca* Boiss., 22, 16.04.2011, ŞH 2710. İr.-Tur.
Hesperis pendula DC., 24, 20.07.2010, ŞH 2569.
Malcolmia africana (L.) R.Br., 19, 06.06.2011, ŞH 3054.
**Erysimum lycaonicum* (Hand.-Mazz.) Hub.-Mor., 37, 06.06.2011, ŞH 3069. End. İr.-Tur.
E. leucanthemum (Stephan) B.Fedtsch., 32, 07.06.2009, ŞH 1148.
E. crassipes Fisch. & C.A.Mey., 23, 05.08.2010, ŞH 2580.
E. smyrnaeum Boiss. & Bal., 13, 22.05.2010, ŞH 1831.
E. repandum L., 1, 15.04.2012, ŞH 3450.
Alliaria petiolata (M.Bieb.) Cavara & Grande, 8, 28.06.2009, ŞH 1336.
Sisymbrium altissimum L., 34, 22.04.2012, ŞH 3471.
S. loeselii L., 36, 15.05.2010, ŞH 1619.
Descuraina sophia (L.) Webb ex Prantl, 26, 28.04.2010, ŞH 1581.
Camelina rumelica Velen., 9, 09.06.2010, ŞH 2202.
C. hispida Boiss. var. *hispida*, 25, 06.05.2012, ŞH 3508.
CAPPARACEAE
Capparis spinosa L. var. *spinosa*, 29, 28.06.2009, ŞH 1338.
Cleome ornithopodioides L., 36, 09.06.2010, ŞH 2203.
RESEDACEAE
R. lutea L. var. *lutea*, 30, 28.04.2010, ŞH 1582.
CISTACEAE
Helianthemum ledifolium (L.) Mill. var. *ledifolium*, 4, 15.05.2010, ŞH 1620.

H. salicifolium (L.) Mill., 13, 15.05.2010, ŞH 1621.
Fumana procumbens (Dunal) Gren. & Godr., 29, 03.07.2011, ŞH 3277.

VIOLACEAE
Viola odorata L., 17, 14.03.2009, ŞH 1011.
V. occulta Lehm., 4, 09.06.2010, ŞH 2206.
V. modesta Fenzl., 34, 16.04.2011, ŞH 2713.

POLYGALACEAE
Polygala pruinosa Boiss. subsp. *pruinosa*, 37, 15.07.2009, ŞH 1451.

PORTULACACEAE
Portulaca oleracea L., 7, 15.10.2010, ŞH 3644.

CARYOPHYLLACEAE
Arenaria serphyllifolia L., 6, 14.03.2009, ŞH 1022.
A. leptocladus (Reichb) Guss., 21, 02.05.2011, ŞH 2764.
A. gypsophiloides L. var. *glabra* Fenzl, 7, 25.06.2010, ŞH 2412. İr.–Tur.
A. acerosa Boiss., 24, 05.06.2010, ŞH 2049. End. İr.-Tur.
Minuartia juniperina (L.) Maire & Petitm., 25, 19.07.2009, ŞH 1452.
M. meyeri (Boiss.) Bornm., 34, 27.05.2011, ŞH 2946. İr.–Tur.
M. hybrida (Vill.) Sch. subsp. *hybrida*, 4, 28.03.2009, ŞH 1091. Akd.
Stellaria media (L.) Vill. subsp. *media*, 28, 28.04.2010, ŞH 1583.
S. media (L.) Vill. subsp. *pallida* (Dumort) Aschers. & Graebn, 8, 26.05.2012, ŞH 3521.
Cerastium anomalum Waldst. & Kit., 22, 05.06.2010, ŞH 2050.
C. perfoliatum L., 2, 28.04.2010, ŞH 1584.
C. dichotomum L. subsp. *dichotomum*., 15, 22.04.2012, ŞH 3480.
Holosteum umbellatum L. var. *umbellatum*, 36, 14.03.2009, ŞH 1027.
Telephium imperati L. subsp. *oriantale* (Boiss.) Nyman, 34, 01.07.2010, ŞH 2455.
Dianthus strictus Banks & Sol. var. *gracillior* (Boiss.) Reverve, 8, 23.05.2009, ŞH 1135.
D. floribundus Boiss., 26, 07.06.2009, ŞH 1150. İr.-Tur.
D. orientalis Adams, 27, 08.07.2010, ŞH 2516.
Petrorhagia cretica (L.) P.W.Ball & Heywood, 2, 05.06.2010, ŞH 2051.
Velezia rigida L., 23, 10.06.2012 ŞH 3963.
Saponaria orientalis L., 39, 15.05.2010, ŞH 1628.
S. prostrata Willd. subsp. *prostrata*, 26, 27.05.2011, ŞH 2948. End. İr.-Tur.
S. prostrata Willd. subsp. *anatolica* Hedge, 4, 22.05.2010, ŞH 1842. End. İr.-Tur.
Phryna ortegioides (Fisch.& C.A.Mey.) Pax & Hoffm., 6, 09.08.2009, ŞH 1497. End. İr.-Tur.
Gysophila pinifolia Boiss. & Hausskn., 34, 08.07.2010 ŞH 2515. End. İr.-Tur.
G. pilosa Hudson, 16, 09.06.2010, ŞH 2215. İr.-Tur.
Vaccaria pyramidata Medik. var. *grandiflora* (Fisch. ex DC.) Cullen, 38, 22.05.2010, ŞH 1843.İr.-Tur.
Silene marschallii C.A.Mey., 4, 28.06.2009, ŞH 1340. İr.-Tur.
S. chlorifolia Sm., 26, 26.06.2011, ŞH 3226. İr.-Tur.
S. cappadocica Boiss. & Heldr., 28, 03.06.2012, ŞH 3853. İr.-Tur.
S. supina subsp. *pruinosa* (Boiss.) Chowdh., 10, 26.06.2011, ŞH 3227.
S. montbretiana Boiss., 21, 27.05.2011, ŞH 2949. İr.-Tur.
S. arguta Fenzl., 1, 23.05.2012, ŞH 3737. İr.-Tur.
S. ampullata Boiss., 7, 22.05.2010, ŞH 1845. İr.-Tur.
S. odontopetala Fenzl., 29, 06.09.2011, ŞH 3387.
S. vulgaris (Moench) Garcke var. *vulgaris*, 17, 23.05.2009, ŞH 1137.
S. compacta Fisch., 9, 09.06.2010, ŞH 2218.
S. chaetodonta Boiss., 12, 10.06.2012, ŞH 3965. İr.-Tur.
S. conoidea L., 23, 16.05.2009, ŞH 1107.
Agrostemma githago L., 2, 05.06.2010, ŞH 2047.

ILLECEBRACEAE
Herniaria incana Lam., 22, 28.05.2010, ŞH 1952.
Paronchia kurdica Boiss. subsp. *kurdica* var. *kurdica*, 3, 14.06.2009, ŞH 1223.

POLYGONACEAE
Atraphix billardieri Jaub. & Spach var. *billardieri*, 36, 23.06.2012, ŞH 4283. İr.-Tur.
Polygonum cognatum Meisn., 38, 09.06.2010, ŞH 2222.
P. arenastrum Boreau, 17, 09.08.2010, ŞH 1498.
P. arenarium Waldst. & Kit., 36, 10.10.2010, ŞH 2641.
P. pulchellum Loisel, 2, 10.08.2010, ŞH 2602.
P. bellardii All., 27, 28.06.2009, ŞH 1343.
P. convolvulus L., 29, 20.07.2010, ŞH 2570.
Rumex acetosella L., 25, 16.07.2010, ŞH 2554.
R. scutatus L., 17, 14.06.2009, ŞH 1225.
R. tuberosus L. subsp. *horizontalis* (K.Koch) Rech., 8, 14.06.2009, ŞH 1226.
R. crispus L., 22, 12.06.2011, ŞH 3134.

CHENOPODIACEAE
Chenopodium botrys L., 34, 09.06.2010, ŞH 2225.
C. foliosum (Moench) Aschers. 2, 03.07.2011, ŞH 3295.
C. album L. subsp. *album* var. *album*, 29, 19.07.2009, ŞH 1454.
Salsola ruthenica Iljin, 7, 09.08.2009, ŞH 1499.
Noaea mucronata (Forssk.) Asch. & Schweinf. subsp. *tournefortii* (Spach)Aellen, 37, 28.06.2009, ŞH 1345.

AMARANTHACEAE
Amaranthus patulus Bert., 16, 01.10.2009, ŞH 1514.
A. albus L., 39, 03.07.2010, ŞH 2504.

TAMARICACEAE
Tamarix tetrandra Pallas ex M.Bieb., 31, 28.04.2011, ŞH 2734.
T. smyrnensis Bunge, 24, 28.06.2009, ŞH 1346.

HYPERICACEAE
**Hypericum lysimachioides* Boiss. & Noe var. *spathulatum* Robson, 23, 05.06.2010, ŞH 2059. İr.-Tur.
H. uniglandulosum Hausskn. ex Bornm, 36, 05.06.2010, ŞH 2056. End. İr.-Tur.
H. scabroides Robson & Poulter, 30, 19.07.2009, ŞH 1455. End. İr.-Tur.
H. scabrum L., 26, 22.05.2011, ŞH 2888. İr.-Tur.
H. perforatum L., 19, 05.06.2010, ŞH 2062.
H. triquetrifolium Tura, 4, 09.06.2010, ŞH 1456.

MALVACEAE
Hibiscus trionum L., 29, 05.08.2010, ŞH 2583.
Malva neglecta Wallr., 2, 28.06.2009, ŞH 1347.
Alcea striata (DC.) Alef. subsp. *striata*, 24, 09.06.2010, ŞH 2230.
A. calvertii (Boiss.) Boiss., 7, 27.05.2011, ŞH 2950. End. İr.-Tur.

LINACEAE
Linum mucronatum Bertol. subsp. *mucronatum* (Bordz.) P.H.Davis, 27, 22.05.2010, ŞH 1856. İr.-Tur.
L. mucronatum Bertol. subsp. *armenum* (Bordz.) P.H.Davis., 26, 23.05.2012, ŞH 3740. İr.-Tur.
L. nodiflorum L., 19, 22.05.2010, ŞH 1857. Akd.
L. catharticum L., 6, 09.06.2010, ŞH 2235. Avr.-Sib.

GERANIACEAE
Geranium rotundifolium L., 22, 15.05.2010, ŞH 1632.
G. dissectum L., 10, 05.06.2010, ŞH 2063.
G. tuberosum L. subsp. *tuberosum*, 3, 14.03.2009, ŞH 1035. İr.-Tur.
G. stepporum P.H.Davis, 14, 19.05.2011, ŞH 2853. İr.-Tur.
Erodium cicutarium (L.) L'Herit. subsp. *cicutarium*, 25, 31.03.2010, ŞH 1555.

ZYGOPHYLLACEAE
Tribulus terrestris L., 4, 19.07.2009, ŞH 1459.
Peganum harmala L., 32, 20.07.2011, ŞH 3346. Çok bölgeli.

RUTACEAE
Haplophyllum armenum Spach., 5, 19.07.2009, ŞH 1460. End.

SIMAROUBACEAE
Ailanthus altissima (Mill.) Swingle, 38, 02.05.2011, ŞH 2774.

VITACEAE
Vitis syvestris Gmelin, 28, 13.05.2012, ŞH 3602.

RHAMNACEAE
Paliurus spina-christii Mill., 26, 15.05.2011, ŞH 3915.

ANACARDIACEAE
Rhus coriaria L., 17, 05.08.2010, ŞH 2584. Akd.
Pistacia terebinthus L. subsp. *palaestina* (Boiss.) Engler, 16, 22.05.2010, ŞH 1859. Akd.

FABACEAE
Genista albida Willd., 29, 28.03.2009, ŞH 1069.
Robinia pseudoacacia L., 27, 22.05.2011, ŞH 2891.
Colutea cilicica Boiss. & Balansa, 36, 15.05.2010, ŞH 1634.
Astragalus campylorrhynchus Fisch. & C.A.Mey., 25, 20.07.2011, ŞH 3347. İr.-Tur.
A. hamosus L., 37, 06.06.2011, ŞH 3063.
A .densifolius Lam., 4, 14.06.2009, ŞH 1230. İr.-Tur.
A. caraganae Fisch. & Mey., 39, 27.05.2011, ŞH 2951. İr.-Tur.
A. christianus L., 8, 20.07.2010, ŞH 2572.
A. lanigerus Desf., 23, 09.06.2010, ŞH 2242. İr.-Tur.
A. gummifer Labill., 25, 14.06.2009, ŞH 1233. İr.-Tur.
A. amblolepis Fisch., 36, 28.06.2009, ŞH 1350. İr.-Tur.

**A. micropterus* Fisch., 20, 14.06.2009, ŞH 1234. End. İr.-Tur.
A. compactus Lam., 5, 05.08.2010, ŞH 2586. İr.-Tur.
A. lamarckii Boiss., 24, 09.06.2010, ŞH 2243. End. İr.-Tur.
A. kurdicus Boiss. var. *muschianus* (Kotschy & Boiss.) Chamberlain, 6, 26.06.2011, ŞH 3234. İr.-Tur.
A. cephalotes Banks & Sol. var. *cephalotes*, 20, 22.05.2010, ŞH 1862.
A. anthylloides Lam., 29, 27.05.2011, ŞH 2953. İr.-Tur.
A. decurrens Boiss., 20, 23.06.2012, ŞH 4200. İr.-Tur.
A. macrocephalus Willd. subsp. *finitimus* (Bunge) Chamberlain, 20, 12.06.2011, ŞH 3141. İr.-Tur.
A. lineatus Lam. *var. longidens* (Freyn) Matthews, 13, 09.06.2010, ŞH 2245. İr.-Tur.
A. odoratus Lam., 2, 01.07.2010, ŞH 2462.
A. ornithopodioides Lam., 6, 28.03.2010, ŞH 1524. İr.-Tur.
A. aduncus Willd., 24, 27.05.2011, ŞH 2954. İr.-Tur.
A. onobrychis L., 36, 06.06.2011, ŞH 3065.
A. bicolor Lam., 25, 07.06.2009, ŞH 1151. İr.-Tur.
A. tigridis Boiss., 22, 27.05.2011, ŞH 2956. İr.-Tur.
**A. scabrifolius* Boiss., 5, 27.05.2011, ŞH 2962. End. İr.-Tur.
A.campylosema Boiss. subsp. *campylosema*, 36, 14.06.2009, ŞH 1236. End. İr.-Tur.
Glycyrrhiza echinata L., 26, 26.06.2011, ŞH 3241.
Cicer pinnatifidum Jaub. & Spach, 31, 22.05.2010, ŞH 1866.
C. echinospermum P.H.Davis, 29, 22.05.2011, ŞH 2892. End. İr.-Tur.
Vicia cracca L. subsp. *stenophylla* Vel., 39, 14.06.2009, ŞH 1237.
V. ervilia (L.) Willd., 36, 15.05.2010, ŞH 1636. Akd.
V. koeieana Rech. f., 26, 28.06.2009, ŞH 1353. İr.-Tur.
V. noeana Reuter ex Boiss. var. *noeana*, 8, 14.06.2009, ŞH 1239. İr.-Tur.
V. peregrina L., 7, 22.05.2010, ŞH 1870.
V. sericocarpa Fenzl var. *sericocarpa*, 27, 28.06.2010, ŞH 1355.
V. cuspidata Boiss., 37, 22.05.2010, ŞH 1871. Akd.
V. lathyroides L., 29, 16.05.2009, ŞH 1108.
V. sativa L. subsp. *sativa*, 30, 17.05.2012, ŞH 3650.
V. sativa L. subsp. *nigra* (L.) Ehrh. var. *nigra*, 25, 28.03.2009, ŞH 1065.
V. narbonensis L.var. *narbonensis*, 8, 22.05.2010, ŞH 1872.
V. galilaea Plitm et Zoh., 13, 23.05.2012, ŞH 3672.
Lens orientalis (Boiss.) Hand.-Mazz., 27, 28.05.2010, ŞH 1957.
Lathyrus vinealis Boiss. & Noe, 26, 14.06.2009, ŞH 1240. İr.-Tur.
L. inconspicus L., 2, 06.06.2011, ŞH 3068.
L. annuus L., 8, 14.06.2009, ŞH 1241. Akd.
L. cicera L., 17, 28.04.2010, ŞH 1588.
L. sativus L., 36, 28.04.2011, ŞH 2742.
Pisum sativum L. subsp. *elatius* (M.Bieb.) Aschers. & Graebn. var. *pumilio* Meikle, 27,09.06.2010, ŞH 2252.
Ononis pusilla L., 28, 14.06.2009, ŞH 1243. Akd.
O. spinosa L. subsp. *leiosperma* (Boiss.) Sirj., 18, 01.07.2010, ŞH 2464. İr.-Tur.
Trifolium repens L. var. *repens*, 35, 22.05.2010, ŞH 1885.
T. campestre Schreb., 7, 22.05.2010, ŞH 1886.
T. physodes Stev. ex Bieb. var. *physodes*, 2, 27.05.2011, ŞH 2963. Akd.
T. resupinatum L. var. *resupinatum*, 22, 28.06.2009, ŞH 1356.
T. pratense L. var. *pratense*, 19, 22.05.2010, ŞH 1887.
T. hirtum All., 24, 22.05.2010, ŞH 1888. Akd.
T. arvense L. var. *arvense*, 18, 28.06.2009, ŞH 1357.
T. purpureum Lois. var. *purpureum*, 29, 27.05.2011, ŞH 2965.
T. hausknechtii Boiss. var. *hausknechtii*, 15, 22.05.2010, ŞH 1890. İr.-Tur.
T. pauciflorum d'Urv., 32, 09.06.2010, ŞH 2255. Akd.
Melilotus officinalis (L.) Desr., 37, 10.09.2010, ŞH 2609.
M. alba Desr., 7, 14.06.2009, ŞH 1248.
Trigonella brachycarpa (Fisch.) Moris, 26, 05.06.2010, ŞH 2068. İr.-Tur.
T. lunata Boiss., 10, 22.05.2010, ŞH 1891. İr.-Tur.
T. spruneriana Boiss. var. *spruneriana*, 4, 28.03.2009, ŞH 1085. İr.-Tur.
T. mesopotamica Hub.-Mor., 29, 27.05.2011, ŞH 2967. İr.-Tur.
T. velutina Boiss., 22, 12.06.2011, ŞH 3145. İr.-Tur.
T. crassipens Boiss., 35, 19.07.2009, ŞH 1463. İr.-Tur.
T. monantha C.A.Mey. subsp. *monantha*, 18, 14.03.2009, ŞH 1016. İr.-Tur.
T. spicata Sibth. & Sm., 36, 28.03.2009, ŞH 1095. Akd.
Medicago radiata L., 5, 09.06.2010, ŞH 2259. İr.-Tur.
M. lupulina L., 31, 14.06.2009, ŞH 1249.
M. sativa L. subsp. *sativa*, 3, 19.07.2009, ŞH 1464.
M. x varia Martyn, 37, 22.05.2010, ŞH 1895.
M. minima (L.) Bart. var. *minima*, 23, 14.06.2009, ŞH 1250.
M. rigidula (L.) All. var. *rigidula*, 19, 15.05.2010, ŞH 1643.
M. rigidula (L.) All. var. *cinerascens* (Jord.) Rouy, 31, 14.03.2009, ŞH 1029.
Lotus corniculatus L. var. *corniculatus*, 8, 14.06.2009, ŞH 1251.
L. corniculatus L. var. *alpinus* Ser., 6, 28.06.2009, ŞH 1359.
L. gebelia Vent. var. *gebelia*, 23, 28.06.2009, ŞH 1360.
L. gebelia Vent. var. *anthylloides* Boiss., 35, 07.06.2009, ŞH 1153. End. İr.-Tur.
Coronilla scorpioides (L.) W.D.J.Koch, 4, 14.06.2009, ŞH 1252.
C. orientalis Miller var. *orientalis*, 2, 09.06.2010, ŞH 2267.
C. varia L. subsp. *varia*, 7, 28.06.2009, ŞH 1361.
Hedysarum pogonocarpum Boiss., 3, 05.08.2010, ŞH 2589. End.
Onobrychis fallax Freyn & Sint., 32, 28.06.2009, ŞH 1362. End.
O. galegifolia Boiss., 37, 14.06.2009, ŞH 1253. İr.-Tur.
**O. cappadocica* Boiss., 4, 14.06.2009, ŞH 1254. End. İr.-Tur.
Ebenus haussknechtii Bornm ex Hub.-Mor., 3, 08.07.2010, ŞH 2522. End. İr.-Tur.
Alhagi pseudalhagi (M.Bieb.) Desv., 36, 19.07.2009, ŞH 1466. İr.-Tur.

ROSACEAE

Prunus armeniaca Lam., 7, 22.05.2010, ŞH 1708. Kültür.
Cerasus microcarpa (C.A.Mey.) Boiss. subsp. *tortuosa* (Boiss. & Hausskn.) Browicz, 38, 22.05.2010, ŞH 1899. İr.-Tur.
C. mahaleb (L.) Mill. var. *mahaleb*, 6, 25.06.2010, ŞH 2423.
Amygdalus communis L., 2, 15.05.2010, ŞH 1645.
A. trichamydalus (Hand.-Mazz.) Woronow var. *trichamydalus*, 13, 05.06.2010, ŞH 2077. İr.-Tur.
Rubus sanctus Schreb., 10, 09.06.2010, ŞH 2272.
R. discolor Weihe & Nees, 17, 28.06.2009, ŞH 1363.
R. canescens DC. var. *canescens*, 14, 09.06.2010, ŞH 2273.
Potentilla recta L., 8, 22.05.2010, ŞH 1900.
P. reptans L., 34, 12.06.2011, ŞH 3160.
Geum urbanum L., 31, 05.06.2010, ŞH 2078. Av.-Sib.
Agrimonia eupatoria L., 17, 10.09.2010, ŞH 2612.
Sanguisorba minor Scop. subsp. *minor*, 36, 22.05.2010, ŞH 1733.
S. minor Scop. subsp. *muricata* (Spach) Briq., 4, 07.06.2009, ŞH 1155.
Rosa hemisphaerica Herrm., 25, 23.05.2009, ŞH 1111. İr.-Tur.
R. pulverulenta M.Bieb., 24, 01.07.2010, ŞH 2467.
R. canina L., 7, 28.06.2009, ŞH 1367.
Crateagus aronia (L.) Bosc. ex. DC. var. *aronia*, 13, 09.06.2010, ŞH 2276.
C. monogyna Jacq. subsp. *monogyna*, 29, 28.03.2009, ŞH 1063.
C. pseudoheterophylla Pojark, 26, 08.07.2010, ŞH 2523. İr.-Tur.
Pyrus elaeagnifolia Pall. subsp. *elaeagnifolia*, 35, 28.06.2009, ŞH 1368.

LYTHRACEAE

Lythrum salicaria L., 24, 10.09.2010, ŞH 2613. Avr-Sib.

ONAGRACEAE

Epilobium hirsutum L., 25, 09.06.2010, ŞH 2277.
E. parviflorum Schreb., 8, 09.08.2009, ŞH 1502.
E.roseum Schreb. subsp. *subsessile* (Boiss.) P.H.Raven, 15, 14.06.2010, ŞH 1255.
E. minutiflorum Hausskn., 31, 19.07.2009, ŞH 1469. İr.-Tur.

DATISCACEAE

Datisca cannabina L., 11, 08.07.2010, ŞH 2524.

CRASSULACEAE

Rosularia radiciflora Boiss. subsp. *kurdica* (Bornm.) Chamb. & Muirhead, 35, 22.05.2010,ŞH 1903. İr.-Tur.
R. haussknechtii Boiss. & Reuter, 23, 22.05.2011, ŞH 1904. End. İr.-Tur.
Sedum album L., 36, 09.06.2010, ŞH 2280.

APIACEAE

Actinolema macrolema Boiss., 36, 01.07.2010, ŞH 2468. İr.-Tur.
A. eryngioides Fenzl, Pug., 20, 03.07.2011, ŞH 3287. İr.-Tur.
Eryngium billardieri Delarbre, 25, 19.07.2009, ŞH 1470. İr.-Tur.
E. campestre L. var. *virens* Link, 5, 05.09.2009, ŞH 1506.
Echinophora tenuifolia L. subsp. *sibthorpiana* (Guss.) Tutin, 36, 10.09.2010, ŞH 2615. İr.-Tur.
Anthriscus nemorosa (M.Bieb.) Spreng., 7, 05.08.2010, ŞH 2593.
Scandix stellata Banks & Sol., 29, 28.06.2009, ŞH 1370.

S. iberica M.Bieb., 15, 28.03.2009, ŞH 1099.
S. pecten-veneris L., 4, 27.05.2011, ŞH 2973.
Bifora radians M.Bieb., 6, 09.06.2010, ŞH 2281.
Smyrnium cordifolium Boiss., 37, 06.06.2011, ŞH 3079. İr.-Tur.
Bunium paucifolium DC. var. *paucifolium*, 28, 25.06.2010, ŞH 2425. İr.-Tur.
B. paucifolium DC. var. *brevipens* (Freyn et Sint) Hedge et Lamond, 25, 05.06.2010, ŞH 2085. İr.-Tur.
P. kotschyana Boiss., 4, 14.06.2009, ŞH 1256. İr.-Tur.
P. tragium Vill. subsp. *lithophila* (Schischk.) Tutin, 1, 19.07.2009, ŞH 1471.
Prangos pabularia Lindl., 2, 03.07.2011, ŞH 3289. İr.-Tur.
P. peucedanifolia Fenzl., 7, 14.06.2009, ŞH 1258. İr.-Tur.
Bupleurum rotundifolium L., 25, 09.06.2010, ŞH 2284.
B. papillosum DC., 14, 22.05.2011, ŞH 2898. End. İr.-Tur.
B. gerardii All., 29, 14.06.2009, ŞH 1260.
Falcaria vulgaris Bernh., 27, 20.07.2011, ŞH 3355.
Ferula orientalis L., 23, 27.05.2011, ŞH 2974. İr.-Tur.
Malabaila dasyantha (K.Koch) Grassh., 28, 03.07.2010, ŞH 2507. İr.-Tur.
M. secacul Banks & Sol., 14, 05.06.2010, ŞH 2084.
Zosima absinthifolia (Vent.) Link, 24, 07.06.2009, ŞH 1156.
Ormosciadum aucheri Boiss., 19, 01.07.2010, ŞH 2472.
**Torilis arvensis* (Huds.) Link subsp. *arvensis*, 5, 19.07.2009, ŞH 1473.
T. leptophylla (L.) Reichb., 24, 14.06.2009, ŞH 1261.
Astrodaucus orientalis (L.) Drude, 24, 28.06.2009, ŞH 1372. İr.-Tur.
Caucalis platycarpos L., 28, 28.03.2009, ŞH 1090.
Turgenia latifolia (L.) Hoffm., 15, 22.05.2010, ŞH 1911.
Lisaea strigosa (Banks & Sol.) Eig., 35, 28.06.2009, ŞH 1373. İr.-Tur.
Daucus carota L., 24, 06.06.2011, ŞH 3082.
Artedia squamata L., 7, 05.06.2010, ŞH 2089.

CAPRIFOLIACEAE
Lonicera caucasica Pall. subsp. *orientalis* (Lam.) Chamb. & Long., 26, 08.07.2010, ŞH 2525. End.
RUBIACEAE
Asperula glomerata (M.Bieb.) Griseb. subsp. *glomerata*, 5, 05.06.2010, ŞH 2006. İr.-Tur.
A. stricta Boiss. subsp. *latibracteata* (Boiss.) Ehrend., 29, 12.06.2011, ŞH 3107. End. İr.-Tur.
A. xylorrhiza Nab., 37, 07.06.2009, ŞH 1181. İr.-Tur.
A. arvensis L., 27, 14.06.2009, ŞH 1206. Akd.
Galium verum L. subsp. *verum*, 35, 28.06.2009, ŞH 1315. Avr.-Sib.
G. mite Boiss. & Hohen., 20, 03.07.2011, ŞH 3299. İr.-Tur.
G. galiopsis (Hand.-Mazz.) Ehrend., 1, 17.06.2012, ŞH 4182. End. İr.-Tur.
G. incanum Sm. subsp. *elatius* (Boiss.) Ehrend., 8, 06.06.2011, ŞH 3026. İr.-Tur.
G.spurium L. subsp. *spurium*, 17, 22.05.2011, ŞH 2929. Avr.-Sib.
G. aparine L., 15, 23.05.2009, ŞH 1121.
G. nigricans Boiss., 27, 22.05.2010, ŞH 1764. İr.-Tur.
Callipeltis cucullaria (L.) Steven, 26, 09.06.2010, ŞH 2137. İr.-Tur.
Cruciata taurica (Pall. ex Willd.) Ehrend., 23, 22.05.2010, ŞH 1763. İr.-Tur.
C. articulata (L.) Ehrend., 22, 05.06.2010, ŞH 2010. İr.-Tur.
VALERIANACEAE
Valeriana sisymbriifolia Vahl, 32, 10.09.2010, ŞH 2616. İr.-Tur.
V. dioscoridis Sm., 7, 10.07.2011, ŞH 3312. Akd.
Valerianella carinata Loisel., 10, 22.05.2011, ŞH 2899.
V. pumila (L.) DC., 2, 15.05.2010, ŞH 1654.
V. coronata (L.) DC., 36, 12.06.2011, ŞH 3160.
V. vesicaria (L.) Moench, 5, 22.05.2010, ŞH 1914.
DIPSACACEAE
Cephalaria aristata K.Koch., 7, 09.06.2010, ŞH 2294.
C. syriaca (L.) Schrad., 29, 03.07.2011, ŞH 3290.
Scabiosa argentea L., 22, 26.06.2011, ŞH 2296.
S. persica Boiss., 35, 09.06.2010, ŞH 2297. İr.-Tur.
S. rotata M.Bieb., 14, 02.05.2011, ŞH 2782. İr.-Tur.
Pterocephalus plumosus (L.) Coult., 37, 13.05.2012, ŞH 3612.
ASTERACEAE
Xanthium spinosum L., 30, 03.07.2011, ŞH 3291.
X. strumarium L. subsp. *strumarium*, 25, 19.07.2009, ŞH 1475.
Chrysophtalmum montanum (DC.) Boiss., 34, 10.09.2010, ŞH 2618. İr.-Tur.
Inula oculus-christi L., 25, 05.09.2010, ŞH 1508. Avr.-Sib.
I. montbretiana DC., 8, 19.07.2009, ŞH 1476. İr.-Tur.
Pulicaria dysenterica (L.) Bernh., 31, 09.06.2010, ŞH 2299.
H. plicatum DC. subsp. *plicatum*, 36, 19.07.2010, ŞH 1477.
H. plicatum DC. subsp. *pseudoplicatum* (Nabelek) P.H.Davis & Kupicha, 26, 03.07.2010, ŞH 2509.
Filago pyramidata L., 5, 14.06.2009, ŞH 1264.
Erigeron acer L. subsp. *acer*, 17, 03.07.2011, ŞH 3292.
Conyza canedensis (L.) Cronquist, 31, 10.10.2010, ŞH 2646.
Bellis perennis L., 15, 28.03.2009, ŞH 1097. Avr.-Sib.
Senecio eriospermus DC. var. *eriospermus*, 34, 26.06.2011, ŞH 3249. İr.-Tur.
S. vernalis Waldst. & Kit., 29, 15.05.2010, ŞH 1657.
Tussilago farfara L., 26, 14.04.2010, ŞH 1554. Avr.-Sib.
Anthemis cretica L. subsp. *pontica* (Willd.) Grierson, 25, 22.05.2010, ŞH 1917.
A. kotschyana Boiss. var. *discoidea* (Bornm) Grierson, 36, 05.06.2010, ŞH 2094.
A. armeniaca Freyn & Sint, 29, 09.06.2010, ŞH 2303. End. İr.-Tur.
A. pseudocotula Boiss., 12, 05.06.2010, ŞH 2095.
Cota tinctoria L. var. *tinctoria*, 36, 28.06.2009, ŞH 1377.
C. coelopoda Boiss. var. *coelopoda*, 21, 14.04.2010, ŞH 1556.
C. austriaca Jacq., 16, 28.04.2010, ŞH 1589.
C. wiedemanniana Fisch. & C.A.Mey., 1, 23.05.2012, ŞH 3700.
Achillea wilhelmsii K.Koch., 8, 05.06.2010, ŞH 2097. İr.-Tur.
A.vermicularis Trin., 25, 01.07.2010, ŞH 2477. İr.-Tur.
A. schischkinii Sosn., 27, 15.05.2010, ŞH 1660. End. İr.-Tur.
A. pseudoaleppica Hub. & Mor., 36, 14.06.2009, ŞH 1266. End. İr.-Tur.
A. biebersteinii Afan., 2, 28.03.2009, ŞH 1072. İr.-Tur.
Tanacetum cadmeum (Boiss.) Heywood subsp. *orientale* Grierson, 5, 09.06.2010, ŞH, 2308. End. İr.-Tur.
T. densum (Lab.) subsp. *amani* Heywood, 11, 19.07.2009, ŞH 1479. End.
Tripleurospermum oreadas (Boiss.) Rech. fil. var. *tchihatchewii* (Boiss.) E. Hossain, 35, 17.06.2012, ŞH 4133.
T. transcaucasicum (Manden.) Pobed., 31, 22.05.2010, ŞH 1922.
Gundelia tournefortii L. var. *armata* Freyn & Sint, 4, 28.03.2009, ŞH 1049. İr.-Tur.
Cousinia sintenisii Freyn, 5, 14.06.2009, ŞH 1267. End. İr.-Tur.
Arctium minus (Hill) Bernh. subsp. *pubens* (Bab.) Arenes, 34, 26.06.2011, ŞH 3261. Avr.-Sib.
Onopordum candidum Nabelek, 7, 26.06.2011, ŞH 3241. İr.-Tur.
O. carduchorum Bornm. & Beauverd, 28, 01.07.2010, ŞH 2479.
Cirsium haussknechtii Boiss., 8, 28.06.2009, ŞH 1380. İr.-Tur.
C. arvense (L.) Scop. subsp. *vestitum* (Wimm. et Grab.) Petr., 24, 09.06.2010, ŞH 2310.
Picnomon acarna (L.) Cass., 16, 05.06.2010, ŞH 2102. Akd.
Ptilostemon afer (Jacq.) Greuter subsp. *eberneus*, 24, 08.07.2010, ŞH 2527. End.
Carduus nutans L. subsp. *nutans*, 1, 25.06.2010, ŞH 2430.
C. pycnocephalus L. subsp. *albidus* (M.Bieb.) Kazmi, 25, 28.05.2010, ŞH 1962.
J. eriobasis DC., Prodr., 5, 10.07.2011, ŞH 3319. İr.-Tur.
Jurinera ancyrensis Bornm., 36, 08.07.2010, ŞH 2528. End. İr.-Tur.
Centaurea balsamita Lam., Encycl., 27, 12.06.2011, ŞH 3168. İr.-Tur.
C. aggregata Fisch. & C.A.Mey. ex DC. subsp. *aggregata*, 30, 09.06.2010, ŞH 2315.
C. virgata Lam., 21, 07.06.2010, ŞH 1159.
C. derderiifolia Wagenitz, 35, 17.06.2012, ŞH 4138. End. İr.-Tur.
C. kurdica Reichardt, 21, 19.07.2009, ŞH 1481. End. İr.-Tur.
C. solstitialis L. subsp. *solstitialis*, 33, 09.06.2010, ŞH 2318.
C. iberica Trev. ex Spreng., 16, 05.06.2010, ŞH 1971.
C. urvillei DC. subsp. *armata* Wagenitz, 2, 26.05.2012, ŞH 3806. Akd.
C. urvillei DC. subsp. *hayekiana* Wagenitz, 29, 28.05.2010, ŞH 1965. End. İr.-Tur.
C. carduiformis DC. subsp. *carduiformis* var. *carduiformis*, 36, 10.07.2011, ŞH 3321.
Cyanus pichleri Boiss. subsp. *pichleri*, 1, 27.05.2011, ŞH 2975.
C. triumfettii All., 37, 09.06.2010, ŞH 2320.
C. depressa M.Bieb., 28, 06.06.2011, ŞH 3089.
Crupina crupinastrum (Moris) Vis., 2, 28.06.2009, ŞH 1386.
Cnicus benedictus L. var. *benedictus*, 4, 09.06.2010 ŞH 2323.
C. benedictus L. var. *kotschyi* Boiss., 35, 25.03.2012 ŞH 3427.

Carthamus persicus Willd., 15, 01.07.2010, ŞH 2481. İr.-Tur.
C. dentatus Vahl, 34, 12.06.2011, ŞH 3170.
Carlina oligocephala Boiss. & Kotschy subsp. *oligocephala*, 27, 17.06.2012, ŞH 4142.
Xeranthemum annuum L., 5, 28.06.2009, ŞH 1388.
Siebera pungens (Lam.) J.Gay., 25, 08.07.2010, ŞH 2529. İr.-Tur.
S. nana (DC.) Bornm., 24, 03.07.2010, ŞH 2510. İr.-Tur.
Chardinia orientalis (L.) Kuntze, 28, 02.05.2011, ŞH 2784. İr.-Tur.
Echinops pungens Trautv. var. *pungens*, 2, 28.06.2009, ŞH 1390. İr.-Tur.
E. orientalis Trautv., 29, 05.08.2010, ŞH 2595. İr.-Tur.
Cichorium inthybus L., 31, 01.07.2010, ŞH 2484.
Scorzonera laciniata L. subsp. *laciniata*, 26, 22.05.2010, ŞH 1930.
S. mollis M.Bieb. subsp. *mollis*, 18, 02.05.2011, ŞH 2771.
S. semicana DC., 29, 22.05.2010, ŞH 1931. End. İr.-Tur.
S. pseudolanata Grossh., 7, 09.06.2010, ŞH 2330. İr.-Tur.
S. tomentosa L., 25, 28.06.2009, ŞH 1394. End. İr.-Tur.
Trogopogon longirostis Bisch. ex Sch. Bip. var. *longirostris*, 25, 05.06.2010, ŞH 2091.
T. pterocarpus DC., 10, 09.06.2010, ŞH 2331. İr.-Tur.
T. latifolius Boiss. var. *angustifolius* Boiss., 17, 15.05.2010, ŞH 1665. İr.-Tur.
T. buphthalmoides (DC.) Boiss. var. *buphthalmoides*, 28, 19.05.2011, ŞH 2860.
Leontodon asperrimus (Willd.) J.Ball., 6, 25.06.2010, ŞH 2431. İr.-Tur.
L. crispus Vill. subsp. *asper* (Waldst. & Kit.) Rohlena var. *asper*, 2, 26.06.2011, ŞH 3263.
Picris kotschyi Boiss., 34, 09.06.2010, ŞH 2332.
Rhagadiolus angulosus (Jaub. & Spach) Kupicha, 24, 28.05.2010, ŞH 1934. İr.-Tur.
Reichardia glauca V.A.Matthews, 36, 06.09.2011, ŞH 3401. İr.-Tur.
Pilosella x auriculoides (Lang) P.D.Sell & C.West, 27, 06.06.2011, ŞH 3092.
Scariola orientalis (Boiss.) Sojak, 26, 10.09.2010, ŞH 2621. İr.-Tur.
L. communis L. subsp. *intermedia* (Bieb.) Hayek, 12, 22.05.2011, ŞH 2905.
Taraxacum montanum (C.A.Mey.) DC., 8, 02.05.2011, ŞH 2788. İr.-Tur.
T. hybernum Stev., 15, 28.06.2009, ŞH 1397.
T. bellidiforme Van Soest., 26, 28.04.2010, ŞH 1590. End. İr.-Tur.
Chondrilla juncea L. var. *juncea*, 12, 05.06.2010, ŞH 1967.
Crepis alpina L., 5, 22.05.2010, ŞH 1723.
C. foetida L. subsp. *rhoeadifolia* (M.Bieb.) Celak., 28, 05.06.2010, ŞH 2105.
C. sancta (L.) Babc., 2, 22.05.2010, ŞH 1929.

CAMPANULACEAE

Campanula glomerata L. subsp. *hispida* (Witasek) Hayek., 2, 27.05.2011, ŞH 2979.
C. involucrata Aucher ex A.DC., 26, 22.05.2011, ŞH 2907. İr.-Tur.
C. sclerotricha Boiss., 31, 09.06.2010, ŞH 2335. İr.-Tur.
C. stricta L. var. *stricta*, 35, 10.09.2010, ŞH 2623. İr.-Tur.
C. strigosa Banks. & Sol., 22, 28.03.2009, ŞH 1089. Akd.
C. propinqua Fisch. & C.A.Mey., 19, 03.06.2012, ŞH 3891. İr.-Tur.
Asyneuma amplexicaule (Willd.) Hand-Mazz. subsp. *amplexicaule* var. *amplexicaule*, 25, 12.06.2011, ŞH 3171.
A. limonifolium (L.) Janch. subsp. *limonifolium*, 35, 09.06.2010, ŞH 2337.
Legousia pentagonia (L.) Thellung, 26, 09.06.2010, ŞH 2338. Akd.

PRIMULACEAE

Primula auriculata Lam., 11, 12.06.2011, ŞH 3172. İr.-Tur.
Androsace maxima L., 27, 28.04.2010, ŞH 1591.
Anagallis arvensis L. var. *caerulea* (L.) Gouan, 31, 15.05.2010, ŞH 1668.
A. foemina Mill., 23, 15.05.2010, ŞH 1669. Akd.

OLEACEAE

Fraxinus angustifolia Vahl subsp. *angustifolia*, 13, 28.04.2010, ŞH 1592.

APOCYNACEAE

Vinca herbacea Waldst. & Kit., 16, 14.04.2010, ŞH 1558.

ASCLEPIDIACEAE

Vincetoxicum canescens (Willd.) Decne. subsp. *canescens*, 4, 05.06.2010, ŞH 2107.

GENTIANACEAE

Centaurium erythraea Rafn subsp. *turcicum* (Velen.) Melderis, 9, 09.06.2010, ŞH 2341.
C. pulchellum (Sw.) Druce, 15, 15.05.2010, ŞH 1671.

CONVOLVULACEAE

Convolvulus reticulatus Choisy subsp. *reticulatus*, 24, 22.05.2010, ŞH 1827. İr.-Tur.
C. lineatus L., 28, 09.06.2010, ŞH 2343.
C. holosericeus M.Bieb. subsp. *macrocalycinus* Hausskn. & Bornm. ex Bornm., 5, 09.06.2010, ŞH 2344. End. İr.-Tur.
C. arvensis L., 2, 22.05.2010, ŞH 1724.
C. galaticus Rostan ex Choisy, 30, 09.06.2010, ŞH 2342. End. İr.-Tur.
C. betonicifolius Mill. subsp. *peduncularis* (Boiss.) Paris, 7, 10.06.2012, ŞH 4010. End. İr.-Tur.

CUSCUTACEAE

Cuscuta brevistyla A.Braun., 17, 05.08.2010, ŞH 2596.

BORAGINACEAE

Heliotropium circinatum Griseb., 35, 28.06.2010, ŞH 1402. İr.- Tur.
H. europaeum L., 7, 10.09.2010, ŞH 2624. Akd.
H. dolosum De Not., 21, 09.06.2010, ŞH 2346.
Lappula barbata (M.Bieb.) Gürke, 36, 12.06.2011, ŞH 3178. İr.-Tur.
Rochelia cancellata Boiss. & Bal., 28, 10.05.2011, ŞH 2823. İr.-Tur.
R. disperma (L.f.) K.Koch var. *disperma*, 29, 09.06.2010, ŞH 2348.
Asperugo procumbens L., 36, 22.05.2011, ŞH 2909. Avr.-Sib.
Myosotis heteropoda Trautv., 23, 19.05.2011, ŞH 2865. İr.-Tur.
M. stricta Link ex Roem. & Schult., 34, 28.06.2009, ŞH 1403. Avr.-Sib.
M. lithospermifolia (Willd.) Hornem., 12, 07.06.2009, ŞH 1163.
Paracaryum cristatum (Schreb.) Boiss. subsp. *cristatum*, 5, 28.05.2010, ŞH 1935. End. İr.-Tur.
Cynoglossum montanum L., 32, 01.07.2010, ŞH 2485. Avr.-Sib.
Buglossoides arvensis (L.) I.M.Johnst., 39, 28.04.2010, ŞH 1594.
Echium italicum L., 20, 28.04.2011, ŞH 2745. Akd.
Moltkia coerulea (Willd.) Lehm., 1, 10.06.2012, ŞH 4011. İr.-Tur.
Onosma sericeum Willd., 24, 14.06.2009, ŞH 1285. İr.-Tur.
O. trachytrichum Boiss., 26, 15.05.2010, ŞH 1675. İr.-Tur.
O. molle DC., 21, 01.07.2010, ŞH 2486. İr.-Tur.
O. albo-roseum Fisch. & C.A.Mey. subsp. *albo-roseum* var. *albo-roseum*, 7, 22.05.2010, ŞH 1722. İr.-Tur.
O. rascheyanum Boiss., 5, 16.07.2010, ŞH 2563. İr.-Tur.
O. roussaei DC., 27, 12.06.2011, ŞH 3182. İr.-Tur.
O. auriculatum Aucher ex DC., 24, 01.07.2010, ŞH 2487. İr.-Tur.
Cerinthe minor L. subsp. *auriculata* (Ten.) Domac, 25, 28.05.2010, ŞH 1936. Avr.-Sib.
Brunnera orientalis (Schenk) John., 29, 07.06.2009, ŞH 1165.
Anchusa leptophylla Roem. & Schult. subsp. *leptophylla*, 1, 19.07.2009, ŞH 1486.
A. azure Mill. var. *azure*, 21, 28.06.2009, ŞH 1405.
A. strigosa Labill, 4, 09.06.2010, ŞH 2359.
A. aucheri DC., 30, 22.05.2010, ŞH 1717.
Nonea melanocarpa Boiss., 28, 05.06.2010, ŞH 1977. İr.-Tur.
N. pulla (L.) DC. subsp. *scabrisquamata* A.Baytop, 25, 14.03.2009, ŞH 1080. İr.-Tur.
N. stenosolen Boiss. & Bal., 7, 09.06.2010, ŞH 2362. End. İr.-Tur.
A. megacarpa DC., 23, 28.04.2010, ŞH 1598. End. İr.-Tur.

SOLANACEAE

Solanum nigrum L. subsp. *nigrum*, 26, 01.07.2010, ŞH 2488.
S. dulcamara L., 31, 05.08.2010, ŞH 2598. Avr.-Sib.
Datura stramonium L., 36, 10.10.2010, ŞH 2657.
Hyoscyamus niger L., 12, 06.06.2011, ŞH 3100.

SCROPHULARIACEAE

Verbascum euphraticum Bentham in DC., 37, 17.06.2012, ŞH 4155. End. İr.-Tur.
V. oocarpum Murb., 27, 01.07. 2010, ŞH 3364. End. İr.-Tur.
V. diversifolium Hochst., 21, 22.05.2010, ŞH 1716. End. İr.-Tur.
V. melitenense Hub.-Mor., 38, 12.06.2011, ŞH 3187. End. İr.-Tur.
V. glomeratum Boiss., 16, 26.06.2011, ŞH 3268. İr.-Tur.
V. kotschyi Boiss. & Hohen., 30, 25.06.2010, ŞH 2433. İr.-Tur.
V. lasianthum Boiss. ex Benth., 29, 14.06.2009, ŞH 1289.
Scrophularia umbrosa Dumort, 11, 09.06.2010, ŞH 2366. Avr.-Sib.
S. rimarum Bornm., 10, 01.07.2010, ŞH 2489.
S. xanthoglossa Boiss. var. *decipiens* (Boiss. & Kotschy) Boiss., 16, 09.06.2010, ŞH 2367. İr.-Tur.
Anarrhinum orientale Bentham, 37, 09.06.2010, ŞH 2368. İr.-Tur.
Linaria genistofolia (L.) Mill. subsp. *confertiflora* (Boiss.) P.H.Davis, 4, 22.05.2010, ŞH 1824.İr.-Tur.
L. chalepensis (L.) Mill. var. *chalepensis*, 27, 26.06.2011, ŞH 3271. Akd.

L. kurdica Boiss. & Hohen. subsp. *kurdica* Boiss. & Huet, 23, 22.05.2010, ŞH 1730. İr.-Tur.
Kickxia spuria (L.) Dum. subsp. *integrifolia* (Brot.) R.Fernandes, 8, 05.08.2010, ŞH 2599.
Veronica bozakmanii M.A.Fisch., 18, 09.06.2010, ŞH 2370. İr.-Tur.
V. triphyllos L., 15, 07.06.2009, ŞH 1169.
V. campylopoda Boiss., 23, 13.05.2012, ŞH 3582. İr.-Tur.
V. triloba (Opiz) Kerner, 31, 22.05.2010, ŞH 1732.
V. anagallis-aquatica L., 8, 10.05.2012, ŞH 3624.
V. oxycarpa Boiss., 36, 17.06.2012, ŞH 4157. İr.-Tur.
V. macrostachya Vahl. subsp. *mardinensis* (Bornm.) M.A.Fisch., 35 , 07.06.2009, ŞH 1171. End. İr.-Tur.
V. orientalis Mill. subsp. *orientalis*, 26, 05.06.2010, ŞH 1983. İr.-Tur.
V. orientalis Mill. subsp. *nimrodi* (Richter ex Stapf) M.A.Fisch., 10, 28.03.2009,ŞH 1057.End.İr.-Tur.
V. multifida L., 2, 06.06.2011, ŞH 3101. İr.-Tur.
Odontites aucheri Boiss., 25, 16.07.2010, ŞH 3478. İr.-Tur.
Bungea trifida (Vahl) C.A. Meyer, 4, 28.03.2009, ŞH 1053. İr.-Tur.

OROBANCHACEAE

Orobanche nana Noe ex G.Beck, 34, 09.06.2010, ŞH 2372.
O. aegyptica Pers., 7, 28.06.2009, ŞH 1411.
O. oxyloba (Reuter) G.Beck., 26, 10.06.2012, ŞH 4015.
O. minor Sm., 36, 26.05.2012, ŞH 3816.
O. anatolica Boiss. & Reuter, 17, 17.05.2012, ŞH 3625.

ACANTHACEAE

Acanthus dioscoridis L. var. *dioscoridis*, 39, 09.06.2010, ŞH 2375. İr.-Tur.

GLOBULARIACEAE

Globularia trichosantha Fisch. & C.A.Mey. subsp. *trichosantha*, 37, 03.07.2011, ŞH 3311.

VERBENACEAE

Verbena officinalis L., 29, 09.08.2009, ŞH 1503.

LAMIACEAE

Ajuga chamaeptys (L.) Schreb. subsp. *chia* (Schreb.) Arcang. var. *chia*, 39, 22.05.2011, ŞH 2918.
A. chamaeptys (L.) Schreb. subsp. *chia* (Schreb.) Arcang. var. *ciliata* Briq., 2, 07.06.2009, ŞH 1173.
Teucrium multicaule Montbret & Aucher ex Benth., 4, 07.06.2009, ŞH 1174. İr.-Tur.
T. parviflorum Schreb., 29, 27.05.2011, ŞH 2987. İr.-Tur.
T. chamaedrys L. subsp. *syspirense* (K.Koch) Rech. f., 11, 09.06.2010, ŞH 2378. İr.-Tur.
T. chamaedrys (Celak.) Rech. fil. subsp. *sinuatum*, 38, 14.06.2009, ŞH 1291. İr.-Tur.
T. polium L., 23, 05.06.2010, ŞH 1986.
Scutellaria salviifolia Benth., 27, 03.07.2010, ŞH 2512. End.
S. orientalis L. subsp. *orientalis*, 11, 09.06. 2010, ŞH 2380. End. İr.-Tur.
S. orientalis L. subsp. *bicolor* (Hochst.) J.R.Edm., 4, 14.06.2009, ŞH 1293. End. İr.-Tur.
S. orientalis L. subsp. *sintenisii* (Hausskn ex Bornm.), 39, 09.06.2010, ŞH 2381. End. İr.-Tur.
Eremostachys molucelloides Bunge., 29, 06.06.2011, ŞH 3020. İr.-Tur.
Phlomis pungens Willd. var. *hispida* Hub.-Mor., 4, 05.06.2010, ŞH 1987.
P. rigida Labill., 25, 16.07.2010, ŞH 3464. İr.-Tur.
P. oppositiflora Boiss. & Hausskn., 37, 01.07.2010, ŞH 2493. End. İr.-Tur.
P. sieheana Rech., 26, 26.06.2011, ŞH 3206. End. İr.-Tur.
P. sintenisii Rech., 36, 28.06.2009, ŞH 1417. End. İr.-Tur.
P. linerais Boiss.& Bal., 4, 10.08.2010, ŞH 3544. End. İr.-Tur.
P. kurdica Rech. fil., 23, 01.07.2010, ŞH 2494. İr.-Tur.
Lamium garganicum L. subsp. *reniforme* (Montbret & Aucher) R.R.Mill, 29, 08.07.2010, ŞH 2542.
L. amplexicaule L., 27, 14.04.2010, ŞH 1560. Avr.-Sib.
L. macrodon Boiss. & A.Huet, 27, 22.05.2011, ŞH 2919. İr.-Tur.
**L. tomentosum* Willd. var. *alpestre* (Trautv.) N.Popova, 17, 22.05.2010, ŞH 1734. İr.-Tur.
Wiedemannia orientalis Fisch. & C.A.Mey., 10, 05.06.2010, ŞH 1988. End. İr.-Tur.
**W. multifida* (L.) Benth., 35, 10.05.2011, ŞH 2826. İr.-Tur.
Molucella laevis L., 8, 12.06.2011, ŞH 3164. İr.-Tur.
**Ballota rotundifolia* C. Koch., 24, 12.06.2011, ŞH 3194. End. İr.-Tur.
Marrubium parviflorum Fisch. & C.A.Mey. subsp. *parviflorum*, 27, 14.06.2009, ŞH 1298.
M. cuneatum Russell, 7, 23.06.2012, ŞH 4232. İr.-Tur.
M. astracanicum Jacq. subsp. *astracanicum*, 29, 12.06.2011, ŞH 3154.
Sideritis montana L. subsp. *montana*, 37, 15.07.2010, ŞH 3268. Akd.
S. vulcacina Hub.-Mor., 36, 08.07.2010, ŞH 2534. End. İr.-Tur.
Stachys creatica L. subsp. *garana* (Boiss.) Rech., 4, 10.06.2012, ŞH 4021. İr.-Tur.
S. spectabilis Choisy ex DC., 31, 01.07.2010, ŞH 2496. İr.-Tur.
S. lavandulifolia Vahl var. *lavandulifolia*, 35, 23.05.2009, ŞH 1117. İr.-Tur.
S. iberica M.Bieb. subsp. *stenostachya* (Boiss.) Rech. f., 25, 01.07.2010, ŞH 2497.İr.-Tur.
S. annua (L.) L. subsp. *annua* var. *annua*, 17, 06.06.2011, ŞH 3012.
**Nepeta nuda* L. subsp. *nuda*, 39, 17.06.2012, ŞH 4167.
Lallemantia peltata (L.) Fisch. & Mey., 1, 19.05.2011, ŞH 2868. İr.-Tur.
L. iberica (M.Bieb.) Fisch. & C.A.Mey., 34, 15.05.2010, ŞH 1682. İr.-Tur.
Prunella vulgaris L., 18, 10.09.2010, ŞH 2627. Avr.-Sib.
Origanum vulgare L. subsp. *gracile* (K.Koch) Letswaart, 8, 28.06.2009, ŞH 1418. İr.-Tur.
Satureja hortensis L., 21, 10.09.2010, ŞH 2628.
Clinopodium vulgare L. subsp. *arundanum* (Boiss.) Nyman, 31, 16.07.2010, ŞH 2543.
Acinos rotundifolius Pers., 19, 14.06.2009, ŞH 1300.
Thymus hausknechtii Velen., 4, 09.06.2010, ŞH 2394. End. İr.-Tur.
T. kotschyanus Boiss. & Hohen. var. *glabrescens* Boiss., 6, 09.06.2010, ŞH 2395. İr.-Tur.
T. kotschyanus Boiss. & Hohen. var. *eriophorus* (Ronniger) Jalas., 15, 19.07.2009, ŞH 1494. İr.-Tur.
T. kotschyanus Boiss. & Hohen. var. *kotschyanus*, 7, 05.07.2010, ŞH 3526. İr.-Tur.
Mentha longifolia (L.) Huds. subsp. *typhoides* (Briq.) Harley var. *typhoides*, 8, 19.07.2009, ŞH 1495.
M. spicata L. subsp. *spicata*, 15, 28.06.2009, ŞH 1421.
Ziziphora capitata L., 16, 02.05.2011, ŞH 3917. İr.-Tur.
Z. persica Bunge, 25, 22.05.2011, ŞH 2921. İr.-Tur.
Z. tenuior L., 19, 25.06.2010, ŞH 2440. İr.-Tur.
Z. taurica M.Bieb. subsp. *taurica*, 35, 06.06.2011, ŞH 3015. İr.-Tur.
Salvia trichoclada Benth., 25, 22.05.2011, ŞH 2922. İr.-Tur.
S. suffruticosa Montbret & Aucher ex Benth., 16, 03.06.2012, ŞH 3926. İr.-Tur.
S. sericeo-pruinosa Rech. f., 36, 17.06.2012, ŞH 4171. End. İr.-Tur.
S. multicaulis Vahl, 24, 15.05.2010, ŞH 1684. İr.-Tur.
S. syriaca L., 34, 06.06.2011, ŞH 3016. İr.-Tur.
S. palaestina Benth., 27, 09.06.2010, ŞH 2110. İr.-Tur.
S. aethiopis L., 36, 19.07.2009, ŞH 1423.
S. ceratophylla L., 25, 12.06.2011, ŞH 3195. İr.-Tur.
S. microstegia Boiss. & Bal., 19, 07.06.2009, ŞH 1177. İr.-Tur.
**S. frigida* Boiss., 29, 23.06.2012, ŞH 4237. İr.-Tur.
S. candidissima Vahl subsp. *candidissima*, 2, 28.06.2009, ŞH 1304. İr.-Tur.
S. virgata Jacq., 31, 09.06.2010, ŞH 2112. İr.-Tur.
S. verticillata L. subsp. *amasiaca* (Freyn & Bornm.) Bornm., 36, 25.06.2010, ŞH 2442. İr. -Tur.
S. russelli Benth., 11, 09.06.2010, ŞH 2120. İr.-Tur.

PLUMBAGINACEAE

Plumbago europea L., 8, 05.08.2010, ŞH 2600. Avr.-Sib.
Acantholimon acerosum (Willd.) Boiss. var. *acerosum*, 5, 22.05.2010, ŞH 1726. İr.-Tur.
A. saxifragiforme (Hauskn. & Sint.) ex Bokhari, 32, 27.05.2011, ŞH 2993. End. İr.-Tur.

PLANTAGINACEAE

Plantago major L. subsp. *major*, 15, 08.07.2010, ŞH 2535.
P. lanceolata L., 29, 28.06.2009, ŞH 1307.

THYMELAEACEAE

Thymelaea aucheri Meissn., 26, 14.06.2009, ŞH 1196. Akd.
T. passerina (L.) Coss. & Germ., 17, 20.07.2011, ŞH 3344.

ELAEAGNACEAE

Elaeagnus angustifolia L., 8, 22.05.2010, ŞH 1883.

SANTALACEAE

Thesium aureum Jaub. & Spach, 26, 22.05.2010, ŞH 1746. End. İr.-Tur.

T. impressum Steudel ex A.DC., 20, 22.05.2011, ŞH 2925. İr.-Tur.
ARISTOLOCHIACEAE
Aristolochia maurorum L., 25, 07.06.2009, ŞH 1179. İr.-Tur.
EUPHORBIACEAE
Andrachne telephioides L., 6, 14.06.2009, ŞH 1198.
Chrozophora tinctoria (L.) Raf., 36, 05.06.2010, ŞH 1997.
Euphorbia chamaesyce L., 26, 25.06.2010, ŞH 2443.
E. petiolata Banks. & Sol., 30, 10.06.2012, ŞH 4067. İr.-Tur.
E. altissima Boiss. var. *altissima*, 6, 12.06.2011, ŞH 3185. İr.-Tur.
E. aleppica L., 12, 09.06.2010, ŞH 2130. İr.-Tur.
E. szovitsii Fisch. & C.A.Mey. var. *kharputensis* Azn. ex M.S.Khan, 1, 23.05.2009, ŞH 1119.İr.-Tur.
E. falcata L. subsp. *falcata* var. *falcata*, 9, 06.06.2009, ŞH 1822.
E. denticulata Lam., 21, 14.06.2009, ŞH 1201. İr.-Tur.
E. macroclada Boiss., 31, 19.07.2009, ŞH 1426. İr.-Tur.
E. cheiradenia Boiss. & Hohen., 25, 28.06.2009, ŞH 1310. İr.-Tur.
E. virgata Waldst. & Kit., 7, 22.05.2010, ŞH 1813.
URTICACEAE
Urtica dioica L., 31, 25.06.2010, ŞH 2445. Avr.-Sib.
Parietaria judaica L., 36, 20.07.2010, ŞH 2565.
P. lusitanica L., 32, 03.07.2011, ŞH 3298. Akd.
MORACEAE
Morus alba L., 16, 22.05.2010, ŞH 1752. Kültür.
M. nigra L., 7, 23.05.2012, ŞH 3704. Kültür.
Ficus carica L. subsp. *carica* (All.) Schinz & Thell., 29, 09.06.2010, ŞH 2127.
F. carica L. subsp. *rupestris* (Hauskn.) Browicz, 35, 02.05.2011, ŞH 2796. İr.-Tur.
ULMACEAE
Ulmus minor Mill. subsp. *minor*, 16, 05.07.2009, ŞH 1497. Akd.
Celtis tournefortii Lam., 34, 28.05.2010, ŞH 1939.
JUGLANDACEAE
Juglans regia L., 36, 15.05.2010, ŞH 1686.
PLATANACEAE
Platanus orientalis L., 35, 19.07.2009, ŞH 1429.
FAGACEAE
Quercus infectoria Olliver subsp. *boissieri* (Reut.) O.Schwartz, 13, 09.06.2010, ŞH 2128.
Q. cerris L. var. *cerris*, 27, 19.07.2009, ŞH 1430.
SALICACEAE
Salix triandra L. subsp. *bornmuelleri* (Hauskn.) A.K.Skvortsov, 7, 07.06.2009, ŞH 1180. İr.-Tur.
S. alba L., 38, 22.05.2010, ŞH 1754. Avr.-Sib.
Populus alba L., 7, 02.05.2011, ŞH 2798. Avr.-Sib.
P. tremula L., 36, 26.05.2012, ŞH 3825. Avr.-Sib.

LILIOPSIDA (MONOCOTYLEDON)
POTAMOGETONACEAE
Potamogeton pectinatus L., 31, 10.09.2010, ŞH 2630.
ARACEAE
Arum maculatum L., 19, 27.05.2011, ŞH 2994.
Biarum carduchorum (Schott) Engl., 17, 22.05.2010, ŞH 1762. İr.-Tur.
Eminium rauwolffii (Blume) Schott var. *rauwolffii*, 23, 15.05.2010, ŞH 1691. İr.-Tur.
LILIACEAE
Asphodeline tenuior (Fisch.) Ledeb. subsp. *tenuiflora* (K.Koch) E.Tuzlacı var. *tenuiflora*, 28, 23.05.2012, ŞH 3708. İr.-Tur.
A. damescena (Boiss.) Baker subsp. *damescena*, 32, 09.06.2010, ŞH 2141. İr.-Tur.
Allium stamineum Boiss., 4, 19.07.2009, ŞH 1433. Akd.
A. myrianthum Boiss., 25, 19.06.2010, ŞH 2142. İr.-Tur.
A. ampeloprasum L., 21, 10.06.2012, ŞH 4047. Akd.
A. atroviolaceum Boiss., 8, 28.06.2009, ŞH 1320.
A. scorodoprasum L. subsp. *rotundum* (L.) Stearn, 29, 14.03.2009, ŞH 1023. Akd.
A. sintenisii Freyn, 5, 14.06.2009, ŞH 1207. End. İr.-Tur.
A. colchicifolium Boiss., 25, 26.06.2011, ŞH 3215. İr.-Tur.
Puschkinia scilloides Adams, 29, 22.05.2010, ŞH 1767. İr.-Tur.
Ornithogalum oligophyllum E.D.Clarke, 30, 14.03.2009, ŞH 1009.
O. orthophyllum Ten., 2, 14.04.2010, ŞH 1563.
O. refractum Kit. ex Schleich., 24, 26.03.2011, ŞH 2676.
Muscari comosum (L.) Mill., 1, 14.04.2010, ŞH 1564. Akd.
M. armeniacum Leichtlin ex Baker, 26, 26.03.2011, ŞH 2678.
M. neglectum Guss., 19, 15.04.2012, ŞH 3460.
Bellevalia sarmatica (Pall. ex Georgi) Woronow, 8, 23.05.2009, ŞH 1123.
B. gracilis Feinburn, 7, 15.04.2012, ŞH 3451. End. İr.-Tur.
Fritallaria caucasica J.F.Adam, 4, 22.05.2011, ŞH 2933.
Tulipa armena Boiss. var. *armena*, 5, 22.05.2010, ŞH 1769. İr.-Tur.
Gagea taurica Stev., 3, 14.04.2010, ŞH 1566. İr.-Tur.
G. chlorantha (M.Bieb.) Schult. & Schult. fil., 36, 26.03.2011, ŞH 2682. İr.-Tur.
G. villosa (Bieb.) Duby var. *villosa*, 4, 14.03.2009, ŞH 1019. Akd.
Colchicum falcifolium Stapf., 15, 14.03.2009, ŞH 1013. İr.-Tur.
C. szovitsii Fisch. & C.A.Mey., 25, 28.03.2010, ŞH 1527. İr.-Tur.
Merendera sobolifera C.A.Mey., 37, 14.04.2010, ŞH 1567. İr.-Tur.
AMARYLLIDACEAE
Ixilorion tataricum (Pall.) Herb. subsp. *montanum* (Labill.) Takht., 29, 07.06.2009, ŞH 1184. İr.-Tur.
IRIDACEAE
Iris reticulata M.Bieb. var. *reticulata*, 36, 26.03.2011, ŞH 2686. İr.-Tur.
I. persica L., 5, 14.03.2009, ŞH 1003. İr.-Tur.
Crocus biflorus Mill. subsp. *tauri* (Maw.) B.Mathew, 29, 14.03.2009, ŞH 1596. İr.-Tur.
C. pallasii Goldb subsp. *pallasii*, 7, 10.09.2010, ŞH 2633.
C. cancellatus Herbert subsp. *damascenus* (Herbert) Mathew, 26, 10.10.2010, ŞH 2658. İr.-Tur.
Gladiolus atroviolaceus Boiss., 28, 09.06.2010, ŞH 2148. İr.-Tur.
ORCHIDACEAE
Cephalanthera longifolia (L.) Fritsch., 31, 28.05.2010, ŞH 1941. Avr.-Sib.
Dactylorhiza iberica (M.Bieb. ex Willd.) Soo, 8, 28.06.2009, ŞH 1322. Akd.
D. osmanica (Klinge) Soo. var. *anatolica* (Nelson) Renz & Taub., 38, 22.05.2010, ŞH 1771. End. İr.-Tur.
TYPHACEAE
Typha latifolia L., 31, 10.06.2012, ŞH 4048.
JUNCACEAE
Juncus inflexus L., 8, 19.07.2009, ŞH 1436.
J. articulatus L., 34, 03.07.2010, ŞH 2501. Avr.-Sib.
CYPERACEAE
Cyperus fuscus L., 31, 20.09.2009, ŞH 1488. Avr.-Sib.
Eleocharis palustris (L.) Roem. & Schult., 25, 07.06.2009, ŞH 1185.
Bolboschoenus maritimus (L.) Palla var. *maritimus*, 26, 26.06.2011, ŞH 3216.
Scirpoides holoschoenus (L.) Sojak, 38, 09.06.2010, ŞH 2151.
Carex diandra Schrank, 30, 10.06.2012, ŞH 4049. Avr.-Sib.
C. stenophylla Wahlenb. subsp. *stenophylloides* (V.I.Krecz.) T.V.Egorova, 37, 08.07.2010, ŞH 2539. İr.-Tur.
C. nigra (L.) Reichard subsp. *dacica* (Heuff.) Soo, 18, 07.06.2009, ŞH 1187. Avr.-Sib.
POACEAE
Elymus repens (L.) Gould subsp. *repens*, 32, 01.07.2010, ŞH 2449. İr.-Tur.
E. hisbidus (Opiz) Melderis subsp. *hisbidus*, 24, 05.06.2010, ŞH 2014. Akd.
Aegilops umbellulata Zhuk. subsp. *umbellulata*, 8, 28.05.2010, ŞH 1942. İr.-Tur.
Ae. triuncialis L. subsp. *triuncialis*, 28, 17.06.2012, ŞH 4075.
Ae. columnaris Zhuk., 1, 05.06.2010, ŞH 2017. İr.-Tur.
Secale ciliatoglume (Boiss.) Grossh., 10,14.06.2009, ŞH 1209. İr.-Tur.
Hordeum murinum L. subsp. *glaucum* (Steud.) Tzvelev, 24, 03.07.2011, ŞH 3302.
H. bulbosum L., 23, 07.06.2009, ŞH 1188.
Taeniatherum caput-medusae (L.) Nevski subsp. *crinitum* (Schreb.) Melderis, 32,25.06.2010,ŞH 2405. İr.-Tur.
Bromus japonicus Thunb. subsp. *japonicus*, 29, 09.06.2010, ŞH 2153.
B. scoparius L., 27, 16.07.2010, ŞH 2548.
B. danthoniae Trin., 4, 03.07.2011, ŞH 3303.
B. tectorum L. subsp. *tectorum*, 22, 15.05.2010, ŞH 1696.
B. sterilis L., 25, 22.05.2011, ŞH 2937.
B. tomentellus Boiss., 8, 14.06.2009, ŞH 1211. İr.-Tur.
Avena sterilis L. subsp. *sterilis*, 37, 05.06.2010, ŞH 2019.
Arrhenatherum elatius (L.) P.Beauv. ex J. & C.Presl subsp. *elatius*, 10, 26.06.2011, ŞH 3218. Akd.
A. palaestinum Boiss., 7, 09.06.2010, ŞH 2155. Avr.-Sib.
Koelaria cristata (L.) Pers., 12, 05.06.2010, ŞH 2020.

Calamagrostis pseudophrogmites (Haller f.) Koeler, 15, 28.05.2010, ŞH 1944. Avr.-Sib.
Alopecurus arundinceus Poir., 36, 06.06.2009, ŞH 1711. Avr.-Sib.
Phleum pratense L., 4, 06.06.2011, ŞH 3040. Avr.-Sib.
P. exaratum Hochst. Ex Griseb. subsp. *exaratum*, 32, 01.07.2010, ŞH 2450.
Agrostis gigantea Roth., 2, 05.06.2010, ŞH 2022. Avr.-Sib.
Apera intermedia Hackel Apud Zederbauer., 28, 17.06.2012, ŞH 4078. İr.-Tur.
Vulpia ciliata Dum. subsp *ciliata*, 38, 05.06.2010, ŞH 2007. Çok bölgeli.
V. unilateralis (L.) Stace, 31, 09.06.2010, ŞH 2164.
Psilurus incurvus (Govan) Schinz & Thell., 4, 03.06.2012, ŞH 3944.
Poa trivalis L., 26, 22.05.2010, ŞH 1782.
P. angustifolia L., 27, 09.06.2010, ŞH 2161.
P. bulbosa L., 39, 03.06.2012, ŞH 3951.
Eremopoa songarica (Schrenk) Roshev., 26, 23.05.2012, ŞH 3714. İr.-Tur.
Catabrosa aquatica (L.) P.Beauv., 18, 09.06.2010, ŞH 2162.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman, 32, 14.06.2009, ŞH 1213.
Briza humilis M.Bieb., 19, 05.06.2010, ŞH 2021.
Echinaria capitata (L.) Desf., 5, 07.06.2009, ŞH 1191.
Melica persica Kunth subsp. *inaequiglumis* (Boiss.) Bor, 17, 12.06.2011, ŞH 3117.
M. persica Kunth subsp. *canescens* (Regel) P.H.Davis, 36, 09.06.2010, ŞH 2166. İr.-Tur.
Stipa holosericea Trin., 10, 22.05.2010, ŞH 1786. İr.-Tur.
S. arabica Trin. & Rupr., 19, 05.06.2010, ŞH 2028. İr.-Tur.
S. ehrenbergiana Trin. & Rupr., 6, 01.06.2009, ŞH 1450. İr.-Tur.
Oryzopsis hymenoides (Roem. & Schult.) Ricker, 28, 25.06.2010, ŞH 2407.
Phragmites australis (Cav.) Trin. ex Steud., 8, 22.05.2010, ŞH 1788. Avr.-Sib.
Eragrostis minor Host, 31, 09.06.2010, ŞH 2169.
Cynodon dactylon (L.) Pers. var. *villosus* Regel, 26, 28.06.2009, ŞH 1327.
Echinochloa crus-galli (L.) P.Beauv., 16, 10.06.2012, ŞH 4062.
Digitaria sanguinalis (L.) Scop., 36, 10.07.2011, ŞH 3335.
Setaria viridis (L.) P.Beauv., 37, 22.05.2010, ŞH 1789.
S. verticillata (L.) P.Beauv. var. *verticillata*, 8, 15.05.2010, ŞH 1697.
Pennisetum orientale Rich., 27, 05.06.2010, ŞH 2031. İr.-Tur.
Sorghum halepense (L.) Pers. var. *halepense*, 26, 19.07.2009, ŞH 1447.
Chrysopogon gryllus (L.) Trin., 35, 28.05.2010, ŞH 1945.
Bothriochloa ischaemum (L.) Keng., 6, 10.06.2012, ŞH 4064.

4. Sonuçlar ve tartışma

Yapılmış olan floristik çalışma, araştırma alanından 4 yıllık sürede (2009-2012) toplanan 3283 bitki örneğine dayanmaktadır. Toplanmış olan bitki örneklerinin sistematik olarak değerlendirilmesi sonucu, araştırma alanında 84 familyaya ait 374 cins ve bu cinslere ait 538 tür, 160 alttür ve 100 varyete olmak üzere toplamda 798 takson saptanmıştır. 798 taksonun 3'ü Pteridophyta, 795'i Spermatophyta bölümüne aittir. Spermatophyta bölümüne ait 795 taksondan 6'sı Coniferophyta (Gymnospermae), 789'u Magnoliophyta (Angiospermae) alt bölümüne dahildir. Magnoliophyta alt bölümündeki 789 taksonun 686'sı Magnoliopsida (Dicotyledoneae), 103'ü Liliopsida (Monocotyledoneae) sınıflarında bulunmaktadır. Bu taksonomik kategorilerin içerdikleri takson sayıları ve oranları Tablo 4.1' de gösterilmiştir. Takson sayısı bakımından araştırma alanındaki ilk 10 büyük familya sıralanmış ve Tablo 4.2' de gösterilmiştir.

Tablo 4.1. Taksonomik Kategorilerin İçerdikleri Takson Sayıları ve Oranları

Not: Oranlama yapılırken her bir kategori, en alttaki toplam sayıya göre oranlanmıştır.		*Familya*		*Cins*		*Tür ve Türaltı Takson*		*Endemik*	
		Adet	*Oran (%)*	*Adet*	*Oran (%)*	*Adet*	*Oran (%)*	*Adet*	*Oran (%)*
Pteridophyta		3	3.57	3	0.80	3	0.37	--	--
Spermatophyta	***Gymnospermae***	3	3.57	5	1.34	6	0.75	--	--
	Angiospermae	78	92.86	366	97.86	789	98.88	85	100
Toplam		84		374		798		85	

Tablo 4.2. İçerdikleri Takson Sayısı Bakımından İlk Büyük 10 Familya.

FAMİLYA ADI	TAKSON SAYISI	TOPLAM TAKSON SAYISINA (798) GÖRE ORANI (%)
Asteraceae	96	12.0
Fabaceae	92	11.5
Lamiaceae	69	8.6
Brassicaceae	61	7.6
Poaceae	53	6.6
Caryophyllaceae	39	4.9
Apiaceae	34	4.3
Boraginaceae	32	4.0
Scrophulariaceae	27	3.4
Liliaceae	26	3.3
TOPLAM	529	66.2
DİĞER	269	33.8

Tablo 4.2.'de görüldüğü üzere, çalışma alanında takson içeriği bakımından büyük familyalar, toplam takson sayısının yarısından daha fazlasını (%66.2) teşkil etmektedir. Araştırma alanındaki bitkilerin teşhisi sonucunda takson içeriği bakımından belirlenen bu büyük familyalar, genellikle Türkiye Florası'nda yer alan ve bölgede yapılan diğer birçok floristik araştırmada da saptanan en büyük familyalar arasındadırlar. Çalışma alanında ilk beş sırayı teşkil eden familyalar (Tablo 4.2) sıralanışları haricinde Doğu Anadolu Florası'nın genel karakteristiğini yansıtır. Bu 10 familya dışında kalan 74 familya ise 269 takson içerip araştırma alanı florasının % 33.8'ni oluşturmaktadır (Tablo 4.2).

Tablo 4.2 'de görüldüğü gibi araştırma alanında belirlenen ilk üç familya sıralaması Asteraceae-Fabaceae-Lamiaceae şeklindedir. Çalışma alanında takson içeriği bakımından ilk üç familya, araştırma alanına yakın yerlerdeki floristik çalışmalarda belirlenen ilk üç familya sıralaması sonuçları ile Tablo 4.3' de karşılaştırılmıştır.

Tablo 4.3. Takson Sayısı Bakımından İlk Büyük Üç Familyanın Çalışma Alanlarına Göre Dağılımı.

ARAŞTIRMA ALANININ ADI	**İLK ÜÇ FAMİLYA SIRALAMASI**
Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Saha (2012)	**Asteraceae–Fabaceae-Lamiaceae**
Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011).	Asteraceae–Fabaceae-Lamiaceae
Elazığ Cip Baraj Gölü-Arındık Köyü Arasındaki Saha (Doğan, 2009).	Fabaceae-Asteraceae-Lamiaceae
Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004).	Asteraceae–Fabaceae-Brassicaceae
Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003).	Asteraceae–Fabaceae-Lamiaceae
Harput Florası (Çakılcıoğlu, 2002).	Asteraceae–Fabaceae-Poaceae
Buzluk Mağaraları ve Şüşnaz (Erkan, 2002).	Asteraceae–Brassicaceae-Poaceae
Çakmakbeli (Duru, 2001).	Fabaceae–Asteraceae-Lamiaceae
Baskil (Katkılar) (Behçet, 1999a).	Asteraceae–Fabaceae-Poaceae
Baskil ve Çevresi (Elazığ) Florası Üzerine Bir Araştırma (Aziret, 1996).	Asteraceae–Fabaceae-Lamiaceae
Keban Baraj Gölü'ndeki Adalar (Ayvaz vd., 1993).	Asteraceae–Fabaceae-Lamiaceae
Mastar, Kup, Yaylım Dağları (Evren, 1985).	Fabaceae–Asteraceae-Brassicaceae
Malatya-Pütürge (Altan, 1984).	Fabaceae–Asteraceae-Brassicaceae
Hazar Dağları (Altan, 1981).	Fabaceae–Asteraceae-Brassicaceae
Hasan Dağı (Evren, 1981).	Fabaceae–Brassicaceae-Asteraceae
Munzur Dağları (Yıldırımlı, 1982).	Asteraceae–Fabaceae–Brassicaceae

Tablo 4.3.'de görüldüğü gibi, takson sayısı bakımından araştırma alanındaki ilk üç familya sıralaması Asteraceae-Fabaceae-Lamiaceae şeklinde olup bu sıralama, Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011), Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003), Baskil ve Çevresi (Elazığ) Florası Üzerine Bir Araştırma (Aziret, 29) ve Keban Baraj Gölü' ndeki Adalar (Ayvaz vd., 1993)'daki floristik çalışma sonuçlarıyla aynı bulunmuştur. Ayrıca alandaki ilk üç familya sırası Elazığ Cip Baraj Gölü-Arındık Köyü Arasındaki Saha Florası (Doğan, 2009) ve Çakmakbeli Florası ile (Duru, 2001) benzerlik göstermektedir.
Takson sayısı bakımından araştırma alanındaki ilk iki familya sırası ise Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011), Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004), Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003), Harput Florası (Çakılcıoğlu, 2002), Baskil ve Çevresi (Elazığ) Florası Üzerine Bir Araştırma (Aziret, 1996), Keban Baraj Gölü'ndeki Adalar (Ayvaz vd., 1993) ve Munzur Dağları (Yıldırımlı, 1982) florası ile aynı bulunmuştur. Ayrıca çalışma alanındaki ilk iki familya sırası Elazığ Cip Baraj Gölü-Arındık Köyü Arasındaki Saha Florası (Doğan, 2009), Çakmakbeli (Duru, 2001), Mastar, Kup, Yaylım Dağları (Evren, 1985), Malatya-Pütürge (Altan, 1984) ve Hazar Dağları (Altan, 1981) floraları ile benzerlik göstermektedir. Araştırma alanında en çok takson içeren cinsler ise Tablo 4.4'te gösterilmiştir.

Tablo 4.4. Araştırma Alanında En Çok Takson İçeren Cinsler.

CİNS ADI	**TAKSON SAYISI**	**TOPLAM TAKSON SAYISINA (798) GÖRE ORANI (%)**
Astragalus	25	3.1
Salvia	14	1.8
Vicia	12	1.5
Silene	12	1.5
Centaurea	10	1.2
Veronica	10	1.2
Alyssum	10	1.2
Euphorbia	10	1.2
Trifolium	10	1.2
Ranunculus	9	1.1
TOPLAM	122	15
DİĞER 364 CİNS	676	85

Tablo 4.4 incelendiğinde, ilk üç cins sıralamasının *Astragalus, Salvia, Vicia ve Silene* şeklinde olduğu görülmekte ve ilk 10 cins 798 taksonun 122'sini (%15) oluşturmaktadır. Araştırma alanında takson sayısı açısından en zengin cinsler olan *Astragalus-Salvia-Vicia- Silene-Centaurea- Veronica ve Alyssum* (Tablo 4.4) gibi geniş yayılış özelliğine sahip cinsler, diğer floristik çalışmalarda (Tablo 4.5) ve Türkiye Florası'nda da bu özelliklerini korumaktadırlar. Bu cinslere ait türler hem kurak hem de nemli yerlerde yetişebilme avantajlarına sahiptirler. Dolayısıyla araştırma alanında da kurak ve nemli habitatların bulunması bu cinslerin alandaki zenginliğini artırmıştır. Yine ilk 5 cinsin sıralanışına bakıldığında çoğunluğu kamefit ve hemikriptofitlerden oluşan taksonların yüksek oranı, ortamın kuraklığı düşünüldüğünde normal bir durumdur.

Centaurea cinsi Türkiye Florası'nda tür sayısı bakımından *Astragalus* ve *Verbascum* cinslerinden sonra üçüncü büyük cins olma özelliğine sahiptir. Yeni eklenen türlerle birlikte tür sayısı yaklaşık 195 olmuştur ve ülkemizde geniş yayılış özelliğine sahiptir (Davis vd., 1988; Güner vd., 2000; Wagenitz, 1975). Endemizm oranı ise %62.1' dir.

Endemizm oranının oldukça yüksektir ve Türkiye *Centaurea* cinsi için oldukça önemli çeşitlilik merkezlerinden biridir (Wagenitz, 1986). Bununla birlikte son zamanlarda yapılan çalışmalar sonucunda taksonomik yönden problemli olan bu cins; *Centaurea, Cyanus, Psephellus* ve *Rhaponticoides* olmak üzere dört farklı cinse ayrılmıştır (Greuter, 2003; Hellwig, 2004). Çalışma alanında bu cinsin takson sayısı bakımından ilk dörde girememesinin sebebi ise daha önce bu cins içerisinde yer alan *C. pichleri* Boiss. subsp. *pichleri, C. triumfettii, C. depressa* bu taksonların yeni düzenlemeye göre *Cyanus* cinsine aktarılmasındandır.

Son yıllarda *Compositae* familyası üzerine çalışmalar artmıştır. 2007 yılında Kubitzki editörlüğünde yapılan ‘‘*Compositae*’’ ve 2009 yılında V.A. Funk (Funk vd., 2009) editörlüğünde yapılan “Systematic, Evolution and Biogeography of *Compositae*” isimli çalışmalar bunlardan en önemlileridir. Bu çalışmalarda *Cota* seksiyonunun cins seviyesine yükseltildiği ve bununla birlikte seksiyonda yer alan tüm taksonların *Cota* cinsine transfer edildiği görülmektedir. Bu yüzden araştırma alanından toplanan ve daha önce *Anthemis* cinsi içerisinde yer alan *A. tinctoria* L. var. *tinctoria, A. coelopoda* Boiss. var. *coelopoda, A. austriaca* Jacq., *A. wiedemanniana* Fisch. & Mey. taksonlar *Cota* cinsi içerisinde verildiğinden *Anthemis* cinsi de araştırma alanında en çok takson içeren ilk on cins içerisine girememiştir. Araştırma alanındaki takson sayısı bakımından ilk üç cins sıralaması ile yakın bölgelerdeki floristik çalışmalar sonucunda tespit edilen ilk üç cins sıralamaları Tablo 4.5.’te görülmektedir.

Tablo 4.5. Takson Sayısı Bakımından Büyük Cinslerin Çalışma Alanlarına Göre Dağılımı.

ARAŞTIRMA ALANININ ADI	**TAKSON SAYISI BAKIMINDAN İLK ÜÇ CİNS SIRASI**
Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Saha (2012)	***Astragalus -Salvia- Vicia* ve *Silene***
Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011).	*Astragalus -Salvia- Vicia* ve *Centaurea*
Elazığ Cip Baraj Gölü-Arındık Köyü Arasındaki Saha (Doğan, 2009).	*Astragalus-Vicia-Salvia*
Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004).	*Astragalus–Silene–Trifolium*
Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003).	*Astragalus–Salvia–Silene*
Harput Florası (Çakılcıoğlu, 2002).	*Vicia–Silene–Trigonella*
Buzluk Mağaraları ve Şüşnaz (Erkan, 2002).	*Silene–Trifolium–Trigonella*
Çakmakbeli (Duru, 2001).	*Astragalus–Trigonella–Trifolium*
Baskil (Katkılar) (Behçet, 1999a).	*Astragalus–Trigonella–Silene*
Baskil ve Çevresi (Elazığ) Florası Üzerine Bir Araştırma (Aziret, 1996).	*Astragalus–Trigonella–Trifolium*
Keban Baraj Gölü’ndeki Adalar (Ayvaz vd., 1993).	*Astragalus–Alyssum–Trifolium*
Mastar, Kup, Yaylım Dağları (Evren, 1985).	*Astragalus–Trigonella-Silene*
Malatya-Pütürge (Altan, 1984).	*Astragalus–Trifolium–Vicia*
Hazar Dağları (Altan, 1981).	*Astragalus–Ranunculus-Aethionema*
Hasan Dağı (Evren, 1981).	*Astragalus–Silene–Alyssum*

Tablo 4.5.’te görüldüğü gibi yapılan çalışmaların büyük çoğunluğunda ilk sırayı *Astragalus* cinsinin aldığı görülmektedir. Bazı çalışmalardaki farklılıkların, çalışılan bölgenin iklimsel, jeolojik, edafik ve coğrafik konumunun farklılığından dolayı olduğunu söyleyebiliriz. Araştırma alanındaki ilk üç cins sıralamasına bakıldığında Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011) ile aynı, ilk iki cins sıralaması bakımından ise Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011) ve Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003) florasıyla aynı olduğu görülmektedir (Tablo 4.5). Araştırma alanından saptanan taksonların bitki coğrafyası bölgelerine göre dağılımı Tablo 4.6.’te gösterilmiştir.

Tablo 4.6. Alandaki Taksonların Fitocoğrafik Bölgelere Göre Dağılımı.

BİTKİ COĞRAFYASI BÖLGESİ	**TAKSON SAYISI**	**TOPLAM TAKSON SAYISINA (798) GÖRE ORANI (%)**
İran–Turan	306	38.4
Akdeniz	36	4.5
Avrupa–Sibirya	34	4.3
Çok Bölgeliler	381	47.7
Bilinmeyenler	34	4.3
Kültür	7	0.8
TOPLAM	798	100

Davis’in Türkiye Florası’nda kullandığı Grid sistemine göre araştırma alanı tümüyle B7 karesi ve İran-Turan fitocoğrafik bölgesinde olup, araştırma alanında B7 karesine ve İran-Turan fitocoğrafik bölgesine ait takson sayısının, diğer kare ve fitocoğrafik bölgelere göre yüksek oranda olması beklenen bir sonuçtur. Ayrıca karasal iklimin görüldüğü yerler, açık alanlar ve step karakterli bölgeler çalışma alanında da baskın olup, İran-Turan elementlerinin alanda 306 takson ve % 38.4’lük değerle yüksek oranda görülmesi normal bir durumdur.

Araştırma alanında normalde karasal iklim hâkim olmasına rağmen, alan rakımının diğer bölgelere oranla daha düşük olması, Keban Baraj Gölü’nün ve birçok sulak alanın etkisi gibi ana sebepler bölgedeki karasal iklimi yumuşatmış ve bölge ikliminin Akdeniz iklimine benzemesine neden olmuştur. Bu nedenle, özellikle Akdeniz iklimine benzeyen vadi içlerinde daha yoğun olarak görülen Akdeniz elementlerinin, araştırma alanında 36 takson ve % 4.5’lik (Tablo 4.6) oranla ikinci sırada olması doğal bir durumdur. Avrupa-Sibirya elementlerinin ekolojik istekleri ise daha

çok sulak, nemli ve gölgelik habitatlardır. Bu özellikteki habitatlara çalışma alanında da yoğun rastlanmış ve araştırma alanındaki Avrupa-Sibirya elementlerinin özellikle bu tür habitatlarda yoğunlaştığı tespit edilmiştir.

Araştırma alanı ve araştırma alanına yakın alanlardaki floristik çalışmalar sonucunda belirlenen taksonların, bitki coğrafyası bölgelerine göre dağılımı Tablo 4.7' de görülmektedir.

Tablo 4.7. Çalışma Alanı ve Yakın Alanlardaki Taksonların Bitki Coğrafyası Bölgelerine Dağılımı.

ARAŞTIRMA ALANI	**BİTKİ COĞRAFYASI BÖLGESİ**		
	İRAN-TURAN	AVR. SİB.	AKDENİZ
Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Saha (2012)	%38.4	%4.3	%4.5
Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011).	38.9	4.2	5.5
Elazığ Cip Baraj Gölü-Arındık Köyü Arasındaki Saha (Doğan, 2009).	32.5	2.1	4.2
Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004).	35.2	5.4	4.9
Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003).	38.2	3.5	4.5
Harput Florası (Çakılcıoğlu, 2002).	34	2	5.1
Buzluk Mağaraları ve Şüşnaz (Erkan, 2002).	20.1	1.8	5.8
Çakmakbeli (Duru, 2001).	35.5	3.5	4.4
Baskil (Katkılar) (Behçet, 1999a).	41.7	7	4.1
Baskil ve Çevresi (Elazığ) Florası Üzerine Bir Araştırma (Aziret, 1996).	30	3.4	4.5
Keban Baraj Gölü'ndeki Adalar (Ayvaz vd., 1993).	42.5	4.9	6.4
Mastar, Kup, Yaylım Dağları (Evren, 1985).	30.8	4.6	7.9
Malatya-Pütürge (Altan, 1984).	30	4.4	5.6
Hazar Dağları (Altan, 1981).	28.2	3.2	8.2
Hasan Dağı (Evren, 1981).	36.0	7	3.6

Araştırma alanındaki taksonların fitocoğrafik bölgelere dağılım oranlarında ilk sırayı İran-Turan, ikinci sırayı Akdeniz, üçüncü sırayı Avrupa-Sibirya elementleri almıştır. Tablo 4.7' den de görüleceği üzere elde ettiğimiz sonuçlar diğer çalışma sonuçlarının bir çoğuyla örtüşmektedir. Bazı çalışmalardaki farklılıkların ise o çalışmaların yapıldığı bölgedeki iklimsel, jeolojik, jeomorfolojik, topoğrafik, edafik ve coğrafik faktörler gibi sebeplerden kaynaklandığını söyleyebiliriz. Ayrıca Tablo 4.7'de görülen araştırma alanlarının birçoğu İran-Turan fitocoğrafik bölgesinde yer almaktadır. Dolayısıyla tüm çalışmalarda takson sayısı bakımından ilk sırayı İran-Turan elementlerin alması normal bir durumdur.

Araştırma alanında tanımlanan 798 taksonun 85'i endemik olup, toplam takson sayısına göre endemizm oranı ise %10.6'dır. Türkiye genelindeki endemizm oranı ise yaklaşık olarak % 34.5'tir (Güner vd., 2000). Araştırma alanındaki endemizm oranı %10.6 olup, bu oran araştırma alanına yakın alanlarda belirlenen endemizm oranlarıyla Tablo 4.8'de karşılaştırılmıştır.

Tablo 4.8. incelendiğinde çalışılan alanlardaki endemizm oranlarının çoğunun birbirine yakın değerler olduğu görülüp, Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004), Keban Baraj Gölündeki Adalar (Ayvaz vd., 1993) ve Çakmakbeli (Duru, 2001) çalışma alanlarındaki endemizm oranlarıyla da birbirlerine çok yakın endemizm oranlarının olduğu görülmüştür. Türkiye genelinde endemizm oranı yaklaşık olarak % 34.5 olup (Güner vd., 2000), bu orana hiçbir floristik çalışmada tam olarak yaklaşılamamıştır. Araştırma alanındaki endemizm oranının düşük çıkmasının nedenini, alanın çevresinde hayvancılığın yaygın oluşundan bitki örtüsünde meydana gelen aşırı tahribat ve tarım alanlarını genişletmek amacıyla doğal ortamlara verilen zararlar şeklinde açıklayabiliriz. Çalışma alanında belirlenen bazı büyük familyalardaki endemizm oranlarının, bu familyaların Türkiye Florası'ndaki endemizm oranlarıyla karşılaştırılması ise Tablo 4.9'da görülmektedir.

Tablo 4.8. Çalışma Alanında ve Yakın Alanlardaki Çalışmalarda Belirlenen Endemizm Oranları.

ARAŞTIRMA ALANI	**ENDEMİZM ORANI (%)**
Salkaya Deresi ile Dambüyük Ovası Arasında Kalan Saha (2012)	**10.6**
Aşağıçakmak ve Keban Baraj Gölü (Elazığ) Arasındaki Saha (Kılıç, 2011)	11.6
Cip Baraj Gölü-Arındık Arasındaki Saha (Doğan, 2009).	8.6
Karga, Kamışlık ve Kuşakçı Dağları (Türkoğlu, 2004).	10.8
Baskil Merkez İlçe-Altınkürek Köyü Arasındaki Yüksek Saha (Kürşat, 2003).	13.0
Harput (Çakılcıoğlu, 2002).	11.7
Buzluk Mağaraları ve Şüşnaz (Erkan, 2002).	11.8
Çakmakbeli (Duru, 2001).	10.1
Baskil (Katkılar) (Behçet, 1999a).	17.2
Keban Baraj Gölündeki Adalar (Ayvaz vd., 1993).	10.5
Mastar, Kup, Yaylım Dağları (Evren, 1985).	12.9
Malatya-Pütürge (Altan, 1984).	12.3
Hazar Dağları (Altan, 1981).	9.7
Hasan Dağı (Evren, 1981).	9.5
Munzur Dağları (Yıldırımlı, 1982).	17.8

Tablo 4.9. Araştırma Alanındaki ve Türkiye Florası'ndaki Bazı Büyük Familyaların Endemik Takson Sayılarının Karşılaştırılması.

Familya	Türkiye Flora'sındaki Endemik Takson Sayısı	Türkiye Flora'sındaki Endemizm Oranı (%)	Araştırma Alanındaki Endemik Takson Sayısı	Araştırma Alanındaki Endemizm Oranı (%)
Asteraceae	430	38.0	15	15.6
Fabaceae	375	39.1	11	11.9
Lamiaceae	240	44.2	13	17.4
Scrophulariaceae	241	52.1	7	22.2
Brassicaceae	194	38.1	6	9.8
Caryophyllaceae	187	40.2	5	12.8
Boraginaceae	108	35.0	3	9.4
Apiaceae	117	28.1	1	2.9
Liliaceae	118	30.4	2	7.7

Tablo 4.9'da görüldüğü gibi Türkiye Florası'ndaki familyaların endemizm oranları ile araştırma alanındaki familyaların endemizm oranları farklılık göstermektedir. Ayrıca Türkiye Florası'nda endemik olarak gösterilmesine rağmen, Türkiye Bitkileri Kırmızı kitabında endemiklikten çıkarılmış olan bazı Astragalus taksonları (*Astragalus densifolius, Astragalus compactus, Astragalus kurdicus* var. *muschianus, Astragalus anthylloides, Astragalus bicolor*) endemik olarak değerlendirilmemiştir. Bu yüzden araştırma alanındaki Fabaceae familyasına ait endemizm oranı düşük çıkmıştır. Yine tablodan görüleceği üzere Scrophulariaceae, Lamiaceae ve Asteraceae familyaları %22.2, %17.4 ve % 15.6'lık endemizm oranlarıyla araştırma alanında birinci, ikinci ve üçüncü sırada bulunmaktadırlar. Endemizm oranları bakımından daha sonra ise %12.8 ve %11.9'luk oranlarıyla Caryophyllaceae ve Fabaceae familyaları gelmektedir. Çalışma alanında tespit edilen 85 endemik taksonun 10'nun hangi fitocoğrafik bölge elementi olduğu bilinmeyip, bu taksonların şu andaki yayılışları 'Flora of Turkey 1-9' (Davis, 1974), 'Flora of Turkey and the East Aegean Islands' adlı eserlerin, 10. (Davis vd., 1988), 11. ciltleri (Güner vd., 2000), yeni kare kayıtları ve flora çalışmaları (Yıldırımlı, 1994-2011; Behçet, 1999b) tarandıktan sonra belirlenmiş ve Tablo 4.10'da gösterilmiştir. Çalışma sonucunda araştırma alanındaki taksonların Raunkier (1934) sistemine göre hayat formları (Biyolojik tipleri) belirlenerek Tablo 4.12'de gösterilmiştir.

Tablo 4.10. Hangi Fitocoğrafik Bölge Elementi Olduğu Bilinmeyen Endemik Taksonların Yayılış Gösterdiği Kareler.

FİTOCOĞRAFİK BÖLGESİ BİLİNMEYEN ENDEMİK TAKSONLAR	YAYILIŞ GÖSTERDİKLERİ KARELER
Papaver clavatum Boiss. et Hausskn. ex Boiss.	B6,7 - C6,7,8
Alyssum praecox Boiss. & Bal. var. *praecox*	A5,9 - B5,7,9 - C2,5,6
Haplophyllum armenum Spach	A5,6,7,8,9 - B5,7
Hedysarum pogonocarpum Boiss.	A5 - B6,7 - C6
Onobrychis fallax Freyn & Sint.	B7,9 - C4
Lonicera caucasica Pallas subsp. *orientalis* (Lam.) Chamb. & Long.	A2,3,4,5,6,7,8 - B3,5,6,7 - C6
Anthemis wiedemanniana Fisch. & Mey.	A4,5 - B1,2,3,4,5,6,7,8,9 - C2,3,4,8
Tanacetum densum (Lab.) subsp. *amani* Heywood.	B5,6,7,9 - C6,7
Ptilostemon afer (Jacq) Greuter subsp. *eberneus* Greuter	A4,5,6,7 – B 2,3,5,6,7, C 2,3,4,5,6
Scutellaria salviifolia Bentham.	A4,5,6,7 - B3,4,5,6,7 - C4,5,6

Tablo 4.11. Alandaki Taksonların Raunkier Sistemine Göre Hayat Formları Dağılımı.

HAYAT FORMU	TAKSON SAYISI	TOPLAM TAKSON SAYISINA (798) ORANI (%)
Fanerofit	43	5.4
Kamefit	56	7.0
Geofit (kriptofit)	89	11.1
Hemikriptofit	331	41.6
Terofit	274	34.3
Parazit	5	0.6
Toplam	798	100

Tablo 4.11'de görüldüğü üzere hayat formu bakımından hemikriptofitler %41.6'lık oranla birinci sırada, % 34.3'lük oranla terofitler ikinci, % 11.1'lik oranla geofitler üçüncü, % 7'lik oranla kamefitler dördüncü, % 5.4'lük oranla fanerofitler beşinci ve % 0.6'lık oranla parazitler altıncı sırada yer almaktadır. Biyolojik spektrum, belirli bir bölgede her bir sınıftaki biyolojik tiplerle, bir vejetasyonu oluşturan türlerin dağılışının % olarak ifade edilmesi olup, Raunkier'e göre ise biyolojik spektrum iklimlerin, genel durumda ise çevrenin belirtisidir. Örneğin tropikal floranın % 60'tan fazlasını fanerofitler meydana getirir. Akdeniz ülkeleri ise yaklaşık olarak % 30 oranında kriptofit (geofit) ve % 20 oranında terofit bitki içermektedir. Kutuplarda ise fanerofitler ve terofitlere rastlanmayıp, hemikriptofitler % 60'lık oranla hakim durumdadırlar (Akman, 2004). Çalışma alanından toplanan endemik taksonların tehlike kategorileri 'Türkiye Bitkileri Kırmızı Kitabı' (Ekim, 2000) isimli kaynaktan kontrol edildikten sonra, LR kategorisindeki son versiyon dikkate alınarak verilmiştir (IUCN, 2001). Tablo 4.12'de alandaki tehlike kategorisindeki endemik taksonlar ve tehlike kategorileri, Tablo 4.13'de ise endemik ve endemik olmayan nadir taksonların tehlike kategorilerine göre dağılımı görülmektedir. Çalışma alanından toplanan ve teşhisleri yapılan bazı taksonların Türkiye Florası'nda belirtilenden farklı, birtakım varyasyonlar gösterdiği saptanarak Tablo 4.14'te gösterilmiştir.

Tablo 4.12. Çalışma Alanında Tehlike Kategorisindeki Endemik Taksonların Durumu.

TEHLİKE KATEGORİSİNDEKİ ENDEMİK TAKSONLAR	**TEHLİKEKATEGORİLERİ**
#Ephedra distachya L.	EN
#Delphinium cyphoplectrum Boiss. var. *stenophyllum*	VU
Consolida glandulosa (Boiss. & Huet.) Bornm.	LC
Ranunculus dissectus Bieb. subsp. *huetii* (Boiss.) Davis.	LC
Ranunculus sintenisii Freyn	VU
Glacium acutidentatum Hausskn. & Bornm.	LC
#Papaver argemone L.	EN
Papaver triniifolium Boiss.	LC
Papaver clavatum Boiss. et Hausskn. ex Boiss.	LC
Isatis condolleana Boiss.	LC
Tchihatchewia isatidea Boiss.	VU
#Alyssum murale Waldst. & Kit. subsp. *murale* var. *murale*	VU
Alyssum praecox var. *praecox*	LC
Alyssum pateri Nyar. subsp. *pateri* Nyar.	LC
Alyssum filiforme Nyar.	LC
Erysimum lycaonicum (Hand.-Mazz.) Hub.-Mor.	LC
Arenaria acerosa Boiss.	LC
Saponarina tridentata Boiss.	LC
Saponarina prostrata Willd. subsp. *anatolica* Hedge.	LC
Phryna ortegioides (Fisch. & Mey.) Pax & Hoffm.	LC
Gypsophila pinifolia Boiss. & Hausskn.	NT
Paronychia kurdica Boiss. subsp. *kurdica* Boiss. var. *kurdica* (Boiss) Mcneill.	LC
Hypericum uniglandulosum Hausskn. ex Bornm.	NT
Hypericum scabroides Robson & Poulter.	VU
Alcea calvertii (Boiss.) Boiss.	LC
Haplophyllum armenum Spach.	LC
Astragalus micropterus Fischer.	LC
Astragalus lamarckii Boiss.	LC
Astragalus decurrens Boiss.	NT
Astragalus scabrifolius Boiss.	CR
Astragalus campylosema Boiss. subsp. *campylosema* Boiss.	LC
Cicer echinospermum P. H. Davis	VU
Lotus gebelia Vent. var. *anthylloides* Boiss.	VU
Hedysarum pogonocarpum Boiss.	LC
Onobrychis fallax Freyn & Sint.	LC
Onobrychis cappadocica Boiss.	LC
Ebenus haussknechtii Bornm. ex Hub.-Mor.	NT
Rosularia haussknechtii Boiss. & Reuter.	NT
Bupleurum papillosum DC.	LC
Lonicera caucasica Pallas subsp. *orientalis* (Lam.) Chamb. & Long.	LC
Anthemis armeniaca Freyn & Sint.	LC
Cota wiedemanniana Fisch. & Mey.	LC
Achillea schishkinii Sosn.	LC
Achillea pseudoaleppica Hub. Mor.	LC
Tanacetum cadmeum (Boiss.) Heywood subsp. *orientale* Grierson	LC
Tanacetum densum (Lab.) subsp. *amani* Heywood.	NT
Cousinia sintenisii Freyn	VU
Ptilostemon afer subsp. *eberneus*	LC
#Jurinea eriobasis DC., Prodr.	DD
Jurinea ancyrensis Bornm.	LC
Centaurea derderiifolia Wagenitz	LC
Centaurea kurdica Reichardt	LC
Centaurea urvillei DC. subsp. *hayekiana* Wagenitz	LC
Scorzonera semicana DC.	LC
Scorzonera tomentosa L.	LC
Taraxacum bellidiforme Van Soest.	LC
Convolvulus galaticus Rostan ex Choisy	LC
Convolvulus holosericeus subsp. *macrocalycinus*	NT
Paracaryum cristatum (Schreber) Boiss. subsp. *cristatum*	LC
Nonea stenosolen Boiss. & Bal.	LC
Alkanna megacarpa DC.	LC
Verbascum euphraticum Bentham in DC.	VU

Tablo 4.12. (Devam ediyor)

Verbascum oocarpum Murb.	VU
Verbascum diversifolium Hochst.	VU
Verbascum melitenense Hub.-Mor.	NT
Linaria genistofolia (L.) Miller subsp. *confertiflora* (Boiss.) Davis	LC
Veronica macrostachya subsp. *mardinensis*	VU
Veronica orientalis subsp. *nimrodi*	LC
Veronica multifida L.	LC
Scutellaria salviifolia Bentham	LC
Scutellaria orientalis L. subsp. *orientalis*	VU
Scutellaria orientalis L. subsp. *bicolor*	LC
Scutellaria orientalis L. subsp. *sintenisii* (Hausskn ex Bornm.) Edmondson	VU
Phlomis oppositiflora Boiss. & Hausskn.	LC
Phlomis sieheana Rech.	LC
Phlomis sintenisii Rech.	VU
Phlomis linerais Boiss.& Bal.	LC
Wiedemannia orientalis Fisch. & Mey.	LC
Ballota rotundifolia C. Koch.	NT
Marrubium parviflorum Fisch. & Mey. subsp. *oligodon* (Boiss.) Seybold	LC
Sideritis vulcacina Hub.-Mor	VU
Thymus hausknechtii Velen.	NT
Salvia cerino-pruinosa Rech f.	EN
Acantholimon saxifragiforme (Hausskn. & Sint) ex Bokhari	VU
Thesium aureum Jaub. & Spach	NT
Asperula stricta Boiss. subsp. *latibracteata* (Boiss.) Ehrend.	LC
Galium galiopsis (Hand.-Mazz.) Ehrend.	EN
Allium sintenisii Freyn	LC
Bellevalia gracilis Feinburn	LC
Dactylorhiza osmanica (KI.) Soo. var. *anatolica* (Nelson) Renz & Taub.	NT
#Bromus tectorum L.	EN

#: Türkiye Bitkileri Kırmızı Kitabı'nda Endemik Olmayan Nadir Bitkiler

Tablo 4.13. Endemik ve Endemik Olmayan Nadir Taksonların Tehlike Kategorilerine Göre Dağılımı.

TEHLİKE KATEGORİLERİ	**ENDEMİKLER**	**ENDEMİK OLMAYANLAR**
EX	--	--
EW	--	--
CR	1	--
EN	2	2
VU	15	3
LC	55	--
NT	12	--
DD	--	1
NE	--	--

Tablo 4.14. Çalışma Alanında, Türkiye Florası'nda Belirtilen Özelliklerinden Farklı Özellik Gösteren Taksonlar.

FARKLILIK GÖSTEREN TAKSON ADI	**FLORADAKİ ÖZELLİKLERİ**	**ÇALIŞMA ALANINDAKİ TAKSONLARIN ÖZELLİKLERİ**
Ephedra distachya	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerden, dere kenarı ve sulak alanlardan toplanmıştır.
Nigella arvensis var. *glauca*	Çiçeklenme ayları belirtilmemiş	Alandan 5-7. aylarda çiçekli toplanmıştır.
Delphinium cyphoplectrum var. *stenophyllum*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1100 m'lerden, yamaçlar ve kayalık alanlardan toplanmıştır.
Adonis aestivalis subsp. *aestivalis*	Çiçeklenme ayları ve yükseklik belirtilmemiş	Alandan 3-5. aylarda, 900-1000 m' lerden toplanmıştır.
Adonis aestivalis subsp. *parviflora*	Çiçeklenme ayları belirtilmemiş	Alandan 4-5. aylarda, çiçekli toplanmıştır.
Ranunculus sintensii	Toplandığı yükseklik belirtilmemiş.	Alandan 900-1200 m'lerden toplanmıştır.
Drabopsis verna	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1050 m'lerden, yamaçlardan toplanmıştır.
Camelina hipsida var. *hipsida*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-950 m'lerden, bozuk step, yol kenarı ve yamaçlardan toplanmıştır.
Capparis spinosa var. *spinosa*	Çiçeklenme ayları ve toplandığı yükseklik belirtilmemiş.	Alandan 6-8. aylarda, 850-1050 m' lerden toplanmıştır.
Helianthemum ledifolium var. *ledifolium*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1050 m'lerden, step, dere kenarı ve yamaçlardan toplanmıştır.
Portula oleracea	Toplandığı yükseklik belirtilmemiş.	Alandan 900-1050 m'lerden toplanmıştır.
Stellaria media subsp. *media*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerde yamaçlardan toplanmıştır.
Stellaria media subsp. *pallida*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-950 m'lerde, tarla içi ve yamaçlardan toplanmıştır.

Tablo 4.14. (Devam ediyor)

Holosteum umbellatum var. *umbellatum*	Çiçeklenme ayları belirtilmemiş.	Alandan 3-5. aylarda, çiçekli toplanmıştır.
Amaranthus patulus	Toplandığı yükseklik belirtilmemiş.	Alandan 900-1000 m'lerden toplanmıştır.
Erodium cicutarium subsp. *cicutarium*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerden, kumlu topraklar, dere kenarından toplanmıştır.
Ailanthus altissima	Toplandığı yükseklik belirtilmemiş.	Alandan 850-1000 m'lerden toplanmıştır.
Robinia pseudoacacia	Toplandığı yükseklik belirtilmemiş.	Alandan 850-1000 m'lerden toplanmıştır.
Vicia nonea var. *nonea*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1100 m'lerden, tarla kenarı ve dere kenarından toplanmıştır.
Vicia narbonensis var. *narbonensis*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerden, tarla kenarı ve dere kenarından toplanmıştır.
Lathyrus annuus	Çiçeklenme ayları belirtilmemiş.	Alandan 6. ayda, çiçekli toplanmıştır.
Pisum sativum subsp. *elatius* var. *pumilio*	Çiçeklenme ayları belirtilmemiş.	Alandan 5-6. aylarda, çiçekli toplanmıştır.
Trifolium campestre	Çiçeklenme ayları belirtilmemiş.	Alandan 5-6. aylarda, çiçekli toplanmıştır.
Trifolium arvense var. *arvense*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1100 m'lerden, sulu alanlar ve yamaçlardan toplanmıştır.
Trifolium hausknechtii var. *hausknechtii*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1100 m'lerden, dere kenarı ve tarla kenarından toplanmıştır.
Medicago minima var. *minima*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 950-1150 m'lerden, yamaçlardan ve yol kenarından toplanmıştır.
Amygdalus trichamygdalus var. *trichamygdalus*	Toplandığı yükseklik, habitatı ve çiçeklenme ayları belirtilmemiş.	Alandan 6-7. aylarda, 950-1200 m'lerden, yamaçlardan toplanmıştır.
Sanguisorba minor subsp. *minor*	Çiçeklenme ayları ve toplandığı yükseklik belirtilmemiş.	Alandan 5-6. aylarda, 900-1000 m'lerden, çiçekli toplanmıştır.
Rosularia radiciflora subsp. *kurdica*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerde, yamaçlardan toplanmıştır.
Eryngium campestre var. *virens*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, yamaçlardan toplanmıştır.
Helichrysum plicatum subsp. *plicatum*	Çiçeklenme ayları belirtilmemiş.	Alandan 6-7. aylarda, çiçekli toplanmıştır
Helichyrsum plicatum subsp. *pseudoplicatum*	Çiçeklenme ayları belirtilmemiş.	Alandan 6-7. aylarda, çiçekli toplanmıştır
Anthemis kotschyana var. *discoidea*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1200 m'lerde, taşlık alan ve yamaçlardan toplanmıştır.
Cota coelopoda var. *coelopoda*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1050 m'lerde, yol kenarı ve tarla kenarlarından toplanmıştır.
Tanacetum densum subsp. *amani*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1200 m'lerde, yamaçlardan toplanmıştır.
Gundelia tournefortii var. *armata*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1150 m'lerde, kayalık ve yamaçlardan toplanmıştır.
Arcticum minus subsp. *pubens*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, tarla içi ve yamaçlardan toplanmıştır.
Cirsium. arvense subsp. *vestitum*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1200 m'lerde, yol kenarı ve yamaçlardan toplanmıştır.
Carduus nutans subsp. *nutans*	Çiçeklenme ayları belirtilmemiş.	Alandan 6-7. aylarda, çiçekli toplanmıştır
Carduus pycnocephalus subsp. *albidus*	Çiçeklenme ayları belirtilmemiş	Alandan 6-7. aylarda, çiçekli toplanmıştır
Jurinea eriobasis	Toplandığı yükseklik belirtilmemiş.	Alandan 900-1050 m'lerden toplanmıştır.
Echinops pungens var. *pungens*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1050 m'lerde, tarla kenarı ve yamaçlardan toplanmıştır.
Tragopogon latifolius var. *angustifolius*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-950 m'lerde, çayırlık alan ve yamaçlardan toplanmıştır.
Vincetoxicum canescens subsp. *canescens*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1100 m'lerde, kayalıklar ve yamaçlardan toplanmıştır.
Anchusa leptophylla subsp. *leptophylla*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerde, tarla kenarı, yol kenarı ve yamaçlardan toplanmıştır.
Linaria chalepensis var. *chalepensis*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1100 m'lerde, yamaçlardan toplanmıştır.
Lamium tomentosum var. *alpestre*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-950 m'lerde, ağaçlık alan ve yamaçlardan toplanmıştır.
Ziziphora taurica subsp. *taurica*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1200 m'lerde, tarla kenarı ve yamaçlardan toplanmıştır.
Euphorbia altissima var. *altissima*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, yamaçlardan toplanmıştır.
Euphorbia falcata. subsp. *falcata* var. *falcata*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 850-1000 m'lerde, dere kenarı ve yamaçlardan toplanmıştır.
Morus alba	Toplandığı yükseklik belirtilmemiş.	Alandan 900-1000 m'lerden toplanmıştır.
Morus nigra	Toplandığı yükseklik belirtilmemiş.	Alandan 850-950 m'lerden toplanmıştır.

Tablo 4.14. (Devam ediyor)

Ficus carica subsp. *carica*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, kayalıklı yamaçlardan toplanmıştır.
Ulmus minor subsp. *minor*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, yol kenarı ve yamaçlardan toplanmıştır.
Galium spurium subsp. *spurium*	Toplandığı yükseklik belirtilmemiş.	Alandan 850-1050 m'lerden toplanmıştır.
Asphodeline. tenuior subsp. *tenuiflora* var. *tenuiflora*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1050 m'lerde, yol kenarı ve yamaçlardan toplanmıştır.
Ornithogalum refractum	Toplandığı yükseklik belirtilmemiş.	Alandan 850-1150 m'lerden toplanmıştır.
Tulipa armena var. *armena*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, yamaçlardan toplanmıştır.
Crocus biflorus subsp. *tauri*	Toplandığı yükseklik ve habitatı belirtilmemiş.	Alandan 900-1000 m'lerde, çayırlık alan ve yamaçlardan toplanmıştır.
Carex diandra	Çiçeklenme ayları belirtilmemiş.	Alandan 5-7. aylarda, çiçekli toplanmıştır
Hordeum murinum subsp. *glaucum*	Çiçeklenme ayları ve toplandığı yükseklik belirtilmemiş.	Alandan 5-7. aylarda, 900-1200 m'lerde toplanmıştır.
Oryzopsis hymenoides	Toplandığı yükseklik belirtilmemiş.	Alandan 850-1050 m'lerden toplanmıştır.

Ayrıca *Centaurea carduiformis* subsp. *carduiformis* var. *carduiformis*' in Türkiye Florası'daki involukrum diken boyu 15 cm' den fazla iken, topladığımız örnekte (Hayta, 3321) 15 cm' den küçük (8 ve 10 cm) örneklere de rastlanmıştır. Bunun yanı sıra aken boyu florada 5-6(-8) iken, topladığımız örneklerde 3-8 mm olarak ölçülmüştür. *Salvia palaestina*' nın alandan toplanan birçok örneğinde (Hayta, 2110) kaliksin saman sarısı renginden meyveye geçiş döneminde lila ve kırmızıya, korollanın ise liladan kırmızıya dönüştüğü tespit edilmiştir. *Teucrium polium'* un floradaki gövde boyu 10-40 cm ve kaliks boyu 3-5 mm iken topladığımız örnekte (Hayta, 3204) gövde boyu 8-45 cm ve kaliks boyu ise 2-6 mm olarak ölçülmüştür. Ayrıca bu türün çalışma alanından toplanan örneklerinde gövde ve kaliks boyu, tüy yoğunluğu gibi karakterlerinde oldukça değişkenlik gösterdiği tespit edilmiştir. *Cota austriaca*'nın floradaki gövde boyu 20-45 cm iken, topladığımız örneklerde (Hayta, 1589; Hayta, 2096) daha küçük gövde boyuna sahip türlerin olduğu (10-43 cm) tespit edilmiştir. Alanda topladığımız örnek (Hayta, 3189) ilk olarak *Salvia euphratica* Montbret & Aucher ex Bentham var. *leiocalycina* (Rech. f.) Hedge. teşhis edilmesine rağmen bu türün gövde, yaprak, kaliks ve braktelerinin piloz tüylü, petiol uzunluğunun 2-7 mm olması sonucunda bu tür ile ilgili birçok araştırma yapmamıza neden olmuştur. Salvia cinsiyle ilgili en son çalışmalar incelendiğinde (Kahraman vd., 2010) bu örneğin *Salvia cerino-pruinosa* olduğu anlaşılmıştır. *Salvia cerino-pruinosa*' nın *Salvia euphratica* var. *leiocalycina*' dan görünen en belirgin farklılığı gövde, yaprak, kaliks ve braktelerinin piloz tüylü olmasıdır. Bölgeden daha öncede toplanan birçok örnek yeniden incelenmiş ve doğru teşhisleri yapılmıştır. Dolayısıyla bu taksonlarla ilgili populasyon çalışmaları da yapılabilir. Ayrıca araştırma alanından toplanan birçok bitki türü yöre halkı tarafından gıda olarakta kullanıldığı için bunların tespiti yapılarak, daha önce bu konuyla ilgili yapılan çalışmalara (Yücel vd., 2011) katkı sağlanabilir.

Araştırma alanından toplanmış olan ve araştırma alanının bulunduğu B7 karesi için yeni kayıt durumundaki taksonların sayısı, yeni kare kayıtları tarandıktan (Yıldırımlı, 1994-2011; Behçet, 1999b) sonra 15 adet bulunmuştur;

Delphinium cyphoplectrum Boıss. var. *stenophyllum* Boiss. (Ranunculaceae), *Ranunculus dissectus* Bieb. subsp. *huetii* (Boiss.) Davis. (Ranunculaceae), *Barbarea verna* (Mill.) Aschers. (Brassicaceae), *Chorispora syriaca* Boiss. (Brassicaceae), *Erysimum lycaonicum* (Hand.-Mazz.) Hub.-Mor. (Brassicaceae), *Hypericum lysimachioides* Boiss. & Noe var. *spathulatum* Robson (Hypericaceae), *Astragalus micropterus* Fischer. (Fabaceae), *Astragalus scabrifolius* Boiss. (Fabaceae), *Onobrychis cappadocica* Boiss. (Fabaceae), *Torilis arvensis* (Huds.) Link subsp. *arvensis* (Huds.) Link. (Apiaceae), *Lamium tomentosum* Willd. var. *alpestre* (Trautv.) N. Popova (Lamiaceae), *Wiedemannia multifida* (L.) Bentham (Lamiaceae), *Ballota rotundifolia* C. Koch. (Lamiaceae), *Nepeta nuda* L. subsp. *nuda* (Lamiaceae), *Salvia frigida* Boiss. (Lamiaceae).

Sonuç olarak; yapılmış olan çalışma il, bölge ve dünya florasının ortaya konması bakımından değerli sonuçlar içermektedir. Ayrıca çalışma, hem Elazığ hem de ülkemizde bundan sonra yapılacak olan floristik çalışmalara ışık tutacak, kaynak olacak ve bu çalışmaların daha kolay ve verimli sürdürülmesine yardımcı olacaktır.

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(Received for publication 14 December 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 57-61

Research article/Araştırma makalesi

Effect of three insecticides on tomato (*Solanum lycopersicum*) seedling germination and early plants growth

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Abstract

Tomato (*Solanum lycopersicum* L.) is one of the most important vegetables, whose production and consumption increased quite rapidly. The effect of three insecticides (alpha-cypermethrin, chlorpyriphos and pirimicarb) on seed germination and seedling growth of this species has been studied, based on morphological parameters monitored and by using four dilutions of the normal concentration used in agriculture (100%, 75%, 50%, 25%) for germinating seeds, and only the recommended concentration in agriculture for growing plants. The results show that the three insecticides induced a delay of germination and growth process. The germinated rate of seeds treated was lower compared to control, and the length of roots and shoots in treated seeds and plants was reduced.

Key words: Insecticides, Tomato, *Solanum lycopersicum*, Germination, Growth

1. Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most widely grown vegetables in the world. In recent years, competition has intensified increasingly as world exports of tomato products from main suppliers. Processing tomatoes are attacked by various arthropods, plant diseases and nematodes which significantly reduce yield and quality of fruit (Oerke et al., 1994).

In the Northern Morocco, the most important way to protect cultures is the chemical pesticides use. Many pesticide types are used, especially organochlorine pesticides, organophosphorus pesticides, carbamate pesticides and pyrethroid pesticides (El Bakouri et al., 2008).

Synthetic pyrethroids are widely used as the broad-spectrum pest control agents in agricultural production because of their selective insecticidal activity, rapid biotransformation and excretion by the mammalian catabolic system and non-persistence in the environment (Ye et al., 2006). Moreover, the pyrethroid insecticides have a greater photostability and a relatively low toxicity when compared to the organochlorine and organophosphorus insecticides (Pang et al., 1994a, b). However, the risk of pesticide residues on the food consumed is present, due to the overuse and accumulation in food chain.

Organophosphorus insecticides (OP) constitute one of the most used pesticide classes employed for both agricultural and landscape pest control. Use of OP has increased considerably, due to their low toxicity and low persistence in environment and mammalian system, compared to organochlorine pesticides. The main mechanism of OP toxicity is related to irreversible binding to acetylcholinesterase (Kamath et al., 2008).

The carbamates correspond to N-substituted esters of carbamic acid and form three classes of carbamates: insecticide carbamate with a methyl group, herbicide carbamate with an aromatic or aliphatic compound, and fungicide carbamate with benzimidazol group (World Health Organization, 1986).

However, the use of these pesticides obtained by chemical synthesis represents the major cause of agricultural soil and groundwater contamination because of their persistence, biodisponibility and mobility (Arias-Estevez et al., 2008). In this way, the study of pesticide occurrence in agricultural soil of the Tangier region shows the presence of many pesticides types such as endosulfan isomers (alpha and beta), endosulfan sulfate, some DDT metabolites and alpha HCH (El Bakouri et al., 2008).

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 BioDiCon. 266-0812

Otherwise, seed dormancy and germination are complex adaptive traits in higher plants, seeing they are influenced by a numerous genes and environmental factors. The germination process starts with seed imbibition and ends with the protrusion of the embryonic axis (normally the radicle) through the enclosing tissues (Bewley and Black, 1985). This process is influenced by many environmental conditions such as salinity (Kashem et al., 2000), hydrous stress (Bradford et al., 1995), moisture and temperature (Bailly et al., 1996; Welbaum et al., 1998; Ravikumar et al., 2002).

In this study, we evaluated evolution of some morphological parameters such as germination and growth process of tomato (*S. lycopersicum*) in response to the application of three insecticides: alpha-cypermethrin (pyrethroid insecticide), chlorpyriphos (organophosphorus insecticide) and pirimicarb (carbamate insecticide), among the most used ones in the North of Morocco.

2. Materials and methods

2.1. Plant material and germination test

Tomato (*S. lycopersicum*) seeds were purchased from Vilmorin (La Ménitré, France) and surface sterilized in 10% (v/v) commercial bleach with stirring for 5 min, followed by extensive washing in sterile distilled water.

Treatment concentrations were prepared using control (distilled water) and 25%, 50%, 75% and 100% (v/v) of the original insecticide solutions (100% represents the normal concentration used in agriculture and will be diluted appropriately with sterile distilled water to give the final concentration). Batches of 50 tomato seeds were sown in 9 cm Petri dishes lined with two layers of filter paper, and 6 ml of each treatment solution was added. The filter papers were constantly moistened with the appropriate solution, and maintained in a growth chamber in darkness at 25°C for 6 days. Three repetitions were performed. At various stages of tomato seed germination (3, 4 and 5 days), seeds of each replicate were collected for measurement. Germination was determined as the time of seed coats rupture and radicle emergence.

2.2. Growing test

For growth study, ten seeds were germinated in each plastic pot (10 x 10 cm). Being watered each day, seedlings were grown together in the greenhouse (24/20°C day/night, 16/8h light/dark photoperiod). The plants used were maintained in greenhouse conditions for 30 days, and then were treated by various insecticides at the concentration used in agriculture (100%). The tests were realized on the 2^{nd}, 5^{th}, 8^{th}, 11^{th} and the 14^{th} day after treatment. Each value represents the average of 3 replications.

2.3. Parameters monitored

At the end of treatments, we have evaluated the germination rate of tomato seeds by counting the number of germinated ones in batches of 50 seeds. The root and shoot length of the germinated seeds were also measured. For the elongation of tomato growing seedlings, we scaled the length of shoots and roots. Each value represents the average of 3 repetitions.

2.4. Statistical analysis

Data were processed by using Statistica Software (Statistica, 1997) for one-way analysis of variance (ANOVA) and the Tukey test for the Post-hoc tests. A significance level of 0.05 was used for all statistical tests.

3. Results

The test period of germination was up to 5 days. The results of Table 1 showed that the germination rate of treated seeds was lower than the control ones. The germination rate of the control was around 97% in the whole test period. A significant decrease in tomato seeds germination rate was observed at different insecticide concentrations since the beginning of the test period; it was varying between 80% and 91% compared to control.

Concerning seedlings growth, different treatments showed a delay in the elongation process compared with control (Table 2). The shoot elongation rate increased concomitantly with time; but it was 25% and 50% reduced in presence of 25% and 100% treatment concentrations in the same order. A substantial inhibitory effect on shoot elongation was observed under insecticides treatment; It varies from 0.81 cm at the 3^{rd} day of treatment to 2.96 cm at the 5^{th} day for the control growing; however, it fluctuates from 0.16 cm to 1.64 cm respectively for the 100% Pirimicarb (3^{th} day) and 25% α-cypermethrin (5^{th} day).

A similar effect of insecticides was also observed in seedlings root elongation. At the 5^{th} day, it was highly reduced in presence of 25% α-cypermethrin (2.41 cm) than that of the control (3.60 cm) (Table 2).

Table 1. Insecticides effect on tomato seeds germination

	3rd day	4th day	5th day
Control	97% ± 1	97% ± 1	97% ± 1
α-cypermethrin			
25%	89% ± 1***	89% ± 1***	89% ± 1***
50%	80% ± 0***	80% ± 0***	80% ± 0***
75%	81% ± 2***	82% ± 2***	82% ± 2***
100%	88% ± 0***	88% ± 0***	88% ± 0***
Chlorpyriphos			
25%	89% ± 2**	91% ± 1**	91% ± 1**
50%	90% ± 2**	91% ± 3*	91% ± 3*
75%	87% ± 1***	90% ± 0***	90% ± 0***
100%	85% ± 3**	85% ± 3**	85% ± 3**
Pirimicarb			
25%	87% ± 1***	89% ± 3*	89% ± 3*
50%	88% ± 0***	88% ± 0***	88% ± 0***
75%	83% ± 2***	83% ± 2***	84% ± 0***
100%	84% ± 0***	84% ± 0***	84% ± 0***

*, ** and *** indicate significant difference at $P \leq 0.05$, 0.01 and 0.001 levels respectively.

Table 2. Insecticides effect on shoot and root elongation in tomato seedlings

	Shoot length (cm)			Root length (cm)		
	3rd day	4th day	5th day	3rd day	4th day	5th day
Control	0.81 ± 0.09	1.84 ± 0.09	2.96 ± 0.12	2.01 ± 0.14	2.81 ± 0.17	3.59 ± 0.07
α-cypermethrin						
25%	0.62 ± 0.02	1.19 ± 0.08**	1.64 ± 0.10***	1.31 ± 0.08***	2.02 ± 0.14***	2.41 ± 0.15***
50%	0.49 ± 0.08**	1.00 ± 0.25***	1.26 ± 0.33***	1.14 ± 0.08***	1.97 ± 0.16***	1.92 ± 0.21***
75%	0.50 ± 0.05**	0.90± 0.15***	1.30 ± 0.22***	1.26 ± 0.01***	1.57 ± 0.12***	2.05 ± 0.21***
100%	0.44 ± 0.07***	0.93 ± 0.17***	1.24 ± 0.08***	1.10 ± 0.03***	1.79 ± 0.05***	1.95 ± 0.14***
Chlorpyriphos						
25%	0.48 ± 0.04***	0.98 ± 0.12***	1.17 ± 0.11***	1.25 ± 0.11***	1.83 ± 0.07***	2.02 ± 0.07***
50%	0.47 ± 0.08***	0.81 ± 0.08***	0.99 ± 0.05***	1.25 ± 0.17***	1.70 ± 0.18***	1.75 ± 0.18***
75%	0.40 ± 0.02***	0.77 ± 0.04***	1.12 ± 0.03***	1.22 ± 0.04***	1.73 ± 0.04***	1.84 ± 0.05***
100%	0.23 ± 0.01***	0.47 ± 0.08***	0.63 ± 0.09***	0.59 ± 0.16***	1.13 ± 0.34***	1.20 ± 0.22***
Pirimicarb						
25%	0.28 ± 0.01***	0.58 ± 0.05***	1.00 ± 0.14***	0.74 ± 0.10***	1.42 ± 0.27***	1.97 ± 0.28***
50%	0.24 ± 0.01***	0.40 ± 0.01***	0.85 ± 0.22***	0.59 ± 0.01***	1.00 ± 0.14***	1.48 ± 0.20***
75%	0.20 ± 0.02***	0.47 ± 0.01***	0.89 ± 0.10***	0.48 ± 0.08***	1.09 ± 0.15***	1.58 ± 0.14***
100%	0.16 ± 0.01***	0.41 ± 0.06***	0.80 ± 0.08***	0.29 ± 0.02***	0.83 ± 0.09***	1.52 ± 0.26***

** and *** indicate significant difference at $P \leq 0.01$ and 0.001 levels respectively

Furthermore, evaluation of length progression of growing seedlings shows a growth delay in the treated ones at the 2nd week of the test period. Shoot length of treated plantlets was around 19 cm, vs. 22.1 cm for the control ones (Table 3). Root length of treated plantlets was also lower and reaches 25 cm, vs. 26.7 cm in untreated seedlings (Table 4).

Table 3. Insecticides effect on shoot length (cm) in tomato seedlings.

	Control	α-cypermethrin	Chloropyriphos	Pirimicarb
2nd day	18.0 ± 1.0	17.9 ± 0.6	17.0 ± 2.3	16.6 ± 1.8
5th day	18.5 ± 0.5	18.1 ± 2.5	17.1 ± 0.2*	17.3 ± 1.7
8th day	19.2 ± 0.2	18.4 ± 0.3*	18.6 ± 1.0	18.1 ± 2.5
11th day	20.4 ± 0.4	18.9 ± 0.6*	18.8 ± 1.0	18.3 ± 0.7**
14th day	22.1 ± 0.6	19.6 ± 0.9*	19.8 ± 0.37**	18.7 ± 0.3**

* and ** indicate significant difference at $P \leq 0.05$ and 0.01 levels respectively

Table 4. Insecticides effect on roots length (cm) in tomato seedlings.

	Control	α-cypermethrin	Chloropyriphos	Pirimicarb
2nd day	22.8 ± 0.7	22.6 ± 0.8	23.7 ± 0.8	23.2 ± 0.3
5th day	23.5 ± 0.6	23.3 ± 0.1	23.9 ± 0.1	23.7 ± 0.8
8th day	24.5 ± 0.7	23.9 ± 0.4	24.6 ± 0.1	24.2 ± 0.7
11th day	25.6 ± 0.3	24.1 ± 0.5**	24.8 ± 0.2*	24.3 ± 0.5*
14th day	26.7 ± 0.2	25.0 ± 0.5**	25.0 ± 0.4**	24.9 ± 0.4**

* and ** indicate significant difference at $P \leq 0.05$ and 0.01 levels respectively

4. Conclusions and discussion

The percentage of germination may reflect the reaction rate of plant seeds to their living environment (Li et al., 2007). The results obtained in this study illustrate an inhibitory effect of germination after treatment by the tested insecticides at various concentrations. In literature, a declines in seed germination rate (more than 50 %) have been reported with other insecticides such as paraquat dichloride (l, l'-dimethyl-4, 4'-bipyridinium dichloride) at 1.0 mg/L in *Typha latifolia* (Moore et al., 1999). A similar effect was showed in *Triticum aestivum*, treated by 5–20 mg/kg of arsenic (Li et al., 2007).

The general symptom of plants under such stresses is growth inhibition (Yang et al., 2001; Wang et al., 2004; Wang and Yang, 2005). In our study, tomato seed-plantlets and seedlings growth was significantly delayed after insecticides application, affecting as well shoots as roots. In this way, many studies reported an inhibitory effect of growth after application of pesticides: (i) around 50%-decreasing of root growth in *Phaseolus vulgaris* and *Pisum sativum* after treatment with chlorsulfuron during the germination process (Fayez and Kristen, 1996), and (ii) low root growth in *Zea mays* seedlings in the presence of pesticides such as chlorsulfuron and metsulfuron-methyl (Fayez et al., 1994). In other way, this effect was also demonstrated with other xenobiotic types like heavy metals. Khatun et al. (2008) underlined a severe growth inhibition of shoots and roots in *Withania somnifera* because of copper contamination.

Many hypotheses explain this delay of growth in treated plants and seedling. Firstly, we can suggest that insecticides induce damages in the meristematic cells, given that Fayez and Kirsten (1996) showed an obvious influence of chlorosulfuron on the cellular structure of root caps of *Pisum sativum*, *Phaseolus vulgaris* and *Vicia faba*, and induce a reduction in root cell division, delaying the root growth (in Fayez and Kristen, 1996). Moreover, a similar effect was reported in literature after contamination by heavy metals. In this way, after exposition of Anatolian black pin (*Pinus nigra* spp. *pallasiana*) to different concentrations of lead, mitotic cell division was significantly decreased, and several mitotic anomalies such as c-mitosis, lagging chromosomes, multipolar anaphases and chromosome bridges were increased (Yücel et al., 2008).

In other side, the insecticides could affect the photosynthetic system by the inhibition of photosystem II and chain electron transport activities as reported for example by Mishra et al. (2008) in *Vigna unguiculata* when treated by dimethoate. Pesticides can also lead to a delay in photosynthetic pigments rates such as chlorophylls (Mishra et al., 2008).

Moreover, in literature the delay of plants growth was reported as an indicator of oxidative stress (Yang et al., 2001; Wang et al., 2004; Wang and Yang, 2005). Generally, the plants cells produce the ROS as a second messenger in some processes of growth and development (Schurmann, 2003; Borland et al., 2006; Grun et al., 2006). There is an interaction between activation and repression of ROS and phytohormones (McCarty and Chory, 2000; Delledome et al., 2003; Del Rio et al., 2006; Terman and Brunk, 2006; Shao et al., 2006, 2008). When the plant is under an oxidative stress, the excess of ROS production can lead to growth perturbations.

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(Received for publication 06August 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 62-70

Research article/Araştırma makalesi

Effects of parasitization and envenomation by the endoparasitic Wasp *Pimpla turionellae* L. (Hymenoptera: Ichneumonidae) on hemolymph protein profile of its host *Galleria mellonella* L. (Lepidoptera: Pyralidae)

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Abstract

The effects of dose-dependent envenomation and by parasitization of *Pimpla turionellae* L. (Hymenoptera: Ichneumonidae) on the hemolymph protein profile of its host *Galleria mellonella* L. (Lepidoptera: Pyralidae) were investigated. Hemolymph proteins were analyzed using spectrophotometry and sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE). The gel was subsequently scanned and the optical densities (OD) of the bands were analyzed. The quantities of proteins detected 4, 8, and 24 h post-treatments in hemolymph of parasitized and envenomated host pupae did not differ much when compared with those of controls. Of the seventeen different protein bands detected at a range of 19.6-181.12 kDa in the hemolymph, there were only changes in OD values of bands at 23.418, 24.714, 32.434, 34.811, and 45.385 kDa following envenomation and parasitism. The electrophoretic pattern of hemolymph proteins from venom injected and control groups of larvae did not differ much from that of pupae except for new protein bands detected at 33.823 and 41.553 kDa. However, three bands with 45.385, 99.000, and 126.850 kDa were not detected in larvae. Hemolymph protein quantity remained steady at all time points tested except for increases for some bands at 8 h following envenomation. The amount of 34.811 kDa protein decreased immediately at 8 h post-injection of 0.02 and 0.05 VRE of venom whereas injection all venom doses except 0.1 VRE resulted in an increase in the amount for 41.553 and 43.412 kDa proteins. There were no qualitative changes in term of novel protein bands in the hemolymph of hosts. Therefore, we suggest that host regulation of *G. mellonella* by parasitism or envenomation of *P. turionellae* involves quantitative changes in the host plasma proteins but does not lead to the up-regulation of novel proteins.

Key words: Hemolymph proteins, *Galleria mellonella*, *Pimpla turionellae*, Venom, Parasitism

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Endoparazitik arı *Pimpla turionellae* L. (Hymenoptera: Ichneumonidae)'nın parazitleme ve zehirinin konağı *Galleria mellonella* L. (Lepidoptera: Pyralidae)'nın hemolenf proteinleri üzerine etkisi

Özet

Pimpla turionellae L. (Hymenoptera: Ichneumonidae)'nın farklı dozlardaki zehrinin ve parazitlemesinin konağı *Galleria mellonella* L. (Lepidoptera: Pyralidae)'nın hemolenf proteinleri üzerine olan etkileri araştırıldı. Hemolenf proteinleri spektrofotometrik ve Sodyum Dodesil Sülfat Poliakrilamid Jel Elektroforez (SDS-PAGE) teknikleri kullanılarak analiz edildi. Jeller tarandıktan sonra, bantların optik densitometrik değerleri analiz edildi. Parazitlenmiş ve zehirle muamele edilen konak pup hemolenfindeki protein miktarları kontrol gruplarıyla karşılaştırıldığında, muameleden 4, 8 ve 24 saat sonrasında değişiklik göstermedi. Hemolenfte belirlenen 19.6-181.12 kDa aralığındaki on yedi farklı proteinden 23.418, 24.714, 32.434, 34.811 ve 45.385 kDa olanların miktarları parazitleme ve zehir etkisine bağlı olarak değişiklik gösterdi. Larvaların hemolenfindeki proteinlerin elektroforetik dağılımlarında hem kontrol grubunda hem de zehir enjekte edilen gruplarda pupa hemolenfinden farklı olarak 33.823 ve 41.553 kDa büyüklüğünde iki yeni protein belirlendi. Bununla birlikte, larvalarda 45.385, 99.000 ve 126.850 kDa

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 BioDiCon. 274-0912

büyüklüğündeki üç band belirlenmedi. Larvalarda hemolenf proteinlerinden bazıları enjeksiyondan 8 saat sonrasında artış gösterirken, diğer proteinler tüm zaman noktalarında değişiklik göstermedi. 34.811 kDa'luk proteinin miktarı 0.02 ve 0.05 kese eşdeğeri zehir (KEZ) dozlarının enjeksiyonundan 8 saat sonra azalma gösterirken 41.553 ve 43.412 kDa büyüklüğündeki proteinler 0.1 kese eşdeğeri zehir (KEZ) dozu haricindeki tüm dozların enjeksiyonundan sonra artış gösterdi. Konak hemolenfinde zehirleme ve zehir enjeksiyonuna bağlı olarak proteinlerde kalitatif bir değişiklik yani yeni bir protein belirlenmedi. Bu nedenle, *P. turionellae* parazitleme veya zehirleme yoluyla konak *G. mellonella*'yı düzenlemesinde konağın plazma proteinlerinde kantitatif değişikliklere neden olduğunu ancak yeni proteinlerin salgılanmasının düzenlenmesinde etkili olmadığını ileri sürmekteyiz.

Anahtar kelimeler: Hemolenf Proteinleri, *Galleria mellonella*, *Pimpla turionellae*, Zehir, Parazitlik

1. Introduction

Parasitoid species regulate the nutritional and physiological states of their hosts to ensure their eggs and larvae successfully develop inside the host (Vinson, 1980; Beckage, 1993; Thompson, 1993). Parasitism-induced manipulations of host physiology, biochemistry and endocrinology include host conditioning by injection of maternal factors derived from ovarian secretions [polydnaviruses (PDVs), virus-like particles (VLPs)] (Bae and Kim, 2004; Kaeslin et al., 2005; Li et al., 2007), and/or venom glands (Nakamatsu and Tanaka, 2003; Rivers et al., 2004; Keenan et al., 2007). Parasitism-associated changes induced by the paralyzing toxin and other ovarian secretions during ovipositing by the adult koinobiont endoparasitoids in host hemolymph protein composition have been extensively documented, and can both alter the expression of normal host proteins and cause the synthesis of parasitism specific novel proteins (Beckage, 1993). Koinobiont species temporarily paralyze their hosts and allow them to grow and develop even after parasitization (Gauld, 1988). However, most idiobiont parasitoids paralyze their hosts permanently, and thus preserve the hosts while the parasitoid progeny feed and develop (Wharton, 1993). Such differences in the action of venoms from koinobiont and idiobiont wasps argue that changes in the nutritional content of the hosts (i.e, hemolymph proteins and amino acids) are more likely to be associated with koinobionts.

Pimpla turionellae L. (Hymenoptera: Ichneumonidae) is a solitary idiobiont endoparasitoid wasp species which uses prepupae and pupae of hosts from an extremely wide range of lepidopteran species (Kansu and Uğur, 1984) and is devoid of symbiotic viruses. Venom from *P. turionellae* has previously been shown to contain a number of biologically active components including melittin, apamin, noradrenaline, serotonin, and phospholipase B. The venom also displays potent paralytic, cytotoxic, and cytolytic effects towards lepidopteran and dipteran hosts (Uçkan et al., 2004; Uçkan et al., 2006; Ergin et al., 2007). The role of venom and/or parasitism in suppressing host immune defense has also been studied (Er et al., 2010; Uçkan et al., 2010; Er et al., 2011). Here, we investigated the effects of dose-dependent envenomation and parasitization of *P. turionellae* on the hemolymph protein profile of its host *Galleria mellonella* L. (Lepidoptera: Pyralidae).

2. Materials and methods

2.1 Parasitoid and host rearing

P. turionellae were reared on pupae (1- or 2-day-old) of *G. mellonella* at 25 ± 1°C, 60 ± 5% RH, and with a photoperiod of 12: 12 h, L: D. Adult parasitoids were fed a 30% (v/v) honey solution and provided with host pupae (four pupae for every 10 female wasps once every three days). Host colony was maintained by feeding the insects with natural blackened comb (Uçkan and Ergin, 2002) to maintain similarity to their natural media in bee hives.

2.2 Preparation of P. turionellae venom and injection into G. mellonella

Venom reservoir contents were isolated from honey- and host-fed 15 to 20-day-old females by dissecting out the venom sacs as described previously (Uçkan et al., 2004). Following centrifugation (3,000 g for 10 min at 25 ± 1°C) to remove cell debris, final venom concentrations were adjusted to 0.05, 0.02, 0.01, and 0.005 venom reservoir equivalents (VREs) for pupae and 0.5, 0.1, 0.05, and 0.02 VREs for larvae with PBS (0.138 M NaCl and 0.0027 M KCl in 0.01 M PBS, pH 7.4). These venom concentrations represent doses previously determined to yield host responses yet fall below the calculated LD_{99} for pupae and larvae (Ergin et al. 2006), respectively. A 5 µl solution of the venom preparation was injected between the last two lateral abdominal segments of 1 to 2-day-old pupae (140 ± 20 mg) and on the first hind leg of last instars (260 ± 10 mg) of the host, previously chilled on ice for 10 min, by using a 10 µl Hamilton microsyringe (Hamilton, Reno, NV). Vaseline was applied to the injection area to prevent hemolymph loss. Controls consisted of pupae and larvae untreated, null-injected, and those injected with only 5 µl PBS.

2.3 Parasitization of G. mellonella pupae

Parasitization was performed on 1- or 2-day-old host pupae by exposing an individual host pupa (140 ± 20 mg) to an individual 15 to 20-day-old wasp female. Parasitized pupae were held at 25 ± 2°C, 60 ± 5% RH under a photoperiod of 12: 12 h LD, as were the controls and venom-treated pupae, until hemolymph collection. *P. turionellae* females normally parasitize host prepupae and pupae in nature (Kansu and Uğur, 1984), therefore parasitization was not used as an experimental assay for larvae of *G. mellonella*.

2.4 Hemolymph collection, SDS-PAGE and densitometric analyses

Hemolymph collection was performed at 4, 8 and 24 h post-treatments from venom-injected, parasitized and control host pupae and larvae. Pupae were bled by piercing the cuticle at the abdomen and larvae on the first hind leg with a sterile 19-gauge needle. Four microliters of hemolymph from each individual pupa and larva were collected at each time period and for each treatment with a glass microcapillary tube (Sigma Chemical Co., St. Louis, MO) and injected into an ice cold eppendorf tube containing 1 mg phenylthiourea (Sigma Chemical, St. Louis, MO, USA) to prevent melanization (Zupko et al., 1993). The hemolymph was spun at 3,000 rpm for 10 min at 4°C to remove hemocytes. The supernatant was transferred to a clean eppendorf tube and vortexed with a pipette. Hemolymph proteins were analyzed using sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE). SDS-PAGE (10% acrylamide) was carried out with the method of Laemmli (1970). The gel was subsequently scanned using an Uvitec Gel Documentation (BioLab) system and the optical densities (OD) of the bands were analyzed by Gel-Pro Analyzer. Each assay was repeated three times for each time point.

2.5 Statistical analysis

Means were compared using one- or two-way analysis of variance (ANOVA) and subsequently, means were separated using Tukey's Honestly Significant Difference (HSD) post hoc tests. SPSS software program (version 15.0 for Windows, SPSS Science, Chicago, IL) was used for data analysis. Results were considered statistically significant when $P < 0.05$.

3. Results

3.1 Effects of parasitization and venom injection on the protein profile of pupae

The quantities of proteins from parasitized and envenomated host pupae did not differ much when compared with those of unparasitized, null- or PBS-injected controls. Analyses using two-way ANOVAs indicated that the effect of venom injection and parasitization on the protein quantity of host pupae was not significant ($P>0.05$), except for protein bands at 19.600, 23.418, 24.714, 32.434, 40.675, 45.385, and 48.846 kDa ($P<0.05$), but time dependent ($P<0.05$). The relationship between treatment and protein quantity was also not influenced by time ($P>0.05$) except for protein bands at 23.418 and 32.434 kDa. Of the seventeen different protein bands detected at a range of 19.600-181.120 kDa in the hemolymph (Table 1), there were only changes in OD values of bands at 23.418, 24.714, 32.434, 34.811, 40.765, 45.385 and 181.120 kDa following envenomation and parasitism at 4, 8 and 24 h post-treatments. Parasitization and envenomation lead up- or down- regulation of only a few proteins. The amount of 23.418 kDa protein increased immediately at 4 h post-injection of 0.05 VRE of venom whereas parasitism resulted in a significant decrease in amount when compared with controls. However, this tendency did not last at later time points. The trend was also alike for the protein band detected at 24.714 kDa with a drastic increase at the highest dose of venom injection (0.05 VRE) and decrease post-parasitization. A significant increase in the amount of 32.434 kDa protein was only observed at 0.01 VRE injection at 4 h post-treatment. At 24 h post-parasitization, the amount also increased significantly when compared to 4 and 8 h. The same trend was also observed for 34.811 and 40.765 kDa proteins with a time-dependent increase in amount at 24 h post-parasitization and at 0.01 VRE injection of venom for the latter. The intensity of 45.385 and 181.120 kDa proteins also increased with all venom dose injections and parasitization at 24 h post-treatments except for 0.01 VRE injection of venom for the latter band. There appeared no qualitative changes in term of novel protein bands in the hemolymph of parasitized or venom injected pupae (Fig. 1).

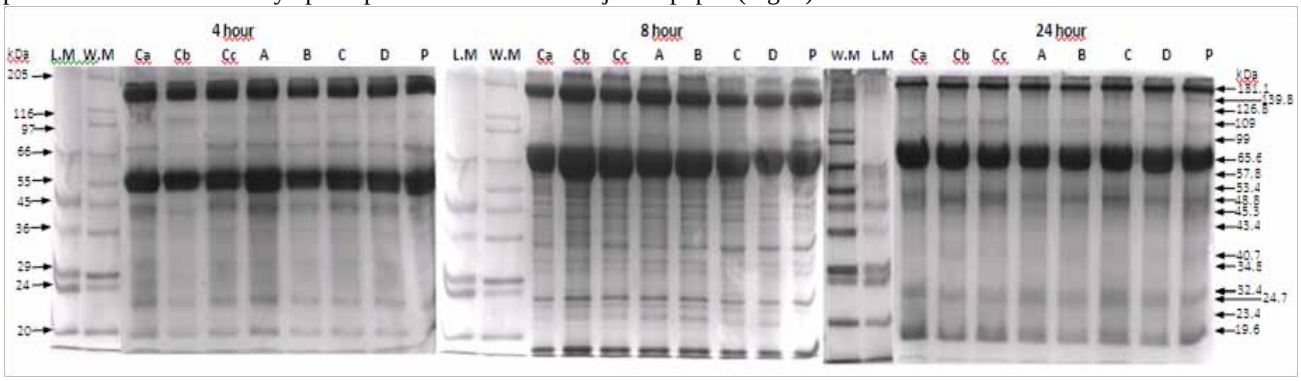

Figure 1. Protein profiles of hemolymph identified by SDS/PAGE using 10% gel from envenomated and parasitized *G. mellonella* pupae at different hours. L.W: Low range molecular weight protein marker (6.5 – 66 kDa); W.M.: Wide range molecular weight protein marker (6.5 – 205 kDa); Ca: Untreated, Cb: Null injected; Cc: PBS injected; A: 0,005 VRE-injected, B: 0.01 VRE-injected; C: 0.02 VRE-injected; D: 0.05 VRE-injected, P: Parasitized

3.2 Effects of venom injection on the protein profile of larvae

The electrophoretic pattern of hemolymph proteins from venom injected and control groups of larvae did not differ much from that of pupae with the exception of new protein bands detected at 33.823 and 41.553 kDa. However, three bands with 45.385, 99.000, and 126.850 kDa were not detected in larvae (Fig. 2). Analyses using two-way ANOVAs indicated that the effect of venom injection and parasitization on the protein quantity of host pupae was not significant ($P>0.05$), except for protein bands at 23.418, 34.811, and 65.686 kDa ($P<0.05$), but time dependent ($P<0.05$) except for protein bands at 40.765, 48.846, 139.880, and 181.120 kDa. The relationship between treatment and protein quantity was also not influenced by time ($P>0.05$) except for protein bands at 23.418, 34.811, 41.553, and 43.412 kDa. Hemolymph protein quantity remained relatively steady at all-time points tested, regardless of the venom concentration injected into *G. mellonella* larvae except for significant increases in quantity at 8 h following envenomation for bands 4, 5, 8, 9, 11, 13, and 14 (Table 2). Another exception to this trend was the significant decrease in the quantity of 23.418 kDa protein of venom injected host larvae at 24 h post injection of all venom doses. Similar to that observed in pupae, envenomation led up- or down-regulation of only a few proteins. The amount of 34.811 kDa protein decreased immediately at 8 h post-injection of 0.02 and 0.05 VRE of venom, whereas injection all venom doses except 0.1 VRE resulted in a significant increase in amount for 41.553 and 43.412 kDa proteins when compared with controls (Table 2).

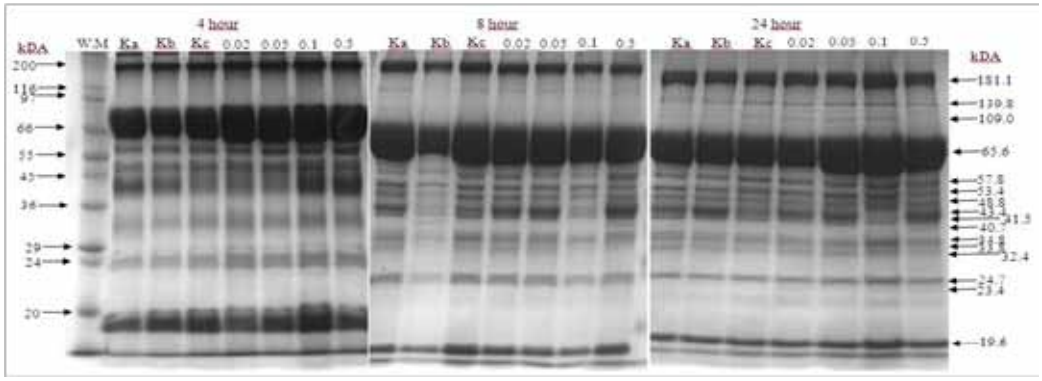

Figure 2. Protein profiles of hemolymph from envenomated *G. mellonella* larvae at different hours were identified by SDS/PAGE using 10% gel. W.M.: Wide range molecular weight protein marker (6.5 – 205 kDa); Ka: Untreated, Kb: Null injected, Kc: PBS injected; 0.02 VRE-injected, 0.1 VRE-injected, 0.5 VRE-injected.

4. Conclusions

Many koinobiont endoparasitoids have been shown to interfere with the changes in their hosts' hemolymph milieu and parasitoid-associated factors such as teratocytes, venom, polidnaviruses, and virus like particles appear to play role in this respect (Jervis and Kidd, 1996). However, our results once more support the concept that altering the host nutritional condition for the benefit of wasp offspring is generally thought to be most common for koinobionts, and would presumably not be expected for a solitary idiobiont parasitoid species like *P. turionellae*. (Sak et al., 2011). Consistent with this prediction are the observations in this study that electrophoretic pattern and O.D. values of proteins of hemolymph from *G. mellonella* pupae and larvae did not differ among controls, parasitized or those injected with isolated venom. Neither parasitism nor envenomation caused a complex array of changes in the hemolymph protein profile; there were only a few changes in the amount of some proteins at certain time points. Venom from *P. turionellae* contains several low molecular weight peptides, catecholamines and biogenic amines (Uçkan et al., 2004). It is likely that the sudden increase in the amount of 23.418 and 24.714 kDa proteins at 4 h post-injection of the highest dose of 0.05 VRE might be induced by these paralyzing toxins in venom. Beckage and Kanost (1993) reported that the effects of parasitism on host hemolymph proteins were protein-dependent and the levels of insecticyanin and two subunits of lipophorin (ApoLp-I and II) were similar to those detected in nonparasitized larvae while arylphorin and serpin-like proteins decreased in parasitized larvae of *Manduca sexta*. Among the latter was ApoLp-III (~22 kDa) which has approximately the same molecular weight with these bands. Stress responses in insects are known to be energetically demanding events and the organisms may redirect energy to repair mechanisms, and pathological effects may deplete energy reserves (Korsloot et al., 2004). The increase in the amount of 23.418 and 24.714 kDa proteins at 4 h post-injection may also be attributed to the envenomation-induced increase in energy demand of the pupae, resulting in an increase in lipid transport in hemolymph by these proteins. However, the question why the same proteins decreased at 4 h post-parasitization still requires an explanation, possibly related with the rapid paralysis of pupae upon oviposition. On the other hand, the up-regulation of several proteins for pupae and larvae following envenomation and parasitism for the latter stage may simply be the result of stress induced by parasitoid related secretions. We favor the possibility that defensive proteins may play a role in this up-regulation. Further analysis is required to identify which of these scenarios is correct.

Table 1. Densitometric analysis of hemolymph proteins of *G. mellonella* pupae envenomated and parasitized by *P. turionellae* at different hours.

Treatment[#]	**O. D. Values**											
	Band 1 (19.600)			**Band 2 (23.418)**			**Band 3 (24.714)**			**Band4 (32.434)**		
	4 h	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**
	0.109	0.069	0.350	0.218	0.220	0.236	0.150	0.083	0.179	0.096	0.122	0.124
Untreated	a x	ab x	a y	ab x	a x	a x	bcd x	a x	a x	a x	a x	a x
	0.079	0.080	0.289	0.220	0.212	0.161	0.133	0.096	0.164	0.117	0.145	0.117
Null	a x	b x	a y	ab x	a x	a x	abc x	a x	a x	a x	a x	a x
	0.075	0.059	0.292	0.228	0.190	0.179	0.162	0.071	0.157	0.120	0.113	0.143
PBS	a x	ab x	a y	ab x	ab x	a x	cd x	a x	a x	a x	a x	ab x
	0.089	0.04	0.225	0.190	0.094	0.199	0.117	0.044	0.181	0.145	0.079	0.166
0.005 VRE	a x	ab x	a y	a y	b x	a y	ab xy	a x	a y	a x	a y	abc x
	0.075	0.061	0.271	0.248	0.126	0.221	0.228	0.062	0.205	0.221	0.091	0.15
0.01 VRE	a x	ab x	a y	ab y	ab x	a x	e x	a y	a x	b x	a y	abc z
	0.088	0.063	0.219	0.230	0.162	0.209	0.177	0.080	0.196	0.138	0.091	0.186
0.02 VRE	a x	ab x	a y	ab x	ab x	a x	d x	a y	a x	a xy	a x	ac y
	0.078	0.062	0.245	0.356	0.178	0.225	0.303	0.100	0.199	0.086	0.102	0.157
0.05 VRE	a x	ab x	a y	c x	ab y	a y	f x	a y	a z	a x	a x	abc x
	0.071	0.020	0.243	0.099	0.110	0.183	0.101	0.033	0.159	0.082	0.054	0.178
Parasitized	a x	a x	a y	d x	ab x	a y	a xy	a x	a y	a x	a x	ac y

Treatment[#]	**O. D. Values**											
	Band 5 (34.811)			**Band 6 (40.765)**			**Band 7 (43.412)**			**Band 8 (45.385)**		
	4 h	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**
	0.136	0.184	0.171	0.173	0.192	0.215	0.178	0.198	0.250	0.210	0.197	0.319
Untreated	a x	a x	ab x	a x	a x	a x	a x	a x	a x	a x	abc x	ab x
	0.104	0.178	0.149	0.132	0.201	0.217	0.139	0.244	0.248	0.164	0.239	0.343
Null	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.121	0.164	0.175	0.131	0.211	0.211	0.141	0.201	0.239	0.157	0.212	0.313
PBS	a x	a x	ab x	a x	a y	a y	a x	a x	a x	a x	ac x	abc y
	0.116	0.124	0.187	0.144	0.111	0.199	0.151	0.131	0.218	0.176	0.137	0.269
0.005 VRE	a x	a x	ab x	a x	a x	a x	a x	a x	a x	a xy	bc x	bc y
	0.145	0.160	0.173	0.120	0.145	0.237	0.131	0.193	0.269	0.145	0.210	0.305
0.01 VRE	a x	a x	ab x	a x	a x	a y	a x	a x	a y	a x	ac x	abc y
	0.137	0.129	0.206	0.132	0.142	0.229	0.142	0.168	0.245	0.159	0.174	0.308
0.02 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	abc x	abc y
	0.134	0.131	0.178	0.116	0.163	0.193	0.123	0.182	0.224	0.140	0.196	0.250
0.05 VRE	a x	a x	ab x	a x	a x	a x	a x	a x	a x	a x	abcxy	c y
	0.096	0.096	0.217	0.091	0.087	0.226	0.080	0.100	0.252	0.103	0.118 b	0.288
Parasitized	a x	a x	b y	a x	a x	a y	a x	a x	a y	a x	x	abc y

Treatment[#]	O. D. Values											
	Band 9 (48.846)			**Band 10 (53.462)**			**Band 11 (57.829)**			**Band 12 (65.686)**		
	4 h	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**
	0.207	0.213	0.339	0.221	0.224	0.325	0.239	0.164	0.290	0.836	0.659	0.959
Untreated	a x	a x	ab x	a x	a x	a x	a x	a xy	a y	a xy	a x	a y
	0.182	0.267	0.404	0.193	0.292	0.303	0.198	0.258	0.269	0.881	0.734	0.883
Null	a x	a xy	b y	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.171	0.261	0.395	0.179	0.259	0.353	0.223	0.255	0.276	0.794	0.747	0.878
PBS	a x	a x	b y	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.208	0.192	0.32	0.198	0.179	0.306	0.213	0.190	0.278	0.749	0.653	0.799
0.005 VRE	a x	a x	ab x	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.151	0.235	0.407	0.166	0.249	0.334	0.179	0.256	0.292	0.771	0.679	0.884
0.01 VRE	a x	a y	b z	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.171	0.215	0.321	0.181	0.216	0.348	0.193	0.215	0.295	0.802	0.689	0.828
0.02 VRE	a x	a xy	ab y	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.151	0.235	0.271	0.153	0.227	0.301	0.197	0.231	0.283	0.792	0.703	0.835
0.05 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.117	0.060	0.337	0.119	0.160	0.331	0.138	0.198	0.285	0.670	0.669	0.857
Parasitized	a x	a x	ab y	a x	a x	a y	a x	a xy	a y	a x	a x	a x

Treatment[#]	O. D. Values														
	Band 13 (99.000)			**Band 14 (109.000)**			**Band 15 (126.850)**			**Band 16 (139.880)**			**Band 17 (181.120)**		
	4 h	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**	**4 h**	**8 h**	**24 h**
	0.230	0.130	0.283	0.204	0.113	0.216	0.203	0.103	0.206	0.451	0.099	0.302	0.736	0.550	0.848
Untreated	a x	a y	a x	a x	a x	a x	a x	a x	a x	a x	a y	a xy	a x	a y	a x
	0.188	0.192	0.255	0.197	0.155	0.220	0.201	0.143	0.172	0.528	0.131	0.266	0.732	0.709	0.843
Null	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a y	a y	a x	a x	a x
	0.181	0.156	0.232	0.166	0.163	0.229	0.166	0.143	0.188	0.278	0.136	0.266	0.715	0.683	0.893
PBS	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a xy	a x	a y
	0.399	0.145	0.212	0.144	0.133	0.196	0.178	0.121	0.195	0.335	0.141	0.271	0.698	0.567	0.917
0.005 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a y	a xy	a xy	a x	a y
	0.389	0.150	0.228	0.177	0.176	0.206	0.174	0.138	0.194	0.313	0.158	0.283	0.709	0.626	0.923
0.01 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x
	0.432	0.149	0.237	0.165	0.159	0.193	0.191	0.143	0.180	0.280	0.139	0.235	0.746	0.643	0.864
0.02 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a xy	a x	a y
	0.406	0.168	0.236	0.174	0.155	0.192	0.180	0.148	0.197	0.321	0.143	0.275	0.716	0.655	0.886
0.05 VRE	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a y	a xy	a x	a x	a y
	0.311	0.213	0.213	0.145	0.152	0.199	0.139	0.135	0.200	0.308	0.147	0.328	0.503	0.535	0.913
Parasitized	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a x	a y

Table 2. Densitometric analysis of hemolymph proteins of *G. mellonella* larvae envenomated by *P. turionellae* at different hours.

Treatment[#]	O. D. Values											
	Band 1 (19.600)			Band 2 (23.418)			Band 3 (24.714)			Band4 (32.434)		
	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h
Untreated	0,542 a x	0,433 a x	0,431 a x	0,074 a x	0,285 a y	0,052 a x	0,174 a xy	0,246 a x	0,077 a y	0,130 a xy	0,181 a x	0,106 a y
Null	0,573 a x	0,440 a xy	0,425 a y	0,085 a x	0,172 a y	0,042 a x	0,160 a x	0,190 a x	0,080 a y	0,146 a x	0,195 a x	0,196 a x
PBS	0,555 a x	0,376 a y	0,376 a y	0,082 a x	0,207 a y	0,064 a x	0,150 a x	0,228 a x	0,091 a x	0,136 a x	0,160 a x	0,150 a x
0.02 VRE	0,462 a x	0,442 a x	0,334 a x	0,175 a x	0,279 a x	0,054 a y	0,168 a x	0,241 a x	0,106 a x	0,145 a x	0,192 a x	0,161 a x
0.05 VRE	0,568 a x	0,463 a x	0,369 a x	0,179 a x	0,170 a x	0,040 a y	0,156 a x	0,189 a x	0,109 a x	0,118 a x	0,169 a x	0,162 a x
0.1 VRE	0,593 a x	0,478 a x	0,488 a x	0,174 a xy	0,216 a x	0,070 a y	0,156 a x	0,148 a x	0,080 a x	0,123 a x	0,243 a y	0,150 a xy
0.5 VRE	0,592 a x	0,484 a x	0,342 a x	0,161 a x	0,208 a x	0,047 a y	0,155 a x	0,162 a x	0,057 a y	0,125 a x	0,199 a y	0,160 a xy

Treatment[#]	O. D. Values											
	Band 5 (33.823)			Band 6 (34.811)			Band 7 (40.765)			Band 8 (41.553)		
	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h
Untreated	0,216 a x	0,328 a x	0,202 a x	0,202 a xy	0,315 ab y	0,159 a x	0,323 a x	0,194 a x	0,269 a x	0,462 a x	0,366 a x	0,353 a x
Null	0,205 a x	0,194 a x	0,249 a x	0,172 a x	0,345 b y	0,216 a x	0,261a x	0,198 ab x	0,323 a x	0,401 a x	0,423 a x	0,489 a x
PBS	0,204 a x	0,234 a x	0,232 a x	0,154 a x	0,363 b y	0,194 a x	0,282 a x	0,180 a x	0,192 a x	0,412 a x	0,465 ab x	0,349 a x
0.02 VRE	0,200 a xy	0,246 a y	0,177 a x	0,159 a x	0,172 c x	0,151 a x	0,240 a x	0,379 c y	0,289 a xy	0,308 a x	0,585 b y	0,410 a x
0.05 VRE	0,188 a x	0,227 a x	0,196 a x	0,133 a x	0,162 c x	0,173 a x	0,229 a x	0,235 ab x	0,230 a x	0,316 a x	0,582 b y	0,358 a xy
0.1 VRE	0,198 a x	0,259 a x	0,251 a x	0,167 a x	0,214 ac x	0,228 a x	0,302 a x	0,294 abc x	0,240 a x	0,433 a x	0,331 a x	0,420 a x
0.5 VRE	0,198 a x	0,288 a y	0,195 a x	0,153 a x	0,207 ac x	0,205 a x	0,247 a x	0,334 bc x	0,237 a x	0,452 a x	0,577 b x	0,411 a x

Treatment[#]	O. D. Values											
	Band 9 (43.412)			Band 10 (48.846)			Band 11 (53.462)			Band 12 (57.829)		
	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h
Untreated	0,395 a x	0,332 a x	0,303 a x	0,342 a x	0,437 a x	0,331 a x	0,345 a x	0,505 a x	0,366 a x	0,439 a x	0,394 a x	0,339 a x
Null	0,384 a x	0,339 a x	0,387 a x	0,352 a x	0,353 a x	0,392 a x	0,379 a x	0,349 a x	0,448 a x	0,442 a x	0,378 a x	0,396 a x
PBS	0,362 a x	0,364 ab x	0,353 a x	0,378 a x	0,356 a x	0,401 a x	0,379 a x	0,450 a x	0,438 a x	0,450 a x	0,473 a x	0,398 a x
0.02 VRE	0,304 a x	0,490 c y	0,310 a x	0,351 a x	0,496 a x	0,371 a x	0,348 a x	0,488 a y	0,370 a x	0,457 a x	0,505 a x	0,401 a x
0.05 VRE	0,314 a x	0,460 bc xy	0,334 a y	0,384 a x	0,397 a x	0,424 a x	0,370 a x	0,470 a x	0,395 a x	0,473 a x	0,441 a x	0,392 a x
0.1 VRE	0,352 a x	0,440 abc x	0,449 a x	0,389 a x	0,382 a x	0,456 a x	0,381 a x	0,426 a x	0,474 a	0,473 a x	0,447 a x	0,450 a x
0.5 VRE	0,408 a x	0,457 bc x	0,346 a x	0,367 a x	0,399 a x	0,337 a x	0,353 a x	0,392 a x	0,337 a x	0,444 a x	0,485 a x	0,412 a x

Treatment[#]	O. D. Values											
	Band 13 (65.686)			Band 14 (109.000)			Band 15 (139.880)			Band 16 (181.120)		
	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h	4 h	8 h	24 h
Untreated	0,831 a x	0,861 a x	0,796 a x	0,187 a x	0,214 a x	0,201 a x	0,353 a x	0,291 a x	0,272 a x	0,727 a x	0,757 a x	0,731 a x
Null	0,876 a x	0,906 a x	0,888 a x	0,173 a x	0,213 a x	0,223 a x	0,250 a x	0,246 a x	0,302 a x	0,744 a x	0,721 a x	0,791 a x
PBS	0,903 a x	0,968 a x	0,895 a x	0,175 a x	0,214 a x	0,217 a x	0,286 a x	0,301 a x	0,331 a x	0,760 a x	0,787 a x	0,762 a x
0.02 VRE	0,907 a xy	0,971 a y	0,838 a x	0,165 a x	0,208 a x	0,214 a x	0,302 a x	0,292 a x	0,309 a x	0,752 a x	0,805 a x	0,757 a x
0.05 VRE	0,899 a x	0,946 a x	0,877 a x	0,171 a x	0,205 a x	0,203 a x	0,295 a x	0,292 a x	0,295 a x	0,782 a x	0,779 a x	0,705 a x
0.1 VRE	0,895 a x	0,944 a x	0,873 a x	0,163 a x	0,240 a x	0,240 a x	0,238 a x	0,282 a x	0,342 a x	0,748 a x	0,763 a x	0,772 a x
0.5 VRE	0,859 a x	0,892 a x	0,812 a x	0,188 a x	0,254 a y	0,195 a x	0,208 a x	0,234 a x	0,276 a x	0,775 a x	0,739 a x	0,683 a x

Acknowledgements

This research was supported by grants (2006-106T255) from the Scientific and Technological Research Council of Turkey (TÜBİTAK).

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(Received for publicatio September 25 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 71-75

Research article/Araştırma makalesi

A new natural hybrid of Cousinia Cass. (Asteraceae) from Türkiye

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Abstract

Cousinia x kurubasgecidiensis Ilcim & H. Ozcelik (Asteraceae) a natural hybrid between *Cousinia vanensis* Hub.-Mor. and *Cousinia boissieri* Buhse from Eastern Anatolia(Türkiye), described as a new to science and illustrated. Morphological, taxonomical and palynological characteristics of *C. x kurubasgecidiensis* compared with its parents. Geographical distribution, ecological features, conservation status and systematical and pollen characters, of the new taxon are given.

Key words: *Cousinia x kurubasgecidiensis*, Asteraceae, Taxonomy, New taxon, Hybride

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Türkiye'den Cousinia Cass. 'ın (Asteraceae) Yeni Bir Doğal Hibriti

Özet

Cousinia x kurubasgecidiensis Ilcim & H. Ozcelik (Asteraceae): Doğu Anadolu bölgemizden *Cousinia vanensis* Hub.-Mor. and *Cousinia boissieri* Buhse arasında yeni bir hibrit olarak tanımlanmış ve özellikleri anlatılmıştır. Ataları olan iki türün özellikleri ile morfolojik, taksonomik ve palinolojik özellikleri karşılaştırılmıştır. Bu makalede, yeni kayıt taksonun coğrafi dağılımı, ekolojik özellikleri, koruma statüsü, sistematik ve polen özellikleri verilmektedir.

Anahtar kelimeler: *Cousinia x kurubasgecidiensis*, Asteraceae, Taksonomi, Yeni takson, Hibrit

1. Introduction

The genus *Cousinia* Cass. (Asteraceae), one of the largest genera of the Asteraceae in Türkiye in endemic and taxon numbers. It is comprises approximately 672 species, of which about 235 occur in Iran (Sheidai et al., 2006; Rechinger, 1972; Ranjbar *et al.*, 2012). Main distribution area of the genus is Russia, Iran, Türkiye and other dried habitat countries (Rechinger, 1986). *Cousinia* have a wide distribution in mountains of Iran. It grouped into 50 section in Flora Iranica (Mehregan *et al.*, 2003). It is represented in Europe by one species (Moore, 1975). The genus *Cousinia* contains 38 species in flora of Türkiye (Hub.-Mor., 1975). In this case, we think its gene center is Eastern Anatolia and Iran and its distribution area is mainly as Irano-Turanian region (İlçim et Özçelik, 1997).

During the specimen collection for the revision of Turkish *Cousinia*, some plants seemed to have intermediate characteristics of *C. vanensis* and *C. boissieri*. After morphological and palynogical studies and checking and examination of many other specimens, we concluded that those intermediate specimens represent an hitherto undescribed natural hyrid in genus *Cousinia.*

The study is based on *Cousinia* materials deposited in GAZI, HUB, ANK, ISTF, GUL, Mustafa Kemal University Herbaria and the plants collected from the field in 1994-2005 years.

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2. Some important characters of the hybrid (*Cousinia x kurubasgecidiensis)*

2.1. Diagnosis

Affinis *C. vanensis* paulo breviora decurrentibus foliis 0.3-1.5 cm diametro (non 1-4.5 cm), capita paulo arachnoideus-lanatus vel glabratus (non dense arachnoideus-lanatus) phylla breviora 4-12 mm diametro (non 6-15 mm**),** pappus 5-7 mm diametro (non 2.5 mm). *C. boissieri,* caulis ascendens (non erectus), foliis decurrentibus (non amplexicaulis) capitula spinis inclusis 1.2-3.5 cm (non 1.67-2.05) differt.

Cousinia x kurubasgecidiensis Ilcim & H. Ozcelik (*Cousinia vanensis* Hub.-Mor. x *Cousinia boissieri* Buhse) Hybr. Nov. (Figure. 1).

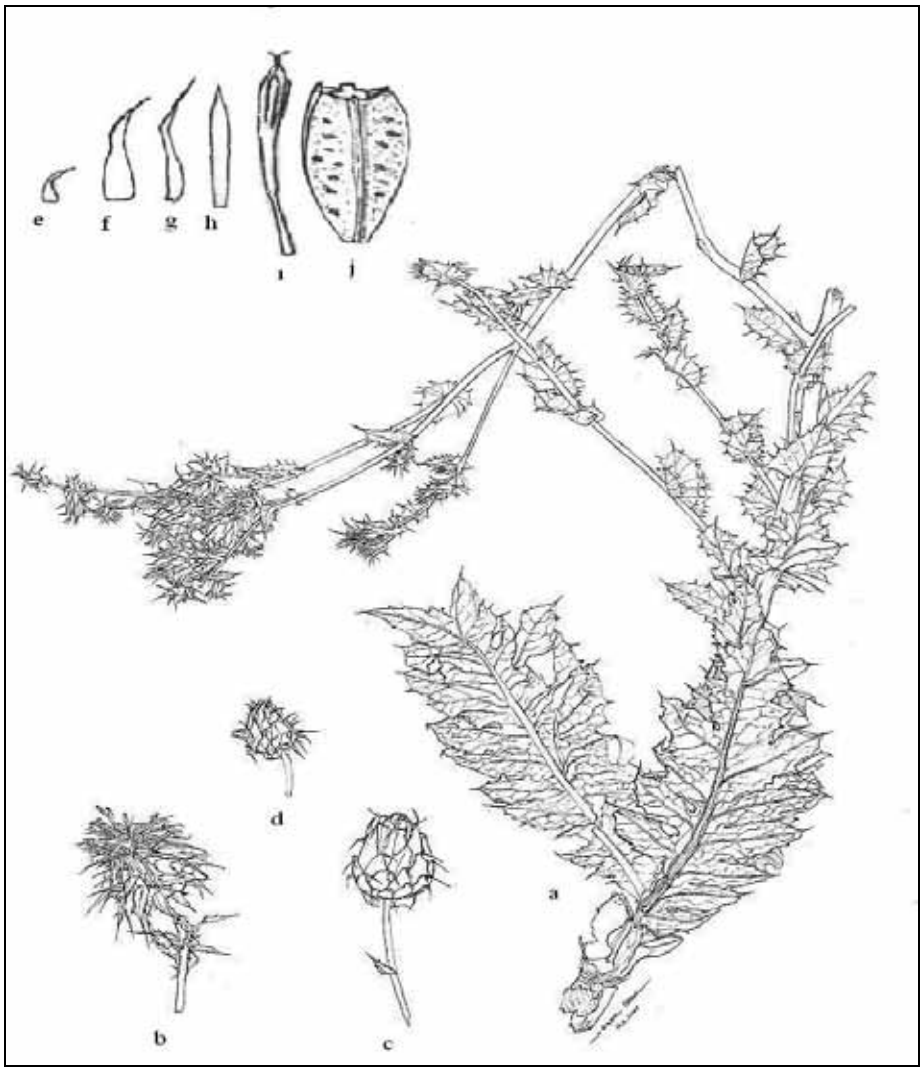

Figure 1. *Cousinia x kurubasgecidiensis* Ilcim & H. Ozcelik hybr. nov. and its parent species:
a. Habit, b. capitula of *C. vanensis;* c. Capitula of *C. boissieri;* d. Capitula, e. Lower phyllary, f.g. Median phyllary, h. inner phyllary, ı.flower, j. seed of *C. x kurubasgecidiensis.*

Type: Türkiye, B9 Van; Kurubaş pass, steppe vegetation, 1700-1900 m., 10 July 1994, A. İlçim 60 (Holo in MKUH; Isotypes in VANF and GUL Herbaria).

2.2. *Description*

Biennial herb, stem 40-70 cm long. St**e**ms slender, terete, simple and/or ascending, branches, forming a broad panicle, loosely arachnoid-wooly to glabrous. Basal leaves oblong-ovate to pinnatifid; usually leathery, white arachnoid-tomentose below upper loosely arachnoid, with crowded spiny teeth, ± wavy at margin; basal leaves oblong 8-14 x 2.5-6 cm, with up to 4-12 pairs triangular or linear segments, terminal lobe not enlarged; stem leaves 2-5 x 2.2-3

cm, median leaves gradually smaller, upper leaves abruptly smaller, shallowly lobed or entire, decurrent into wings up to 0.3-1.5 cm long. Capitula 5-62, with 27-103 flowered, flowers tubular deep pink to purple. Involucre broadly ovoid to globose 1.2-3.5 cm board incl. spines. Phyllaries 46-88, loosely arachnoid wooly or soon glabrescent, apical apandage horizontal or reflexed, 4-12 mm long with 2-5 mm long terminal spine and 2-4 very small lateral prickles or not. Corolla pink or purple, 12-21 mm long, achenes obovate to obpyramidal, brown, 3.5-4.5 x 2-2.2 mm, black dotted. Pappus 5-7 mm long. Fl: 7-8.

2.3. *Ecology and geography*

Van Lake region in Türkiye is an important center of biodiversity for *Cousinia*s. Hybridisation of the genus occur generally in this area. The hybrid is occuring in a small area named as Kurubaşgeçidi on Van and Gürpınar road, almost 10 km. from Van city and at (1700-)1900-2300 m. Vegetation of the area is antropogenic steppe on vulcanic rocks. Elevation of the pass almost 2300 m. at peak and 1700 m. at the base. The area have a strong earthquake and eroded and sandy places and also rich floristical structure and poor vegetation. In the vegetation; *Astragalus* L. spp., *Cousinia vanensis*, *C. boissieri*, *Centaurea virgata* Lam., *Glaucium corniculatum* (L.) Rud., *Crambe orientalis* L., *Gypsophila bicolor* Freyn & Sint., *Echinophora orientalis* Hedge & Lamond, *Scorzonera latifolia* (Fisch. & Mey.) DC., *Cerinthe minor* L., *Phlomis armeniaca* Willd., *Salvia multicaulis* Vahl., *Salvia kronenburgii* Rech. fil., *Delphinium carduchorum* Chowdhuri & Davis, *Delphinium cyphoplectrum* Boiss., *Isatis glauca* Aucher ex Boiss. subsp. *iconia* (Boiss. & Heldr.) Davis, *Linum pycnophyllum* Boiss. et Heldr. subsp. *kurdicum* Davis, *Marrubium parviflorum* Fisch. et Mey. subsp. *oligodon* (Boiss.) Seybold are dominant.

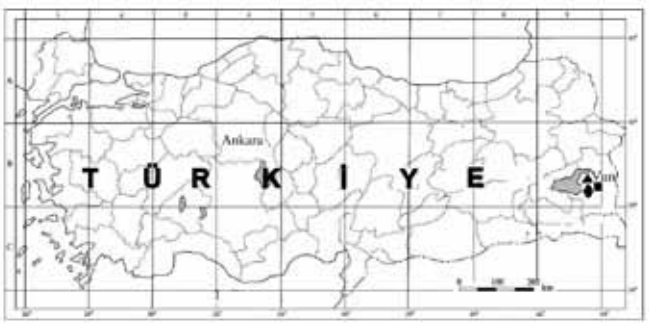

Figure 2. Distributions of *Cousinia x kurubasgecidiensis* (♦) *C. vanensis* (■) *C. boissieri* (▲)

2.4. *Conservation status*

Known only from type locality. The estimated area of occupancy is less than 10 km^2. It is suggested that this new species should be placed under the IUCN threat category 'Criticilly Endangered (CR)' (Anonymous, 2001).

2.5. *Pollen characters*

Pollens of *C. x kurubasgecidiensis*, *C. vanensis* and *C. boissieri* were studied by light microscopy. Pollens of the taxon were taken from the isotype specimen, some of important characteristics of these pollens results are; por shape is sphaeroideal, exine thinckness in fresh pollen 6.39 and 6.63 µm respectively; intine thinckness 1.02 µm. The pollen characteristics of *C. vanensis* are; pore shape sphaeroidal like as in *C. kurubasgecidiensis;* exine thinckness in fresh pollen 6.26 µm and 7.13 µm respectively; intine thinckness 1.13 µm. The pollen characteristics of *C. boissieri* are; pore shape suboblate different from other two taxa. Exine thinckness in fresh pollen are 6.05 µm and 6.11 µm respectively. Intine thinckness is 1.24 µm thick. The details of this study are presented in Table 2.

As a result of the palinological research, general morphological properties of pollens were determined as a radial symetry, Amb shape triangular, exine structure techtata, ornamentation reticulate. Lamina is narrow around aperture and polar while it is wide between apertures. Shape of pollen is prolate. Pollen morphologies of *C. vanensis* and *C. boissieri* were similar each to other, whereas polen of *C. x kurubasgecidiensis* was smaller than parental two species and it has abnormal morphology. Polar axis, equator axis, mesoporium, amb size, intin tickness, apocolpium values of *C. x kurubasgecidiensis* were smaller than *C. vanensis* and *C. boissieri*. Althought polen shape of *C. x kurubasgecidiensis* was smaller and also equator exine thicker than above two species. It is suboblate of *C. boissieri* while pore shape for *C. vanensis* and *C. x kurubasgecidiensis* are spherical (Figure 3). According to (Aytuğ, 1967) pollen morphologies of hybrides are very different from each to other in shape and abnormal in structure. Proportion of abnormal pollens must be more than 50 %. According to Gauss Bent, the conclusion can be found from 100 measurements in normal pollens and also 300 measurement in the hybrid taxon pollens. This stiuation is valid for *C. x kurubasgecidiensis*. Pollen morphology of the taxon is very variable (Figure 3).

There are some informations and researches on palynological characters which have taxonomical importance for determination of filogenetic relationship between genus and species (Erdtman, 1957). Number and state, exine structure, ornamentation, general view and greatness of the pores in taxonomical studies are very important characters used to distinguish some genus and species.

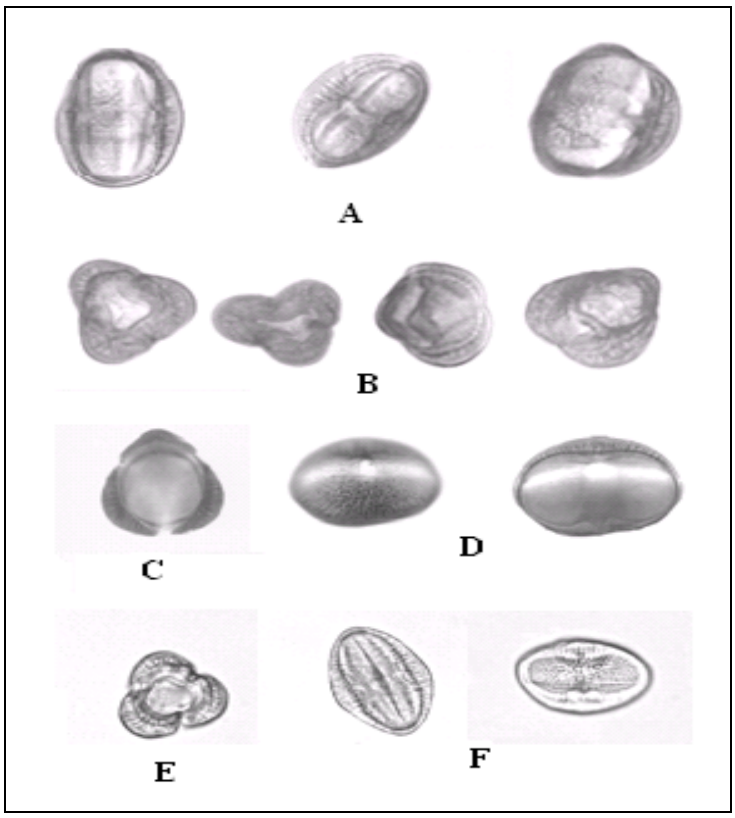

Figure 3. Pollen morphologies: **A.** equatoral wiev **B.** polar wiev of *C. x kurubasgecidiensis*; **C.** polar wiev **D.** equatoral view of *C. vanensis;* **E.** Polar wiev **F.** equatoral view *C. boissieri.*

3. Discussion and results

This new taxon share same locality with *C. boissieri* and *C. vanensis*. Its similar to *C. vanensis* but clearly differs from it short decurrent wings 0.3-1.5 cm (not 1-4.5 cm) capitula loosely arachnoid wooly or soon glabrescent (not densely arachnoid-wooly) phyllaries short 4-12 mm (not 6-15 mm) lenght of pappus 5-7 mm (not 2-5 mm). Also, it differs from *C. boissieri* in that it having ascending stems (not erect). The leaves are decurrent (not amplexicaule), and the capitula are larger 1.2-3.5 cm. (not 1.67-2.05).

The pollens of *C. kurubasgecidiensis*, *C. vanensis* and *C. boissieri* were studied by light microscopy. The pollens of *C. kurubasgecidiensis* studied from the isotype, some of the important characteristics of these pollens results are; por shape is sphaeroidea thinckness of the exine in fresh pollen are 6.39 µm and 6.63 µm respectively. Intine is 1.02 µm thick. The details of this study are presented in Table 2.

The pollens characteristics of *C. vanensis* are; por shape is sphaeroidea like as in *C. kurubasgecidiensis*. The thinckness of the exine in fresh pollen are 6.26 µm and 7.13 µm respectively. Intine is 1.13 µm thick.. The details of this study are presented in Table 2.

The pollen characteristics of *C. boissieri* are; por shape is suboblate different from other two species. The thinckness of the exine in fresh pollen are 6.05 µm and 6.11 µm respectively. The intine is 1.24 µm thick. The details of this study are presented in Table 2.

As a result of the palinological research, general morphological properties of pollens were determined as a radial symetry, Amb shape triangular, exine structure techtata, ornamentation reticulate. Lamina is narrow around aperture and polar while it is wide between apertures. Shape of pollens are prolate. Pollen morphology of *C. vanensis* and *C. boissieri* were similar to each other whereas *C. x kurubasgecidiensis* was smaller than those two species and have abnormal morphology. Polar axis, equator axis, mesoporium, amb size, intin tickness, apocolpium values of *C. kurubasgecidiensis* were smaller than *C. vanensis* and *C. boissieri*. Althought polen shape of *C. x kurubasgecidiensis* was smaller than another two species, equator exine thicker than *C. vanensis* and *C. boissieri*. Pore shape in *C. boissieri* was suboblate while in *C. vanensis* and *C. x kurubasgecidiensis* it was sphaeroidea (Figure 3). According to (Aytuğ,

1967) polen morphology of hybrides is very different from each other with shape and have abnormal morphology. Proportion of abnormal pollens are more than 50 %. Hybride species have variable polen morphology. In the normaly in pollens Gauss Bent can be found from 100 measurements whereas in the hybride pollens it can't be obtainable at 300 measurement. This stiuation also was observed at *C. x kurubasgecidiensis* because of the different and variable polen morphology of this species (Figure 3).

There are some informations and researches on palynological characters which have taxonomical importence for determination of filogenetic realtionship between genus and species (Erdtman, 1957). In taxonomical studies number of the pores and state, exine structure, ornamentation, general view and greatness are an important characters used to distinguish some genus and species.

Irano-Turanian is the most important region for genus *Cousinia*. Most of its species grow naturally in this region**.** Herbal parts of the plants used for fuel by local people. Most of them are endemics for Türkiye and they are breeding a large number of seeds. Germinations are very low because of embryos of these seeds are used for food by some insect larvas. Van Lake region in Türkiye is an important center of diversity for ***Cousinia***s. Hybridisation occur generally in this area. In this paper, one of these hybrids is reported. Tremblings of the earth (usually produced by volcanic action or other forces under the earth's crust) and landslips in volcanic areas might be effected to hybridisation in the genus.

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(Received for publication 29 December 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 76-87

Research article/Araştırma makalesi

Chromosome count and karyotype study of eleven *Nepeta* L. (Lamiaceae) species from Iran

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Abstract

Nepeta L. genus (Lamiaceae Family) with high morphological and chromosomal diversity is one of the large genus of Iran with important genetic resources in this country. In order to study the karyotype features in *Nepeta* species, 11 species and 31 accessions were collected from natural habitats of Zagros region. Their chromosome number and karyotype were studied using mitotic metaphase. The cluster analysis with Squared Euclidean Distance and Ward Methods were done by use of SPSS software ver.20 to display the chromosomal diversity. The results of this research showed that the studied taxa were diploid, tetraploid and hexaploid. Chromosome numbers were 2n=18, 22, 26, 32, 34, 36, 42, 54 and basic chromosome numbers were x=7, 8, 9, 11, 13, 17. Most of the numbers and all of the karyotypes were reported for Iran for the first time. The karyotypic results showed the diversity among the species as mostly displayed median point (M), median region (m) and sub median region (sm) and the chromosome lengths were in the range of 0.64-2 µm. From the clustering results, high chromosomal diversity was found in *N. glomerulosa, N. fissa, N. pungens, N. daenensis* and *N. schiraziana* accessions. It is concluded that Zagros region is one of the diversity centers in Iran and provide the evolutionary trends in this genus.

Key words: Karyotype, Chromosome number, *Nepeta*, Lamiaceae, Iran

1. Introduction

Nepeta L. (catmint) genus belonging to Lamiacaea Family and Nepetoideae subFamily (Cantino et al., 1992) is one of the largest and medicinal genera in this Family with 300 species growing as perennial, rarely annual, herbaceous and fruticose plants (Rechinger, 1982; Kaya and Dirmenci, 2008). *Nepeta* species are significantly distributed in Eurasia, North Africa, North and Central America and Canary Islands. The diversity and species richness are found in South West Asia and Himalayas (Jamzad et al., 2000; Celenk et al., 2008). This genus has 75 species in Iran, of which 39 are endemic (Rechinger, 1982; Jamzad et al., 2003).

Nepeta species being used in traditional medicine as antispasmodic, expectorant, diuretic and antiseptic activities are widely recommended by pharmaceutics and make them important among taxonomists (Celenk et al., 2008). The essential oils richness of species, not only enhances its medicinal value but also improves its acceptability beyond the domain of *Nepeta* genus (Kaya and Dirmenci, 2008).

Taxonomically, the classification of *Nepeta* has been contentious and debatable (Celenk et al., 2008). Bentham (1848) divided it into 8 sections and 109 species, Briquet (1896) documented 2 sections and 150 species. Additionally, Rechinger (1982) recognized 12 sections, Budantsev (1993) categorized 19 sections and 210 species, Dirmenci (2003 PhD thesis, 2005) acknowledged 11 sections for this genus, and Hassan et al. (2011) also reported 22 *Nepeta* species from Himalaya. Consequently, the above mentioned different classifications underscore the sharp and evolving disagreement among taxonomist concerning the subject including the research implication (Jamzad et al., 2003). Frequent hybridization and introgression, together with considerable habitat variation make *Nepeta* a particularly complex genus (Celenk et al., 2008).

Morphologically, the characters as leaf form, indumentum and margin, inflorescence type, calyx and corolla indumentum, nutlet form and color are appropriate morphological characters to determine the *Nepeta* species and display high variability, even among related species (Hedge and Lamond, 1982; Jamzad et al., 2003). These variations were first reported by Baden (1984) in leaves, bracteoles and calyx of *N. camphorata* Boiss. & Heldr. and *N. heldreichii*

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Hal. The Leaf morphology differences are noticeable even among the same species. Jamzad et al. (2000) and Kaya and Dirmenci (2008) argue that using nutlet micro morphology could help in classification of the *Nepeta* genus in the future. Furthermore, Jamzad et al. (2003) reported that the distribution of flavones in *Nepeta* genus provided some valuable data for the phylogenetic relationships. Moreover, Celenk et al. (2008) using palynological data in *Nepeta* genus argued that pollen features are appropriate markers for relationships in this genus.

Consistent with the complex nature of the *Nepeta* genus, significant number of cytological reports are widely known. Based on chromosome studies in different *Nepeta* species, ranging from 2n=14, 16, 18, 32, 34, 36, 54 and basic chromosome numbers, x= 7, 8, 9, 13, 17, 18 (Aryavand, 1975, 1977; Gill, 1979; Marceno and Princiatto, 1980a; Gill, 1981; Ubera, 1983; Snogerup, 1985; Seidenbinder and Verlaque, 1985; Budantsev et al., 1992; Blatisberger and Huber, 1993; Khatoon and Ali, 1993; Trigas and Iatrou, 2006; Saggoo et al., 2011). The chromosome number 2n= 18 and 36 are common in this genus whereas basic chromosome number as x=9 and 17 and 2n=34 are few common (Baden, 1983). On the contrary, Saggoo et al. (2011) reported that x=8 and x=9 were common in this genus. Also, Baden (1983) was observed B chromosome in some of *Nepeta* species. The karyological and chromosome morphology reports of this genus are mainly limited. However, Baden (1983) reported the karyotype of *N. sibthorpii* Benth. with three different groups of chromosome.

The chromosome count and karyotype studies are not only useful in predicting morphological similarity and diversity among *Nepeta* species they are valuable sources of taxonomic and biosystematics information. The absence and sometimes limited research work on chromosome data on the *Nepeta* species in Iran and Zagros means that the chromosome counts and karyology were made on *Nepeta* chromosomes from Zagros region. The objectives of this study are 1) to present karyological information, particularly the differences among them and 2) to determine the chromosome number and basic chromosome number of these taxa. Some of the chromosome numbers and all of the karyotypic illustrations are first reported for Iran.

2. Materials and methods

2.1. *Plant materials*

11 species and 31 accessions collected from natural habitats of Zagros province are listed in Table 1. Voucher specimens of the taxa studied were deposited in the Herbarium of Shahrekord University. The chromosome counts and karyology were done on chromosome 11 species and 31 accessions from Zagros region including *N. bakhtiarica* Rech., *N. persica* Boiss., *N. kotschyi* Boiss, *N. Juncea* subsp. *destrorum* Bornm., *N. glomerulosa* subsp. *carmanica* (Bunge) Benth., *N. oxyodonta* Boiss., *N. sessilifolia* Bunge, *N. pungens* (Bunge) Benth., *N. schiraziana* Boiss., *N. daenensis* Boiss. and *N. fissa* C.A. Mey.

2.2. *Chromosomal studies*

The following procedures were followed, in carrying out the chromosomal studies. For mitotic studies, the seeds collected from various accessions were germinated in sterilized Petri dishes. Then root tips meristems were pre-treated with an ice bath at 4º C for 18 hours and then fixed in a mixture of ethanol: acetic acid (3:1, respectively) for 24 hours. The root tips were macerated in a 1N HCl solution at 60º C for about 5 minutes. A squash technique was used for cytological studies with 2% aceto-orcein solution (Ozkan, 2006). OLYMPUS BX50 photomicroscope provided the clearest mitotic metaphase among 25 cells. Ideograms prepared from mitotic metaphase. Chromosome measurements were based on five metaphase plates (Ozkan and Soy, 2007). From the point of view of chromosome morphology, the chromosome pairs were determined (Levan et al., 1964). In other to ensure the reliability and validity of the statistical estimates, the cluster analysis with Squared Euclidean Distance and Ward Methods were applied using SPSS software ver. 20 with eight cytological characters (L, S, L/S (AR), TL, %TF or the total form percentage $[(\Sigma SA/\Sigma TL)*100]$, A1 or intra chromosomal asymmetry index $[1-\sum(SA/LA)/n]$, A2 or intra chromosomal asymmetry index $[Sd/X]$; Sd is the average of standard deviation, and X is the mean chromosome length, DRL or difference of range relative length [MaxRL%-MinRL%]) (Huziwara, 1962; Romero-Zarko, 1986; Sheidaei and Jalilian, 2008; Kalvandi et al., 2012).

3. Results

Following the completion of the study, consistent with the chosen research design and methodology, the following results were recorded.

3.1. *N. schiraziana*

The results of this study showed that the chromosome number of *N. schiraziana* is 2n= 6x =54 (Figure 1 A, B), the basic chromosome number is x= 9 and hexaploid species. The above result was the first of its kind in Iran. The karyotype of this species showed Median point (M), median region (m) and sub median region (sm) (Table 2, Figure 3). The chromosome length ranged from 0.64-0.88 μm. The karyotype data were first reported for Iran.

Table 1. the vouchers details of studied *Nepeta* species from Iran

Species/accession	Locality	Altitude (m)
N. bakhtiarica	Chaharmahal va Bakhtiari- Naghan, dopolan	2114
N. persica 1	Chaharmahal va Bakhtiari- saman, Ben	1800
N. persica 2	Isfahan- damaneh	1750
N. persica 3	Kohkilouye va Boyer Ahmad- Yasouj	1800
N. glomerulosa subsp. *carmanica* 1	Chaharmahal va Bakhtiari- boroujen, Lordegan	1797
N. glomerulosa subsp. *carmanica* 2	Isfahan- Vanak Semirom	2000
N. glomerulosa subsp. *carmanica* 3	Kohkilouye va Boyer Ahmad- Sisakht	1900
N. glomerulosa subsp. *carmanica* 4	Chaharmahal va Bakhtiari- Lordegan, Vanak	2402
N. glomerulosa subsp. *carmanica* 5	Chaharmahal va Bakhtiari- Gandoman, Naghe	2440
N. glomerulosa subsp. *carmanica* 6	Chaharmahal va Bakhtiari- Gandoman	2470
N. oxyodonta 1	Chaharmahal va Bakhtiari- Naghan, Helen forest	1855
N. oxyodonta 2	Chaharmahal va Bakhtiari-Naghan, gardane Bare morde	1869
N. juncea subsp. *desertorum* 1	Chaharmahal va Bakhtiari- Boroujen, Sourak	2670
N. juncea subsp. *desertorum* 2	Chaharmahal va Bakhtiari- Boroujen	2610
N. juncea subsp. *desertorum* 3	Isfahan- Vanak Semorom	2150
N. sessilifollia	Chaharmahal va Bakhtiari- Ben, Sheikhe Shaban	2700
N. pungens 1	Chaharmahal va Bakhtiari- Chaleshtor	2000
N. pungens 2	Chaharmahal va Bakhtiari- Ben	2398
N. pungens 3	Isfahan- Damane	1850
N. pungens 4	Kohkilouye va Boyer Ahmad- Yasouj	1900
N. pungens 5	Isfahan- Semirom	1850
N. schiraziana 1	Chaharmahal va Bakhtiari- Naghan, kouh-e Kalar	2370
N. schiraziana 2	Chaharmahal va Bakhtiari- Nghan, Chahar Tagh	2400
N. schiraziana 3	Kohkilouye va Boyer Ahmad- toward Shiraz	1700
N. kotschyi	Chaharmahal va Bakhtiari- Naghan, Helen forest	1917
N. fissa 1	Isfahan- Fereydan	2200
N. fissa 2	Chaharmahal va Bakhtiari- Saman, Tiran	1941
N. fissa 3	Chaharmahal va Bakhtiari- Saman, Hore	2190
N. daenensis 1	Chaharmahal va Bakhtiari- Chahar tagh, kouh-e Kalar	2488
N. daenensis 2	Chaharmahal va Bakhtiari- Naghan, Chahar Tagh	2680
N. daenensis 3	Kohkilouye va Boyer Ahmad- Sisakht	2650

3.2. *N. pungens*

Cytological studies revealed that the chromosome number of 2n=2x=22 was observed in *N. pungens* (Figure 1 C, D), basic chromosome number is x=11 and diploid species. The karyotype is median point (M) and median region (m) (Table 2, Figure 3). The chromosome length varied from 0.69-1.1µm. The chromosome number and karyotype of this species were first reported for Iran.

3.3. *N. fissa*

The chromosome number of *N. fissa* was 2n=2x=22 (Figure 1 E, F), basic chromosome number is x= 11 and diploid species. Median point (M), median region (m) and sub median-region (sm) chromosomes were found in karyotype of this species (Table 2, Figure 3). The chromosome length varied from 0.82-1.47 µm. This is the first time that the karyotype of this species has been reported for Iran.

3.4. *N. juncea* subsp. *desertorum*

The chromosome number of *N. juncea* subsp. *desertorum* was 2n=2x=26 (Figure 1 G, H), the basic chromosome number is x= 13 and diploid species. The karyotype of this species is median point (M), median region (m) and sub-median region (sm) (Table 2, Figure 4). The chromosome length varied from 1.21-1.38 µm. The chromosome number and the karyotype of this species have been first accounted in Iran.

3.5. *N. glomerulosa* subsp. *carmanica*

The chromosome number of *N. glomerulosa* subsp. *carmanica* is 2n= 2x =18 (Figure 1 I, J), the basic chromosome number is x= 9 and diploid species. The karyotype of this species has median point (M), median region (m) and sub-median region (sm) (Table 2, Figure 4). The chromosome length ranged from 1.36-2 µm. The chromosome number and karyotype of this species were first reported in Iran.

3.6. *N. persica*

The chromosome number of *N. persica* was 2n=4x=36 (Figure 2 A, B), basic chromosome number is x=9 and tetraploid species. The karyotype of this species is median point (M), median region (m) and sub-median region (sm) (Table 2, Figure 4). The chromosome length ranged from 1.02-1.22 µm. The karyotype of this species was first reported for Iran.

3.7. *N. oxyodonta*

The chromosome number of *N. oxyodonta* is 2n=6x=42 (Figure 2 C, D), the basic chromosome number is x= 7 and hexaploid species. The karyotype of this species displayed median point (M) and median region (m) (Table 2, Figure 4). The chromosome length varied from 0.83-1.25 µm. Chromosome record of this species was first reported for Iran.

3.8. *N. Daenensis*

Cytological studies showed that the chromosome count of *N. daensisi* is 2n=4x=32 (Figure 2 E, F), the basic chromosome number is x=8 and tetraploid species. Median point (M), median region (m) and sub-median region (sm) chromosomes were observed in karyotype (Table 2, Figure 5). The chromosome length was in range of 0.92-1.27 µm. Chromosome data were first accounted in Iran.

3.9. *N. sessilifolia*

Cytological studies showed that the chromosome number of *N. sessilifolia* is 2n=2x=26 (Figure 2 G), basic chromosome number is x=13 and diploid species. The karyotype of this species is median point (M) and median region (m) (Table 2, Figure 5). The chromosome length ranged from 1.08-2.25 µm. The chromosome number and karyotype of this species were first reported in Iran.

3.10. *N. kotschyi*

The chromosome number of 2n=2x=34 is reported for *N. kotschyi* (Figure 2 H), the basic chromosome number is x= 17 and diploid species. Median point (M), median region (m) and sub-median region (sm) were observed in karyotype of this species (Table 2, Figure 5). The chromosome length ranged from 1.09-2.5 µm. Chromosome data of this species were first recorded in Iran.

3.11. *N. bakhtiarica*

N. bakhtiarica is one of the Zagros endemic species which displayed the chromosome number of 2n=2x=18 (Figure 2 I), the basic chromosome number is x=9 and diploid species. The karyotype of this species showed median point (M) and median region (m) (Table 2, Figure 5). The chromosome ranged from 1.06-2.21 µm. The chromosome counts and karyotype of this Iranian endemic species were recorded for the first time.

The ploidy levels of *Nepeta* species were diploid, tatraploid and hexaploid, and basic chromosome numbers were as x=7, 8, 9, 11, 13, 17 which eight of chromosome counts were first reported for Iran. The highest symmetrical karyotype was observed in *N. schiraziana* (TF= 49%), *N. oxyodonta* (TF= 48%), *N. daenensis* (TF=48%) and *N. persica* (TF=48%) (Table 3). Moreover, the highest cytological variations were observed in A1, DRL, TL, L and A2 characters (Table 3). The highest DRL displays the structural variation in chromosome which is observed in *N. glomerulosa* (DRL=4.99). The highest C.V. was found in *N. daenensis* (C.V.=80.7; A1) and the lowest was found in *N. persia* (C.V.=0.02; TF%). The highest chromosome arm was observed in *S. glomerulosa* (L=1.13) and the lowest was in *S. schiraziana* (L=0.31) (Table 3).

The results of cytological characters and cluster analysis showed two groups, 1) this group comprised two subgroups a) *N. glomerulosa* subsp. *carmanica* (diploid), b) *N. glomerulosa* subsp. *carmanica* (diploid), *N. juncea* subsp. *desertorum* (diploid), *N. bakhtiarica* (diploid), *N. fissa* (diploid), *N. pungens* (diploid) and 2) this group contained two subgroups c) *N. sessilifolia* (diploid), *N. oxyodonta* (hexaploid), *N. daenensis* (tetraploid), *N. schiraziana* (hexaploid) d) *N. daenensis* (tetraploid), *N. schiraziana* (hexaploid), *N. pungens* (diploid), *N. fissa* (diploid), *N. persica* (tetraploid), *N. kotschyi* (diploid) (Figure 6). High chromosomal diversity was found in *N. glomerulosa*, *N. fissa*, *N. pungens*, *N. daenensis* and *N. schiraziana* accessions.

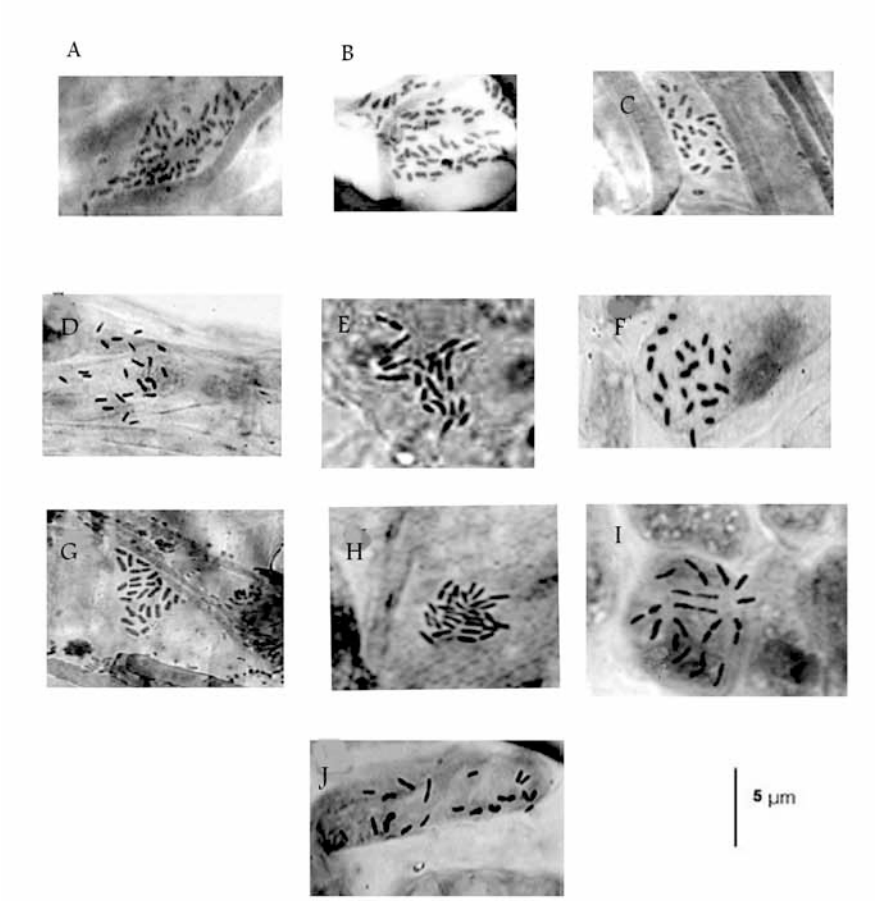

Figure1. Photomicrograph of mitotic division in somatic cells of five *Nepeta* species. A, B: *N. schiraziana* (2n=54), C, D: *N. pungens* (2n=22), E, F: *N. fissa* (2n=28), G, H: *N. juncea* subsp. *desertorum* (2n=26), I, J: *N. glomerulosa* subsp. *carmanica* (2n=18).

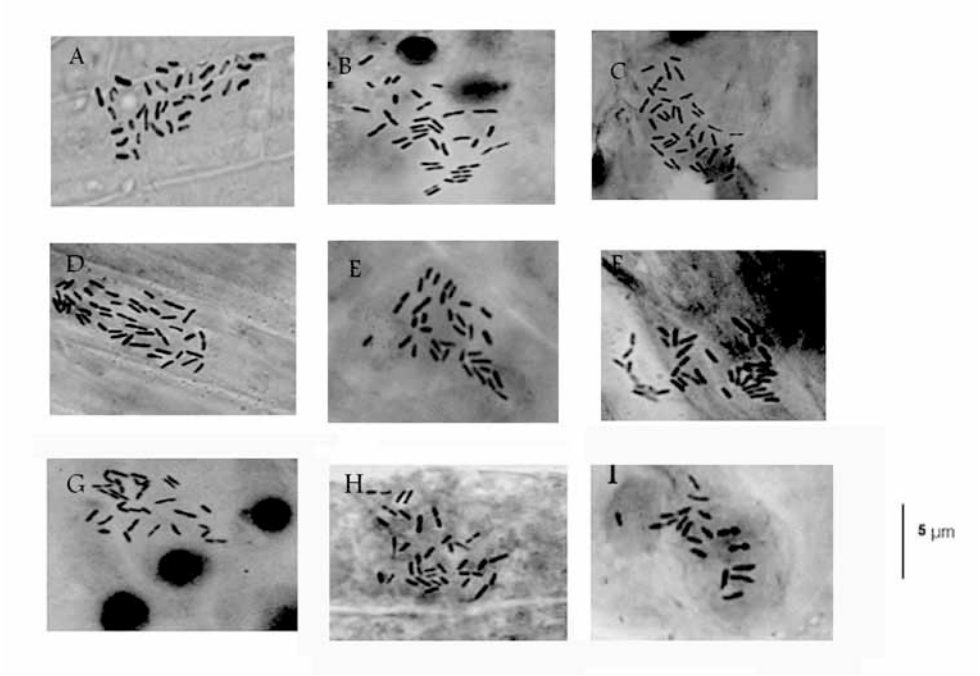

Figure 2. Photomicrograph of mitotic division in somatic cells of six *Nepeta* species. A, B: *N. persica* (2n=36), C, D: *N. oxyodonta* (2n=42), E, F: *N. daenensis* (2n=32), G: *N. sessilifolia* (2n= 26), H: *N. kotschyi* (2n= 34), I: *N. bakhtiarica* (2n= 18).

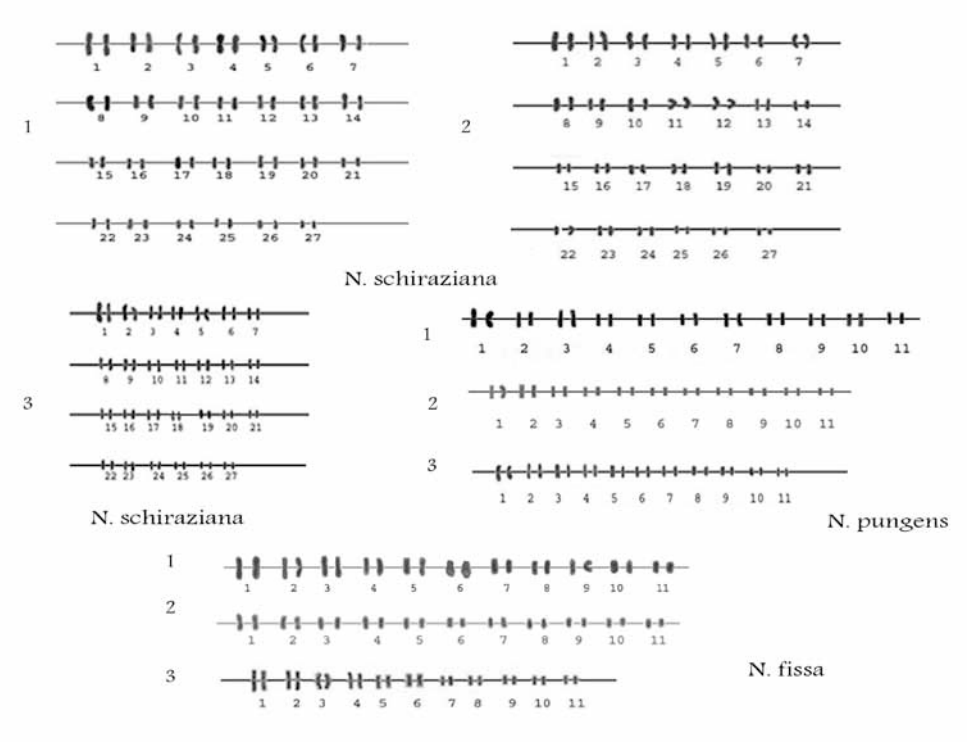

Figure3. Representative of ideogram in four *Nepeta* species.

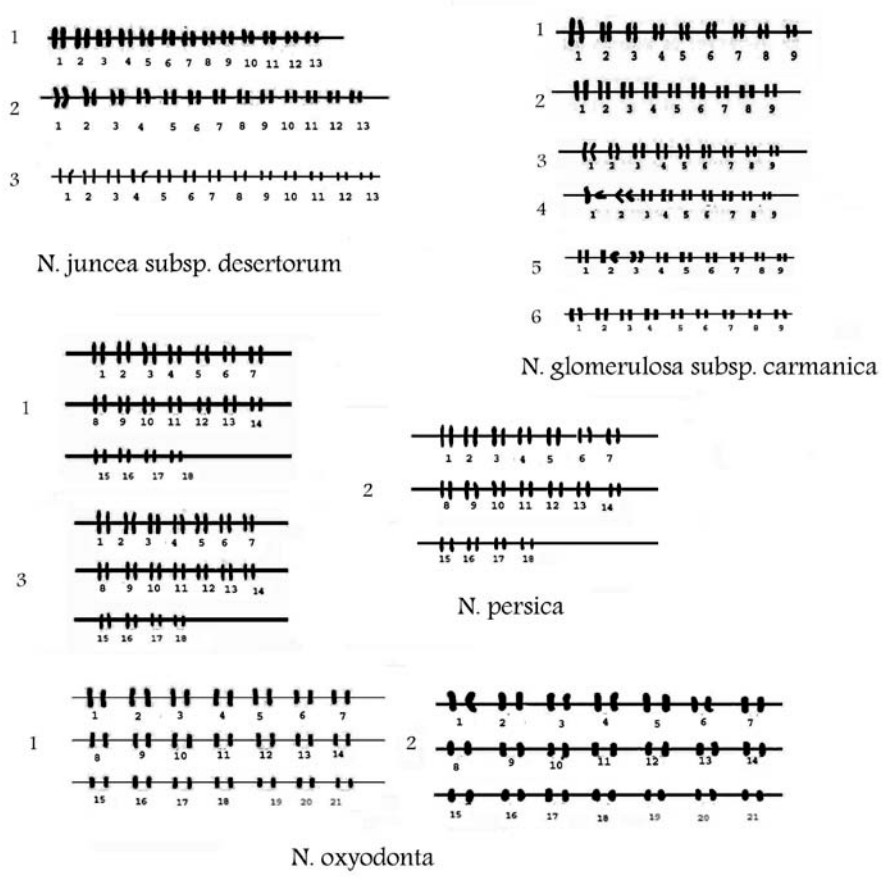

Figure 4. Representative of ideogram in four *Nepeta* species

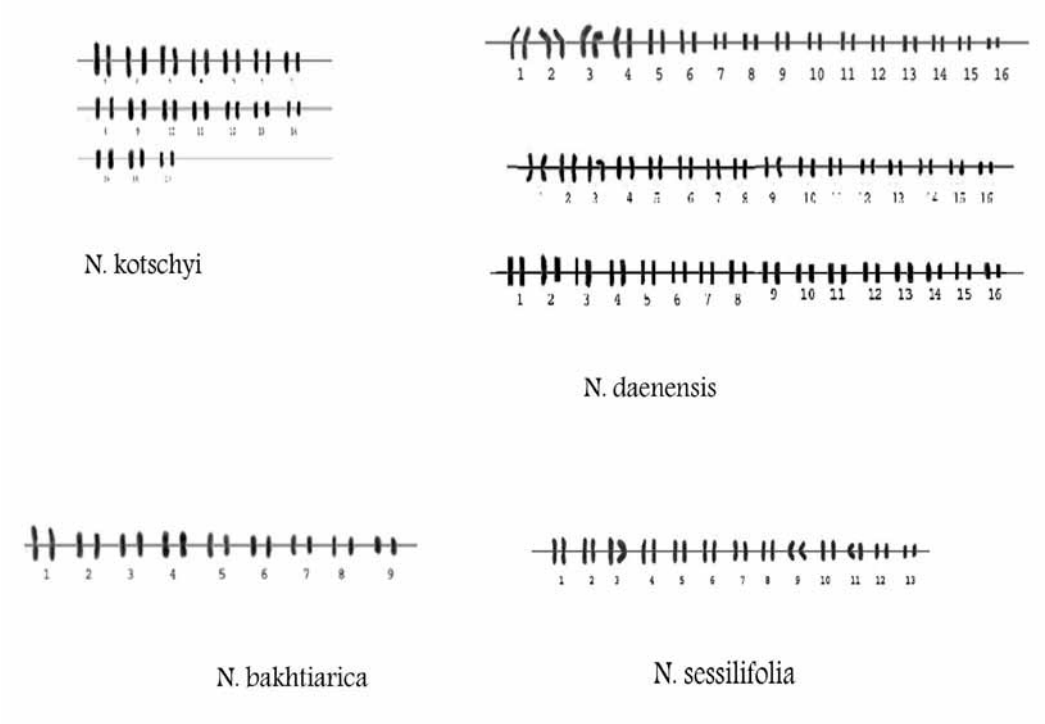

Figure 5. Representative of ideogram in four *Nepeta* species

Table 2. the chromosome number, basic chromosome number, ploidy levels and karyotype formulae in eleven *Nepeta* species

Species	Chromosome number	Basic chromosome number	Ploidy levels	Karyotype formulae
N. bakhtiarica	2n=2x=18	X=9	diploid	5M+4m
N. glomerulosa subsp. *carmanica*	2n=2x=18	X=9	diploid	3M+3m+3sm,5M+4m, 4M+5m,5M+2m+2sm, 7M+1m+1sm,8M+1sm
N. fissa	2n=2x=22	X=11	diploid	9M+1m+1sm, 10M+1m, 8M+2m+1sm
N. pungens	2n=2x=22	X=11	diploid	3M+8m, 11M, 7M+4m
N. persica	2n=4x=36	X=9	tetraploid	7M+10m+1sm, 11M+6m+1sm,8M+4m+6sm
N.sessilifolia	2n=2x=26	X=13	diploid	11M+2m
N. juncea subsp. decertorum	2n=2x=26	X=13	diploid	11M+1m+1sm,3M+10m, 7M+4m+2sm
N. kotschyi	2n=2x=34	X=17	diploid	4M+6m+6sm
N. daenensis	2n=4x=32	X=8	tetraploid	13M+3m,11M+4m+1sm,12M+2m+2sm
N. oxyodonta	2n=6x=42	X=7	hexaploid	19M+2m,13M+8m
N. schiraziana	2n=6x=54	X=9	hexaploid	15M+4m+8sm, 11M+3m+13sm, 11M+ 11m+5sm

Table 3. the chromosome features in eleven and 33 accessions of *Nepeta* species

Species/accession	S	L	L/S	Tl	A1	A2	%TF	DRL
N. schiraziana	0.31	0.32	0.96	0.64	0.02	0.35	48	2.79
N. schiraziana	0.37	0.39	1.05	0.78	0.04	0.37	47	2.31
N. schiraziana	0.44	0.45	1.02	0.88	0.03	0.37	49	2.50
C.V.	16.2	15.7	3.96	15.7	33.3	3.05	2.08	9.48
N. pugens	0.46	0.61	1.32	1.07	0.24	0.28	43	4.71
N. pugens	0.47	0.58	1.23	1.05	0.17	0.19	44	2.76
N. pugens	0.33	0.45	1.37	0.78	0.31	0.23	42	2.85
N. pugens	0.33	0.36	1.09	0.69	0.07	0.27	47	3.22
N. pugens	0.47	0.61	1.3	1.1	0.35	0.2	42	2.32
C.V.	17.1	21.1	7.93	19.3	50	17.39	4.74	28.7
N. fissa	0.44	0.58	1.32	1.02	0.23	0.33	42	4.69
N. fissa	0.63	0.84	1.33	1.47	0.23	0.33	42	4.69
N. fissa	0.37	0.45	1.22	0.82	0.22	0.25	43	3.5
C.V.	27.1	30.6	4.65	30	2.27	13.7	1.34	15.8
N. juncea subsp. *decertorum*	0.54	0.64	1.18	1.19	0.12	0.26	46	2.89
N. juncea subsp. *decertorum*	0.5	0.7	1.4	1.21	0.32	0.2	41	2.77
N. juncea subsp. *decertorum*	0.64	0.74	1.15	1.38	0.15	0.23	46	3.51
C.V.	20	7.24	10.48	7.9	52.6	13.04	6.57	12.7
N. glomerulosa subsp. *carmanica*	0.74	0.96	1.29	1.7	0.35	0.18	42	3.65
N. glomerulosa subsp. *carmanica*	0.73	0.97	1.32	1.7	0.27	0.18	42	2.96
N. glomerulosa subsp. *carmanica*	0.67	1.04	1.55	1.71	0.41	0.29	38	4.99
N. glomerulosa subsp. *carmanica*	0.69	0.88	1.27	1.58	0.22	0.19	43	3.2
N. glomerulosa subsp. *carmanica*	0.86	1.13	1.31	2	0.31	0.17	42	5.65
N. glomerulosa subsp. *carmanica*	0.57	0.79	1.38	1.36	0.28	0.22	41	2.86
C.V.	12.6	15.4	7.4	11.9	20	20	4.23	29.8
N. persica	0.5	0.56	1.12	1.07	0.08	0.22	48	2.42
N. persica	0.49	0.52	1.06	1.02	0.04	0.22	48	2.63
N. persica	0.58	0.63	1.08	1.22	0.06	0.22	48	2.64
C.V.	7.69	9.64	2.77	9.1	33.3	5	0.02	4.68
N. oxyodonta	0.47	0.59	1.25	1.25	0.51	0.19	46	1.55
N. oxyodonta	0.4	0.43	1.07	0.83	0.06	0.26	48	2.17
C.V.	9.3	21.5	10.34	27.8	75	18.8	3	23.1

Table 3. (continued)

N.sessilifolia	0.79	0.95	1.20	0.93	0.16	0.21	45	2.59
N. kotschyi	0.73	0.93	1.27	1.66	0.22	0.23	43	2.50
N. daenensis	0.5	0.53	1.06	1.04	0.06	0.35	48	3.83
N. daenensis	0.61	0.66	1.08	1.27	0.06	0.17	48	1.79
N. daenensis	0.43	0.49	1.13	0.92	0.09	0.26	46	2.51
C.V.	17.6	14.2	3.3	15.8	80.7	34.6	2.32	38
N. bakhtiarica	0.64	0.77	1.20	1.43	0.16	0.21	45	4.15

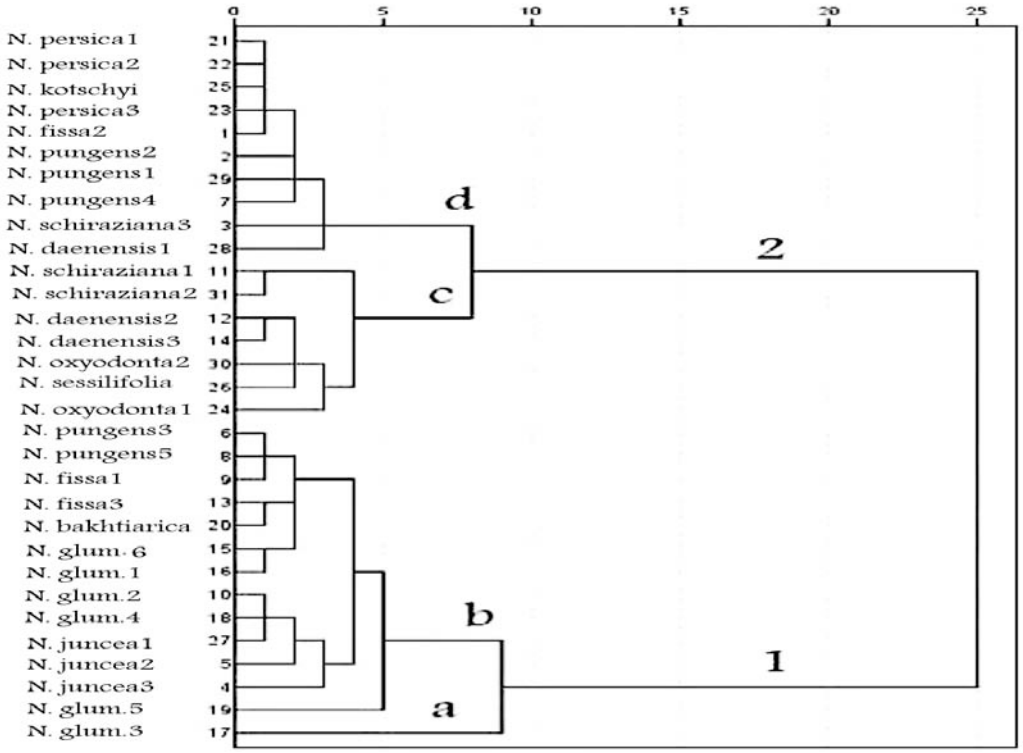

Figure 6. dendrogram of cytological characters and 31 accessions of *Nepeta* species in Iran

4. Conclusions and discussion

The current study presents the somatic chromosome numbers, basic chromosome numbers, and levels of ploidy and karyotype details of 11 species of *Nepeta* in Iran.

The ploidy levels of *Nepeta* species are diploid, tetraploid and hexaploid, and chromosome numbers are 2n= 18, 22, 26, 32, 34, 36, 42, 54. From the basic chromosome number reported above, it appears that *Nepeta* has more than one basic chromosome number. Consequently, these *Nepeta* species are thought to be diploid, tetraploid and hexaploid which is consistent with the literature. To validate this viewpoint, studies in the microsporogenesis of these species will be necessary to substantiate the process. The import of the foregoing is to provide reasonable evidential support for the differences and similarities of the *Nepeta* species studied in the context of the report.

According to the literature, some of the *Nepeta* species are characterized by several basic chromosome number such as x= 7 (Snogerup, 1985; Saggoo et al., 2011), 8 (Aryavand, 1977; Gill, 1981; Baden, 1983; Saggoo et al., 2011), 9 (Aryavand, 1977; Baden, 1983; Ubera, 1983; Gill, 1984; Budantsev et al., 1992; Khatoon and Ali, 1993; Ghaffari and Kelich, 2006; Saggoo et al., 2011), 13 (Saggoo et al., 2011), 17 (Casas, 1976; Ubera, 1983; Budantsev et al., 1992; Blatisberger and Huber, 1993) and 18 (Aryavand, 1977; Gill, 1979, 1984; Ubera, 1983; Seidenbinder and Verlaque, 1985; Khatoon and Ali, 1993). Based on the chromosome number Casas (1976), Aryavand (1977), Gill (1979, 1981,

1984), Ubera (1983), Baden (1983), Snogerup (1985), Seidenbinder and Verlaque (1985), Budantsev et al. (1992), Khatoon and Ali (1993), Blatisberger and Huber (1993), and Ghaffari and Kelich (2006) reported chromosome variation of 2n= 14, 18, 32, 34, 36 and 54 in different *Nepeta* species which refer the tetraploid and hexaploid levels and agree with our results. The basic chromosome number of x= 7, 8, 9, 13, 17 were accorded with previous results, however the chromosome number of 2n= 22 and 42 and basic chromosome number of x= 11 were not based on the previous reports. From the literature, it appears that *Nepeta* has different levels of ploidy. In this study, *N. pungens, N. fissa, N. juncea* subsp. *desertorum, N. glomerulosa* subsp. *carmanica, N. sessilifolia, N. kotschyi* and *N. bakhtiarica* are dioloid whereas *N. persica* and *N. daenensis* are tetraploid, and *N. schiraziana* and *N. oxyodonta* are hexaploid. Based on previous data, the diploid, tetraploid and hexaploid *Nepeta* species were common (Casas, 1976; Aryavand, 1977; Gill, 1979, 1981; Baden, 1983; Ubera, 1983; Gill, 1984; Snogerup, 1985; Seidenbinder and Verlaque, 1985; Budantsev et al., 1992; Khatoon and Ali, 1993; Blatisberger and Huber, 1993; Ghaffari and Kelich, 2006). Moreover, Saggoo et al. (2011) were reported 2n= 18, 36 and x=9, and diploid and tetraploid levels for 14 *Nepeta* species from India. In addition, the tetraploid cytotypes in 15 *Nepeta* species have been reported. It seems that the diverse chromosome numbers and basic numbers of *Nepeta* species indicate that the group of species in different regions has differentiated independently after diffusion (Yang et al., 2004). Moreover, the high base number of 17 appears to be secondary in origin and might have arisen by amphiploidy (Gill, 1979). The different chromosome numbers indicate that aneuploidy occurs in these species (Esra et al., 2011). However, remarkable variation could reflect the nuclear DNA variation (Javadi et al., 2011).

The karyotype details of *Nepeta* species in this context have not exactly been reported so far. Baden (1983) first reported the metacentric and sub-metacentric for *N. sibthorpii* which supports our results. Baden (1983) argues that details karyotype studies are difficult due to the small size of chromosomes. In this study, the chromosome type is median point (M), median region (m) and sub-median region (sm) and the range of chromosome length in this study varies between 0.64-2 µm which is supported by Baden (1983) and mostly without constrictions which not corresponds with Baden (1983). Among the studied taxa, the highest length value was observed in *N. glomerulosa* subsp. *carmanica* (0.97-1.13µm) and the lowest was in *N. schiraziana* (0.31 µm). The karyotype and variation patterns in basic chromosome number were related to the specific speciation mechanisms (Sheidaei and Jalilian, 2008), which suggests an important role in speciation and evolution of *Nepeta* species. The differences in chromosome length might come from population growth in different regions (Esra et al., 2011).

B chromosomes, which are also recognized as accessory chromosomes, have been often detected in some of *Nepeta* species. Baden (1983) first reported 2n= 16+1-2B and 1-2 satellites for *N. sibthorpii*. In our results, there are not any B chromosomes and satellite in taxa studied.

The chromosome number of *N. fissa* was previously reported 2n=18 from Iran, Teheran province by Aryavand (1977). In our results the chromosome number of this species was observed 2n= 22 which is contrary to the previous report. In this case of variability, Gill (1979) reported the intra-specific races for some of *Nepeta* species. Moreover, *N. schiraziana* was reported 2n=16 by Aryavand (1975), whereas in this research we found 2n=54 for this species. Aryavand (1977) also reported n= 8 for *N. persica* from Iran, Isfahan province. Nevertheless in this research we found 2n=4x=36 and n=9 for this species. Based on the chromosome number variation, Budantsev et al. (1992) were reported 2n=34, n=17 in *N. cataria* L. which differs from that of Sugiura (1940) and Gill (1979)' report, who obtained 2n=36. Saggoo (1983, PhD thesis) reported n= 9 for *N. distans* Royle ex Benth. and n=18 for *N. hindostana* (Roth.) Haines, but Gill (1984) reported n=18 for *N. diastans* and n= 9 for *N. hindostana*. Nakata et al. (2001) reported n=9 (2n=18) for *N. subsessilis* Maxim. with intra-specific polyploidy. Budanstsev et al. (1992) recorded 2n= 34 for *N. grandiflora* M. Bieb. and Krahulcova (1991) obtained 36 for this species. *N. racemosa* Lam. was first reported by Aryavand (1975) with n=18 and tetraploid level but Ghaffari and Kelich (2006) reported 2n=18, n=9 and diploid level for this species. Also, Baden (1983) reported 2n= 16 for *N. camphorata* although Gill (1981) obtained 2n=32 for this species. Budanstsev et al. (1992) reported 2n= 16 and 18 for *N. transcaucasica* Grossh. It can be inferred that the chromosome number of *Nepeta* species displayed high variations. Moreover, Saggoo et al. (2011) reported that aneupliody is operative both at diploid and polyploidy levels. They conclude that five species namely as *N. cataria* (2n=34, 36), *N. distans* (2n= 18, 26), *N. grandiflora* (2n= 34, 36), *N. nepetella* L. (2n= 34, 36) and *N. transcaucasica* (2n=16, 18) display intra-specific aneuploidy without effecting ploidy level. It might be concluded that out breeding systems may be responsible for the chromosome variations (Murray and Young, 2001).

Khatoon and Ali (1993) reported n=9 for *N. juncea*. In our results we found 2n=26 for *N. juncea* subsp. *desertorum*. Based on the variations of chromosome number in *Nepeta* subspecies, Seidenbinder and Verlaque (1985) obtained 2n=36 for *N. nepetella* but Ubera (1983) recorded n=17 for *N. nepetella* subsp. *aragonensis*.

Based on the results of cluster analysis, the diploid species as *N. fissa* (2n=2x=22), *N. pungens* (2n=2x=22), *N. juncea* (2n=2x=26), *N. bakhtiarica* (2n=2x=18) and *N. glomerulosa* (2n=2x=18) were clustered in one group. In addition, *N. daenesis* (2n=4x=32) with tetraploid level was closely clustered with *N. schiraziana* (2n=6x=54) and *N. oxyodonta* (2n=6x=42) as hexaploid species. It seems that haxaploid and tetraploid species display different groups with diploid species. Moreover, *N. persica* (2n=4x=36) as tetraploid species and *N. oxyodonta* as hexaploid species were also grouped with some of diploid species. The highest cytological diversity observed in *N. fissa, N. pugens, N. glomerulosa, N. schiraziana* and *N. daenensis*. Obviously, the diploid accessions have more diversity than the tetraploid and

hexaploid species as *N. daenensis, N. schiraziana* and *N. pugens*. Most of the diploid species were closely clustered, and the tetraploid and hexaploid species were grouped in one cluster. These differences between ploidy levels might be due to the high gene flow at infra-specific levels and chromosome variation of these species. Furthermore, the diploid species have high potential to initiate speciation (Sheidaei and Jalilian, 2008). Chromosomal variations at the diploid levels seem to play a leading role and sympatric speciation via hybridization and polyploidization (Zhiyum et al., 2004). The change in the chromosomal traits is one of the mechanisms of inter and intra species diversification (Kalvandi et al., 2012).

Finally, *Nepeta* is a genus with diverse chromosome numbers and in some of the species the variability in chromosome complements is common (Goldblatt and Johnson, 2003). However, changes in the chromosome number and variation of karyotype structure can be considered as the main device of species diversification and the predominant feature of chromosomal evolution of this genus (Zhiyum et al., 2004; Sheidaei and Jalilian, 2008). Identifying the chromosome number of eleven *Nepeta* species in this study provides a base for biosystematic studies. Consistent with the study objectives, it is concluded that Zagros region is one of the diversity and speciation centers for this genus in Iran and provide the evolutionary trends in this genus. Further research work could be advanced to uncover necessary differences and similarities where necessary in other to provide additional insights and perspectives regarding *Nepeta* genus and related species.

Acknowledgements

Authors are grateful to Shahrekord University which supported this research.

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(Received for publication 06 January, 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 88-92

Research article/Araştırma makalesi

Nuclear DNA content of an endemic species for Turkey: *Silene sangaria*

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Abstract

The nuclear DNA content of *Silene sangaria* Coode & Cullen, an endemic species for Turkey, was determined by flow cytometrical analyses techniques. The plant samples were collected from their natural habitats. They transferred into pots and placed in the growth chamber. For flow cytometry analysis, young leaves were chopped in an $MgSO_4$ buffer with propidium iodide on ice in a petri dish. Nuclei, which were stained with propidium iodide, were analyzed on an EPICS XL model flow cytometer. The nuclear DNA content (2C-value) of *S. sangaria* was found to be 4.76 ± 0.20 pg. The somatic chromosome number of the species was determined using conventional karyological methods and counted as 2n = 4x = 48. This study contributes to the data on the nuclear DNA content of angiosperm taxa.

Key words: Caryophyllaceae, *Silene sangaria*, Endemic species, Nuclear DNA content, Flow cytometry

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Türkiye için endemik bir türün çekirdek DNA miktarı: *Silene sangaria*

Özet

Türkiye florası için endemik bir tür olan *Silene sangaria* Coode & Cullen 'nın çekirdek DNA miktarı flov sitometri yöntemiyle analiz edildi. Bitkiler doğal ortamlarından toplandı ve saksılara ekilerek büyüme kabinine yerleştirildi. Flow sitometri analizi için, genç yapraklar buz üzerinde, bir petri içinde propidium iodid ilaveli $MgSO_4$ tamponu içinde parçalandı. Propidium iodid ile boyanan çekirdekler EPICS XL (Beckmann Coulter) model flov sitometri ile analiz edildi. *Silene sangaria*' nın çekirdek DNA miktarı (2C-değeri) 4.76 ± 0.20 pg olarak hesaplandı. Türün somatik kromozom sayısı klasik karyolojik metodları kullanılarak belirlendi ve 2n = 4x = 48 olarak sayıldı. Bu çalışmanın angiosperm taksonlarının çekirdek DNA miktarı bilgilerine katkı sağladığı düşünülmektedir.

Anahtar kelimeler: Caryophyllaceae, *Silene sangaria*, Endemik tür, Çekirdek DNA içeriği, Flow sitometri

1. Introduction

Genus *Silene* L. (Caryophyllaceae) comprises about 700 species divided into 44 sections widely distributed throughout the Northern hemisphere (Siroky et al., 2001). *Silene* is represented in 136 species in the flora of Turkey and 40% of these species are endemic (Coode and Cullen, 1967; Davis et al., 1988; Yildiz and Cirpici, 1996; Tan and Vural, 2000; Duran and Menemen, 2003; Deniz and Dusen, 2004). Genus *Silene* is one of the largest genera of flowering plants in the world and the most species-rich taxa in Turkey.

S. sangaria is an endemic plant in the flora of Turkey and grows only in Karasu, Sakarya; Kilyos, Istanbul; and Igneada, Kırklareli. According to "Red Data Book of Turkish Plants", the conservation status of *S. sangaria* is vulnerable (Ekim et al., 2000). Moreover, this plant is listed in Appendix 1 (strictly protected flora species), which covers the "convention on the conservation of European wildlife and natural habitats" (Council of Europe, 1979).

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 BioDiCon. 265-0712

Silene species have 2n = 20, 2n = 24, and 2n = 48 (x = 10 and x = 12) chromosome numbers (Petrova, 1995; Yildiz and Cirpici, 1996). The chromosome number of *S. sangaria* has been reported earlier as 2n = 48 by Yildiz and Cirpici (1996). The DNA 1C-values for twelve species of the *Silene* genus are known to be between 1.00 and 3.30 pg (Suda et al., 2003; Bennett and Leitch, 2004). However, the nuclear DNA content of *S. sangaria* is unknown. Nuclear DNA C-values are an important genomic character used in many diverse disciplines including taxonomy, systematics, genome evolution, phylogeny, ecology, plant breeding, conservation, and cell and molecular biology (Bennett et al., 2000). The DNA amount in plant nuclei has been estimated since 1950, leading to the discovery of the constancy in organisms and the key role in biology of DNA (Swift, 1950). Unfortunately, the DNA amount is known only for about 1.4% of the angiosperm taxa and approximately 50% of angiosperm families (Bennett and Leitch, 2005; Dolezel and Bartos, 2005). The DNA amount of angiosperm taxa in global flora is expected to be easily determined using new technologies (e.g., flow cytometry) in the future.

2. Materials and methods

Plants and their seeds were collected from a natural population in Igneada, Kırklareli (European Turkey) (Figure 1). Some plants were prepared as herbaria materials and voucher specimens were deposited in EDTU Herbarium (EDTU 13277) (Trakya University, Edirne, Turkey). Others were transferred into pots and placed in a growth chamber at 27°C with a 16/8 h photoperiod.

The technique of standard root-tip squash was used for the chromosome preparations. Seeds were germinated in darkness at 25°C on moist filter paper in petri dishes. Actively growing 4 mm root tips were excised from the germinating seeds. The root tips for chromosome counts were pretreated with 0.5% Colchicine (Sigma) for 3 h at room temperature (RT), and fixed Carnoy (3 ethyl alcohol; 1 acetic acid) for 15 min. Then, they were hydrolyzed with 5 N HCl for 1 h at RT and were stained with Schiff's reagent (Sigma) for 2 h in darkness at RT. Dissected meristems were squashed and mounted in 45% acetic acid. For permanence, the preparations were frozen at -20°C in a deep freeze. Then they were passed through an alcohol-xylene dehydration series and mounted in Entellan (Merck). The slides were examined using an Olympus BH2 light microscope (Tokyo, Japan) and the images were taken with a ProgRes C12 Plus digital camera (Jenoptik, Germany).

For flow cytometric analysis, the young leaves of growing plants were prepared according to Tuna et al. (2001). As an internal standard diploid *Hordeum vulgare* L. cv. Hitchcock (2n = 2x = 14 and 2C-value 10.68 pg) were used (Tuna et al., 2001). Fresh leaf fragments of *S. sangaria* and *H. vulgare* were chopped with a razor blade on ice in a plastic petri dish containing 1 ml of $MgSO_4$ buffer (ice-cold) with 1 $mgml^{-1}$ dithiothreitol (Sigma), 100 μlml^{-1} propidium iodide (Sigma), and 2.5 μlml^{-1} triton X-100 (Sigma). Then the suspension was filtered through a 40 µm nylon mesh (BD Falcon) and centrifuged at 13000 rpm for 2 min. The supernatant was removed and the pellet was homogenized in 600 µl of the above-mentioned $MgSO_4$ buffer after adding 2.5 μlml^{-1} RNase (DNase free, Roche). The suspension was incubated at 37°C for 15 min in an oven before the flow cytometric analysis (Tuna et al., 2001).

The prepared materials were analyzed at Trakya University, Faculty of Medicine on an EPICS XL model flow cytometer (Beckman Coulter). Analyses were performed on 10 different plants three times, and averages and standard deviations of measures were taken. The mean DNA content per plant was based on 10000 scanned nuclei. The formula used for converting fluorescence values to DNA content was as follows: sample nuclear 2C DNA content = [(sample G_1 peak mean) / (standard G_1 peak mean)] x standard 2C DNA content (pg DNA) (Dolezel and Bartos, 2005).

3. Results

S. sangaria was collected on coastal maritime sand in a rather limited region in Igneada. The locations of the plants were determined using GPS. Their location coordinates were 40 ° 50′ N, 27° 58′ E; 41° 49′ N, 27° 57′ E; and 41° 51′ N, 27° 56′ E.

The chromosome number of *S. sangaria* was found to be 2n = 4x = 48 and, it was a tetraploid with x = 12 (Figure 2). This result is similar to that of Yildiz's (1994). Yildiz (1994) reported that the species has 18 pairs of metacentric (M, m) chromosomes and 6 pairs of submetacentric (sm) chromosomes. Its total chromosome length is 39.81 µm (for n = 24), and its average chromosome length is 1.658 µm (Yildiz, 1994). In the above mentioned study, the investigated specimens were collected from the Karasu coast of Sakarya, Turkey (Yildiz, 1994).

The 2C-value of *S. sangaria* was found to be 4.76 ± 0.20 pg (1C-value 2.38 pg) (Figure 3). The nuclear DNA amounts of the *Silene* genus are known only for twelve species although the genus contains about 700 species (Siroky et al., 2001; Suda et al., 2003; Bennett and Leitch, 2004). The 1C-values of *Silene* range from 1.00 (*S. coeli-rosa*) to 3.30 (*S. chalcedonica*) pg (Suda et al., 2003; Bennett and Leitch, 2004). The difference between 1C-values of these species is approximately three-fold. The average of 1C-values of *Silene* species were 2.37 pg and the standard deviation was estimated at 0.73. The 1C-value of *S. sangaria* (2.38 pg) was almost identical to the mean value of known species (2.37 pg). This species has a 2n = 48 chromosome number although the others have 2n = 24 chromosome counts (Löve and Löve, 1982; Halkka, 1985; Siroky et al., 1999; Siroky et al., 2001; Suda et al., 2003; IPCN 2012). It is surprising that the DNA amount of *S. sangaria* with 2n = 48 chromosomes is smaller than those of other species with 2n = 24

chromosomes such as *S. chalcedonica* and *S. nutans.* Yildiz (1994) reported that the chromosomes of polyploid species are generally smaller than those in the diploid species. Similarly, Bennett et al. (2000) reported that the genome sizes of polyploids are smaller than their diploid relatives. The reason for the decrease in genome size is usually the deletion and elimination of the repeating parts on chromosomes (Siljak-Yakovlev et al., 2005). More data are needed for the evaluation of nuclear DNA amounts of *Silene* concerning 1C-values of this genus. The 1C-values and chromosome numbers of the *Silene* species whose genomes are known are shown in Table 1. The data are presented by combining available data from current literature and the results of this study. *S. sangaria* is the only polyploid species among the ones whose genome size is known.

Figure 1. The location of *Silene sangaria* («)

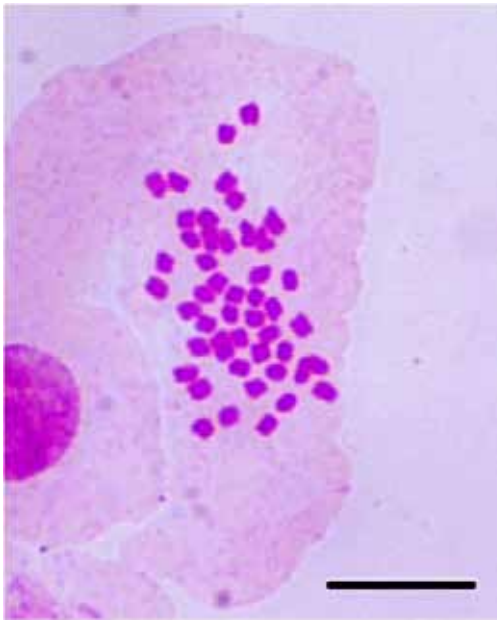

Figure 2. Mitotic metaphase chromosomes of *Silene sangaria* (2n = 4x = 48) Scale bar: 10 µm.

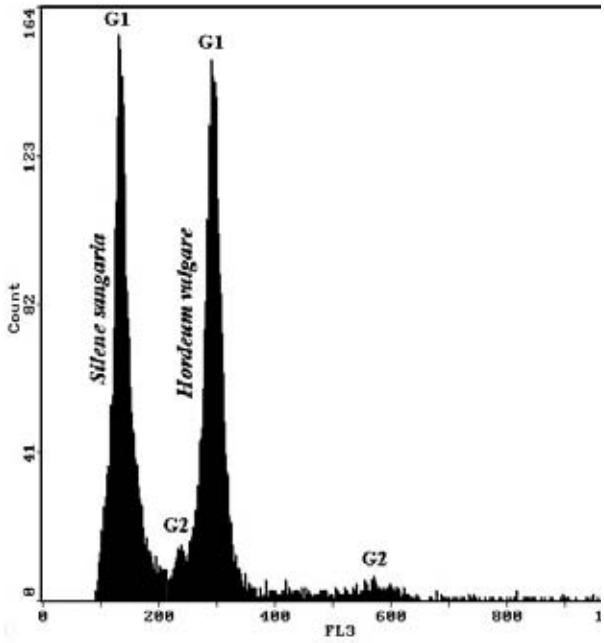

Figure 3. The flow cytometric histogram of *S. sangaria*

Leitch et al. (1998) suggested that the species with 1C-values less than 1.4 pg are defined as having "very small" genomes whereas species with 1C-values less than 3.5 pg are defined as having "small" genomes. Likewise, species with 1C-values greater than 14.0 pg are defined as having "large" genomes, and species with 1C-values greater than 35.0 pg are defined as having "very large" genomes (Leitch et al., 1998). In addition to this terminology, species with 1C-values between 3.51 pg and 13.99 pg are called "intermediate" by Soltis et al. (2003). According to these data, *S. sangaria* has small genome since it has 2.38 pg 1C-value (≤ 3.5 pg). However, Greilhuber et al. (2005) proposed the new genome terminology as "holoploid genome size" (the DNA content of the complete chromosome complement of an organism, abbreviated as 1C, 2C, etc.) and "monoploid genome size" (the DNA content of the monoploid genome set, abbreviated as 1Cx, 2Cx, etc). The "symbol x" refers to the basic chromosome number (Greilhuber et al. 2005). According to this terminology, the 1Cx DNA value is 1.19 pg while the 1C DNA value is 2.38 pg of *S. sangaria.*

Table 1. Nuclear DNA contents and chromosome numbers of *Silene* species

Species	Chromosome number (2n)	1C (pg)
Silene bertelotiana	24[7]	2.55[7]
Silene chalcedonica	24[6]	3.30[1]
Silene coeli-rosa	24[3]	1.00[1]
Silene dioica	24[2]	2.70[1]
Silene lagunensis	24[7]	2.59[7]
Silene latifolia	24[5]	2.70[1]
Silene nocteolens	24[7]	2.58[7]
Silene nutans	24[4]	3.20[1]
Silene pendula	24[6]	1.18[1]
Silene pogonocalyx	24[7]	2.61[7]
Silene rubra	---	2.85[1]
Silene sangaria	**48**	**2.38**
Silene vulgaris	24[6]	1.13[1]

[1]Bennett and Leitch, 2004; [2]Halkka, 1985; [3]IPCN, 2012; [4]Löve and Löve, 1982; [5]Siroky et al., 1999; [6]Siroky et al., 2001 ; [7]Suda et al., 2003

Genome sizes correlate with many factors such as ecological environment, live form, cell sizes, reproductive features, minimum generation times, and ancestral aspects. Small genome size is ancestral for Caryophyllales, and Caryophyllaceae also have a small ancestral genome size. In Caryophyllales clade, the mean of 1C-value is 1.7 pg (Soltis et al., 2003). To explain the genome size variation, the biological factors that depend on the organism are not adequate. This variation is also related to ecological factors such as temperature (Bennett et al., 2000). Humanity faces the mass extinction of biodiversity because of global warming and pollution. Although the relationships between genome sizes and plant species loss are unclear, a relationship likely exists (Bennett et al., 2000). Therefore, the data on DNA amounts helps to improve conservation strategies.

Acknowledgements

This study was supported by Trakya University Plant Breeding Application and Research Centre (TUBIM). We thank the staff at Haematology Laboratory (Department of Haematology, Faculty of Medicine, Trakya University) for their help in performing the flow cytometric analyses.

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(Received for publication 20 July 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 93-100

Research article/Araştırma makalesi

An ethnobotanical research on handmade musical instruments in Şanlıurfa, South East Anatolia, Turkey

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Abstract

This study, carried out in 2004/2005, examines the processing of woody plants utilized for the manufacture of traditional musical instruments in the Şanlıurfa city, and identifies their scientific names. The findings indicate that 25 plant species belonging to 17 families are used for the construction of eight musical instruments. Most of these plants belong to the following families: Rosaceae (4), Pinaceae (4), Fagaceae (2), and Moraceae (2). Scientific names of plant species and their vernacular names are also reported.

Key words: Ethnobotanic, Folk music, Handcraft, Musical instruments, Şanlıurfa

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Şanlıurfa (Güneydoğu Anadolu Bölgesi)'da el yapımı müzik aletleri üzerine bir Etnobotanik araştırma

Özet

2004/2005 yıllarında yürütülen bu çalışmada, Şanlıurfa'daki geleneksel müzik aletlerinin üretimi için kullanılan odunsu bitkilerin işlenmesi ve bilimsel isimlerine yer verilmiştir. Sekiz müzik aletleri yapımı için 17 familyaya ait 25 bitki türünün kullanıldığı tespit edilmiştir. Bu bitkilerin çoğu Rosaceae (4), Pinaceae (4), Fagaceae (2) ve Moraceae (2) familyalarına aittir: Ayrıca, bitki türlerinin bilimsel ve yerel isimleri de verilmiştir.

Anahtar kelimeler: Etnobotanik, Halk müziği, El sanatları, Müzik aletleri, Şanlıurfa

1. Introduction

The province of Şanlıurfa is located in Southeastern Anatolia and surrounded with Diyarbakır, Mardin, Gaziantep and Adıyaman. The province of Şanlıurfa extends over a land of 18,584 km². Its population is 1,716, 254 (2011 year). Şanlıurfa is located in the northern hemisphere between the 37 49' 12"- 40 10' 00" eastern meridian and the 36 41' 28"- 37 57' 50" northern parallel. It is located in the Irano-Turanian phytogeographic region and very close to the Euphrates River (Figure 1). Şanlıurfa has been a region of transition and intersection of many cultures, dominated by many states and communities throughout history due to its geographical location. Some roads and routes between Arabic countries, Mesopotamia, center of ancient civilizations in early age and middle age, and Europe passed through Şanlıurfa. Şanlıurfa was and is an important city with the fact that it was located on historical, military, commercial roads connecting east to west (Segal, 1970; Anonymus, 1999-1).

Semiarid mediterranean climate occurs in research area. According to Emberger the precipitation- temperature coefficient (Q) is 42.94. Annual mean temperature is 18.7 ºC. The maximum mean temperature (M) is 46.8 ºC, in July. The minimum mean tempereature (m) is –6.8 ºC, in february. Annual rainfall is about 457.8 mm and the seasonal precipitation regime is Winter, Spring, Autumn and Summer. This is the first variant of the East Mediterranean precipitation regime (Meteoroloji Bülteni, 1994).

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Şanlıurfa, in the region known as upper Mesopotamia, has a pretty rich past in Folk Music and it has an important place in this area in Turkey. For this reason, instruments that are used show a great diversity. These instruments take a rather important place in local music, and are used especially in weddings, overnight stays on mountains, and at folkloric night-outs. Most of these instruments are called as 'Folk Instruments'. Cura, çöğür, bağlama, divan sazı, ud, cümbüş, Urfa tamburu, kanun, keman, kaval, zurna, davul, def, darbuka, kaşık, zilli maşa, çarpara and leğen are the most common ones. Both instruments called as neşetkâr and rebap are known that they were played in the past, yet they are not available today (Anonymus, 2002).

Şanlıurfa Folk Music has been an elite posture with the structure of musical instruments, the structure of melody, richness of lyrics, number of songs, systematic and qualified execution. The Folk Music has opened the door of beauty to us with the tone variety and dialect features of local performers who are talented for execution (Anonymus, 2002).

In this study, which woody plants are cultivated in production of instruments and its application purposes have been searched.

In the literature scanning, it has been investigated that there are some studies related with ethnobotanical aspects of woody plants: Açın (1976, 1980, 1987), Kürkçüoğlu (1997), Açın (2004), Balos and Akan (2007), Akan et al. (2008), Yenigün (2010), Aslan et al. (2011), Altay and Karahan (2012), Işık and Uslu, (2012), Sop et al. (2012).

Figure 1. A study area, Şanlıurfa, Turkey
Şekil 1: Çalışma alanı, Şanlıurfa, Türkiye

2. Materials and methods

This study have been realized by consulting resources such as Çekirge Saz Group, Akel Saz Group, Çoban Saz Group taking place in ancient house organized 'Sıra Gecesi' in, at the core of Şanlıurfa and ŞURKAV officials (Şanlıurfa Culture Education Art and Research Foundation) in between the years of 2004 and 2005. The findings obtained have been compared with the instructions of literature in the study (Anonymus, 1999-2). The individuals who cultivated woody plants for musical instruments have been found, the craftsmen have been interviewed directly and the information we obtained have been saved in 'Şanlıurfa Ethnobotanic Data Base'. The original tree of this material, the regional names of instruments and the places to obtain the raw material have been determined. The plant specimens have been ideentified according to Flora of Turkey (Davis, 1965-1985). Furthermore, the photos of instruments have been taken and numbered in order to file (Figures. 2-9).

3. Results

The names of the instruments and the expression which kind of plants they are made of are presented in Table 1 with the scientific names. Moreover, the photographs of all materials are given below and their application fields are stated. It is pointed that the raw materials are generally supplied from Birecik, Siverek, Viranşehir districts of Şanlıurfa; Gaziantep, Nizip, İstanbul and İzmir. The names of the instruments, the resource of the instruments' parts, scientific names of plants, common used names of plants and regional names are given in Table 1.

3.1. Saz (Figure 2): Constitutes from three main parts called body, handhold and Initial part. The body, which resembles a half-pucker, is made of *Morus nigra* L., *Platanus orientalis* L. and *Castanea sativa* by carving. A chest part which is made of generally *Carpinus orientalis* Miller, *Castanea sativa* Mill., *Abies cilicica* (Kotschy) Carr., *Pinus nigra* L. subsp. *Pallasiana*, *Picea orientalis* (L.) Link is put on the body. The handhold part linked with keys appropriate with folk music is made of *Juniperus excelse* Bieb., *Tilia rubra* DC. which are light and inflexible. The

initial part is made of from *Carpinus orientalis* Mill. and *Rosa damescena* Miller in order to provide appropriate accord and key adjustments. A plectrum, which is made of peel of the body of *Cerasus microcarpa* (C.A.Meyer) Boiss.

3.2. Kanun (Figure 3): Is made of wooden (*Carpinus orientalis* Miller, *Junglans regia* L., *Platanus orientalis* L., *Pinus brutia* Tin. The initial part of threshold is made of *Picea orientalis* (L.) Link, *Acer pseudoplatanus* L. *Diospros ebenum* Koen.

3.3. Def (Figure 4): The hoops are made of *Carpinus orientalis*, *Juniperus excelse* Bieb., *Platanus orientalis* L., and *Junglans regia* L.. The craftsmen who practiced def in Şanlıurfa are Abdullah Kücük, Mehmet Kücük and Osman Kaplan.

3.4. Ney (Figure 5): Ney, which is a wind instrument, constitutes the basic part of Anatolia Classical Music. The pipe, which is used in practicing ney, must be nine-nodded (*Arundo donax* L.). Ney, which is the part of Mevlevi music, is played in Islamic ceremonies and particular religious ceremonies in Şanlıurfa (Sevgili, 1997). The masters of Ney are Halil Sercan and Gökhan Özkök.

3.5. Davul (Drum) (Figure 6): The hoop part is mostly made of *Carpinus orientalis* Miller, *Pinus nigra* L. subsp. *pallasiana, Junglans regia* L. and *Fagus orientalis* Lipsiky. The hooks are made of *Junglans regia* L., *Morus alba* L. and *Buxus sempervirens* L. In practicing handle, *Populus alba* L. tree is desired. Also some performers use *Amygdalus communis* L., *Junglans regia* L. and *Pinus nigra* L. subsp. *pallasiana*. trees in order to obtain more effective –stronger tone. The stick is mostly made of parts of *Punica granatum* L. tree.

3.6. Zurna (Shrill Pipe) (Figure 7): It is made of *Prunus spinosa* L., *Juniperus excelse* Bieb., *Carpinus orientalis* Miller, *Fraxinus excelsior* L., *Arundo donax* L., *Morus nigra* L., *Tilia rubra* DC. and *Cornus mas* L. The most famous craftsman practicing Zurna is Cemal Delikose in Şanlıurfa district.

3.7. Kaval (Figure 8): Kaval are made of *Arundo donax* L.. Kavals are made by master Cemal Deliköse in Şanlıurfa.

3.8. Ud (Lute) (Figure 9): The body part is made of *Morus alba* L., *Juniperus excelse* Bieb., *Junglans regia* L., *Diospros ebenicum* Koen. and *Platanus orientalis* L. The chest part is made of *Juniperus excelse* Bieb. , *Junglans regia* L., *Pinus nigra* L. subsp. *pallasiana* and *Picea orientalis* (L.) Link. The handhold is made of *Junglans regia* L. and *Diospros ebenicum* Koen. The initial part is made of *Picea orientalis* (L.) Link and *Junglans regia* L. The chest covering is made of *Junglans regia* L., *Diospros ebenicum* Koen., *Prunus spinosa* L. and *Fraxinus excelsior* L. Famous Master Hasan Pamaksız has been attending for 25 years in Şanlıurfa. He sells his products to music groups in Şanlıurfa and people he knows in Turkey. Moreover, there are musicians who prefer to be practiced their Uds by Hasan Parmaksız in Greece.

Figure 2. The most famous craftsman practicing Saz, Yahya Çekirge, in Şanlıurfa
Şekil 2. Şanlıurfa'da en ünlü Saz ustası, Yahya Çekirge

Figure 3: The craftsman practicing Kanun, Semih Rastgeldi.
Şekil 3: Kanun'un ustası Semih Rastgeldi

Figure 4. The craftsmen practicing Def, Abdullah Kücük ve Mehmet Kücük.
Şekil 4. Def ustaları, Abdullah Kücük ve Mehmet Kücük.

Figure 5. The craftsman practicing Ney, Gökhan Özkök.
Şekil 5. Ney ustası, Gökhan Özkök

Figure 6. The hand-made drums in Şanlıurfa
Şekil 6. Şanlıurfa'da el yapımı davullar

Figure 7. The hand-made Zurna by Cemal Deliköse in Şanlıurfa
Şekil 7. Şanlıurfa'da Cemal Deliköse tarafından el yapımı Zurna

Figure 8. The hand-made Kavals of Şanlıurfa
Şekil 8.Şanlıurfa'da yapılan el yapımı Kavallar

Figure 9. The craftsman, Hasan Parmaksız, practicing Ud
Şekil 9. Ud ustası Hasan Parmaksız

Table 1. The names of the instruments, the resource of the instruments parts, plant scientific names, common used names and local names
Tablo1. Enstrümanların adları, parçaları, bitkilerin bilimsel, yöresel ve yaygın isimleri

The name of musical instrument	Instrument parts	Plants scientific name (Family)	Common used names	Local names
Saz	Tekne (Body)	*Morus nigra* L. (Moraceae)	karadut	tu
		Platanus orientalis L. (Platanaceae)	çınar	dare mezin
		Castanea sativa Miller (Fagaceae)	kestane	hingiç
	Tekne üstü (chest part)	*Carpinus orientalis* Miller (Betulaceae)	Doğu gürgeni	gogen
		Abies cilicica (Kotschy) Carr. (Pinaceae)	Toros göknarı	boz ağaç
		Pinus nigra L. subsp. *pallasiana* (Pinaceae)	karaçam	çama reş
		Picea orientalis (L.) Link (Pinaceae)	Doğu ladini	soç
	Saz sapı (Handhold)	*Juniperus excelse* Bieb. (Cupressaceae)	Boylu ardıç	evrîst
		Tilia rubra DC. (Tiliaceae)	ıhlamur	axlemûr
	Akord düğmesi (Accord switch)	*Carpinus orientalis* Miller (Betulaceae)	Doğu gürgeni	gogen
		Rosa damescena Miller (Rosaceae)	Isparta gülü	gula sor
	Mızrap (plectrum)	*Cerasus microcarpa* (C.A.Meyer) Boiss. (Rosaceae)	yabani kiraz	kiraz
Davul (drum)	Kasnak(hoop)	*Carpinus orientalis* Miller (Betulaceae)	Doğu gürgeni	gogen
		Pinus nigra L. subsp. pallasiana (Pinaceae)	karaçam	çam
		Junglans regia L. (Juglandaceae)	ceviz	guz
		Fagus orientalis Lipsiky (Fagaceae)	kayın	Doğu kayını
	Çember(hook)	*Junglans regia* L. (Juglandaceae)	ceviz	guz
		Morus alba L. (Moraceae)	akdut	tu
		Buxus sempervirens L. (Buxaceae)	şimşir	şimşir
	Tokmak (Handle)	*Populus alba* L. (Salicaceae)	ak kavak	kovık
		Junglans regia L. (Juglandaceae)	ceviz	guz
		Pinus nigra L. subsp. *pallasiana* (Pinaceae)	karaçam	çam
	Çubuk (Stick)	*Punica granatum* L. (Punicaceae)	nar	hennar
		Amygdalus communis L. (Rosaceae)	badem	behiv
Kanun	Tekne (body)	*Carpinus orientalis* Miller (Betulaceae)	Doğu gürgeni	gogen
		Junglans regia L. (Juglandaceae)	ceviz	guz
		Platanus orientalis L. (Platanaceae)	çınar	dare mezın
		Pinus brutia Tin. (Pinaceae)	kızılçam	çam
	Eşik (treshold)	*Picea orientalis* (L.) Link (Pinaceae)	Doğu ladini	soç
		Acer pseudoplatanus L. (Aceraceae)	dağ akçaağacı	kelebek
		Diospros ebenum Koen. (Ebenaceae)	abanos	ebenos
	Başlık (initial part)	*Picea orientalis* (L.) Link (Pinaceae)	Doğu ladini	soç
Def	Kasnak (hoop)	*Carpinus orientalis* Miller (Betulaceae)	Doğu gürgeni	gogen
		juniperus excelse Bieb. (Cupressaceae)	boylu ardıç	boz ardıç
		Platanus orientalis L. (Platanaceae)	çınar	dare mezın
		Junglans regia L. (Juglandaceae)	ceviz	guz
Ney	Gövde(body)	*Arundo donax* L. (Poaceae)	kargı kamışı	masur kamışı
Zurna (Shrill pipe)	Gövde (body)	*Prunus spinosa* L. (Rosaceae)	erik	İncaze
		Juniperus excelse Bieb. (Cupressaceae)	Boylu ardıç	boz ardıç
		Carpinus orientalis Miller (Betulaceae)	Doğu gürgeni	gogen
		Fraxinus excelsior L. (Oleaceae)	dişbudak	dare mezın

Table 1. (Continued)

		Cornus mas L. (Cornaceae)	kızılcık	zoğal
	Sipsi (pipe)	*Arundo donax* L. (Poaceae)	kargı kamışı	masur kamışı
	Lüle(bangle)	*Morus nigra* L.(Moraceae)	karadut	tu
		Tilia rubra DC. (Tiliaceae)	Ihlamur	ihlamur
Ud (Lute)	Tekne (body)	*Morus alba* L. (Moraceae)	akdut	tu
		Juniperus excelse Bieb. (Cupressaceae)	boylu ardıç	boz ardıç
		Junglans regia L. (Juglandaceae)	ceviz	guz
		Diospros ebenicum Koen. (Ebenaceae)	abanos	ebenos
		Platanus orientalis L. (Platanaceae)	çınar	dare mezın
	Tekne üstü (gögüs) (chest part)	*Juniperus excelse* Bieb. (Cupressaceae)	boylu ardıç	boz ardıç
		Junglans regia L. (Juglandaceae)	ceviz	guz
		Pinus nigra L. subsp. pallasiana (Pinaceae)	karaçam	çam
		Picea orientalis (L.) Link (Pinaceae)	Doğu ladini	soç
	Ud sapı (handhold)	*Junglans regia* L. (Juglandaceae)	ceviz	guz
		Diospros ebenicum Koen. (Ebenaceae)	abanos	ebenos
	Burguluk (initial part)	*Picea orientalis* (L.) Link (Pinaceae)	Doğu ladini	soç
		Junglans regia L. (Juglandaceae)	ceviz	guz
	Gögüs kaplama (chest covering)	*Junglans regia* L. (Juglandaceae)	ceviz	guz
		Diospros ebenicum Koen. (Ebenaceae)	abanos	ebenos
		Prunus spinosa L. (Rosaceae)	erik	incaze
		Acer pseudoplatanus L. (Aceraceae)	dağ akçaağacı	kelebek
		Fraxinus excelsior L. (Oleaceae)	dişbudak	dare mezın
Kaval	Gövde(body)	*Arundo donax* L. (Poaceae)	kargı kamışı	masur kamışı

4. Conclusions

Within this study, 25 wooden plant samples which belong to17 families and 25 species and which are used in obtaining raw materials in order to produce musical instrument in the center of Şanlıurfa have been detected.

It is observed that most of the resources of raw materials in producing instruments in the center of Şanlıurfa belong to the families of Rosaceae (4), Pinaceae (4), Fagaceae (2) and Moraceae (2). The species of *Morus* and *Pinus* is represented by two samples while others are represented by one (Table 1, Table 2).

Table 2. The trees are used in different musical musical instrument parts and the number of tool use
Tablo 2. Ağaçların kullanıldıkları müzikal enstrüman parçaları ve farklı müzik aletinde kullanım sayısı

Plant name	Family	Part of musical instrument	The number of tool
Abies cilicica (Kotschy) Carr.	Pinaceae	reed boat over	1
Acer pseudoplatanus L.	Aceraceae	Treshold of Kanun, lute chest coating	2
Amygdalus communis L.	Rocaceae	drum stick	1
Arundo donax L.	Poaceae	reed flutes, flute	2
Buxus sempervirens L.	Buxaceae	drum circle	1
Carpinus orientalis Miller	Betulaceae	reed boat over, reed tuning knob, drum pulley, Kanun tray, flutes body	5
Castanea sativa Miller	Fagaceae	reed boat	1
Cerasus microcarpa (C.A.Meyer) Boiss.	Rocaceae	saz quill	1
Cornus mas L.	Cornaceae	The body of shrill pipe	1
Diospros ebenicum Koen.	Ebenaceae	boat lute, oud handle, ud chest coating, the threshold Kanun	4
Fagus orientalis Lipsiky	Fagaceae	drum pulley	1
Fraxinus excelsior L.	Oleaceae	The body of shrill pipe, oud chest coating	2
Junglans regia L.	Juncaceae	drum pulley, drum circle, drum mallet, Kanun boat, boat lute, oud boat higher, ud handle, lute auger,, oud chest coating	9
Juniperus excelse Bieb.	Cupressaceae	reed stem, horn housing, boat lute, oud boat over	4
Morus alba L.	Moraceae	drum circle, lute boat	2
Morus nigra L.	Moraceae	reed boat, horn nozzle	2
Picea orientalis (L.) Link	Pinaceae	reed boat higher, the threshold law, the title of the Kanun, above the boat lute, oud auger	5
Pinus brutia Tin.	Pinaceae	Kanun boat	1
Pinus nigra L. subsp. *pallasiana*	Pinaceae	reed boat higher, drum pulley, drum, hammer, ud boat over	4
Platanus orientalis L.	Platanaceae	Kanun boat, boat oud, saz boat	3
Populus alba L.	Salicaceae	the drum hammer	1
Prunus spinosa L.	Rosaceae	The body of flutes, oud chest coating	2
Punica granatum L.	Punicaceae	drum stick	1
Rosa damescena Miller	Rosaceae	instrument tuning button	1
Tilia rubra DC.	Tilicaceae	reed stem, horn nozzle	1

As shown in Table 2, in terms of number of usage, *Junglans regia* 9, *Carpinus orientalis* and *Picea orientalis* 5, *Juniperus excelsa, Pinus nigra* and *Diospros ebenicum* 4 usage and *Platanus orientalis* has 3 usage. The remaining trees are used in 1 or 2 different musical instrument. Importance of these trees are commonly used in the construction of musical instruments.

Most of timbered trees brought to wood bazaar are planted by river, lake, stream; in gardens and nurseries which are used for specific purposes. Logs brought from the nearest villages to the center and from around Siverek, Birecik, Halfeti and Viranşehir are sold in wood bazaar. Inappropriate plants to be planted are *Castanea sativa* (Chestnut), *Abies cilicica* (Toros fir tree), *Picea orientalis* (Eastern spruce), *Juniperus excelse* (long juniper), *Tilia rubra* (lime), *Buxus sempervirens* (Boxwood), *Fagus orientalis* (Eastern beach), *(Fraxinus excelsior* (ash tree), *Carpinus orientalis*,(Eastern hornbeam), *Acer pseudoplatanus* (Butterfly*), Pinus brutia* (Reddish pine), *Pinus nigra* (black pine), *Diospros ebenicum* (ebony) and *Cornus mas* (cornelian cherry tree). These are brought to wooden bazaar from Gaziantep, Kahramanmaras, Adana, İstanbul, and Izmir by order. 'Neccar' masters (carpenters) in the bazaar, these raw materials are brought to workshops, are processed and are used in manufacturing the musical instruments when requested. Furthermore, this occupation passes to son from farther.

In the talking one to one realizing with musicians in music groups organizing 'Sıra Geceleri', we have learnt that the reasons that they prefer handy work instruments are the qualification of the tone, the significant effectiveness of the tone, non-absorptiveness of the tone by the instrument, and accord–fairness. In the case these instruments are broken down, it is possible to be repaired by craftsmen.

In this research, we have made a path for ethnobotanical qualifications of musical instruments made of plants, which are a part of our natural beauty. We expect that this study will shed light on more comprehensive researches concerning ethnobotanical and folkloric studies.

To date, many trees are used in making instruments (Eroğlu, 2003). It was observed that the trees which are used for musical instruments have specific characteristics. The first of these is capable of making a sound of a tree. Hardness of the selected trees, weights, and which parts of the instruments should be used according to the color (Işık and Uslu, 2012).

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(Received for publication 20 December 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 101-113

Research article/Araştırma makalesi

Flora of Ulus Mountain (Balikesir/Turkey)

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Abstract

This study was carried out to determine flora of Ulus Mountain (Balikesir/Turkey) between the periods 2010-2012. According to the P.H. Davis's grid system, the area is in the B2 square. As a result of identification of plant specimens, 382 plant taxa (264 species, 77 subspecies and 41 varieties) belonging to 63 families and 245 genera were established. 59 taxa are new records for B2 grid square and the endemism rate is 8,11%. The distribution of this taxa according to phytogeographical regions are follows; Mediterranean elements 16,7%, Europe-Siberian elements 13,5%, Irano-Turanien elements 3,1%.

Key words: Balıkesir, B2 square, Endemism, Flora, Ulus Mountain

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Ulus Dağı'nın florası (Balıkesir/Türkiye)

Özet

Bu çalışma 2010-2012 yılları arasında Ulus Dağı'nın (Balıkesir/Türkiye) florasını tespit etmek için yapılmıştır. Çalışma alanı P.H. Davis'in grid sistemine göre B2 karesinde yer alır. Örneklerin teşhis edilmesi sonucu, 63 familyaya ait 245 cins ve bu cinse ait 382 takson (264 tür, 77 alttür ve 41 varyete) tespit edilmiştir. Bu taksonlardan 59'ı B2 karesi için yeni kayıttır ve 31'i ise endemiktir. Taksonların fitocoğrafik bölgelere dağılımı şöyledir; Akdeniz elementleri %16,7, Avrupa-Sibirya elementleri %13,5 ve Iran-Turan elementleri %3,1.

Anahtar kelimeler: Balıkesir, B2 karesi, Endemizm, Flora, Ulus Dağı

1. Giriş

Ülkemiz sahip olduğu bitki türleri açısından dünyada zengin ülkelerin başında gelmektedir. Bir ülkenin florasının zenginliği, o ülkede yetişen tür sayısı ile doğru orantılıdır. Bu bulgular doğrultusunda ülkemiz 12.006 bitki türü ile dünyada oldukça zengin bir floraya sahiptir (Davis, 1965-1985, Davis vd., 1988, Güner vd., 2000, Erik ve Tarıkahya, 2004). Avrupa kıtası, ülkemizin yaklaşık olarak 15 katı büyüklüğünde olmasına rağmen aşağı yukarı 12000 türe sahip olduğu düşünülürse Türkiye'nin biyolojik çeşitliliği daha da dikkat çekici hale gelecektir (Tutin ve Heywood, 1964-1980). Bu zenginliğin yanında bitkilerin yayılışı ve çeşitli vejetasyon tiplerine sahip olması ile de ülkemiz ilginç bir floraya sahiptir. Ayrıca Türkiye florasının ilginçliği sadece tür sayısının fazla olması ile değil birde çok sayıda endemik türe sahip olmasından kaynaklanmaktadır (Ekim vd., 1989).

Türkiye'nin bitki zenginliğin nedenleri jeolojik ve jeomorfolojik yapıların etkisiyle ikliminin, toprağının ve yükseltilerinin farklı olması ile sıralanır. Asya ile Avrupa arasında bir köprü konumumda olması, çok sayıda cinsin gen merkezi olması ve birçok kültür bitkisinin Anadolu ve çevresinde bulunması Türkiye'yi dünya üzerinde zengin bir floraya ve bunun yanında değişik vejetasyan tiplerine de sahip olmasını mümkün kılar. Ayrıca ülkemizin Avrupa-

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Sibirya, Akdeniz ve İran-Turan gibi üç farklı fitocoğrafik bölgenin kesişme noktasında bulunması da bitki zenginliğine katkı sağlar (Ekim vd., 1989).

Araştırma alanı B2 karesinde Balıkesir ili Bigadiç ile Sındırgı ilçeleri arasında yer almaktadır. Balıkesir ili çevresinde (Erdoğan vd., 2011, Daşkın, 2012) ve sınırları içerinde yer alan B1 karesinde (Özen, 1997, Doğan ve Özen, 1999, Sanön ve Özen, 2001) ve B2 karesinde (Dirmenci, 2006) floristik çalışmalar gerçekleştirilmiştir. Ayrıca çalışma alanının çevresindeki Simav Dağı (Yayıntaş, 1983), Eğrigöz Dağı (Görk, 1983), Demirlik ve Kulaksız Dağları (Akçiçek, 2002) üzerine de flora ve vejetasyon çalışmaları yapılmıştır. Araştırma alanı olarak Ulus dağının seçilmesinin başlıca nedenlerini şöyle sıralayabiliriz: Alana özgü floristik bir araştırmanın yapılmamış olması, alanın Akdeniz ile Avrupa-Sibirya bitki coğrafyası bölgelerinin geçiş zonunda bulunması, farklı vejetasyon tiplerinin alanda yan yana yer alması ve ulaşım kolaylığıdır.

2. Materyal ve metot

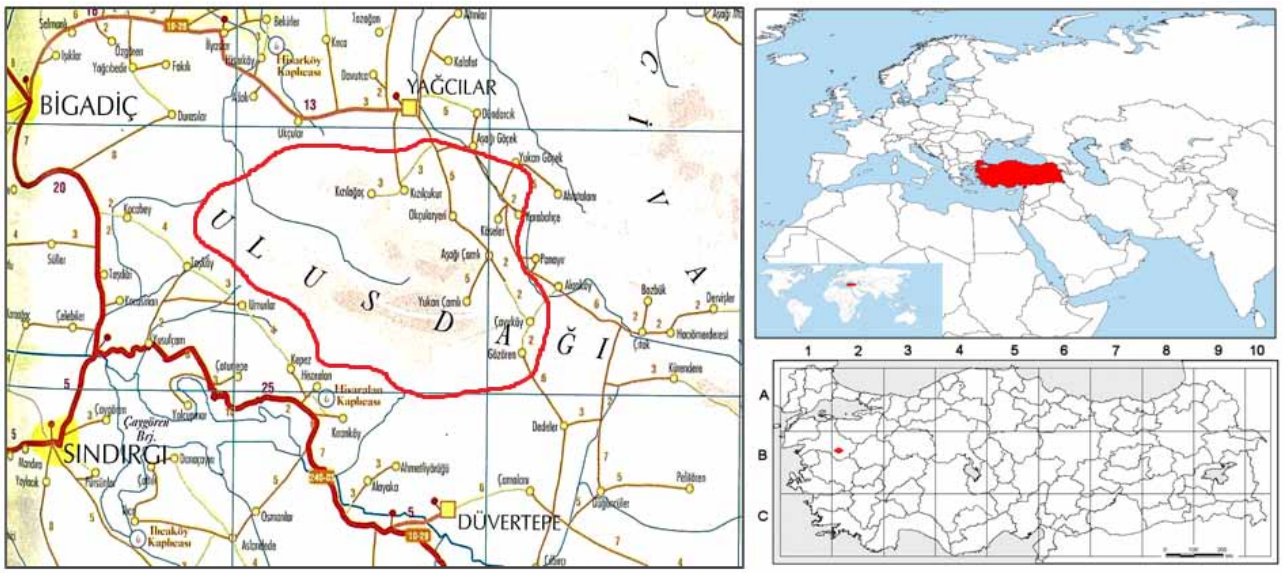
Bu çalışmanın materyallerini oluşturan bitkiler 2010-2012 yılları arasında araştırma bölgesinde düzenli periyotlarla yapılan arazi çalışmaları sonucunda toplanmıştır. Çalışma alanının toprak yapısı ve büyük toprak gruplarına ait bilgiler, 'Balıkesir İli Arazi Varlığı' adlı eserden elde edilmiştir (Anonim, 1999). Araştırma alanının jeolojisi ile ilgili verilere Balıkesir İli Maden Teknik Arama (MTA) kaynaklarından ulaşılmıştır (Anonim, 1978). Araştırma bölgesinin iklimsel verileri ise Devlet Meteoroloji İşleri Genel Müdürlüğü'nün Sındırgı, Bigadiç ve Dursunbey istasyonlarından sağlanmıştır (Anonim, 1975-2011). Araştırma alanının iklim özellikleri Emberger'in Akdeniz Bölgeleri için belirlediği (Akman, 1990, Akman vd., 2001) De Martonne-Gottman ve Erinç'in (Dönmez, 1984) formüllerinden yararlanılmıştır.

Arazi çalışmaları sonucu toplanan örnekler, bilimsel metotlara uygun bir şekilde herbaryum örneği haline getirilmiş olup, Balıkesir Üniversitesi Necatibey Eğitim Fakültesi herbaryumunda muhafaza edilmektedir. Örneklerin büyük çoğunluğu 'Türkiye ve Doğu Ege Adaları Florası' adlı eserden faydalanılarak teşhisleri gerçekleştirilmiştir (Davis, 1965-1985, Davis vd., 1988, Güner vd., 2000). Bazı şüpheli durumlarda Avrupa Florası (Tutin ve Heywood, 1964-1980), Irak Florası (Townsend ve Guest, 1966-1980), Flora Orientalis (Boissier, 1867-1888) ve Bursa Bitkileri kitabı (Kaynak vd., 2007) gibi temel eserlerden yararlanılmıştır. Ayrıca Türkiye Florası' na ilave edilen taksonlar 'Türkiye Florasına İlave Edilen Türlerin Listesi I, II, III, IV' adlı yayınlardan kontrol edilmiştir (Özhatay vd., 1994, 1999, 2009, Özhatay ve Kültür, 2006). Otör isimleri 'Authors of Plant Names' eserine göre düzenlenmiştir (Brummit ve Pomel, 1992). B2 karesi yeni kayıtları için araştırma alanının çevresinde yapılan flora ve vejetasyon (Çırpıcı, 1985, Vural vd., 1985, Gemici vd., 1993) ve Yıldırımlı'nın 'The chorology of the Turkish species' (Yıldırımlı, 1997, 1999, 2000, 2001, 2002, 2005, 2008) çalışmaları incelenmiştir. B2 karesi için yeni kayıtlar (*) işareti ile gösterilmiştir.

3. Bulgular

3.1. Araştırma alanının özellikleri

Araştırma alanı Balıkesir sınırları içerisinde Sındırgı ve Bigadiç ilçeleri arasında 39° 19' 24" kuzey enlemleri ile 28° 23' 21" doğu boylamları arasında yer alır (Şekil 1). Yüksekliği 240-1768 m'ler arasında değişir. Türkiye florasındaki kareleme sistemine göre (Davis, 1965-1985) B2 karesinde yer alır. Balıkesir ili sınırları içerisinde orman işletmesi yönünden Balıkesir Orman Genel Müdürlüğü, Sındırgı ve Bigadiç Orman İşletme Şefliklerine bağlıdır.

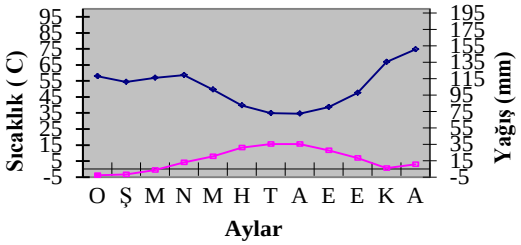


Şekil 1. Araştırma alanın haritası

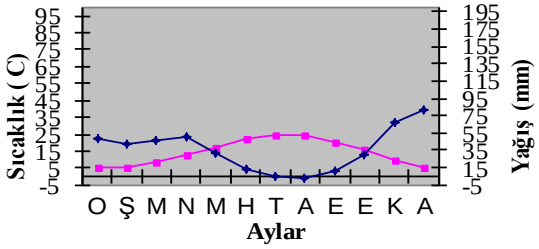
Araştırma alanında kırmızı kahverengi topraklar, kireçsiz kahverengi orman toprakları, kireçsiz kahverengi topraklar, alüvyal topraklar ve vertisoller olmak üzere 5 tip hakim büyük toprak grubu bulunmaktadır (Anonim, 1999).

İnceleme alanında, volkanik kayaçlar üzerinde uyumsuz olarak oluşan gölsel çökeller geniş yer kaplamakta olup, 'Bigadiç formasyonu' olarak adlandırılmışlardır. Formasyon olasılıkla Üst Miyosen-Alt Pliyosen yaştadır (Anonim, 1978).

Araştırma alanı çevresindeki meteoroloji istasyonlarının sıcaklıkla ilgili verilerine göre yıllık ortalama sıcaklık Sındırgı'da 14,3°C, Bigadiç'te 14,3°C ve Dursunbey'de 12°C'dir. Ortalama sıcaklığın en yüksek olduğu aylar üç istasyonda da Temmuz ayıdır. Ayrıca Sındırgı'da ortalama sıcaklık Ağustos ayında da en yüksek değerdedir. En fazla yağış bütün istasyonlarda Aralık ayında görülür. En az yağış Sındırgı ve Bigadiç'te Ağustos ayında, Dursunbey'de ise Temmuz ayında görülür (Anonim, 1975-2011).

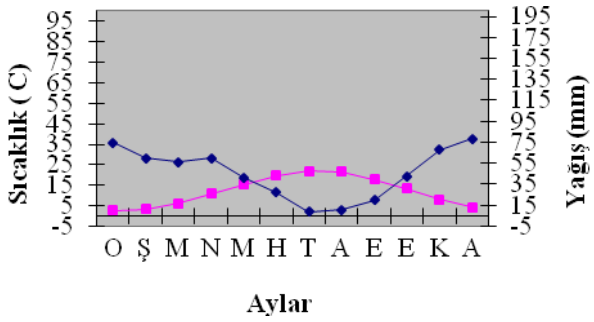


Şekil 2. Ulus Dağı zirvesinin iklim diyagramı

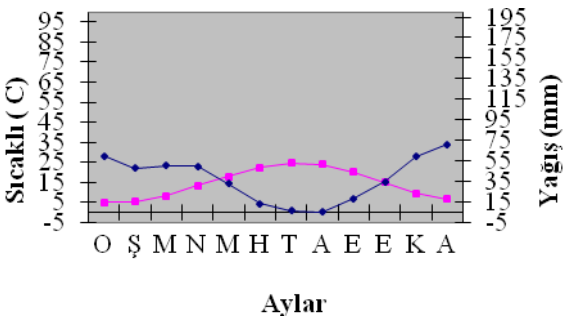


Şekil 3. Sındırgı ilçesinin iklim diyagramı

Dursunbey, Bigadiç ve Sındırgı içlerinden alınan aylık ortalama sıcaklık ve yağış verilerinin kullanılması ile bu ilçelere ait iklim diyagramı çizilmiştir (Şekil 3-5). Bu ilçelerin hepsinde kurak evre Mayıs ayının sonuna doğru başlayıp Ekim ayının ortalarında bitmektedir. Ayrıca bu üç ilçenin iklim değerlerinden yararlanılarak Ulus Dağı zirvesinin iklim diyagramı oluşturulmuş (Şekil 2) ve zirvede kurak evre gözlenmemiştir (----) **Yağış, (----) Sıcaklık.**



Şekil 4. Dursunbey ilçesinin iklim diyagramı



Şekil 5. Bigadiç ilçesinin iklim diyagramı

Araştırma alanını gözlemlendiğinde alanın büyük bir kısmında *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe (600-1600) taksonu hakimdir. Bunun yanında *Pinus brutia* Ten. alanda hakim olan ikinci çam türüdür ve 300-600 (700) m' ler arasında yayılış gösterir. Araştırma alanında üçüncü hakim olan ağaçlar ise *Quercus infectoria* Olivier subsp. *boissieri* (Rauter) O. Schwarz, *Q. infectoria* Olivier subsp. *infectoria*, *Q. cerris* L. subsp. *cerris*, *Q. pubescens* Willd. ve (500) 600-800 m' ler arasında hakimdir. Ayrıca çalışma alnının dere kenarlarında genellikle *Fagus orientalis* Libsky ve *Populus alba* L. gibi odunsu türler yaygındır.

Odunsu türlerin yanında bazı otsu ve çalı türleride alanda yer yer hakimliğini gösterir. Özellikler Mayıs-Haziran aylarında yol kenarlarında *Campanula lyrata* Lam. subsp. *lyrata*, *Silene vulgaris* (Moench) Garcke var. *vulgaris* ve *Cistus creticus* L. gibi taksonlar hakimdir. Ayrıca *Lathrus laxiflorus* (Desf.) Kuntze subsp. *laxiflorus*, *Trifolium campestre* Schreb, *T. arvense* L. var. *arvense*, *T. purpureum* Loisel. var. *purpureum*, *Moenchia mantica* (L.) Bartl. subsp. *mantica* ve *Centaurea triumfettii* All. ise orman altı/orman açıklıklarında kısımlarda yaygın olarak bulunan otsu türlerdendir.

Soğanlı bitkilerden *Ornithogalum nutans* L., *Crocus pulchellus* Herb., *Asparagus acutifolius* L. ve endemik bir tür olan *Muscari latifolium* J.Kirk araştırma alanında yaygın olarak bulunur.

Bitki Toplanan Lokaliteler

1. Bigadiç, Namazlar Deresi, kayın-karaçam içi, 1230 m

2. Bigadiç, Adalı orman deposu civarı, *Cistus-Quercus* açıklığı, 420m, 39° 24' 254" K / 028° 18' 872" D

3. Bigadiç, Adalı Köyü, Dıçkı Deresi, meşe içi,

460 m, 39° 23' 101" K / 028° 15' 721" D
4. Bigadiç, Adalı Orman İşletme Şefliği, Orman deposu civarı, 420 m, 39° 24' 254" K / 028° 18' 872" D
5. Bigadiç, Namazlar Deresi girişi, nemli alanlar, 570 m, 39° 21' 768" K / 028° 16' 493" D
6. Bigadiç, Yağcılar Köyü, Çayırlık, 564 m, 39° 24' 276" K / 028° 20' 775" D
7. Bigadiç, Aşağı Çamlıca Köyü, step alan, 360 m, 39° 21' 150" K / 028° 26' 561" D
8. Bigadiç, Aslan alan mevki, Orman içi, 1430 m, 39° 19' 988" K / 028° 23' 669" D
9. Bigadiç, Aşağı Çamlıca Köyü yolu, 1250 m, 39° 21' 843" K / 28° 26' 778" D
10. Bigadiç, Ulus Dağı zirvesi, Alpin zon, 1768 m, 39° 18' 989" K / 028° 23' 325" D
11. Bigadiç, Yukarı Çamlı Köyü üstü, orman açıklığı, 1158 m, 39° 19' 900" K / 028° 25' 817" D
12. Sındırgı, Çaygören Barajı başlangıcı, yol kenarı, 278 m, 39° 15' 798" K / 028° 17' 900" D
13. Sındırgı, Hisaralan Kaplıcası çevresi, kükürtlü topraklar, 330 m, 39° 16' 193" K / 028° 18' 995" D
14. Sındırgı, Kızılcahamam mevki, Orman altı, 1416 m, 39° 18' 596" K / 028° 21' 779" D
15. Sındırgı, Kıran Köy üstü, Orman altı, 1170m, 39° 17' 431" K / 028° 23' 498" D
16. Sındırgı, Sarıcaova mevki, 1291 m, 39° 18' 348" K / 028° 26' 008" D
17. Sındırgı, Çaygören Barajı civarı, yol kenarı, 290 m, 39° 15' 689" K / 028° 17' 504" D
18. Sındırgı, Hisaralan Kaplıcaları, çam-meşe içi, 350 m, 39° 16' 045" K / 028° 19' 070" D
19. Sındırgı, Yusufçam Köyü yolu üzeri, maki bitki örtüsü, 300 m
20. Sındırgı, Hisaralan Kaplıca üstü, kayalık yamaçlar, 420 m, 39° 16' 430" K / 028° 20' 033" D
21. Sındırgı, Kepez Köyü üstü, meşe açıklığı, 1046 m, 39° 18' 162" K / 028° 20' 016" D
22. Sındırgı, Sarıcaova mevki, yol kenarı, Kayalık yamaçlar, 1268 m, 39° 18' 131" K / 028° 25' 607" D
23. Sındırgı, Sarıcaova Kule yolu üzeri, Orman açıklığı, 1400 m, 39° 18' 536" K / 028° 24' 707" D
24. Sındırgı, Sekdere üstü, yol kenarı, 930 m, 39° 16' 845" K / 028° 25' 122" D
25. Sındırgı, Sarıcaova yolu üzeri, yabani kavak-karaçam içi, 1318 m, 39° 17' 977" K / 028° 24' 783" D
26. Sındırgı, Hisaralan Kaplıcaları civarı, kükürtlü topraklar, 310 m, 39° 16' 212" K /028° 18' 998" D
27. Sındırgı, Kepez Köyü, Eğlence mevkii, kayalık yamaçlar, 1182 m, 39° 18' 670" K / 028° 20' 718" D
28. Sındırgı, Dört yol mevki, step, 1066 m, 39° 17' 064" K / 028° 23' 457" D
29. Sındırgı, Sarıcaova mevkii, karaçam içi, 1278 m, 39° 18' 348" K / 028° 26' 005" D
30. Sındırgı, Kıran Köyü yolu üzeri, kayalık yamaçlar, 492 m, 39° 16' 427" K / 028° 20' 032" D
31. Sındırgı, Kıran Köyü üzeri, meşe açıklığı, 676 m, 39° 16' 247" K / 028° 20' 773" D
32. Sındırgı, Çaygören barajı çevresi, yol kenarı, 292 m, 39° 15' 979" K / 028° 16' 270" D
33. Sındırgı, Kepez Köyü, yol kenarı, 803 m, 39° 17' 28" K / 028° 19' 433" D
34. Sındırgı, 965m, 39° 16' 957" K / 028° 28' 662" D
35. Bigadiç, Adalı Köyü, Orman deposu, kızılçam açıklığı, 420 m, 39° 24' 254" K / 028° 16' 872" D
36. Bigadiç, Yukarı çamlı, step, 1260 m
37. Bigadiç, Kara dere üstü, nemli alanlar, 1105 m
38. Bigadiç, Yukarı çamlı köyü üstü, step, 1365 m.
39. Bigadiç, Çal Köyü yolu, orman altı, 941 m, 39° 22' 470" K / 028° 18' 598" D
40. Bigadiç, Adalı orman deposu civarı, step alan, 420 m, 39° 24' 254" K / 028° 18' 872" D
41. Bigadiç, Çalca köyü civarı, orman altı, 540 m, 39° 22' 307" K / 028° 16' 731" D
42. Bigadiç, Hisaralan, Kepez yol ağzı, 570 m, 39° 21' 768" K / 028° 16' 493" D
43. Bigadiç, Sarıcaova, step, 1265 m, 39° 18' 108" K / 028° 24' 603" D
44. Bigadiç, Ulus kule altı, Radar çeşme üstü, kayalık yamaçlar, 1598 m, 39° 18' 450" K / 028° 23' 410" D
45. Bigadiç, Sarıcaova yolu üzeri, ormanlık alan, 675 m
46. Bigadiç, Ulus yolu üzeri, Ahmet Ekdi mevkii, 1311 m, 39° 17' 576" K / 028° 24' 246" D
47. Bigadiç, Kıran Köyü yolu, 539 m, 39° 16' 260" K / 028° 20' 065" D
48. Sındırgı, Hisaralan Kaplıcaları, kükürtlü toprak, 361m, 39° 16' 042" K / 028° 19' 057" D
49. Sındırgı, Gözeren-Sarıca Ova yolu üzeri, dere kenarı, 1282 m, 39° 18' 197" K / 028° 25' 489" D
50. Sındırgı, Hisaralan orman ekip binası üstü, Kızılçam açıklığı, 338 m, 39° 16' 100" K / 028° 18' 959" D
51. Sındırgı, Baraj başlangıç yolu, İstasyon çevresi, yol kenarı, 285 m, 39° 15' 543" K / 028° 16' 280" D
52. Sındırgı, Ulus Zirve, 1768 m
53. Sındırgı, Sarıcaova yangın havuzu çevresi, step alan, 1280 m, 39° 18' 336" K / 028° 25' 960" D
54. Sındırgı, Hisaralan, Kepez yol ayrımı, 640 m, 39° 17' 003" K / 028° 19' 869" D
55. Bigadiç, Okçular Köyü, Kara dere, nemli alanlar, 606 m, 39° 23' 128" K / 028° 19' 943" D
56. Bigadiç, Orman deposu civarı, step alan, 417 m, 39° 24' 281" K / 028° 16' 871" D
57. Bigadiç, Kız suyu mevkii, Fındık,-Karaağaç açıklığı, 1000 m, 39° 20' 815" K / 028° 19' 685" D
58. Bigadiç, Dağarcık yolu, orman açıklığı, 952 m, 39° 21' 952" K / 028° 21' 406" D
59. Bigadiç, Ulus kule, 1768 m,
60. Sındırgı, Sarıcıova- Zirve arası, orman içi açıklığı,1409 m, 39° 18' 504" K / 028° 24' 783" D
61. Sındırgı, Kıran Köyü, dere içi, 784 m, 39° 16' 433" K / 028° 21' 659" D
62. Sındırgı, Ulus zirve, 1768 m,
63. Sındırgı, Kıran Köyü üzeri, kayalık yamaçlar, 594 m, 39° 16' 101" K / 028° 20 ' 285" D
64. Sındırgı, Simav yolu üzeri, Çaygören barajı kenarı, 287 m, 39° 15' 397" K / 028° 16' 460" D
65. Sındırgı, Kepez Köyü, nemli alanlar, 904 m, 39° 17' 601" K / 028° 19' 432" D
66. Sındırgı, Dört yol üstü, karaçam-laden açıklığı, 1116 m, 39° 17' 188" K / 028° 23' 629" D
67. Sındırgı, Hisaralan orman ekip binası üstü, orman içi, 358m,39° 16' 050" K / 028° 19' 070" D
68. Bigadiç, Yukarı Çamlı Köyü, Aslan alanı havuzu arası 6. km., orman içi, 1500 m, 062° 15' 76" K / 435° 36' 11" D
69. Bigadiç, Adalı köyü, meşe açıklığı, 215 m, 06° 03' 866" K / 43° 67' 736" D
70. Bigadiç, Halıca kulesi altı, Mavişin damı üzeri, Orman altı, 1195m, 06° 16' 234" K / 43° 53' 766 " D
71. Bigadiç, Namazlar deresi, Dere içi, 360 m, 063° 59' 94" K / 412° 41' 77" D
72. Bigadiç, Topal Mehmet'in çiftliğinin altı, kayalık yamaçlar, 785 m, 061° 10' 11" K / 435° 52' 33" D
73. Bigadiç, Aşağı Çamlık Köyü, nemli alanlar, 760 m, 062° 49' 27" K / 435° 72' 81" D
74. Bigadiç, Adalı orman deposu civarı, orman içi, 360 m, 063° 59' 54" K / 412° 41' 77" D
75. Bigadiç, Topal Mehmet'in çiftliği, dere içi, nemli alanlar, 530 m, 061° 34' 70" K / 43° 54' 467" D
76. Bigadiç, Durasal bağları, meşe açıklığı, 360 m, 063° 59' 94" K / 41° 24' 177" D
77. Bigadiç, Okçular köyü-Nuri değirmeni arası, kayalık yamaçlar, 580 m, 062° 19' 22" K / 436° 10' 46" D
78. Bigadiç, Güngörmez mevkii, kayalık yamaçlar, 760 m, 062° 46' 65" K / 435° 83' 54" D
79. Sındırgı, Çaygören barajı, step alan, 275 m, 39° 15' 798" K / 028° 17' 501" D
80. Sındırgı, Kızılcık alan mevkii, step, 1398 m, 39° 18' 653" K / 028° 22' 022" D
81. Bigadiç, Ulus yolu, Kıran köyü üzeri, Ormanlık alan, 1004 m,39° 16' 850" K / 028° 23' 223" D
82. Sındırgı, Kıran Köyü yolu, ormanlık alan, 526 m, 39° 16' 319" K / 028° 20' 056" D
83. Sındırgı, Ak dere, sulak alan, 1297 m,

39° 18' 036" K / 028° 24' 315" D
84. Sındırgı, Sarıcaova yolu üzeri, 685m.
85. Sındırgı, Hisaralan kaplıcaları üzeri, sulak alan, 400 m, 39° 16' 131" K / 028° 29' 281" D
86. Sındırgı, Kepez Köyü üzeri, Yol kenarı, 1232 m, 39° 18' 395" K / 028° 20' 890" D
87. Sındırgı, Sarıcaova, Havuz-Kule arası, orman içi açıklığı, 1341 m, 39° 18' 471" K / 028° 25' 590" D
88. Sındırgı, Eğlence yeri, çınar çeşme, nemli alanlar, 1266 m, 39° 18' 577" K / 028° 21' 172" D
89. Sındırgı, Sarıcaova, orman açıklığı, 1281 m, 39° 18' 337" K / 028° 26' 004" D
90. Sındırgı, Hisar içi kaplıcaları, orman içi, 375 m.
91. Sındırgı, Kıran Köyü üstü, kayalık yamaçlar, 1098 m, 39° 17' 176" K / 028° 23' 701" D
92. Sındırgı, Kamertepe, 1298 m, 39° 18' 036" K / 028° 24' 393" D

Kısaltmalar
Akd. :Akdeniz elementi
Avr-Sib. :Avrupa-Sibirya elementi
End. :Endemik
İr-Tur. :İran-Turan elementi
ÖG. :Özal Güner

3.2. Araştırma alanında saptanan bitki listesi

DIVISIO: PTERIDOPHYTA

EQUISETACEAE
Equisetum palustre L., 75, 14.05.2012, ÖG 1910

ASPLENIACEAE
Ceterach officinarum DC., 5, 10.05.2011, ÖG 1127

POLYPODIACEAE
Polypodium vulgare L., 25, 23.06. 2011, ÖG 1444

ASPIDIACEAE
Polystichum setiferum (Forssk.) Moore ex Woyn.
25, 23.06. 2011, ÖG 1442

ATHYRIACEAE
Athyrium filix-femina (L.)Roth
9, 10.05.2011, ÖG 1228

DIVISIO: SPERMATOPHYTA

CLASSIS: GYMNOSPERMAE

PINACEAE
Pinus nigra subsp. *pallasiana* (Lamb.) Holmboe
1, 10.05.2011, ÖG 1003
P. brutia Ten., 17, 24.05.2011, ÖG 1327, Akd.
P. pinea L., 15, 24.05.2011, ÖG 1283

CUPRESSACEAE
Juniperus excelsa M.Bieb., 78, 14.05.2012, ÖG 1956
J. oxycedrus L. subsp. *oxycedrus*
5, 10.05.2011, ÖG 1199

CLASSIS: ANGIOSPERMAE

SUBCLASSIS: DICOTYLEDONAE

RANUNCULACEAE
Nigella elata Boiss., 42, 05.07.2011, ÖG 1585
Delphinium peregrinum L., 42, 05.07.2011, ÖG 1584
Anemone coronaria L., 66, 20.04.2012, ÖG 1769
Ranunculus constantinopolitanus (DC.) d'UrV.
65, 20.04.2012, ÖG 1753
R. ficaria L.subsp. *ficariiformis* (F.W.Schultz) Rouy & Foucaud, 2, 10.05.2011, ÖG 1014
R. brutius Ten., 72, 14.05.2012, ÖG 1858
R. gracilis Clarke, 4, 10.05.2011, ÖG 1104
R. damascenus Boiss. & Gaill.
9, 10.05.2011, ÖG 1227
R. chius DC., 65, 20.04.2012, ÖG 1755, Akd.
R. repens L., 15, 24.05.2011, ÖG 1295
R. marginatus d'Urv. var. *marginatus*
14, 24.05.2011, ÖG 1275

PAPAVERACEAE
Papaver dubium L., 5, 10.05.2011, ÖG 1115
P. rhoeas L., 74, 14.05.2012, ÖG 1882
P. argemone L., 6, 10.05.2011, ÖG 1162
Hypecoum imberbe Sm., 21, 24.05.2011, ÖG 1406
Corydalis solida (L.) Clairv., subsp. *solida*
66, 20.04.2012, ÖG 1722

BRASSICACEAE
Raphanus raphanistrum L., 6, 10.05.2011, ÖG 1157
Cardaria draba (L.) Desv. subsp. *draba*
78, 14.05.2012, ÖG 195
Isatis floribunda Boiss. ex Bornm.
4, 10.05.2011, ÖG 1094
Capsella bursa-pastoris (L.) Medik.
6, 10.05.2011, ÖG 1156
Calepina irregularis (Asso) Thell.
6, 10.05.2011, ÖG 1178
Fibigia clypeata (L.) Medik.76, 14.05.2012, ÖG 1924
Neslia apiculata Fish., C.A. Mey. & Ave-Lall.
13, 24.05.2011, ÖG 1272
Arabis caucasica Willd. subsp. *caucasica*
1, 10.05.2011, ÖG 1008
Cardamine graeca L., 5, 10.05.2011, ÖG 1123
**Alyssum trichostachyum* Rubr.
5, 10.05.2011 ÖG 1132
A. borzaeanum Nyar., 77, 14.05.2012, ÖG 1946
Clypeola jonthlaspi L., 6, 10.05.2011, ÖG 1163
Erophila verna (L.) D.C. subsp. *verna*
2, 10.05.2011, ÖG 1016
Aubrieta canescens (Boiss.) Bornm. subsp. *canescens* 9, 10.05.2011, ÖG 1240, End.
Alliaria petiolata (M.Bieb.) Cavara & Grande
73, 14.05.2012, ÖG 1873
Turritis laxa (Sm.) Hayek, 16, 24.05.2011, ÖG 1315
Conringia orientalis (L.) Dumort.
75, 14.05.2012, ÖG 1900
**Alyssoides utriculata* (L.) Medik.
76, 14.05.2012, ÖG 1875
Descurainia sophia (L.) Webb ex Prantl
5, 10.05.2011, ÖG 1144
Barbarea trichopoda Hausskn. ex Bornm.
6, 10.05.2011, ÖG 1194a, End.
Sisymbrium loeselii L., 7, 10.05.2011, ÖG 1213

CISTACEAE
Cistus laurifolius L., 15, 24.05.2011, ÖG 1282
C. creticus L., 4, 10.05.2011, ÖG 1086

VIOLACEAE
Viola odorata L., 72, 14.05.2012, ÖG 1854
**V. suavis* M.Bieb., 16, 24.05.2011, ÖG 1307
**V. canina* L., 7, 10.05.2011, ÖG 1207

POLYGALACEAE

Polygala anatolica Boiss. & Heldr.
86, 18.06.2012, ÖG 2073

PORTULACACEAE
Portulaca oleracea L., 26. 23.05.2011, ÖG 1465

CARYOPHYLLACEAE
Cerastium glomeratum Thuill., 2, 10.05.2011, ÖG 1036
Moenchia mantica (L.) Bartl. subsp. *mantica*
4, 10.05.2011, ÖG 1084
Dianthus calocephalus Boiss.
31, 23.06.2011, ÖG 1499a
Saponaria glutinosa M.Bieb., 24, 23.06.2011, ÖG 1434
Silene compacta Fisch., 25, 23.06.2011, ÖG 1440
S. supina M.Bieb subsp. *pruinosa* Chowdhuri
4, 10.05.2011, ÖG 1087
S. dichotoma Ehrh. subsp. *dichotoma*
74, 14.05.2012, ÖG 1884
S. vulgaris (Moench) Garcke var. *vulgaris*
43, 05.07.2011, ÖG 1561
Agrostemma githago L., 71, 14.05.2012, ÖG 1838
A. gracilis Boiss., 35, 05.07.2011, ÖG 1518, Akd.

POLYGONACEAE
Rumex pulcher L., 75, 14.05.2012, ÖG 1903
**R. olympicus* Boiss., 83, 18.06.2012, ÖG 2018, End.
R. tuberosus L. subsp. *tuberosus*
71, 14.05.2012, ÖG 1828
R. acetosella L., 15, 24.05.2011, ÖG 1288
**R. bucephalophorus* L.
18, 24.05.2011, ÖG 1391, Akd.
R. crispus L., 88, 18.06.2012, ÖG 2089

HYPERICACEAE
Hypericum montbretii Spach, 20, 24.05.2011, ÖG 1384
H. olympicum L. subsp. *olympicum*
46, 05.05.2011, ÖG 1623
**H. aucheri* Jaub. & Spach, 18, 24.05.2011, ÖG 1349
H. adenotrichum Spach
74, 14.05.2012, ÖG 1894, End.
H. perforatum L., 81, 18.06.2012, ÖG 2031

MALVACEAE
Malva sylvestris L., 73, 14.05.2012, ÖG 1872
M. neglecta Wallr., 35, 05.07.2011, ÖG 1527
**Alcea rosea* L., 85, 18.06.2012, ÖG 2063
**A. apterocarpa* Boiss.
36, 05.07.2011, ÖG 1540a, İr.-Tur., End.
A. pallida (Willd.) Waldst.& Kit.
82, 18.06.2012, ÖG 2112
Althaea cannabina L., 86, 18.06.2012, ÖG 2068

TILIACEAE
**Tilia argentea* DC.
73, 14.05.2012, ÖG 1871, Avr.-Sib.

GERANIACEAE
Geranium dissectum L., 4, 10.05.211, ÖG 1105
G. pyrenaicum Burm.f., 5, 10.05.2011, ÖG 1147
G. pusillum L., 7, 10.05.2011, ÖG 1217
G. lucidum L., 4, 10.05.2011, ÖG 1079
G. tuberosum L. subsp. *tuberosum,*
68, 14.05.2012, ÖG 1782
G. rotundifolium L., 7, 10.05.2011, ÖG 1215
G. robertianum L., 18, 24.05.2011, ÖG 1379
G. macrostylum Boiss., 25, 23.06.2011, ÖG 1456
**G. subcaulescens* L'Her ex DC.
61, 20.04.2012, ÖG 1732a
Erodium cicutarium (L.) L'Her. subsp. *cicutarium*
2, 10.05.2011, ÖG 1038

VITACEAE
**Vitis sylvestris* C.C.Gmel, 76, 14.05.2012, ÖG 1930

RHAMNACEAE
Paliurus spina-christi Mill., 79, 18.06.2012, ÖG 1962

ANACARDIACEAE
Rhus coriaria L., 54, 15.10.2011, ÖG 1675
Pistacia terebinthus L., 54, 15.10.2011, ÖG 1674, Akd.
P. terebinthus L. subsp. *terebinthus*,
55, 15.10.2011, ÖG 1698

FABACEAE
Chamaecytisus hirsutus (L.) Link
7, 10.05.2011, ÖG 1201
**Spartium junceum* L., 19, 24.05.2011, ÖG 1354, Akd.
Genista lydia Boiss. var. *lydia*
15, 24.05.2011, ÖG 1295
Galega officinalis L.
36, 05.07.2011, ÖG 1537, Avr.-Sib.
**Astragalus plumosus* Willd. var. *plumosus*
80, 18.06.2011, ÖG 1972
Psoralea bituminosa L., 21,24.05.2011, ÖG 1404, Akd.
Vicia grandiflora Scop. var. *grandiflora*
2, 10.05.2011, ÖG 1030
V. hybrida L., 7, 10.05.2011, ÖG 1200, Akd.
**V. narbonensis* L. var. *narbonensis*
5, 10.05.2011, ÖG 1140
**V. sativa* L. subsp. *sativa*, 8, 10.05.2011, ÖG 1216
**V. villosa* Roth subsp. *dasycarpa* (Ten.) Cavillier
4, 10.05.2011, ÖG 1075
V. villosa Roth subsp. *varia* (Host) Corb.
20, 24.05.2011, ÖG 1376
Lathyrus digitatus (M.Bieb.) Fiori
1, 10.05.2011,ÖG 1005, Akd.
L. sphaericus Retz., 6, 10.05.2011, ÖG 1175
L. laxiflorus (Desf.) Kuntze subsp. *laxiflorus*
25, 23.06.2011, ÖG1451
L. undulatus Boiss.
4, 10.05.2011, ÖG 1075-25, 23.06.2011, ÖG 1438, End.
Ononis spinosa L. subsp. *leiosperma* (Boiss.) Sirj.
43, 05.07.2011, ÖG 1594
Trifolium speciosum Willd.
18, 24.05.2011, ÖG 1334, Akd.
T. campestre Schreb, 43, 05.07.2011, ÖG 1563
T. pannonicum Jacq. subsp. *elonpatom* (Willd.) Zoh.
24, 23.06.2011, ÖG 1430, End.
T. purpureum Loisel. var. *purpureum*
30, 23.06.2011, ÖG 1492
T. stellatum L. var. *stellatum*, 3, 10.05.2011, ÖG 1045 *T. repens* L. var. *repens*, 4, 10.05.2011, ÖG 1099
T. pratense L. var. *pretense*, 36, 05.07.2011, ÖG 1542
T. hirtum All., 38, 05.07.2011, ÖG 1557, Akd.
T. cherleri L., 18, 24.05.2011, ÖG 1387a, İr.-Tur.
T. resupinatum L. var. *resupinatum*
20, 24.05.2011, ÖG 1376
T. arvense L. var. *arvense*, 14, 24.05.2011, ÖG 1275
T. dubium Sibth., 4, 10.05.2011, ÖG 1091.
Melilotus bicolor Boiss. & Balansa
5, 10.05.2011, ÖG 1142, İr.-Tur., End.
M. officinalis (L.) Pall., 13, 24.05.2011, ÖG 1268
Medicago polymorpha L. var. *polymorpha*

6, 10.05.2011, ÖG 1189 - 20, 24.05.2011, ÖG 1386
M. orbicularis (L.) Bartal., 3, 10.05.2011, ÖG 104
Dorycnium graecum (L.) Ser.
39, 05.07.2011, ÖG 1564
Lotus corniculatus L. var. *tenuifolius* L.
25, 23.06.2011, ÖG 1447
**Anthyllis vulneraria* L. subsp. *hispidissima* (Sagorski) Cullen, 57, 15.10.2011, ÖG 1705, Akd.
Coronilla varia L. subsp. *varia*
24, 23.06.2011, ÖG 1427
Adenocarpus complicatus (L.) Gay
28, 23.06.2011, ÖG 1476 - 40, 05.07.2011, ÖG 1573
Lupinus angustifolius L. subsp. *angustifolius*
3, 10.05.2011, ÖG 1044

ROSACEAE
Prunus spinosa L. subsp. *dasyphylla* (Schur) Domin.
21, 24.05.2011, ÖG 1403, Avr.-Sib.
Rubus canescens DC. var. *glabratus* (Godron) Davis & Meikle, 24, 23.06.2011, ÖG 1433, Avr.-Sib.
Potentilla recta L. grub b, 41, 05.2011, ÖG 1571
P. reptans L., 28, 23.06.2011, ÖG 1477
P. buccoana Clem., 68, 14.05.2012, ÖG 1790, End.
Fragaria vesca L., 45, 05.07.2011, ÖG 1621
Sanguisorba minor Scop. subsp. *muricata* Brig
3, 10.05.2011, ÖG 1064
**Alchemilla mollis* (Buser) Rothm.
81, 18.06.2012, ÖG 2034
Rosa foetida Herrm, 21, 24.05.2011, ÖG 1399, İr.-Tur.
R. canina L., 21, 24.05.2011, ÖG 1412
Crataegus microphylla C. Koch
6, 10.05.2011, ÖG 1149
C. monogyna Jacg. subsp. *monogyna*
3, 10.05.2011, ÖG 1062
C. monogyna Jacg. subsp. *azarella* Franco
75, 14.05.2012, ÖG 1913
C. orientalis Pall. ex Bieb. var. *orientalis*
52, 15.10.2011, ÖG 1662
**Cydonia oblonga* Mill., 76, 14.05.2012, ÖG 1918
Pyrus elaeagnifolia Pall subsp. *elaeagnifolia*
48, 05.07.2011, ÖG 1636
P. amygdaliformis Vill. var. *amygdaliformis*
76, 14.05.2012, ÖG 1935
Filipendula vulgaris Moench
29, 23.06.2011, ÖG 1478, Avr.-Sib.
**Malus sylvestris* Mill. subsp. *orientalis* Browicz
16, 24.05.2011, ÖG 1312
M. sylvestris Mill., 58, 15.10.2011, ÖG 1715, Kültür

LYTHRACEAE
Lythrum salicaria L.
48, 05.07.2011, ÖG 1635, Avr.-Sib.

O**NAGRACEAE**
Epilobium hirsutum L., 45, 05.07.0211, ÖG 1609
E. angustifolium L., 25, 23.06.2011, ÖG 1454
E. montanum L., 89, 18.06.2012, ÖG 2109, Avr.-Sib.

CRASSULACEAE
Umbilicus erectus DC., 24, 23.06.2011, ÖG 1429
Sedum pallidum M.Bieb. var. *pallidum*
3, 10.05.2011, ÖG 1059

SAXIFRAGACEAE
Saxifraga sibirica L. subsp. *sibirica*
9, 10.05.2011, ÖG 1124

APIACEAE
Eryngium campestre L. var. *virens* (Link) Weins
79, 18.06.2012, ÖG 1961
E. bithynicum Boiss.
25, 23.06.2011, ÖG 1637, İr.-Tur., End.
E. creticum Lam., 79, 18.06.2012, ÖG 1960, Akd.
Anthriscus nemorosa (M. Bieb.) Spreng
7, 10.05.2011, ÖG 1205
Scandix pecten-veneris L., 5, 10.05.2011, ÖG 1126
Lagoecia cuminoides L.
18, 24.05.2011, ÖG 1339, Akd.
Conium maculatum L., 7, 10.05.2011, ÖG 1212
Ferulago aucheri Boiss., 3, 10.05.2011, ÖG 1053, End.
F. humilis Boiss., 14, 24.05.2011, ÖG 1276, Akd., End.
F. sylvatica (Besser) Rchb.
2, 10.05.2011, ÖG 1033, Avr-Sib.
F. macrosciadea Boiss. & Balansa
82, 18.06.2012, ÖG 2002, Akd., End.
Bifora radians M.Bieb., 18, 24.05.2011, ÖG 1349
Heracleum platytaenium Boiss.
78, 14.05.2012, ÖG 1952, Öks., End.
Artedia squamata L., 82, 18.06.2012, ÖG 2003
Ferula anatolica Boiss.
76, 14.05.2012, ÖG 1929, Akd., End.
Malabaila aurea Boiss.
76, 14.05.2012, ÖG 1915a, Akd.
**Smyrnium creticum* Mill, 18, 24.05.2011, ÖG 1328
Daucus carota L., 31, 23.06.2011, ÖG 1501

ARALIACEAE
Hedera helix L., 71, 14.05.2012, ÖG 1820

CAPRIFOLIACEAE
Sambucus ebulus L.
44, 05.07.2011, ÖG 1605, Avr.-Sib.

VALERIANACEAE
Valeriana dioscoridis Sm.
5, 10.05.2011, ÖG 1111, Akd.

DIPSACACEAE
Dipsacus laciniatus L., 45, 05.07.2011, ÖG 1619
Scabiosa atropurpurea L.
69, 14.05.2012, ÖG 1809
S. reuteriana Boiss.
71, 14.05.2011, ÖG 1831, Akd., End.
Pterocephalus plumosus Coult.,
25, 23.06.2011, ÖG 1461

ASTERACEAE
**Telekia speciosa* (Schreb.) Baumg.
4, 10.05.2011, ÖG 1078, Avr.-Sib.
Conyza canadensis (L.) Cronquist
51, 15.10.2011, ÖG 1659
Bellis perennis L., 9, 10.02.2011, ÖG 1226, Avr.-Sib.
Doronicum orientale Hoffm., 1, 10.05.2011, ÖG 1007
Xanthium strumarium L. subsp. *cavanillesii* (Schouw) D.Love & Dans., 79, 18.06..2012, ÖG 1963
Tussilago farfara L.
60, 20.04.2012, ÖG 1724a, Avr.-Sib.
Anthemis tinctoria L. var. *tinctoria*
21, 24.05.2011, ÖG 1416 - 51, 05.07.2011, ÖG 1580
A. cretica L. subsp. *leucanthemoides* (Boiss.) Grierson, 3, 10.05.2011, ÖG 1057- 27, 23.06.2011, ÖG 1467
A. aciphylla Boiss. var. *aciphylla*
1, 10.05.2011, ÖG 1009, End.
Cirsium hypoleucum DC.

25, 23.06.2011, ÖG 1450, Öks.
Achillea coarctata Poir., 32, 23.06.2011, ÖG 1509
A. biebersteinii Afan., 89, 18.06.2012, ÖG 2097
A. nobilis L. subsp. *neilrechii* (a. kerner) Form.
81, 18.06.2012, ÖG 1977, Avr.-Sib.
Onopordum illyricum L.
35, 05.07.2011, ÖG 1521, Akd.
Picnomon acarna (L.) Cass.
36, 05.07.2011, ÖG 1539, Akd.
**Carduus pycnocephalus* L. subsp. *pycnocephalus*
2, 10.05.2011, ÖG1019, Akd.
Centaurea solstitialis L. subsp. *solstitialis*
42, 05.07.2011, ÖG 1583
C. urvillei DC. subsp. *armata* Wagenitz
71, 14.05.2012, ÖG 1817, Akd.
C. depressa M.Bieb., 20, 24.05.2011, ÖG 1368a
C. triumfettii All., 38, 05.07.2011, ÖG 1553
C. virgata Lam., 53, 15.10.2011, ÖG 1671
Xeranthemum annuum L.
31, 23.06.2011, ÖG 1496, İr-Tur.
Echinops viscosus DC. subsp. *bitynicus* (Boiss.) Rech. 36, 05.07.2011, ÖG 1536
**Tragopogon olympicus* Boiss.
75, 14.05.2012, ÖG 1901, Akd., End
T. longirostris Sch. Bip. var. *abbreviatus* Boiss.
2, 10.05.2011, ÖG 1029
Leontodon crispus Vill., 91, 18.06.2012, ÖG 2118
Cichorium intybus L., 35, 05.07.2011, ÖG 1522 *Scorzonera cana* (C.A. Mey) O.Hoffm.
32, 23.06.2011, ÖG 1508
Sonchus asper (L.) Hill var. *glaurescens* (Jord.) Ball ex Ball, 2, 10.05.2011, 1027
Pilosella piloselloides (Vill) Sojak subsp. *magyarica* (Peter) S.Braut. & Grauter, 74, 14.05.2012, ÖG 1886
P. hoppeana (Schult) F.W. Schultz & Sch.Bip. subsp. *lydia* (Bornm. & Zahn) Sell & West
92, 18.06.2012, ÖG 2140, End.
Lapsana communis L. subsp. *intermedia* (Bieb.) Hayek, 28, 23.06.2011, ÖG 1473
Taraxacum scaturiginosum G.E.Haglund
1, 10.05.2011, ÖG 1011
Crepis sancta (L.) Bornm, 18, 24.05.2011, ÖG 1393
C. reuteriana Boiss. & Heldr. subsp. *reuteriana*
74, 14.05.2012, ÖG 1876
Tyrimnus leucographus (L.) Cass.
18, 24.05.2011, ÖG 1348, Akd.
**Hieracium vagum* Jord
49, 15.10.2011, ÖG 1648, Avr.-Sib.
Logfia arvensis (L.) Holub, 20, 24.05.2011, ÖG 1358
Carthamus dentatus Vahl, 40, 05.07.2011, ÖG 1586
Senecio vernalis Waldst. & Kit.
5, 10.05.2011, ÖG 1140
Sonchus oleraceus (L.) L., 82, 18.06.2012, ÖG 2005
Mycelis muralis (L.) Dumort.
81, 18.06.2012, ÖG 2049, Avr.-Sib.
**Chrysanthemum segetum* L.
35, 05.07.2011, ÖG 1521
Calendula arvensis L., 32, 23.06.2011, ÖG 1506
Tanacetum parthenium (L.) Sch. Bip.
36, 05.07.2011, ÖG 1545
Scolymus hispanicus L.
32, 23.06.2011, ÖG 1511, Akd.
Lactuca serriola L.
79, 18.06.2012, ÖG 1964, Avr.-Sib.
Chondrilla juncea L. var. *juncea*
47, 05.07.2011, ÖG 1625

CAMPANULACEAE
Campanula lyrata Lam. subsp. *lyrata*
19, 24.05.2011, ÖG 1352, End.
**C. lyrata* Lam. subsp. *icarica* Runemark ex Phitos
25, 23.06.2011, ÖG 1455
C. cymbalaria Sm., 25, 23.06.2011, ÖG 1446
Asyneuma limonifolium (L.) Janch. subsp. *limonifolium,* 44, 05.07.2011, ÖG 1603
Legousia speculum-veneris (L.) Durande ex Vill.
31, 23.06.2011, ÖG 1497
L. pentagonia (L.) Thell.
18, 24.05.2011, ÖG 1397, Akd.

PRIMULACEAE
Lysimachia vulgaris L., 45, 05.04.2011, ÖG 1616
**L. verticillaris* Spreng, 45, 05.04.2011, ÖG 1616a,
L. atropurpurea L., 74, 14.05.2012, ÖG 1898, Akd.
Cyclamen mirabile Hilderb.,
51, 15.10.2011, ÖG 1657, Akd.

OLEACEAE
Jasminum fruticans L., 21, 24.05.2011, ÖG 1405, Akd.
Phillyrea latifolia L., 66, 20.04.2012, ÖG 1762, Akd.

GENTIANACEAE
Centaurium erythraea Rafn. subsp. *erythraea*
32, 23.06.2011, ÖG 1505, Avr.-Sib.

CONVOLVULACEAE
Convolvulus arvensis L., 79.18.2012, ÖG 1959
C. betonicifolius Mill. subsp. *betonicifolius*
82, 18.06.2012, ÖG 1998
C. cantabricus L., 31, 23.06.2011, ÖG 1504
**Ipomoea. sagittata* Poir., 48, 05.07.2011, ÖG 1627
I. purpurea (L.) Roth
48, 05.07.2011, ÖG 1626, Kültür

BORAGINACEAE
Myosotis arvensis (L.) Hill subsp. *arvensis*
4, 10.05.2011, ÖG 1090, Avr.-Sib.
**M. densiflora* C. Koch, 1, 10.05.2011, ÖG 1004
M. alpestris F.W. Schmidt subsp. *alpestris*
78, 14.05.2012, ÖG 1955
M. lithospermifolia Hornem, 9, 10.05.2011, ÖG 1228
Cynoglossum montanum L.
81, 18.06.2012, ÖG 2027, Avr.-Sib.
**Lithospermum purpurocaeruleum* L.
82, 18.06.2012, ÖG 2011, Avr.-Sibir.
Echium italicum L., 35, 05.07.2011, ÖG 1517, Akd.
E. plantagineum L., 5, 10.05.2011, ÖG 1137, Akd.
Onosma bornmuelleri Hausskn. & Bornm.
31, 23.06.2011, ÖG 1500, End.
**O. armenum* DC., 3, 10.05.2011, ÖG 1055, End.
Symphytum orientale L.
7, 10.05.2011, ÖG 1209, Avr.-Sib.
Anchusa officinalis L. grub b,
10, 10.05.2011, ÖG 1254
A. undulata L. subsp. *hybrida* (Ten.) Cout.
2, 10.05.2011, ÖG 1032
Buglossoides arvensis (L.) I.M. Johnst.
2, 10.05.2011, ÖG 1015
Heliotropium europaeum L., 13, 24.05.2011, ÖG 1259
Alkanna orientalis (L.) Boiss. var. *leucantha* (Bornm.) Hub.-Mor., 20, 24.05.2011, ÖG 1382, İr-Tur., End.

SCROPHULARIACEAE

**Verbascum nudatum* Murb. var. *spathulatum* Hub.-Mor., 18, 24.05.2011, ÖG 1357, İr.-Tur., End.
V. cherianthifolium Boiss. subsp. *cherianthifolium*
25, 23.06.2011, ÖG 1439
V. splendidum Boiss., 35, 05.07.2011, ÖG 1531, End.
**Scrophularia xanthoglossa* Boiss. var. *decipiens* (Boiss. &Kotschy) Boiss.,
3, 10.05.2011, ÖG 1047 İr.-Tur.
Linaria genistifolia (L.) Mill. subsp. *genistifolia*
77, 14.05.2012, ÖG 1943, Avr.-Sib.
Digitalis ferruginea L.subsp. *ferruginea*
49, 15.10.2011, ÖG 1639
Veronica anagallis-aquatica L.
14, 24.05.2011, ÖG 1273
V. chamaedrys L., 5, 10.05.2011, ÖG 1139, Avr.-Sib.
V. jacquinii Baumg., 5, 10.05.2011, ÖG 1122, Avr.-Sib.
Odontites verna Dumort subsp. *serotina* Corb.
49, 15.10.2011, ÖG 1642, Avr.-Sib.
Pedicularis comosa L.var. *sibthorpii* (Boiss.) Boiss.
27, 23.06.2011, ÖG 1468
Parentucellia latifolia Caruel subsp. *latifolia*
4, 10.05.2011, ÖG 1108, Akd.

OROBANCHACEAE
Orobanche caryophyllacea Sm
81, 18.06.2012, ÖG 2023

LAMIACEAE
Ajuga orientalis L., 23, 24.05.2011, ÖG 1424
**Teucrium lamiifolium* d'urv subsp. *lamiifolium*
45, 05.07.2011, ÖG 1614
T. chamaedrys L. subsp. *chamaedrys*
44, 05.07.2011, ÖG 1598, Avr. - Sib.
**Lamium purpureum* L. var. *purpureum*
1, 10.05.2011, ÖG 1010, Avr.-Sib.
L. garganicum L. subsp. *reniforme* (Montbet & Aucher ex Benth) R.R. Mill, 5, 10.05.2011, ÖG 1125
L. amplexicaule L., 65, 24.05.2012, ÖG 1754, Avr.-Sib.
**Sideritis perfoliata* L., 44, 23.06.2011, ÖG 1559
Stachys tmolea Boiss.
25, 23.03.2011, ÖG 1445, Akd., End.
**S. cretica* L. subsp. *lesbiaca* Rech.
32, 23.06.2011, ÖG 1512, Akd.
S. cretica L. subsp. *anatolica* Rech.
28, 23.06.2011, ÖG1474, İr-Tur., End
**S. alpina* L. subsp. *macrophylla* (Albov) R.Bhattacharjee,
75, 14.05.2012, ÖG 1906,
S. byzantina K. Koch
86, 19.06.2012, ÖG 2078, Avr.-Sib.
S.obliqua Waldst. & Kit.
86, 19.06.2012, ÖG 2085, Akd.
Prunella vulgaris L.
45, 05.07.2011, ÖG 1620, Avr.-Sib.
Melissa officinalis L. subsp. *officinalis*
9, 10.05.2011, ÖG 1231
Origanum vulgare L. subsp. *hirtum* (Link) letsw.
46, 05.07.2011, ÖG 1622, Akd.
Thymus zygioides Griseb. var. *zygioides*
69, 14.05.2012, ÖG 1812, Akd.
T. longicaulis C. Presl subsp. *longicaulis*
36, 05.07.2011, ÖG 1543 - 40, 05.07.2011, ÖG 1574
**Mentha longifolia* (L.) L. subsp. *longifolia*
45, 05.07.2011, ÖG 1618,
M. spicata L. subsp. *spicata*
52, 15.10.2011, ÖG 1664, Akd.
M. pulegium L., 53, 15.10.2011, ÖG 1669
Clinopodium vulgare L. subsp. *vulgare*,
36, 05.07.2011, ÖG 1532
C. graveolens (M.Bieb.) Kuntze subsp. *rotundifolium* (Pers.) Govaerts, 6, 10.05.2011, ÖG 1148
Scutellaria velenovskyi Rech.f.
52, 15.10.2011, ÖG 1663, Akd.
Nepeta nuda L. subsp. *nuda*, 36, 05.07.2011, ÖG 1544
N. viscida Boiss., 29, 23.06.2011, ÖG 1490 Akd., End.
Salvia tomentosa Mill., 18, 24.05.2011, ÖG 1534, Akd.
S. verbenaca L., 64, 20.04.2012, ÖG 1747
S. sclarea L., 11, 10.05.2011, ÖG 1258a

PLANTAGINACEAE
Plantago lanceolata L., 13, 24.05.2011, ÖG 1264
P. lagopus L., 2, 10.05.2011, ÖG 1025, Akd.

RAFFLESIACEAE
**Cytinus hypocistis* (L.) L. subsp. *kermesinus* Guss.
4, 10.05.2011, ÖG 1110, Akd.

ARISTOLOCHIACEAE
Aristolochia pallida Willd., 68, 14.05.2012, ÖG 180

EUPHORBIACEAE
Mercurialis annua L., 13, 24.05.2011, ÖG 1261
**Euphorbia myrsinites* L., 68, 14.05.2012, ÖG 1781
E. herniariifolia Willd. var. *glaberrina* Hal.
13, 24.05.2011, ÖG 1272

URTICACEAE
**Urtica dioica* L., 75, 14.05.2012, ÖG 1904, Avr.-Sib.

MORACEAE
Morus nigra L., 58, 15.10.2011, ÖG 1713
Ficus carica L. subsp. *carica*, 48, 05.07.2011, ÖG 1632

JUGLANDACEAE
Juglans regia L., 20, 24.05.2011, ÖG 1372

PLATANACEAE
Platanus orientalis L., 57, 15.10.2011, ÖG 1708a

FAGACEAE
Fagus orientalis Libsky
1, 10.05.2011, ÖG 1002, Avr.-Sib.
Quercus infectoria Olivier subsp. *boissieri* (Rauter) O. Schwarz, 18, 24.05.2011, ÖG 1344
Q. infectoria Olivier subsp. *infectoria*
54, 15.10.2011, ÖG 1673, Avr.-Sib.
Q.cerris L. subsp. *cerris*
71, 14.05.2012, ÖG 1819, Akd.
Q. pubescens Willd, 66, 20.04.2012, ÖG 1759

CORYLACEAE
Corylus avellana L. var. *avellana*
29, 23.06.2011, ÖG 1479, Avr.-Sib.
Carpinus betulus L.
57, 15.10.2011, ÖG 1708b, Avr.-Sib.

BETULACEAE
Alnus glutinosa (L.) Gaertn. subsp. *glutinosa*
57, 15.10.2011, ÖG 1707, Avr.-Sib.

SALICACEAE
Salix alba L., 81, 18.06.2011, ÖG 2050, Avr.-Sib.
**S. cinerea* L., 81, 18.06.2011, ÖG 2033, Avr.-Sib.
Populus alpa L., 72, 14.05.2012, ÖG 1866, Avr.-Sib.

RUBIACEAE
Asperula arvensis L., 39, 05.07.2011, ÖG 1365, Akd.
A. involucrata Wahlenb.
25, 26.06.2011, ÖG 1459, Öks.
Galium paschale Forssk.
81, 18.06.2011, ÖG 2045, Akd.
**G. verum* L. var. *glabrescens* Ehrend.
71, 14.05.2012, ÖG 1840
G. rivale (Sibth. & Sm.) Griseb.
4, 10.05.2011, ÖG 1097, Avr.-Sib.
Cruciata taurica (Palas exWilld) Ehrend.
21, 24.05.2011, ÖG 1410, İr.-Tur.
**C. laevipes* Opiz, 16. 24.05.2011, ÖG 1309, Avr.-Sib.

SUBCLASSİS: MONOCOTYLEDONAE

ARACEAE
Dracunculus vulgaris Schott
82, 18.06.2012, ÖG 1994a, Akd.

LILIACEAE
**Ruscus aculeatus* L. var. *angustifolius* Boiss.
50, 15.10.2011, ÖG 1649
**Asparagus acutifolius* L.
21, 24.05.2011, ÖG 1417, Akd.
Ornithogalum nutans L.
16, 24.05.2011, ÖG 1298, Akd.
O. oligophyllum E.D.Clarke, 3, 10.05.2011, ÖG 1060
Muscari latifolium J.Kirk
1, 10.05.2011, ÖG 1001, Akd., End.
M. comosum (L.) Mill.
41, 05.07.2011, ÖG 1575, Avr.-Sib.
**Asphodelus aestivus* Brot.
6, 10.05.2011, ÖG 1182, Akd.
**Fritillaria bithynica* Baker
68, 14.05.2012, ÖG 1798, Akd.
Tulipa orphanidea Boiss. ex Heldr.
23, 24.05.2011, ÖG 1423, Akd.
Asphodeline lutea (L.) Rchb.
68, 14.05.2012, ÖG 1779, Akd.
Gagea villosa (M.Bieb.) Sweet var. *villosa*
68, 14.05.2012, ÖG 1793, Akd.
Colchicum umbrosum Steven
53, 15.10.2011, ÖG 1672, Öks.

IRIDACEAE
Iris suaveolens Boiss. & Reut.
68, 14.05.2012, ÖG 1780, Akd.
Crocus pulchellus Herb.
57, 15.10.2011, ÖG 1640, Akd.
C. flavus Weston subsp. *dissectus* T.Baytop & B.Mathew, 67, 20.04.2012, ÖG 1773, End.
Gladiolus italicus Mill., 86, 18.06.2012, ÖG 2076

ORCHIDACEAE
Cephalanthera rubra (L.) Rich.
19, 24.05.2011, ÖG 1351 - 44, 05.07.2011, ÖG 1604
C. epipactoides Fisch. & C.A.Mey.
71, 14.05.2011, ÖG 1824, Akd.
**Ophrys sphegodes* Mill., 66, 20.04.2012, ÖG 1772
Orchis purpurea Huds.
16, 24.05.2011, ÖG 1299, Avr.-Sib.
O. mascula (L.) L., 14, 24.05.2011, ÖG 1281
O. laxiflora Lam., 66, 20.04.2012, ÖG 1763, Akd.
Limodorum abortivum (L.) Sw.,
91, 18.06.2012, ÖG 2115
**Serapias vomeracea* (Burm fil) Brig subsp. *laxiflora* (Soo) Gölz & H. R. Reinhard
4, 10.05.2011, ÖG 1092, Akd.

JUNCACEAE
Juncus anatolicus Snogerup
13, 24.05.2011, ÖG 1269, Akd., End.

CYPERACEAE
**Cyperus longus* L., 81, 18.04.2012, ÖG 2022
Carex pendula Huds.
81, 18.04.2012, ÖG 2024, Avr.-Sib.

POACEAE
Aegilops umbellulata Zhuk.
74, 14.05.2012, ÖG 1895a, İr.-Tur.
A. markgrafii (Greuter) K. Hammer,
17, 24.05.2011, ÖG 1324, Akd.
Hordeum bulbosum L., 69, 14.05.2012, ÖG 1807
**Bromus danthoniae* Trin., 74, 14.05.2012, ÖG 1895b
B. sterilis L., 6, 10.05.2011, ÖG 1158
**Avena fatua* L. var. *glabrata* Peterm.
17, 24.05.2011, ÖG 1326a, Avr.-Sib.
**A. wiestii* Steud., 69, 14.05.2012, ÖG 1806
Alopecurus arundinaceus Poir.
13, 24.05.2011, ÖG 1266, Avr.-Sib.
**Lolium persicum* Boiss. & Hohen.
13, 24.05.2011, ÖG 1268, İr.-Tur.
L. rigidum Gaudich. var. *rigidum*
6, 10.05.2011, ÖG 1194b
Poa trivialis L., 69, 14.05.2012, ÖG 1815
P. bulbosa L., 6, 10.05.2011, ÖG 1170b
Dactylis glomerata L.subsp. *glomerata*
2, 10.05.2011, ÖG 1042, Avr.-Sib.
Phragmites australis (Cav.) Trin. ex Steud.
85, 17.06.2012, ÖG 2064, Avr.-Sib.
Vulpia myuros (L.) C.C. Gmel.
31, 23.06.2011, ÖG 1499a
Briza maxima L., 78, 14.05.2012, ÖG 1950

4. Sonuçlar ve Tartışma

Araştırma süresince bitki örneklerinin değerlendirilmesi ile 63 familyaya ait 245 cins ve bu cinslere ait 264 tür, 77 alttür ve 41 varyete olmak üzere toplam 382 takson tespit edilmiştir. Tespit edilen bu taksonlardan 5'i Pteridophyta ve 377'si da Spermatophyta bölümüne aittir. Spermatophyta' ya ait taksonlardan 5'i Gymnospermae sınıfına, geriye kalan 372 takson ise Angiospermae sınıfına aittir. Angiospermae sınıfına ait bu taksonlardan 329'u Dicotyledonae, 43'ü ise Monocotyledonae alt sınıfına aittir. Bu 382 taksondan 31'i Türkiye için endemik ve 59 takson ise B2 karesi için yeni kayıttır.

Araştırma alanında en çok takson içeren ilk 10 familya (Tablo 1); Asteraceae 48, Fabaceae 39, Lamiaceae 29, Brassicaceae 21, Rosaceae 20, Apiaceae 18, Boraginaceae 16, Poaceae 16, Liliaceae 12 ve Scrophulariaceae 12 şeklinde sıralanır. Asteraceae familyası ülkemizde olduğu gibi araştırma alanında da en çok taksona sahiptir. Bu familya üyelerinin çeşitli ortamlarda yetişebilme yeteneğine sahip olması, geniş yayılış alanlarında varlık gösterebilmesi ve

ekolojik toleranslarının oldukça yüksek olması araştırma alanında çok sayıda takson ile temsil edilmesini mümkün kılar. Asteaceae'den sonra Fabaceae, Lamiaceae ve Brassiaceae familyaları da hem araştırma alanında hem de ülkemizde çok sayıda taksona sahiptir.

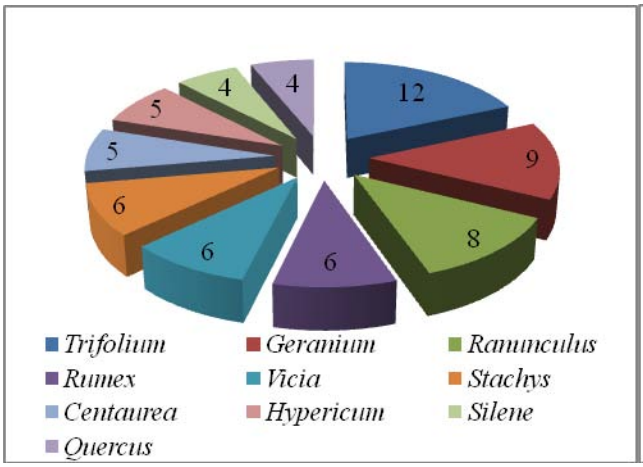
Tablo 1. En fazla takson içeren familyalar ve yüzdesi

Familyalar	**Takson sayısı**	**%**
Asteraceae	48	12,5
Fabaceae	39	10,2
Lamiaceae	29	7,5
Brassicaceae	21	5,4
Rosaceae	20	5,2
Apiaceae	18	4,7
Boraginaceae	16	4,1
Poaceae	16	4,1
Liliaceae	12	3,1
Scrophulariaceae	12	3,1
Diğerleri	153	40,0
Toplam	**382**	**100,0**

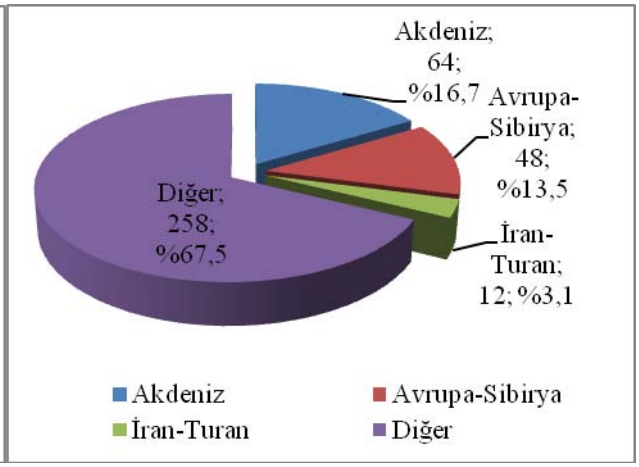
Tablo 2. En fazla cins içeren familyalar ve yüzdesi

Familyalar	**Cins sayısı**	**%**
Asteraceae	38	15,4
Brassicaceae	20	8,1
Fabaceae	18	7,3
Lamiaceae	15	6,9
Apiaceae	13	5,2
Rosaceae	12	4,8
Poaceae	11	4,4
Liliaceae	10	4,0
Boraginaceae	10	4,0
Scrophulariaceae	8	3,2
Diğerleri	91	36,9
Toplam	**246**	**100,0**

Cinslerin familyalara göre dağılımında (Tablo 2) takson sayısında olduğu gibi yine Asteraceae familyası % 15,4 ile ilk sırada yer alır. Bu familyayı sırasıyla Brassicaceae (% 8,1), Fabaceae (% 7,3), Lamiaceae (% 6,9), Apiaceae (%5,2), Rosaceae (% 4,8), Poaceae (% 4,4), Liliaceae (% 4,0), Boraginaceae (% 4,0) ve Scrophulariaceae (% 3,2) gelir.
Araştırma alanında en çok takson içeren cinsler Şekil 6'da gösterildiği gibi *Trifolium, Geranium, Ranunculus, Silene, Vicia, Stachys, Centaurea, Hypericum, Rumex* ve *Quercus* şeklindedir. *Trifolium* cinsine çalışma alanında ilk sı-



Şekil 6. En fazla takson içeren cinsler



Şekil 7. Taksonların floristik bölgelere göre dağılımı

rada rastlanmasının nedenleri; genellikle dere kenarlarında oldukça fazla yer alması, nemli bölgelere adaptasyonunun iyi olması ve çayır–mera vejetasyonunun geniş alanlara yayılması şeklinde açıklanabilir. Ülkemizde *Astragalus, Verbascum* ve *Centaurea* sırasıyla en çok tür içeren cinslerdir. Çalışma alanında bu sıra *Trifolium, Geranium* ve *Ranunculus* şeklindedir. *Astragalus* cinsinin sıralamada ilk sıralarda yer almamasının nedenleri, bu cinsin step alanlarda yaygın olması ve araştırma alanında step alanların oldukça az olmasından kaynaklandığı düşünülmektedir. Bu sıralama bazı çalışmalarda (Sanön ve Özen, 2001) *Trifolium, Silene* ve *Vicia* şeklinde yer alır. Bu sıralama genellikle bölgenin toprak, yükseklik, mikroklima ve vejetasyon özelliklerine bağlıdır

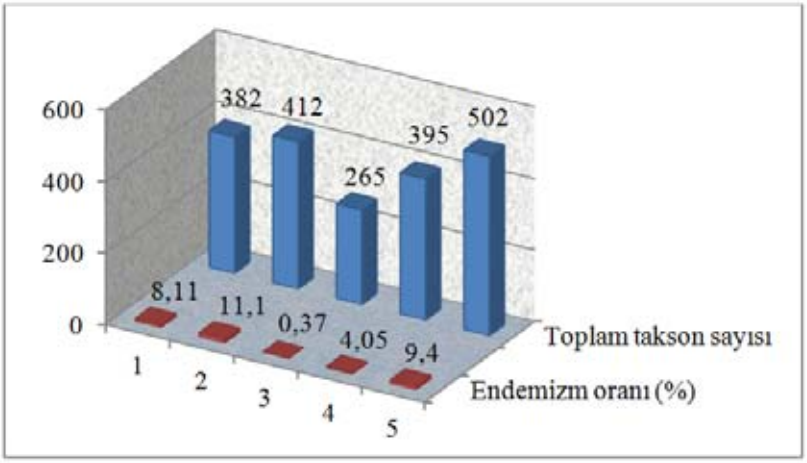
Çalışma alanının fitocoğrafik bölgelere göre takson sayısının (Şekil 7) dağılımı; Akdeniz 64, Avrupa-Sibirya 48 ve İran-Turan 12 şeklindedir. Araştırma alanı, Akdeniz ile Avrupa-Sibirya bölgelerinin geçiş noktasında bulunmakla birlikte, alanda İran-Turan bitkileri de görülmektedir. Akdeniz elementlerinin çok sayıda olmasını bölgede Akdeniz ikliminin hakim olması ve Akdeniz fitocoğrafya bölgesinin içerinde yer almasından kaynaklanmaktadır. Inceleme alanının Avrupa-Sibirya fitocoğrafik bölgesine yakın olması bu fitocoğrafik bölgeye ait takson sayısının ikinci sırada olmasına neden olduğu söylenebilir. 382 taksondan yalnız 12'sinin İran-Turan elementi olması bu taksonların geniş yayılışlı olmasından kaynaklandığı düşünülmektedir.

Tablo 3 Karşılaştırma yapılan alanlardaki en zengin familyalar

Familyalar	1	2	3	4	5
Asteraceae	48	52	23	59	60
Fabaceae	39	56	14	69	68
Lamiaceae	29	22	11	33	34
Brassicaceae	21	22	7	31	31
Rosaceae	20	8	8	28	15
Apiaceae	18	11	14	20	13
Boraginaceae	16	11	11	22	25
Poaceae	16	25	18	29	30
Diğerleri	177	205	159	104	226
Toplam	**382**	**412**	**265**	**395**	**502**

1. Ulus Dağı (Balıkesir)
2. Gölcük Orman İşletme Şefliği (Balıkesir)
3. Balıkesir Üniv. Çağış Kamptüsü ve Çevresinin Flora ve Vejetasyonu (Balıkesir)
4. Eğrigöz Dağı (Kütahya)
5. Simav Dağı (Kütahya

Araştırma alanında takson sayısı bakımından ilk beş sırayı Asteraceae, Fabaceae, Lamiaceae, Brassicaceae ve Rosaceae almaktadır. Tablo 3 incelendiğinde Ulus Dağı ile Sanön ve Özen'in (2001) çalışmaları karşılaştırıldığında, iki çalışmada Asteraceae familyasının takson sayılarının fazla olduğu görülmekte, ancak diğer çalışmalarda (Dirmenci, 2006, Görk, 1983, Yayıntaş, 1983) Fabaceae familyasının takson sayısı bakımından zengin olduğu Tablo 3'te de görülmektedir.



1. Ulus Dağı (Balıkesir)
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3. Balıkesir Üniv. Çağış Kamptüsü ve Çevresinin Flora ve Vejetasyonu (Balıkesir)
4. Eğrigöz Dağı (Kütahya)
5. Simav Dağı (Kütahya)

Şekil 8. Karşılaştırma yapılan alanların endemizm durumu

Ülkemiz endemizm bakımından oldukca zengindir. Toplamda 12006 takson bulunan Türkiye'de 3778 takson endemiktir. Endemizm oranı %31,4'dür (Erik ve Tarıkahya, 2004). Ama çalışma alanı endemizm bakımından ülkemizde olduğu kadar zengin değildir. Bu alanında yapılan çalışmalar sonucunda tespit edilen 382 taksondan 31'i endemik olup endemizm oranı %8,11'dir. Araştırma alanının endemizm oranının yakın çevresinde yapılmış olan floristik çalışmalardaki endemizm oranı ile karşılaştırılması Şekil 8'de verilmiştir. Şekil 8'deki verilere göre endemizm oranının en yüksek olduğu çalışma %11,1 ile Gölcük Orman İşletme Şefliği (Dirmenci, 2006) gelir. Endemizm oranının en düşük olduğu araştırma ise %0,37 ile Sanön ve Özen' in (2001) yapmış olduğu floristik çalışmanın olduğu görülmektedir.

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(Received for publication 19 December 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 114-133

Research article/Araştırma makalesi

A synopsis of genus *Astragalus* L. sect. *Stereothrix* Bunge (Fabaceae)

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Abstract

A synopsis of *Astragalus* sect. *Stereothrix* Bunge (Fabaceae) is presented and the relationships between the species are discussed within the section. A description for the section and a key to its 15 species in Iran are given. Also two ignored species belonging to the section in Flora Iranica, *Astragalus badelehensis* Maassoumi & Taheri and *A. mahneshanensis* Maassoumi & Moussavi, are reviewed again here. *A. savanatensis* and *A. andabilensis* collected from Fars and Ardebil Provinces of Iran, respectively are described as new species, illustrated are compared with their nearest relatives. *A. savanatensis* is a rare species in the subalpine areas of Estahban and closely related to *A. ledinghamii* Barneby occurs in the same area. The habit, shape of calyx and petals are very similar in both species, but *A. savanatensis* differs sufficiently from its relative by having peachy flower (vs. yellowish white), plant length 24.5 -- 34 cm (vs. 7 -- 20 cm), stem length up to 20 cm (vs. 1 -- 3 cm), leaflet in 4–6 (vs. 2 -- 4) pairs, leaflet size 5 -- 45 × 1 -- 3 mm (vs. 7 -- 25 × 1.3 -- 2 mm), keel length 8 -- 10 mm (vs. 6.8 -- 7.6 mm) and peduncle length 9.3 -- 18.5 cm (vs. 2 -- 6 cm). *A. andabilensis* is a rare species occurs in the subalpine areas of Khalkhal and closely related to *A. capito* Boiss. & Hohen. occurs in Tehran province. The habit, shape of calyx and petals are very similar in both species, but *A. andabilensis* differs sufficiently from its relative by plant length 11.5 -- 21.5 cm (vs. 4 -- 9 cm), white stem hairs toward the nodes increasingly black (vs. all white stem hairs), appressed hairs on the upper sides of leaflets (vs. spreading hairs), white peduncle hairs toward the raceme increasingly black (vs. all white hairs) and peduncle length 5 -- 14.5 cm (vs. 0.5 -- 2 cm). In addition, meiotic chromosome number and behavior were studied in the new species. This report is the first cytogenetic analysis of these taxa. Both species are diploid plants and possess 2n = 2x = 16 chromosome numbers, consistent with the proposed base number of x = 8. The general meiotic behavior of the species was regular, with bivalent pairing and normal chromosome segregation at meiosis. However, some meiotic abnormalities in *A. savanatensis* include varied degrees of ring and fragmented chromosomes, precocious migration in metaphase I and II, bridges and laggards in anaphase I and II, micronuclei in telophase I, binucleate in telophase I and II and tripolar cells in telophase II. In *A. andabilensis*, fragmented chromosomes in metaphase I and II were observed. Asynchronism in meiosis was seen in both species.

Key words: *Astagalus savanatensis*, *A. andabilensis*, Iran, Meiotic behavior, *Astragalus*, Sect. *Stereothrix*

1. Introduction

The genus *Astragalus* L. is belonging to the tribe Astragaleae of Papilionoideae in the family Fabaceae, occurring in cold mountainous regions of Europe, Asia, and North America, and is the most numerous in Central Asia (Ranjbar and Karamian, 2003; Polhill, 1981). In terms of species number, *Astragalus* may be the largest genus of vascular plants, represented by a total of ca. 2500 taxa (Lock and Simpson, 1991; Mabberley, 1997; Maassoumi, 1998; Ranjbar and Karamian, 2002). Iran has more than 840 species and is one of the main centers of diversity of the genus (Lock and Simpson, 1991; Mabberley, 1997; Maassoumi, 1998; Ranjbar and Karamian, 2002; Ranjbar et al., 2012). *Astragalus* has been divided into approximately 150 sections, of which *Astragalus* sect. *Stereothrix* is one of the most diverse and variable. *A.* sect. *Stereothrix* was established by Bunge (1868/69), naturally placed in the *A.* subgen. *Hypoglottis*, which is characterized by perennial growth and the presence of simple hairs (Bunge, 1868-1869). The entire section was revised by Podlech (2009) for the Flora Iranica. *Astragali* such as *A.* sect. *Dasyphyllium*, *A.* sect.

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 BioDiCon. 270-0812

Stereothrix, *A.* sect. *Hypoglottoidei* along with *A.* sect. *Malacothrix* classified under *A.* subgen. *Hypoglottis* Bunge. Recently, two sections, *A.* sect. *Hemiphaca* and *A.* sect. *Hemiphragmium* have been transferred into *A.* subgen. *Hypoglottis* (Ranjbar and Karamian, 2002).

Chromosome counts, based on x = 8 have been reported in the vast majority of Old World species. In addition, counts based on base numbers of x = 6 or x = 7 have been encountered in few species (Maassoumi, 1987; Bader et al., 1996). Meanwhile, studies on the cytology of *Astragalus* in America (Ledingham and Rever, 1963; Pretel Martinez, 1974; Liston, 1990; Dopchiz et al., 1995) confirmed the existence of basic numbers ranging between 11 and 15. The preponderance of species with a basic number of x = 8 led to conclude that it is the primary basic number in *Astragalus* (Maassoumi, 1987, 1989; Badr et al., 1996). They further assumed that the x = 6 and x = 7 numbers have been derived from x = 8 by aneuploid loss of chromosomes. However, comprehensive studies on the karyotype criteria of *Astragalus* species in relation to their systematic treatment are generally lacking. The importance of chromosomal information in plant systematics and evolution has attracted the attention of several workers. At the generic level and below chromosome features have provided a range of possibilities for understanding the affinities of taxa. Examples illustrating the role of chromosomal data in solving systematic problems in plant genera are found in *Onobrychis* (Ranjbar et al., 2009, 2010a, 2010b, 2010c). At the generic level and below in *Astragalus* chromosomes features have provided a range of possibilities for understanding the affinities of taxa. As reported by several authors, Ledingham (1957, 1960), Aryavand (1983), Maassoumi (1987), Maassoumi (1989), Bader and Sherif (2007) and Al-Turki et al. (2000), variation in chromosome number in the genus *Astragalus*, differentiates Old World species from those of America. Most of the cytological studies in the tribe Astragaleae have concentrated on the chromosome count (Aryavand, 1983; Maassoumi, 1987, 1989; Sheidai et al., 1996, 2000, 2007; Aytaç 1997; Ekici et al., 2005; Bader and Sherif, 2007; Ranjbar et al., 2010c, 2011a, 2011b). The basic chromosome number (x = 8) and five ploidy levels (2n = 2x = 16, 2n = 4x = 32, 2n = 6x = 48, 2n = 8x =64 and 2n = 12x = 96) are present in the genus. However, studies on the impact of cytogenetic data on the interspecific and phylogenetic relationships in the genus are still limited. Also, little is known about the nature of genetic variability in diploid species and the taxonomic relationships of the different taxa in the genus.

2. Materials and methods

2. 1. Morphology

A. savanatensis and *A. andabilensis* were collected from the field in different regions of their natural geographical distributions during several excursions in Iran. The collected materials were in vegetative phase and deposited at BASU, Hamedan, Iran. Also several sheets and photo specimens belonging to *A.* sect. *Stereothrix* have been examined for each taxon from the following herbaria: B, G, PR, W and WU.

2. 2. Cytogenetic study

Chromosome number and meiotic behavior were analyzed in only two populations of *A. savanatensis* and *A. andabilensis*. Voucher specimens were kept at BASU, Hamedan, Iran. 15 flower buds from at least 2 plants at an appropriate stage of development were fixed in 70% ethanol, chloroform and propionic acid (6:3:2) for 24 h at room temperature and then stored in 70% ethanol at 4°C until used. Anthers were squashed and stained with 2% acetocarmine. All slides were made permanent by the Venetian turpentine. Photographs of chromosomes were taken on an Olympus BX-41 photomicroscope at initial magnification of X 1000. Chromosome counts were made from well-spread metaphases in intact cells, by direct observation and from photomicrographs.

3. Results and discussion

3. 1. Morphology

***Astragalus* sect. *Stereothrix* Bunge. Astrag geront. I (1868) 53**

Low or fairly tall short-stemmed herbaceous perennials, vested with simple or rarely mixed white and black hairs. Stipules shortly adnate to petiole, connate or free, herbaceous. Leaves imparipinnate or simple in *A. koelzii*. Inflorescence in dense heads; corolla white, yellow or purple. Bracteoles none except in *A. damghanensis*. Calyx infundibular-cylindric; teeth setiform plumose-pubescent, slightly shorter to longer than the tube. Pods small, sessile, rarely stipitate, linear to oblong, included in the calyx, carinate ventrally, grooved dorsally, coriaceus, bilocular, many-seeded.

3. 2. Key to the species of astragalus sect. stereothrix in Iran

1a - Plants up to 34 cm long; peduncles 5 -- 18.5 cm long……..…...……..……..2
1b - Plants up to 20 cm long; peduncles 0.3 -- 7 cm long……...……..…….3
2a - Plant 24.5 -- 34 cm long, stems thick, up to 20 cm long, peduncles 9.8 -- 18 cm long, stems covered with appressed, white hairs 0.5 -- 0.9 mm long, leaves 4.5 -- 20.5 cm long, leaflets 4–6 pairs, stipules 6 -- 15 mm long, peduncles 9.3 -- 18.5 cm long, standard 11 -- 12.5 × 6 -- 6.5 mm long, wings 9 -- 10 × 1 -- 1.7 mm long…….……..……*A. savanatensis*
2b - Plant 11.5 -- 21.5 cm long, stems slender, up to 7.6 cm long, peduncles 5 -- 14.5 cm long, stems covered with spreading, white and black hairs up to 1.5 mm long, leaves 1.7 -- 4.7 cm long. leaflets 9 -- 15 pairs, stipules 2 -- 7 mm long, peduncles 5 -- 14.5 cm long, standard 13 -- 17 × 7 -- 8 mm long, wings 10 -- 13 × 2 mm long……...……..……..…..….*A. andabilensis*
3a - Petals violet……...……..……..……...……..…..……4
3b - Petals white to yellow (except *A. montis-varvashti* with lilac keel)……...……...……..…...……6
4a - Bracteole developed, 0.5 -- 0.8 mm long, peduncles 2.5 -- 5 cm long, bracts 6 -- 10 mm long, standard emarginated at the apex, keel 9 -- 10 mm long, wings limbs obliquely emarginated ……..……..……..……*A. damghanensis*
4b - Bracteole absent……...……..……5
5a - Stem 1.5 -- 2 cm long, leaflets 6 -- 7 pairs, leaves greenish, peduncles ± 1 cm long, bracts 11 -- 12 mm long, standard rounded at the apex …...…….……...…..*A. pseudocapito*
5b - Stem 4 -- 7 cm long, leaflets 12 -- 13 pairs, leaves reddish, peduncles 2.5 -- 3.5 cm long, bracts ca. 14 mm long, standard emarginated at the apex ..…….……...……*A. mahneshanensis*
6a - Leaves unifoliolate ……..……...……..……..……..*A. koelzii*
6b - Leaves imparipinate ……...……..……...……..…...……..…….7
7a - Standard truncated at the apex …...……...……..…...……..……..*A. bavanatensis*
7b - Standard rounded or emarginated at the apex …….……..……...…….8
8a - Leaflets 2 -- 4 pairs ……..……..……..…..…*A. ledinghamii*
8b - Leaflets 5 -- 12 pairs …..……...……..……...……..……..9
9a - Calyx 12 ≤ mm long …...……..……..……..……10
9b - Calyx up to 12 mm long …..……...……..……..……13
10a - Peduncle 0.5 -- 1 cm long, leaflets 6 -- 7 pairs, bract 6 -- 7 mm long .....……*A. podosphaerus*
10b - Peduncle 0.5 -- 6 cm long, leaflets 7 -- 12 pairs, bract 7 -- 13 mm long ….....11
11a - Leaves 1.3 -- 2 cm long, petiole 0.4 -- 0.6 cm long, leaflets 3 -- 4 × ca. 1 mm long, all petals deep yellow ……...……..……...……*A. badelehensis*
11b - Leaves 1.5 -- 5 cm long, petiole 0.5 -- 1.5 cm long, leaflets 3 -- 9 × 1 -- 4 mm long, petals not as above
……..……...……...……...……...…..……12
12a - Plant 4 -- 12 cm long, stem hairs up to 0.5 mm long, stipules unimorphic, linear-acuminate, 4 -- 8 mm long, up to 1 mm adnate to petiole, peduncle 0.5 -- 6 cm long, bract narrowly ovate, acuminate, 9 -- 13 mm long ...…..……...……...…..…*A. montis-varvashti*
12b - Plant 4 -- 8 cm long, stem hairs up to 1 mm long, stipules heteromorphic, lower stipules 3 -- 4 mm long, linear-acuminate, upper stipules up to 10 mm long, narrowly triangular, up to 2 mm adnate to petiole, peduncle 0.5 -- 3 cm long, bract subulate, 7 -- 10 mm long ...……...…..*A. sphaeranthus*
13a - Bract up to 2 mm long ….……...…..……...…....*A. doshman-ziarensis*
13b - Bract up to 10 mm long ….……..…..……...…….14
14a - Stems with spreading hairs, calyx 9 -- 10 mm long, glabrous at the base, toward the teeth up to rather densely covered with white and black hairs, standard 8 -- 9 mm long, blade up to 2.5 mm wide ……..…..……...……...……..*A. altimontanus*
14b - Stems with appressed hairs, calyx 10 -- 12 mm long, densely covered with white hairs and occasionally some shorter black hairs, standard 13 -- 14 mm long, blade 6 -- 7 mm wide ……*A. capito*

3. 3. Two new species for flora of Iran

Astragalus savanatensis Ranjbar, Vitek & Mahmoudian, sp. nova. (Figure 1) (sect. *Stereothrix*)

Differt ab *A. ledinghamii* Barneby caulibus pilis appressis (nec semiappressis), ad 0.9 mm (nec ad 1.5 mm) longis obtectis, 24.5 -- 34 cm (nec 7 -- 20 cm) longis, stipulis 6 -- 15 mm (nec 2.5 -- 6 mm) longis, petiole 2 -- 7 mm longo (nec 1 -- 1.5 mm longis, foliis petiole 4.5 -- 20.5 cm longo suffultis (nec ad 4 cm longo), foliolis ad 6-jugis (nec 2 -- 4 jugis), 5 -- 45 × 1 -- 3 mm (nec 7 -- 25 × 1.3 -- 2 mm), pedunculis 9.3 -- 18.5 cm (nec 2 -- 6 cm) longis, bracteis ad 7 mm (nec 2 -- 4.5 mm) longis, obtectis, vexillo 7.8 -- 9 mm longo et 3.2 -- 4 mm lato (nec 11 -- 12.5 mm longo et 6 -- 6.5 mm lato).

Type: Iran, Prov. Fars, Estahban, 1633 m, 9. 4. 2010, *Ranjbar & Mahmoudian 22641* (holotype: BASU!, isotype: W!).
Plants 24.5 -- 34 cm tall, caudex divided, with short branches, densely covered with remnants of old leaves. Stems several, nearly prostrate at the base, ca. 20 cm long, densely covered with appressed white hairs 0.5 -- 0.9 mm long. Stipules greenish, narrowly triangular to linear, acute to acuminate, 6 -- 15 mm long, shortly adnate to petiole, densely covered with appressed white hairs. Leaves 4.5 -- 20.5 cm long; petiole 2 -- 7 cm long. Leaflets in 4 -- 6 pairs, linear to lanceolate, 5 -- 45 × 1 -- 3 mm, acute to acuminate at the tip, densely covered with appressed white hairs up to 2.2 mm long on both sides. Peduncle 9.3 -- 18.5 cm long, densely white hairy like the stem, 0.3 -- 1.2 mm long. Raceme ovoid to cylindrical, densely many flowered, 3 -- 5 × ca. 2.5 cm. Bracts greenish, 4 -- 7 mm long, linear-acute, with merely white hairs. Flowers sessile. Calyx 11 -- 13 mm long; campanulate-tubular; in lower part of the tube sparsely to loosely, in upper part and at the teeth densely covered with long spreading white hairs; teeth linear, 5 -- 8 mm long, hairy on outer side. Petals peachy. Standard 11 -- 12.5 mm long, limbs obovate, 6 -- 6.5 mm wide, emarginated at the apex. Wings 9 -- 10 mm long; blades oblong, rounded at the apex, 4 -- 4.5 × 1 -- 1.7 mm; auricle 0.5 -- 0.6 mm long; claw 5 -- 5.5 mm long. Keel 8 -- 10 mm long; with gibbously curved lower edge and nearly straight upper edge, shortly acute at the apex, 4 -- 4.5 × 2 -- 2.5 mm; auricle minute, claw 4 -- 5.5 mm. ovary with a stipe 1 -- 2 mm long, elliptic, glabrous; style glabrous. Legumes unknown.

3. 4. Phenology. Flowering was observed to occur in March and April; fruit ripening occurred from May to June.

3. 5. Suggested conservation status

Astragalus savanatensis is a narrow endemic. It is very rare and known only from the type locality in Estahban. The estimated area of occupancy is less than 500 m^2 and the number of individuals below one hundred. It should be classified as Endangered (EN) according to criterion (IUCN 2001).

3. 6. Etymology

The specific epithet is named after the type-locality, an ancient name for "Estahban", Fars Province, Iran.

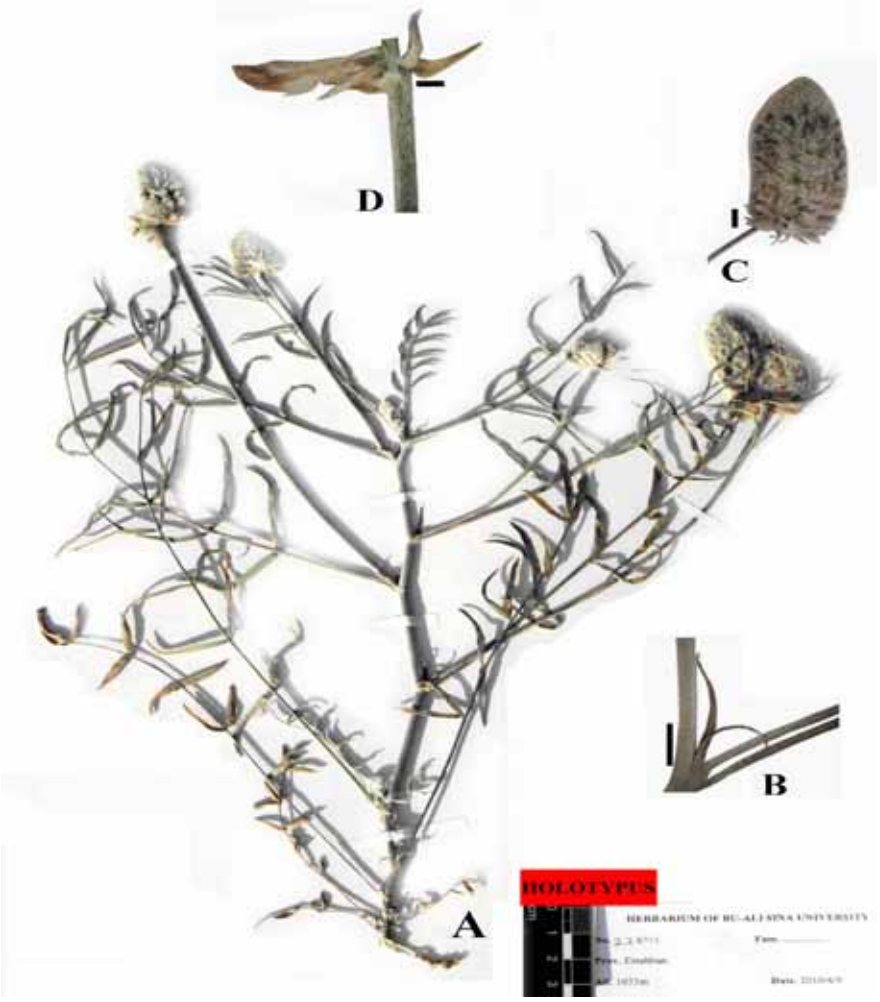

Figure 1. *Astragalus savanatensis* (Ranjbar & Mahmoudian 22641, BASU). (A) Type specimen; (B) Close up of leaflet; (C) Close up of stipules; (D) Close up of a flower with bracts; (E) Close up of cylindrical inflorescence. Scale (B-E): 5 mm. Photograph provided by Ranjbar & Negaresh

3. 7. Taxonomic remarks

Astragalus savanatensis it is related to *A. ledinghamii* in similar habit, shape of calyx and petals, but these taxa are well separated by flower color, plant length, stem and stipule lengths, the number and size of leaflets, peduncle length and size of standard, keel and wings (Table 1).

Astragalus andabilensis Ranjbar & Mahmoudian sp. nova. (Figure 2) (sect. *Stereothrix*)

Differt ab *A. capito* Boiss. & Hohen. Caulibus pilis patentibis albis nigrisque (nec subappressis albis), ad 1.5 mm (nec ad 0.5 mm) longis obtectis, 5 -- 7.6 cm (nec 1 -- 4 cm) longis, stipulis 2 -- 4 mm (nec ad 7 mm) longis, foliolis ad 9 -- 15 jugis (nec 6 -- 9 jugis), utrimque dense pilis subappressis (nec dense pilis appressis) obtectis, pedunculis 5 -- 14.5 cm (nec 0.5 -- 2 cm) longis, pilis albis nigrisque (nec albis), obtectis.

Type: Iran, Ardebil, Khalkhal, Andabil, 1900 m, 4. 6. 2010, *Ranjbar & Mahmoudian 20946* (holotype: BASU!; isotype W!).

Plants 11.5 -- 21.5 cm tall, caudex divided, with short branches, densely covered with remnants of old leaves. Stems several, nearly prostrate at the base, somewhat flexuse, 5 -- 7.6 cm long, densely covered with spreading white and especially below the nodes densely black hairs up to 1.5 mm long. Stipules 2 -- 4 mm long, pale yellowish, papery, triangular to narrowly triangular, adnate to the petiole for ca. 2 mm, densely white hairy, sometimes also with some black hairs, toward the base densely black hairs. Leaves 1.7 -- 4.7 cm long; petiole 0.3 -- 0.5 cm long. Leaflets in 9 -- 15 pairs, narrowly elliptic, 3 -- 8 × 2 -- 2.5 mm, acute to acuminate at the apex, densely covered with appressed white hairs 0.2 -- 1.2 mm long on both sides. Peduncle 5 -- 14.5 cm long, densely covered with spreading white hairs, toward the raceme also with increasing black hairs 0.3 -- 1.5 mm long. Raceme ovoid-globose, densely many flowered, 2 -- 2.5 × 2 -- 2.5 cm. Bracts greenish to dark brownish, 4 -- 9 mm, very narrowly triangular to linear-acute, white and black hairy. Flowers sessile. Calyx 11 -- 12 mm long; campanulate-tubular; in lower part of the tube sparsely to loosely, in upper part and at the teeth densely covered with long spreading white and sometimes black hairs; teeth linear, 4 -- 7 mm long, hairy on outer side. Petals all white, in dry state often yellowish. Standard 13 -- 17 mm long obovate-elliptic, 7 -- 8 mm wide, narrowed at the base, emarginated at the apex. Wings 12 -- 13 mm long; blades narrowly oblong, rounded at the apex, 6 × 2 mm; auricle 0.5 -- 1 mm long; claw ca 7 mm long. Keel 9 -- 11 mm long; with in upper part widely curved lower edge and nearly straight upper edge, obtuse at the apex, ca. 4 × 2.5 -- 3 mm; auricle indistinct, claw 5 -- 7 mm. ovary with a stipe 1 -- 2 mm long, narrowly elliptic, glabrous; style glabrous. Legumes unknown.

3. 8. Phenology

Flowering was observed to occur in June and July; fruit ripening occurred from July to August.

3. 9. Suggested conservation status

Astragalus andabilensis is a narrow endemic. It is very rare and known only from the type locality in Khalkhal. The estimated area of occupancy is less than 500 m^2 and the number of individuals below fifty. It should be classified as Endangered (EN) according to criterion (IUCN 2001).

3. 10. Etymology

The specific epithet is named after the type-locality, “Andabil”, Ardebil Province, Iran.

3. 11. Taxonomic remarks

Astragalus andabilensis is a rare and local endemic NW Iran and known from four specimens collected at a single locality. It occurs in open forest zone in the sub-mountainous region near the village Andbil, south of Khalkhal in Ardebil Province. It is closely related to *A. capito* by having large bracts and size of calyx, calyx teeth, corolla and leaflets. However, they are well separated by plant height, stem, peduncle and stipule length, number of leaflets, color, size and arrangement of stem hairs, color and size of peduncle hairs (Table 2).

3. 12. Addition of two ignored taxa in Flora Iranica

Astragalus badelehensis Maassoumi & Taheri (sect. *Stereothrix*) 2005, in Maassoumi, The genus *Astragalus* in Iran, vol. 5: 417 - *A.* sect. *Stereothrix* - Holotype: Iran, prov. Semnan, Damghan, Gardaneh-e Badeleh, 1600 m, 29.06.1996, *Maddah 2874* (holotype TARI!, isotype BASU!).

Differt ab *A. capito* Boiss & Hohen. Caulibus pilis patentibus (nec appressis) obtectis, calyce 9 -- 10 mm longo, tubo basi glabro ceterum pilis in tuberculis minutis insidentibus obtectis (nec ad 12 mm longis, omnino dense pilis non in tuberculis insidentibus obtectis), vexillo 8 -- 9 mm longo et c. 2.5 mm lato (nec 13 -- 14 mm longo et 6 -- 7 mm lato).

Figure 2. *Astragalus andabilensis* (*Ranjbar & Mahmoudian 20946*, BASU). (A) Type specimen; (B) Close up of stem, nodes and leaves in type specimen; (C) Close up of inflorescence and flowers in type specimen; (D) Close up of leaves and stem indumentum in type specimen; (E) Habit and habitat of *A. andabilensis* in field; (F) Close up of inflorescence and flowers of *A. andabilensis* in field. Photograph provided by Ranjbar & Negaresh

Astragalus mahneshanensis Maassoumi & Moussavi (sect. *Stereothrix*) 2005, in Maassoumi, Some interesting new species of the genus *Astragalus* from Iran. -Iran. Journ. Bot. 11 (1) 101-109. Tehran. - *A.* sect. *Stereothrix* - Holotype: Iran, prov. Zanjan, Mahneshan, N W Alam Kandi village, 2950 m, 21.09.2002, *Moussavi 3957* (holotype TARI, isotype Zanjan Research center).

Differt ab *A.pseudocapito* Podlech foliolis 13 jugis (nec 6 -- 7 jugis); ab *A. leucothrichus* corolla intense violacea (nec flava), vexillo c. 17 mm longo (nec 22 mm longo); ab *A. hakkariensis* Podlech foliolis 13 jugis (nec 7 jugis).

Plants up to 14 cm tall, caudex up to 4.5 cm long, repeatedly branched in upper part, covered with remnants of old stipules. Stems of the year up to 7 cm long, densely covered with appressed white, near the nodes also with black hairs up to 1 mm long. Stipules pale yellowish, papery, triangular to narrowly triangular, adnate to the petiole for 1 -- 2 mm, densely white hairy, sometimes also with some black hairs, especially at the base. Leaves 1.3 -- 2 cm long; petiole 0.4 -- 0.6 cm long. Leaflets in 8 -- 13 pairs, narrowly elliptic, 3 -- 4 × ca 1 mm, acute at the apex, densely covered with appressed white hairs 0.5 -- 0.7 mm long on both sides. Peduncle up to 4.5 cm long, densely covered with spreading white hairs, toward the raceme also with increasing black hairs 0.5 -- 1.5 mm long. Raceme ovoid-globose, densely many flowered, ca. 3 × 2.5 cm. Bracts greenish, ca 7 mm, very narrowly triangular to linear-acute, white and black hairy. Flowers sessile. Calyx 12 -- 13 mm long; campanulate-tubular; in lower part of the tube sparsely to loosely covered with black hairs, in upper part and at the teeth densely covered with long spreading white and shorter black hairs; teeth linear, 5 -- 6 mm long, hairy on outer side. Petals all deep yellow. Standard 13 -- 15 mm long ovate-elliptic, ca 8 mm wide, narrowed at the base, emarginated at the apex. Wings 11 -- 12.5 mm long; blades narrowly oblong, rounded at the apex, ca 6 × 2 -- 2.5 mm; auricle ca. 1 mm long; claw 5 -- 6.5 mm long. Keel 10 -- 11 mm long; with in upper part widely curved lower edge and nearly straight upper edge, acutish at the apex, 4 -- 5 × ca 3 mm; auricle indistinct, claw ca 5.5 mm. ovary narrowly elliptic, glabrous; style glabrous. Legumes unknown.

3. 13. Cytogenetic study

The meiotic irregularities observed in *A. savanatensis* include fragmented chromosomes in D/MI; chromosome bridges, laggard chromosomes, micronuclei and binucleate in AI/TI, asynchronism and precocious chromosomes migrating to the poles in MII and AII/TII, laggard, bridge, and triad in AII/TII (Figure 3). The ranges of meiotic stages

Table 1. Diagnostic morphological characters of *A. ledinghamii* and *A. savanatensis*. Data are based on the type photo and original description.

Morphological characters	*A. ledinghamii*	*A. savanatensis*
Plant height (cm)	7 -- 20	24.5 -- 34
Stem length (cm)	1 -- 3	up to 20
Hair length on stem (mm)	up to 1.5	up to 0.9
Leaf length (cm)	up to 4	4.5 -- 20.5
Petiole length (mm)	1 -- 1.5	2 -- 7
Leaflets number	2 -- 4	4 -- 6
Hair length on leaflet (mm)	0.5 -- 1.5	0.7 -- 2.2
Stipule length (mm)	2.5 -- 6	6 -- 15
Peduncle length (cm)	2 -- 6	9.3 -- 18.5
Bract length (mm)	2 -- 4.5	up to 7
Calyx tube size	4 -- 4.5 × 1.6 -- 1.9	5 -- 6 × 4 -- 6
Standard size	7.8 -- 9 × 3.2 -- 4	11 -- 12.5 × 6 -- 6.5
Keel size	6.8 -- 7.6 × 1.6	8 -- 10 × 2 -- 2.5
Wing length (mm)	7 -- 7.8	9 -- 10
Wing claw length (mm)	4.2 -- 4.7	5 -- 5.5

Table 2. Diagnostic morphological characters of *A. capito* and *A. andabilensis*. Data are based on the type photo and original description.

Morphological characters	*A. capito*	*A. andabilensis*
Plant height (cm)	4 -- 9	11.5 -- 21.5
Stem length (cm)	1 -- 4	5 -- 7.6
Stem indumentum	subappressed	spreading
Stem indumentum color	white	white and black, below the nodes densely black
Hair length on stem (mm)	up to 0.5	up to 1.5
Leaflet number	6 -- 10	9 -- 15
Leaflet indumentum on lower surface	subappressed	appressed
Leaflet blade	elliptic to obovate	narrowly elliptic
Peduncle length (cm)	0.5 -- 2	5 -- 14.5
Peduncle indumentum color	white	white, toward the raceme increasingly black
Bract indumentum color	white	white and black
Petal color	white-yellow, rarely violet	white, in dry state yellowish

were found in anthers within the same flower in *A. savanatensis*. A total of 189 diakinesis/metaphases I (D/MI) (24.9%), 172 anaphase I/telophase I (AI/TI) (22.72%), 51 metaphase II (MII) (6.73%) and 345 anaphase II/telophase II (AII/MII) (45.57%) cells were analysed. The D/MI cells were usually regular with predominant bivalent (II) pairing. ring/rod bivalents were found in 25.92% of diakinesis cells and varied degrees of fragmented chromosomes were observed in 38.62% of diakinesis and metaphase I cells (Figure 3C, D, G-I). Chromosome bridges and laggard chromosomes were observed in 3.48% and 5.23% of anaphase I cells, respectively (Figure 3K-M). The thickness of bridges observed and the number of chromosomes involved in their formation varied among different meiocytes. Genetic as well as environmental factors have been considered as the reason for chromosome stickiness in different plant species (Nirmala and Rao, 1996). Pagliarini (1990) reported that laggards may result from late chiasma terminalization. Ascending chromosomes are the result of precocious migration and, according to Utsunomiya et al. (2002), generally consist of univalent chromosomes formed during late prophase stages by precocious chiasma terminalization in early metaphase I or may even result from low chiasma frequency or from the presence of asynaptic or desynaptic genes (Pagliarini, 2000). Abnormalities such as precocious chromosome migration to the poles in

metaphase I (Figure 3F) and laggards in Anaphase I (Figure 3K, M), leading to the formation of micronuclei in telophase I (Figure 3O). Asynchronism and precociously migration of chromosomes to the poles were observed in 47.05% and 9.80% of Metaphase II cells, respectively (Figure 3Q-S), laggard, bridge, and precociously migration of chromosomes to the poles were found in 0.86%, 0.57%, and 0.28% of AII/TII cells, respectively (Figure 3U, V). Triad showing equally sized microspores was also observed (Figure 3X).

The meiotic irregularities observed in *A. andabilensis* include: Fragmented chromosomes in D/MI and Asynchronism and fragmented chromosomes in MII (Figure 4). A total of 118 diakinesis/metaphases I (D/MI) (12.93%), 317 anaphase I/telophase I (AI/TI) (34.75%), 99 metaphase II (MII) (10.85%) and 378 anaphase II/telophase II (AII/MII) (41.44%) cells were analysed. Fragmented chromosomes were found in 33.89% of D/MI cells (Figure 4C, D) and also chromosome stickness and precociously migration of chromosomes to the poles can be observe in these figures. Fragmented chromosomes were found in 7.07% of MII cells (Figure 4G) and asynchronism which cells presenting one of the groups of chromosomes in metaphase while the other group are disorganized were observed in 92.92% of MII cells (Figure 4H, I). It should be considered that there was no metaphase II cell without any irregularity in the studied population and also there was just one laggard cell among 378 cells (0.26%) in AII/TII stages.

3. 13. Cytogenetic study

The meiotic irregularities observed in *A. savanatensis* include fragmented chromosomes in D/MI; chromosome bridges, laggard chromosomes, micronuclei and binucleate in AI/TI, asynchronism and precocious chromosomes migrating to the poles in MII and AII/TII, laggard, bridge, and triad in AII/TII (Figure 3). The ranges of meiotic stages were found in anthers within the same flower in *A. savanatensis*. A total of 189 diakinesis/metaphases I (D/MI) (24.9%), 172 anaphase I/telophase I (AI/TI) (22.72%), 51 metaphase II (MII) (6.73%) and 345 anaphase II/telophase II (AII/MII) (45.57%) cells were analysed. The D/MI cells were usually regular with predominant bivalent (II) pairing. ring/rod bivalents were found in 25.92% of diakinesis cells and varied degrees of fragmented chromosomes were observed in 38.62% of diakinesis and metaphase I cells (Figure 3C, D, G-I). Chromosome bridges and laggard chromosomes were observed in 3.48% and 5.23% of anaphase I cells, respectively (Figure 3K-M). The thickness of bridges observed and the number of chromosomes involved in their formation varied among different meiocytes. Genetic as well as environmental factors have been considered as the reason for chromosome stickiness in different plant species (Nirmala and Rao, 1996). Pagliarini (1990) reported that laggards may result from late chiasma terminalization. Ascending chromosomes are the result of precocious migration and, according to Utsunomiya et al. (2002), generally consist of univalent chromosomes formed during late prophase stages by precocious chiasma terminalization in early metaphase I or may even result from low chiasma frequency or from the presence of asynaptic or desynaptic genes (Pagliarini, 2000). Abnormalities such as precocious chromosome migration to the poles in metaphase I (Figure 3F) and laggards in Anaphase I (Figure 3K, M), leading to the formation of micronuclei in telophase I (Figure 3O). Asynchronism and precociously migration of chromosomes to the poles were observed in 47.05% and 9.80% of Metaphase II cells, respectively (Figure 3Q-S), laggard, bridge, and precociously migration of chromosomes to the poles were found in 0.86%, 0.57%, and 0.28% of AII/TII cells, respectively (Figure 3U, V). Triad showing equally sized microspores was also observed (Figure 3X).

The meiotic irregularities observed in *A. andabilensis* include: Fragmented chromosomes in D/MI and Asynchronism and fragmented chromosomes in MII (Figure 4). A total of 118 diakinesis/metaphases I (D/MI) (12.93%), 317 anaphase I/telophase I (AI/TI) (34.75%), 99 metaphase II (MII) (10.85%) and 378 anaphase II/telophase II (AII/MII) (41.44%) cells were analysed. Fragmented chromosomes were found in 33.89% of D/MI cells (Figure 4C, D) and also chromosome stickness and precociously migration of chromosomes to the poles can be observe in these figures. Fragmented chromosomes were found in 7.07% of MII cells (Figure 4G) and asynchronism which cells presenting one of the groups of chromosomes in metaphase while the other group are disorganized were observed in 92.92% of MII cells (Figure 4H, I). It should be considered that there was no metaphase II cell without any irregularity in the studied population and also there was just one laggard cell among 378 cells (0.26%) in AII/TII stages.

3. 14. Geographical distributional and ecology

Almost all members of *A.* sect. *Stereothrix* are Irano-Turanian elements. Iran with 15 species, of which 14 are endemic (*A. altimontanus* Podlech & Maassoumi, *A. andabilensis* Ranjbar & Mahmoudian, *A. badelehensis* Maassoumi & Taheri, *A. bavanatensis* Zarre & Podlech**,** *A. capito* Boiss. & Hohen, *A. damghanensis* Podlech, *A. doshman-ziarensis* Maassoumi & Podlech, *A. savanatensis* Ranjbar, Vitek & Mahmoudian, *A. koelzii* Barneby, *A. ledinghamii* Barneby, *A. mahneshanensis* Maassoumi & Moussavi, *A. montis-varvashti* Podlech, *A. podosphaerus* Boiss. & Hausskn., *A. pseudocapito* Podlech, *A. sphaeranthus* Boiss.) and Turkey with 13 species (9 endemic) are centers of diversity of the section. Nearly 33.3% of the species (5) belonging to this section in Iran are distributed in southern Zagros mountains in Fars Province and about 53% of species (8) are distributed in central Alborz mountains (Figure 5). The widest ranging species of the section are *A. capito*, *A. ledinghamii*, *A. sphaeranthus* and *A. podosphaerus*. Almost the remaining species have narrow distribution patterns include *A. altimontanus* (between Karaj and Chalus), *A. andabilensis* (Ardebil,

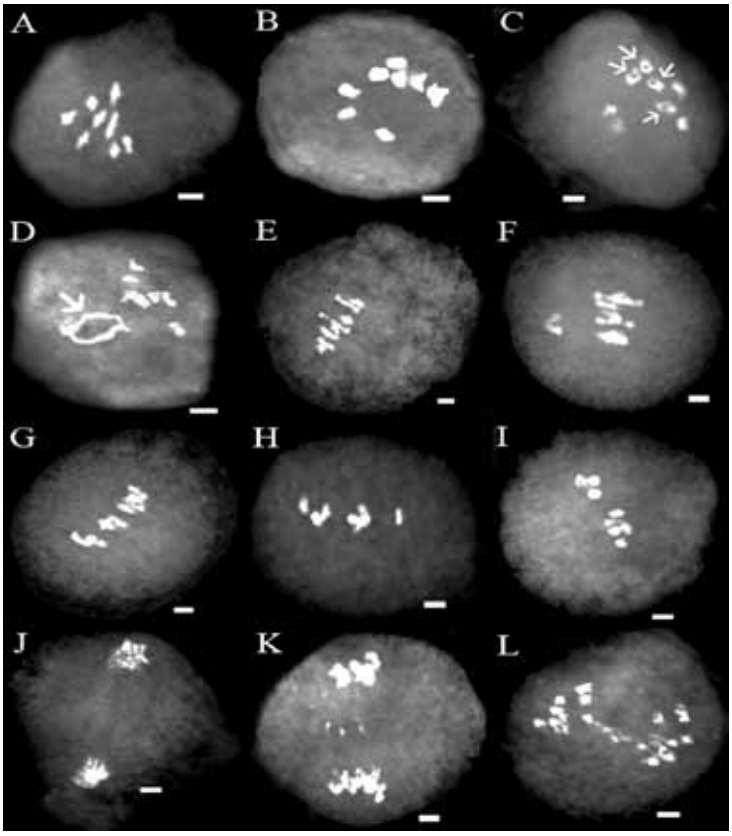

Figure 3. Meiotic behavior in A. savanatensis: A, B) Diakinesis with 8 bivalents; C) Diakinesis with 4 ring chromosomes and fragmented chromosomes; D) Diakinesis with 6 II + 1 IV (bold arrow); E) Metaphase I; F) Metaphase I with a bivalent migrating precociously to the pole; G-I) Fragmented chromosomes in metaphase I; J) Anaphase I; K) Anaphase I with thin bridges and laggards; L) Anaphase I with bridge. Scale: 3 µm.

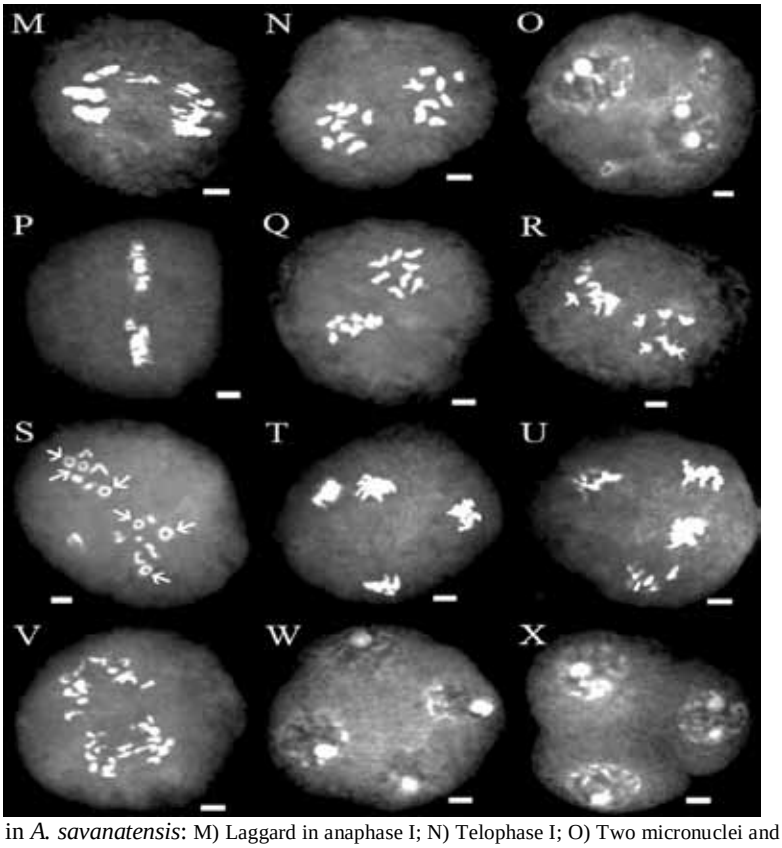

Figure 3. Meiotic behavior in *A. savanatensis*: M) Laggard in anaphase I; N) Telophase I; O) Two micronuclei and binucleate in telophase I; P) Metaphase II; Q) Asynchronism in meiosis; R) Metaphase II with precocious chromosomes migration to the poles; S) Metaphase II with 3 ring chromosomes in both plates and precocious chromosome migration to the pole; T) Anaphase II; U) Anaphase II with laggard; V) Anaphase II showing a thin bridge, laggard and precocious chromosomes migration to the poles; W) Telophase II; X) Triad showing equally sized microspores and binucleate in one microspore. Scale:3 µm.

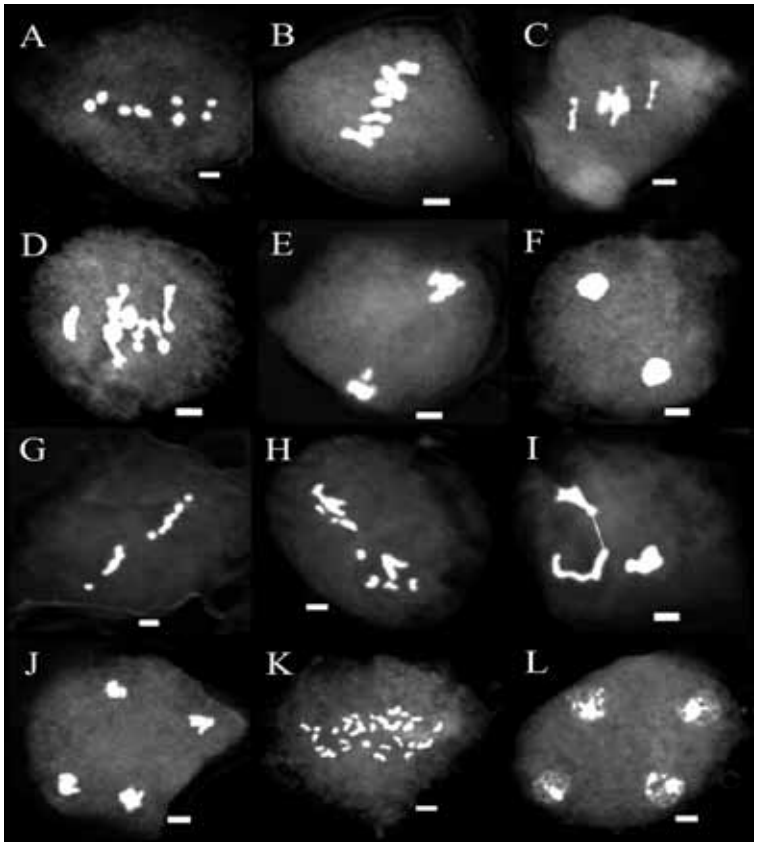

Figure 4. Meiotic behavior in *A andabilensis*: A) Diakinesis with 8 bivalents; B) Metaphase I; C) Fragmented chromosomes and chromosome stickiness in metaphase I; D) Fragmented chromosome and precocious migration of chromosomes to the poles in metaphase; I, E) Anaphase I; F) Telophase I; G) Metaphase II with fragmented chromosome; H, I) Asynchronism in meiosis; J) Anaphase II; K) Late anaphase II; L) Telophase II. Scale: 3 µm.

Table 3. Number of pollen mother cells (PMCs) analyzed and percentage of PMCs meiotic behavior in populations of *A. savanatensis* and *A. andabilensis*.

Meiotic characters	*A. savanatensis*	*A. andabilensis*
Cell number	757	912
D/MI	24.9	12.93
% Fragmented chromosome	38.62	33.89
% Ring & rod bivalents	25.92	0
AI/TI	22.72	34.75
% Laggard chromosome	5.23	0
% Bridge	3.48	0
MII	6.73	10.85
% Asynchronism	47.05	92.92
% Precocious chromosomes	9.80	0
% Fragmented chromosome	0	7.07
AII/TII	45.57	41.44
% Laggard chromosome	0.86	0.26
% Bridge	0.57	0
% Precocious chromosomes	0.28	0

Abbreviations: D/MI: Diakinesis/Metaphase I, AI/TI: Anaphase I/Telophase I, MII: Metaphase II, AII/TII: Anaphase II/Telophase II.

Khalkhal, Andbil), *A. badelehensis* (Semnan, Badeleh), *A. bavanatensis* (Fars, Abadeh, Bavanat), *A. damghanensis* (Semnan, Dameghan), *A. doshman-ziarensis* (Fars, Doshman-ziary area), *A. savanatensis* (Fars, Estahban), *A. koelzii* (Bakhtiari), *A. montis-varvashti* (Mazandaran, Alborz mountains), *A. mahneshanensis* (Zanjan, Mahneshan) and *A. pseudocapito* (Azarbaijan-e-sharghi, Sarab). Most species grow on slopes at 1500-3500 m. But *A. montis-varvashti* is distributed in Alborz Mountains of Mazandaran at 3500-4100 m and *A. damghanensis* is distributed at 450 m. In general, it appears that local endemism play an important role in the Iranian species of this section (Lock & Simpson, 1991; Podlech, 2009 and Maassoumi, 1998).

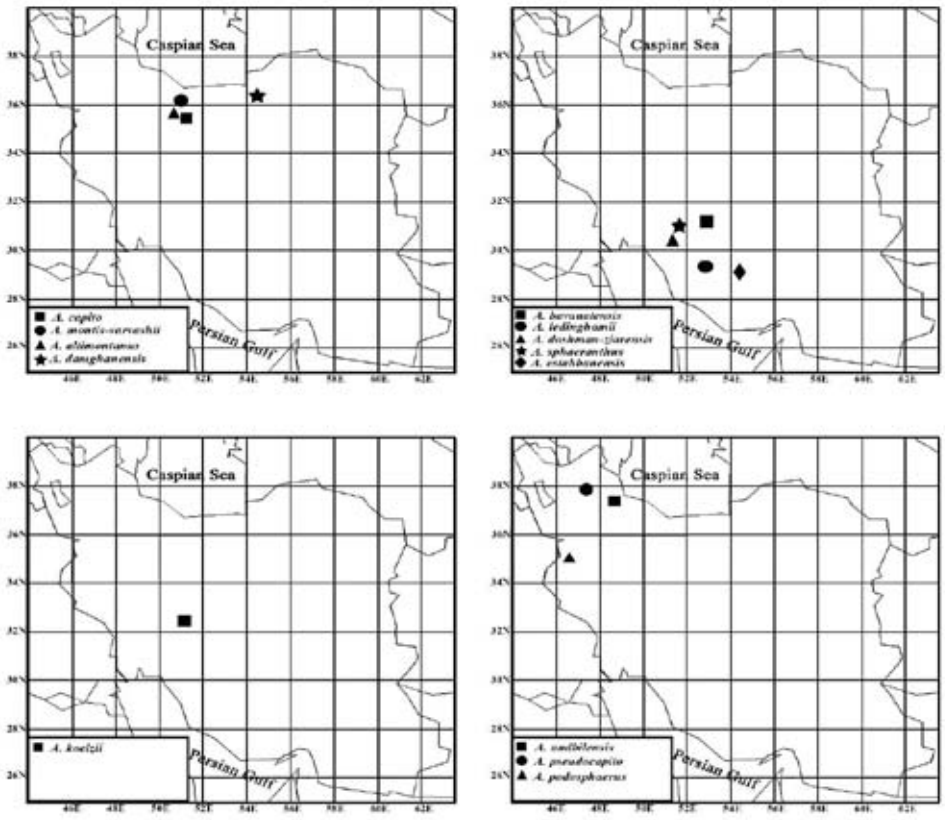

Figure 5. Distribution of *Astragalus* sect. *Stereothrix* in Iran

3. 15. An index for all taxa described within Astragalus sect. Stereothrix

1) *A. altimontanus* Podlech & Maassoumi 2003, Feddes Repert. 114: 348 - *Stereothrix* - Holotype: 68 km from Karaj to Chalus, 2250 m, 18.6.1973, *Babakhanlu & Amin 15417* (TARI; iso: MSB, W!).

It is a narrowly distributed endemic species. It is known from a single locality and deposed at TARI, MSB and W (photo in BASU!). It occurs in Kandavan mountain of Alborz Province (Figure 6). *A. altimontanus* grows in steppe to forest clay zones between Karaj and Chalus (Maassoumi, 2005). Its validity is confirmed here.

Figure 6. Type specimen of *A. altimontanus*

2) *A. badelehensis* Maassoumi & Taheri 2005, in Maassoumi, The genus *Astragalus* in Iran, vol. 5: 417 - *Stereothrix* - Holotype: Iran, Prov. Semnan, Damghan, Gardaneh-e Badeleh, 1600 m, 15.4.1375 (persian. calend.), *Maddah 2874* (TARI!; iso: BASU!).

A. badelehensis is a narrowly distributed endemic species. It is known from a single locality and deposed at TARI and BASU. It occurs around Siahkuh mountain in Semnan Province (Figure 7). *A. badelehensis* grows in dry-steppe and stony clay zones around Damghan (Maassoumi, 2005). In "Flora Iranica", *A. badelehensis* has not been mentioned from Iran by Podlech (2009). Its validity is confirmed here.

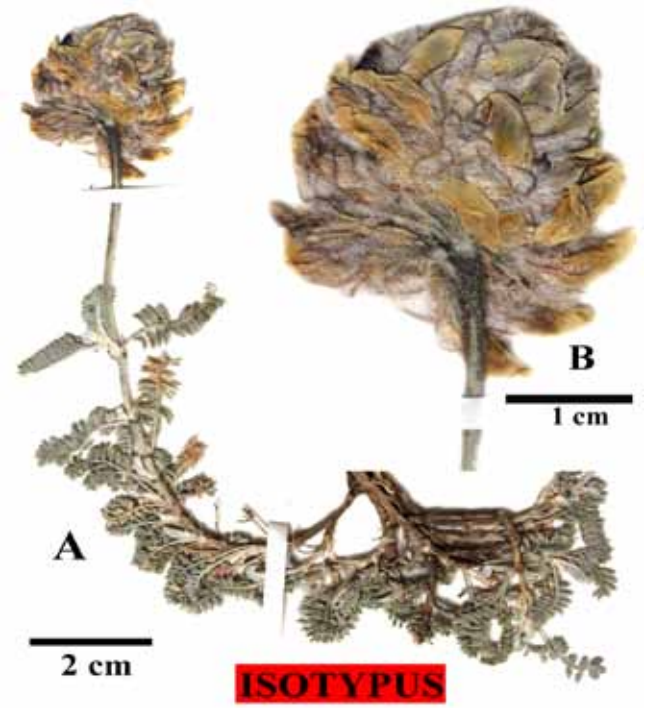

Figure 7. *A. badelehensis* (Maddah 2874, BASU): (A) Type specimen; (B) Close up of inflorescence and flowers

3) *A. barbatus* Lam. 1785, Encycl. Méth. Bot. 1: 314- *Stereothrix* - Lectotype (Podlech, Sendtnera 5: 250. 1998): *Astragalus* armenus villosissimus, capitulis rotundioribus, fl. purpureis', Armenia, *Tournefort* (P-LA: foto MSB; iso: B-W 14051, BM, FI-W, M, P: Hb. Vaillant, P-TRF nr. *3630*: foto MSB, BASU!).

Astragalus barbatus is distributed in Armenia, Anatolia and Libanon. As it is widely distributed and also found in northwestern parts of Iran, it shows considerable variation in morphology (Figure 8), especially in the type of indumentum (Chamberlain and Matthews, 1969; Maassoumi, 1998; Podlech, 2008). In "Flora Iranica", *A. barbatus* has not been mentioned from Iran by Podlech (2009).

Figure 8. Type specimen of *A. barbatus*

4) *A. bavanatensis* Zarre & Podlech 2005, Feddes Repert. 116: 77 - *Stereothrix* - Holotype: Iran, Prov. Fars, Abadeh, Bavanat, Sourian, 24.6.1969, *Termeh & Izadyar 14718*-E (IRAN!; iso: MSB, W!).

A. bavanatensis is a narrowly distributed endemic species. It is known from a single locality and deposed at IRAN, MSB and W (Podlech, 1999; Zarre et al., 2005). It occurs in Bavanat mountain of Fars Province (Figure 9). *A. bavanatensis* grows in dry-steppe and stony clay zones between Safashar and Sourian. Its validity is confirmed here.

5) *A. brachypetalus* Trautv. 1886, Trudy Imp. S.-Petersburgsk. Bot. Sada 9: 446 - *Hypoglottidei* - Lectotype (Podlech and Sytin, Sendtnera 3: 152. 1996): [Kasikibaran distr. Karabach: locality wrong, the plant does not occur in Caucasus], *Smirnow* (LE: sheet marked as lectotypus; iso: LE) (Figure 10).

This species was transferred from *A.* sect. *Stereothrix* to *A.* sect. *Hypoglottidei* by Podlech (2008). It is distributed in mountain slopes, witch-grass steppes and woodland-scrub associations, at the altitudes of (800) 1000-1850 m. - Caucasus: S. Transc. (Karabakh); Soviet Centr. Asia: Mtn. Turkm. (Kopet-Dagh); Turkey: Kars, Aras valley.

Figure 9. Type specimen of *A. bavanatensis*

Figure 10. Type specimen of *A. brachypetalus*

6) *A. capito* Boiss & Hohen. 1849, in Boissier, Diagn. pl. orient., ser. 1, 9: 40 - *Stereothrix* - Holotype: [Iran] in monte Totschal prope Teheran, 23.7.1843, *Kotschy 571* (G-BOIS; iso: BM, BP, E, FI-W, G, GOET, H, K, LE, MSB, OXF, P, PRC, REG, TUB, W!: foto MSB, BASU!, WAG) (Figure 11A).

- var. *violaceus* Bornm. & Gauba 1935, Repert. Spec. Nov. Regni Veg. 39: 99 - Holotype: [Iran] Elburs, Kandevan, 6.7.1935, *Gauba 642* (W!: foto MSB, BASU!) (= *A. capito* Boiss. & Hohen.)

- var. *ulodjensis* (Širj. & Rech.f.) Parsa 1966, Fl. Iran 9: 25 - Basion.: *A. ulodjensis* Širj. & Rech.f. (= *A. capito* Boiss. & Hohen.) (Figure 11B).

A. ulodjensis Širj. & Rech.f. 1953, Anz. Österr. Akad. Wiss., Math.-Naturwiss. Kl. 90: 115 - *Stereothrix* -Holotype: [Iran] Mazanderan, Distr. Kudjur, in monte Ulodj, 3200-3400 m, 9.8.1948, *Rechinger 6524* (W!: foto MSB, BASU!) (= *A. capito* Boiss. & Hohen.) (Figure 11C).

A. capito is the most problematic species of *A.* sect. *Stereothrix*. It was described in 1849 originally based of collection *Kotschy 571* of Totschal mountain in N Teheran. Then, *A. capito* var. *violaceus* Bornm. & Gauba was described as a variety of *A. capito* (Bornmuller and Gauba, 1935) (Figure 11B). In 1953 *A. ulodjensis* was described by Širjaev and Rechinger as a new species (Figure 11C). *A. ulodjensis* was reduced to a variety by Parsa (1966). However, because of differences are not sufficient for separating them, they were treated as a synonym of *A. capito* Boiss. & Hohen. (Chamberlain and Matthews, 1969; Maassoumi, 1998; Podlech, 2009).

7) *A. chamberlainianus* Sümbül 1991, Edinb. J. Bot. 48: 27. *Stereothrix* - Holotype: Turkey, C4 Içel, Anamur-Kazanci road, Kizilalan mevkii, 1300 m, 24.6.1984, H. Sümbül 3110 (E; iso: HUB).

A. chamberlainianus is a local endemic Anatolia. It occurs in C4 Içel in south Anatolia (Podlech, 2008; Maassoumi, 1998).

8) *A. coodei* (sphalm. 'coodie') Chamb. & Matthews 1969, Notes Roy. Bot. Gard. Edinburgh 29: 290 -Hypoglottidei - Holotype: Turkey, A4 Ankara, Karagöl, 40 miles N Ankara, 1100 m, J.J.E. *Coode & Jones 2184* (E).

A. coodei is a local endemic to Anatolia. It occurs around Ankara mountain (Chamberlain and Matthews, 1969; Maassoumi, 1998). This species was transferred from *A.* sect. *Stereothrix* to *A.* sect. *Hypoglottidei* by Podlech (2008).

9) *A. damghanensis* Podlech 2005, Feddes Repert. 116: 78 - *Stereothrix* - Holotype: Iran, Mazanderan, 41 km from Damghan on road to Sari, 450 m, 17.5.1978, *Wendelbo & Assadi 29574* (MSB; iso: TARI).

It is a narrowly distributed endemic species. It is known from a single locality and deposed at TARI & MSB (Podlech, 2008). It occurs in the north slope of Sepheid kuh mountain in Semnan Province. *A. damghanensis* grows in dry-steppe and clay zones between Damghan and Sari.

10) *A. doshman-ziariensis* Maassoumi & Podlech 1989, Iran. J. Bot. 4: 74 (1988) - *Stereothrix* - Holotype: Iran, Fars, Nurabad, Doshman-Ziary region, Ab-Zalou village, Kuh-e Tasak, 1900-2500 m, 31.5.1983, *Mozaffarian 45827* (TARI!: foto MSB; iso: MSB) (Figure 12).

A. doshman-ziariensis is a narrowly distributed endemic species. It is known from a single locality and deposed at TARI & MSB (Podlech, 2008). It occurs in east slope of Tashak mountain in Fars Province. Just above this area its population grows in dry-steppe and stony clay zones between Nurabad and Shiraz. Its validity is confirmed here.

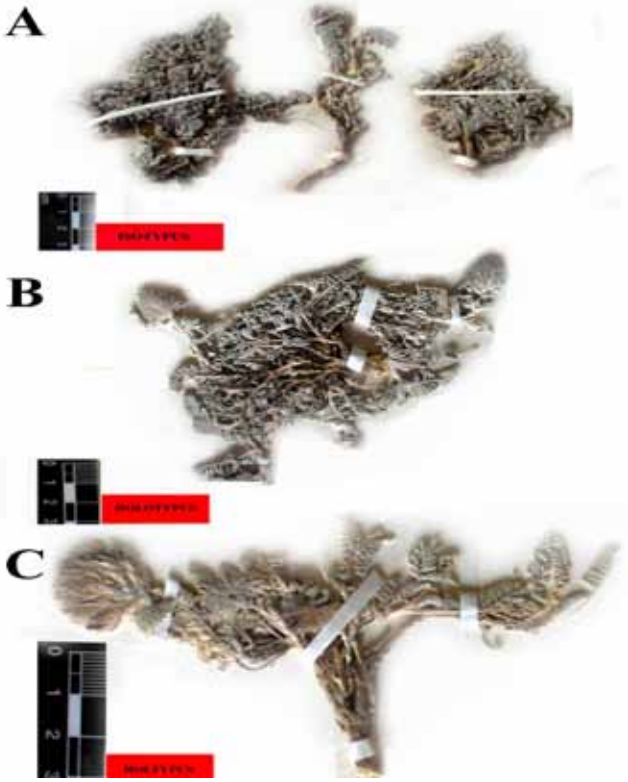

Figure 11. (A) Type specimen of *A. capito*, (B) Type specimen of *A. capito* var. *violaceus*, (C) Type specimen of *A. ulodjensis*

Figure 12. *A. doshman-ziariensis*. (A) Habit. Scale: 2.5 cm, (B) Standard, (C) Wing, (D) Keel. Scale: 1 cm. Illustration from Iran. J. Bot. 4: 74 (1988)

11) *A. hakkariensis* Podlech 1999, Sendtnera 6: 168 - *Stereothrix* - Holotype: Türkei, C10 Prov. Hakkari, 5 km W Esendere gegen Yüksekova, 1720 m, 24.7.1983, *Nydegger 18427* (MSB; iso: BASBG).
A. hakkariensis is a narrow endemic to Hakkari in C10 Anatolia (Podlech, 2008).

12) *A. hirtus* Bunge 1868, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 54 in clave [et l.c. 15 (1): 87. 1869] -*Malacothrix* - Holotype: Persia media inter Gäs et Murtschehar, N Isfahan, *Bunge & Bienert* (P: in juvenile state, without flowers); Epitype (Zarre and Podlech, Rostaniha 7, suppl. 2: 238. 2006): Iran, Prov. Esfahan, at the beginning of road from Golpeyegan to Muteh, 1850 m, 20.7.1998, *Maassoumi* & *Mozaffarian 76711* (MSB; iso-epitype TARI).

A. hirtus Bunge originally described from the type specimen at juvenile state without flowers and placed in *A.* sect. *Stereothrix*. It was collected from Golpeyegan to Muteh (*Maassoumi & Mozaffarian 76711*) and treated as the epitype of *A. hirtus* by Zarre & Podlech (Podlech, 2008).

13) *A. koelzii* Barneby 1974, Brittonia 26: 113 - *Stereothrix* - Typonym: *A. unifoliolatus* Širj. & Rech.f. non Bunge.
Originally it was placed in the monotypic section of *Koelziana*, but linked to *A.* sect. *Stereothrix* by *A. ledinghamii* (Barneby, 1974; Maassoumi, 1998; Lock and Simpson, 1991; Podlech, 2008; Podlech, 2009).

With an interesting systematic position, it is a very rare endemic and known only from the type collection from Bakhtiari, Peshmshurun. Although the shape of leaf or leaflets in this species is similar to some other species of *A.* sect, *Incani*, the shape and size of its leaf or leaflets is very conspicuous (Figure 13). As *A. koelzii* is not related to *A.* sect, *Incani*, it seems that its similarity in leaf or leaflets shape most probably resulted from a convergence.

14) *A. kurnet-es-saudae* Eig 1955, Syst. Stud. Astrag. Near East: 36 - *Stereothrix* - Syntypes: N Lebanon, Jebel Matrafe, near Kurnet-es-Sauda, 2400 m, 13.7.1934, *Eig, Feinbrun & Zohary* (HUJ); contre bas à l'est des grands sommets de Kornet Saouda, 7.7.1933, *Mouterde* (= *A. hispidus* Labill.).
A. kurnet-es-saudae is a narrowly distributed endemic species. It is known from a single locality and deposed at HUJ (Podlech, 2008). It occurs in Jebel Matrafe, near Kurnet-es-Sauda from Lebanon. This name was reduced to synonymy under *A. hispidus* Labill. by Podlech (2008).

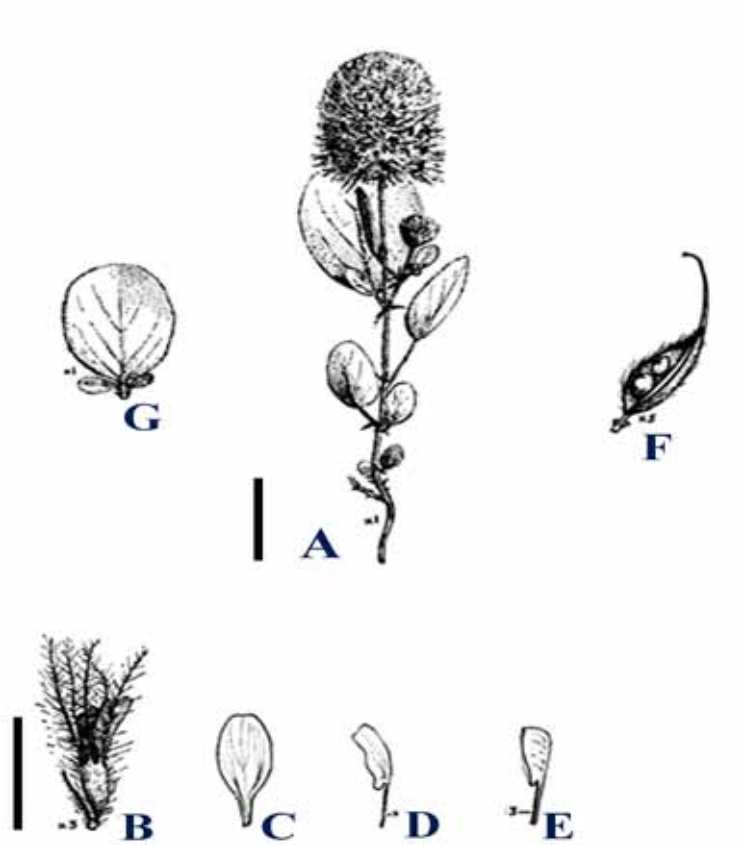

Figure 13. *A. koelzii*. (A) Habit, (B) Calyx, (C) Standard, (D) Wing, (E) Keel. Illustration from Barneby 1974, Brittonia 26: 113. Scale (A): 2 cm, (B-F): 1 cm

15) *A. ledinghamii* Barneby 1974, Brittonia 26: 111- *Stereothrix* - Holotype: Iran, Fars, about Shiraz and Firuzabad, 12 km N Shiraz, 1000-2000 m, 30.5.1965, *Ledingham & Assefi* 4070 (NY; iso: W!, foto BASU!).

A. ledinghamii is a narrow endemic to N Shiraz in Fars Province of Iran. It is morphologically close related to *A. doshman-ziariensis* (Figure 14), especially because of its prostrate habit and more or less large leaflets (Barneby, 1974; Maassoumi, 1998; Lock and Simpson, 1991; Podlech, 2008; Podlech, 2009).

Figure 14. Type specimen of *A. ledinghamii*

16) *A. leucothrix* Freyn & Bornm. 1891, Österr. Bot. Z. 41: 406 - *Stereothrix* - Lectotype (Podlech, Sendtnera 6: 183. 1999): [Turkey] Pontus australis, Amasia, ex gr. Logman et Kirklar ad arcem, 600-800 m, 28.5.1890, *Bornmüller 1840* (B: sheet marked as lectotypus; iso: B, BRNM, G, JE, W!: foto BASU, MSB, WU!).

This species is a narrow endemic from Turkey. It is growing in Amasyai çankırı and Sivas provinces (Podlech, 2008). *A. leucothrix* is closely related to *A. barbatus* and *A. nanus* (Figure 15), but distinguished well by its violet flowers (Chamberlain and Matthews, 1969).

Figure 15. Type specimen of *A. leucothrix*

17) *A. mahneshanensis* Maassoumi & Moussavi 2005, Iran. J. Bot. 11: 104 - *Stereothrix* - Holotype: Iran, prov. Zanjan, Mahneshan NW, Alam Kandi village. 2950 m, 30.5.1381 (persian. calend.), *Mouusavi 3957* (TARI; iso: Zanjan Research Center).

A. mahneshanensis is a narrow endemic to NW Mahneshan in Zanjan Province of Iran. It is known from a single locality and deposed at TARI & Zanjan Research Center (Maassoumi, 2005). In "Flora Iranica", *A. mahneshanensis* has not mentioned from Iran by Podlech (2009).

18) *A. mahmutlarensis* Podlech 2008, Feddes Repert. 119: 32 - *Stereothrix* - Holotype: Turkey, C4 Antalya, ca. 35 km NE Mahmutlar (Alanya), 1270 m, 11.6.2002, *Ulrich A/20* (MSB).

A. mahmutlarensis is a narrow endemic to Anatolia. It is known from a single locality and deposed at MSB (Podlech 2008).

19) *A. montis-varvashti* Podlech 1999, Sendtnera 6: 169 - *Stereothrix* - Holotype: Iran, Prov. Mazanderan, Elburz, Elika, Varvasht mountains, 3500-4100 m, 4.8.1972, *Terme 15240-E* (W!; iso: IRAN!, MSB, foto BASU!) (Figure 16).

A. montis-varvashti is a narrowly distributed endemic species. It is known from a single locality and deposed at W, IRAN and MSB (photo in BASU). It occurs in Siah kuh mountain in Semnan Province and grows in dry-steppe and stony clay zones around Damghan (Maassoumi, 2005).

Figure 16. Type specimen of *montis-varvashti*

20) *A. nabelekii* Czeczott 1932, Acta Soc. Bot. Poloniae 9: 36 - *Hypoglottidei* - Type: [Turkey] Paphlagonia, mt. Kush-Kayasy (jugum Ilgaz-Dagh), 2400 m, 26.7.1925, *Czeczott 495* (KRAM).

A. nabelekii is a local endemic to Anatolia. It occurs in steppe zone of Kush-Kayasy mountain, (Chamberlain & Matthews, 1969; Maassoumi, 1998).

21) *A. nanus* DC. 1802, Astragalogia: 143, t. 17 - *Stereothrix*, illeg. [homotypic with *A. hispidus* Labill.] – Holotype: in Syria, Labillardière (in herb. Desfontaines: FI-W!) (≡ *A. hispidus* Labill.).
- subsp. *nanus* (DC.) Ponert 1973, Feddes Repert. 83: 620 - Basion.: *A. nanus* DC. (= *A. hispidus* Labill.).

A. nanus is the most widespread species of *A.* sect. *Stereothrix*. It occurs in Anatolia, Syria and Lebanon (Rechinger, 1961; Chamberlain and Matthews, 1969; Maassoumi, 1998).

22) *A. podosphaerus* Boiss. & Hausskn. in Boiss. 1872, Fl. Or. 2: 255 - *Stereothrix* - Lectotype (Podlech, Sendtnera 5: 259. 1998): [Iran] in monte Schahu Kurdestaniae, 11000', vii.1867, *Haussknecht* (G-BOIS; iso: JE, LE, P).

A. podosphaerus is a narrowly distributed endemic species. It occurs in Schahu mountain in Kurdistan Province. *A. podosphaerus* grows in dry-steppe and stony clay zones around Tazehabad (Maassoumi, 2005).

23) *A. pseudocapito* Podlech 2004, Ann. Naturhist. Mus. Wien 105 B: 594 - *Stereothrix* - Holotype: Iran. Azarbaijan, Sarab, Gharieh-ye Mir-Kuh-Hadji, 1700-1900 m, 11.-12.6.1986, *Termeh & Daneshpajouh* 41369-E (MSB; iso: IRAN!, W!, foto BASU!).

A. pseudocapito is a rare and local endemic to NW Iran and known from three specimens collected only from a single locality. It occurs in dry-steppe zone of sub-mountainous regions near the village Sarab in Azarbaijan Garbi Province (Podlech, 2009).

24) *A. robertianus* Kit Tan & Sorger 1987, Aliso 11: 622 - *Onobrychoidei* - Holotype: Turkey, Agri, SW of Balik Gölü, 2400 m, 4.8.1983, *Sorger 83-36-18* (LI: foto MSB).

This species was transferred from *A.* sect. *Stereothrix* to *A.* sect. *Onobrychoidei* by Podlech (2008) and then treated as a synonym of *A. psoraloides* Lam. (Aytaç 2012).

25) *A. saganlugensis* Trautv. 1858, Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersbourg 16: 323 -*Hypoglottidei* - Lectotype (Podlech & Sytin, Sendtnera 3: 170. 1996): [Turkey] In Turcia asiatica, inter montes saganlugenses et Arserum [Erzerum], 19.8.1855, *Lagowski* (LE: sheet marked as lectotypus, foto MSB; iso: G-BOIS, LE: foto E).

This species was transferred from *A.* sect. *stereothrix* to *A.* sect. *Hypoglottidei* by Podlech (2008).

26) *A. setosulus* Gontsch**.** 1947, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 10: 33 - *Stereothrix* -Lectotype (Podlech and Sytin, Sendtnera 3: 172. 1996): [Ukraine] Tauria, in monte Demerdshi, in vic. opp. Aluschta, 25.7.1894, *Alexeenko* (LE: sheet marked as lectotypus; iso: LE, MSB).

It is a narrowly distributed endemic species. It is known from a single locality and deposed at LE and MSB. It occurs in Demerdzhi mountain near Alushta.

27) *A. sikaramensis* Širjaev & Rech. F. Biol. Skr. Dan. Vid. Selsk. 9, 3: 39 (1957), Figure 31 et 32. - Afghanistan orientalis: In valle Kurram, Sikaram, 2300-4000 m (*Aitchison 435*, 916, sub nomine *A. leucocephalo* Grah., iso: C).

A. sikaramensis is a narrowly distributed endemic species of *A.* sect. *Stereothrix*. It occurs in the mountainous region of Sikaram, in Kurram valley (Podlech, 2008). In "Flora Iranica", *A. sikaramensis* has not been mentioned from Afghanistan by Podlech (2009).

28) *A. sorgerae* Hub.-Mor. & Chamb. 1969, Notes Roy. Bot. Gard. Edinburgh 29: 289 - *Stereothrix* -Holotype: Turkey, C3 Isparta, Dedegöldag, ca. 1600 m, 3.7.1965, *Sorger 65-43-129* (LI: foto MSB; iso: G).

A. sorgerae is an endemic species to SW Anatolia (Chamberlain and Matthews, 1969).

29) *A. sparsipilis* Hub.-Mor. & Chamb. 1969, Notes Roy. Bot. Gard. Edinburgh 29: 290 - *Stereothrix* - Holotype: Turkey, C4 Konya, ob dem Wald von Gevne bei Hadim, 1800 m, 18.6.1948, *Renz & Huber-Morath 9473* (G!).

A. sparsipilis is endemic to Anatolia (Chamberlain and Matthews, 1969).

30) *A. sphaeranthus* Boiss**.** 1846, Diagn. pl. orient., ser. 1, 6: 37 - *Stereothrix* - Holotype: [Iran] mt. Kuh-Daena, 2.8.1842, *Kotschy 799* (G-BOIS; iso: BM, FI-W, G, K: foto MSB, LE, MSB, OXF, P, PR, PRC, W!: foto BASU, MSB, ZT).

A. sphaeranthus is a narrowly distributed endemic species of *A.* sect. *Stereothrix* (Figure 17). It occurs in steppe zone of the mountain Daena near Yassuj, in Khogilouyeh and Boirahmad Province (Podlech, 2009).

Figure 17. Type specimen of *A. sphaeranthus*

31) *A. stridii* Kit Tan 1987**,** Aliso 11: 621 - *Malacothrix* - Holotype: Turkey, C5 Nigde, Narpiz valley, NW part of Aladag, 6 km SE Demirkazik köyü, 2300-3000 m, 23.7.1984, *Görk, Hartvig & Strid 23923* (C; iso: E: foto MSB, MSB).
It is a narrow endemic from Turkey. This species was collected from Niğde Province and transferred from *A.* sect. *Stereothrix* to *A.* sect. *Malacothrix* by Podlech (2008).

32) *A. subhanensis* Gharemani-nejad & Behçet 2003, Ann. Bot. Fennici 40: 209 - *Stereothrix* - Holotype: Turkey, Van Province, B9 Bitlis, Adilcevaz, Subhan Dağli [Subhan Mt.], Sote Yaylasi [highland], east of Çanakyayla village, 2300 m, 21.6.1987, *Behçet 41* (FAR; iso: FAR, VANF).

Astragalus subhanensis is endemic to Turkey and was collected from Van Province. It is well separated from other species of the section by presence of a few hairs on the wings. The closest relative of *A. subhanensis* is *A. barbatus* (Ghahremani-nejad and Behçet, 2003).

Acknowledgements

The great help of Dr. Vitek, Dr. Wallofer, Dr. Till, Dr. Gautier and Mr. Fumeaux during our visit to the herbaria W and WU in Vienna and G in Geneve is much appreciated. This research received financial support from the Bu-Ali Sina University.

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(Received for publication 17 August 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 134-152

Research article/Araştırma makalesi

Serpentine Flora of Turkey

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Abstract

This study was carried out to illustrate the importance of the edaphic and geological isolation for the floristic diversity and endemism. Some of the most important reasons for the floristic diversity of Turkey are the edaphic, geological and geomorphogical diversity and different topographical structures. The fact that there is an extensive endemism on the land developed from the gypsum and serpentine rocks with extreme conditions is explained by the ‘’geological isolation’’ and these regions are called “geologic island“ or “edaphic island”.

Turkey is very rich as regards to ophiolitic rock and endemism. Except for the eastern and south eastern part of the country the ultramaphic rocks are present all over Turkey. They are frequently observed in Kütahya, Balıkesir, Antalya, Muğla, Hatay and Adana regions in Amanos Mountains, in Eastern Taurus, north and northeast of Mersin and between Niğde and Adana, in Aladağ massive and thousands of kilometer square land from Adana to Erzincan. Also they are locally present between Ankara and Çanakkale regions.

In this study there were 223 taxa determined grow upon the ultramaphic serpentine rocks based on the species published in Flora of Turkey volumes I-XI and other sources and the observation made in the fields. Among these 223 taxa which prefer on the serpentine rocks 142 of them are endemic and 8 taxa are rare on the national and international scales. The distribution of the taxa according to families were found to be as follows; Asteraceae, 36 taxa; Lamiaceae, 21 taxa; Brassicaceae, 20 taxa; Liliaceae, 17 taxa; Caryophyllaceae, 16 taxa; Scrophulariaceae, 15 taxa; Poaceae, 13 taxa; Apiaceae, 11 taxa; Plumbaginaceae, 9 taxa; Fabaceae, 8 taxa; Boraginaceae, 7 taxa; Rubiaceae, 7 taxa; Crassulaceae, 6 taxa; Convolvulaceae, 6 taxa; Euphorbiaceae, 6 taxa and others 25 taxa. IUCN threatened categories of the endemic and rare taxa grown on serpentine rocks are 1 taxon EX; 20 taxa CR; 29 taxa EN; 27 taxa VU; 27 taxa LR(cd); 8 taxa LR(nt); 14 taxa LR(lc); 7 taxa DD. When we take the distribution of the serpentine rock in the country we see that the endemism is particularly located alongside the Anatolian Diagonal. One of the reasons for this endemism is found to be the geological isolation and most of the newly found taxa are distributed on the serpentine rocks and this shows the necessity of the further floristic studies of the region.

As a result of the investigation of the 223 taxa which were found to adapt to serpentine extreme conditions 97 of them were regarded as the *serpentinophyt* (which lives only on serpentine i.e an obligate) and remaining 126 of them were found to be s*erpentinovag* (is capable to grow both on the serpentine and other edaphic condition i.e facultative). In order to verify these results it is necessary to investigate the genetic solutions, adaptation ways and life strategies of these taxa to these extreme conditions.

Key words: Flora, Endemism, Serpentine, Serpentinophyt, Serpentinovag, Turkey

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Türkiye serpantin florası

Özet

Bu çalışma, edafik ve jeolojik izolasyonun floristik çeşitlilik ve endemizm açısından öneminin ortaya konulması amacıyla gerçekleştirilmiştir. Türkiye’nin floristik çeşitliliğinin önemli nedenlerinden birkaçı edafik, jeolojik

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 BioDiCon. 307-0313

ve jeomorfolojik çeşitlilik ve farklı topoğrafik yapılardır. Ekstrem ekolojik şartlar içeren Jips, Serpantin gibi kayaçlardan gelişen topraklarda endemizmin yoğun olması "jeolojik izolasyon" ile açıklanmakta, bu bölgeler "jeolojik ada" ya da "edafik ada" olarak adlandırılmaktadır.

Türkiye'de ofiolitik kayaçlar endemizm bakımından oldukça zengindir. Ultramafik kayaçlar yurdumuzun doğu ve güneydoğu illeri hariç bir çok yerinde yayılmaktadır. Kütahya ve Balıkesir çevrelerinde, Antalya ve Muğla civarında, Hatay ve Adana civarında Amanos dağlarında, Doğu Toroslarda Mersin'in kuzeyi ve kuzeydoğusunda, Niğde ve Adana arasında Aladağ masifi içinde, Adana'dan-Erzincan'a kadar yüzlerce kilometrelik hat boyunca uzanır. Ayrıca Ankara ve Çanakkale çevrelerinde de lokal de olsa rastlanmaktadır.

Bu çalışmada Türkiye Florası I-XI ciltler ve daha sonra yayımlanan türler ve arazi gözlemlerine dayalı olarak yurdumuzda önemli bir yayılışa sahip ultramafik kayaçlardan serpantin üzerinde uzmanlaşan 223 takson tespit edilmiştir.

Serpantin kayaçlar üzerinde uzmanlaştığı tespit edilen 223 taksondan 142'si endemik, 8 takson ise ulusal ya da küresel ölçekte nadir taksonlardır. Taksonların familyalara göre dağılımı; Asteraceae, 36; Lamiaceae, 21; Brassicaceae, 20; Liliaceae, 17; Caryophyllaceae, 16; Scrophulariaceae, 15; Poaceae, 13; Apiaceae, 11; Plumbaginaceae, 9; Fabaceae, 8; Boraginaceae, 7; Rubiaceae, 7; Crassulaceae, 6; Convolvulaceae, 6; Euphorbiaceae, 6; diğerleri, 25 olarak saptanmıştır. Serpantin üzerinde gelişen endemik ve nadir taksonların bilinen IUCN tehlike kategorileri, 1 takson EX; 20 takson CR; 29 takson EN; 27 takson VU; 27 takson LR(cd); 8 takson LR(nt); 14 takson LR(lc); 7 takson DD'dir. Yurdumuzda serpantin kayaçların yayılış alanları dikkate alındığında özellikle "Anadolu Diyagonali" üzerinde yoğunlaştığı, diyagonal üzerindeki endemizmin bir diğer nedeninin jeolojik izolasyon olduğu ortaya konulmuştur. Yeni tespit edilen taksonların büyük çoğunluğunun serpantin kayaçlar üzerinde yayılıyor olması, bu alanlarda detaylı floristik araştırmaların gereğini ortaya koymaktadır.

Serpantin sistemlere uyum sağladığı tespit edilen 223 taksonun yayılış alanları incelenmiş ve 97 taksonun Serpantinofit (zorunlu serpantin bitkisi=obligat) olarak adlandırılabilecegi, geri kalan 126 taksonun ise serpantinovag (hem serpantin üzerinde hem de serpantin dışındaki farklı edafik koşullarda gelişebilen=fakültatif) olarak değerlendirilebileceği kanaatine varılmıştır. Bu taksonların habitata uyum için geliştirdikleri genetik çözümler ile uyumsal açılımları ve yaşam stratejileri ile ilgili araştırmalarla bu sonuçlar kesinlik kazanabilecektir.

Anahtar kelimeler: Flora, Endemizm, Serpantin, Serpantinofit, Serpantiovag, Türkiye

1. Introduction

Turkey located between 36°- 42° northern longitudes and 26°-45° eastern latitudes is one of the floristically richest countries in the calmer belt with nearly 12,000 flowering plants (including the taxa related to sub species). The floristic diversity reflects phytogeographic, edaphic, climatic, habitat and topographic richness of the country.

The level of endemism is very high in Turkey which was the diversification center of many types and sections. This high endemism are mainly attributed to geological climatic and topographical heterogenety. As a result of this, Anatolia is the gene center of many species in its close vicinity (Erik and Tarikahya, 2004).

Flora of Turkey first took the attention of the foreign scientists and so many scientists coming from various countries collected plants from Anatolia at various times . The collection and the herbariums where these collections are located established by these researches created an important data for the writing of 'Flora of Turkey'. The first manifestation of these accumulated data was a five volume book written by E. Boissier entitled "Flora Orientalis" (Boissier, 1867-1888). The Flora of Turkey was published under the editorship of P.H. Davis with 9 volumes within a period of twenty years between 1965-1985. In order to add the new data found after the publication of the last volume the volume 10 was written by entirely Turkish scientists in 1988 and volume 11 was published as a supplement again by the group of Turkish workers (Güner et.al., 2000) (Erik and Tarikahya, 2004).

The major reasons for the biological diversity are the adaptation of the plants to the extreme edaphic conditions called the "*edaphic islands*". The very intensive endemism on the soils developed from these rocks (gypsum, serpentine) was attributed to the "*geological endemism* " and these regions are called "*geologic island* " or "*edaphic island* ". Only could the plants which developed genetic solution to the extreme edaphic conditions be able to survive these lands (Reeves et.al 1999; Rajakaruna, 2004).

The ecological specivity in the use of habitat is very common in nature (Futuyma and Moreno 1988; Stevens 1989; Brown 1995; Gaston and Blackburn, 2000). The ecologic designs have played an important role in the loss or the appearance of the biological diversity throughout the revolution process. However the revolutionary origin of the adaptation to the habitat has not been fully clarified yet.

Serpentine rocks are known to be very rich regarding to endemism throughout the world (Brooks, 1987; Kruckeberg, 2002). For instance 1.5% of California is covered by serpentine rocks and only 176 (12%) of the 1410 plants living in California are serpentine endemic. If we think that only 669 taxa is related to serpentine, this number is quite high.

The ultramaphic (serpentine) rocks cover less than 1% of the world in patchwork manner. There are multi dimensional edaphic factors in the formation of serpentine rocks which includes physical, chemical and biotic elements (Brooks, 1987; Brady et.al., 2005).

The regions where the ophiolitic rocks are widely present have a very big importance for the endemism in Turkey. The ophiolithic rocks which are rich in minerals are classified as gabro-ultrabasic rocks. The serpentine rocks are formed by the change of peridotite and pyroxene as a result of hydration (Hoşgören, 2000). The soil with serpentine rocks (formed by the hydration of magnesium silicate) is difficult to dissociate and have a shallow and stony structure. Serpentine soils contain large amounts of Magnesium which is not suitable for the growth of plants. The serpentine soils are also rich in heavy metals such as Nickel, Chrome and Cobalt as well as Magnesium and Iron but poor in nutritious elements such as Calcium, Potassium and Phosphorous (Avcı, M., 2005).

These toxic elements in serpentine soils have a very negative effect upon the growth of plants. However some plants are observed to develop a good adaptation to it. The serpentine rocks are very rich as regards to endemic plants and this is called "geologic isolation". The serpentine habitats are also called "geological islands". Some of the plants with good genetic adaptation to extreme edaphic conditions are observed to have wide distribution on these lands (Kantarcı, 1987; Kruckeberg et.al, 1999; Reeves et.al, 1999; Adıgüzel and Reeves, 2002). Wallace, in his study entitled "*The Klamath Knot: Explorations of myth and evolution*" described the serpentine land as "although the look of the forests is not very good, the areas where these rocks are widely present are the refuge for their flora. The difficulty of physical and chemical endurance to the areas with ultramaphic rocks made the life adapt amazing changes (attributed to Wallace, 1983 by Rajakaruna 2004). (Avcı, M. , 2005).

The most characteristic species of Mediterranean Region *Alyssum* is also known as Nickel hyperaccumulator. *Alyssum* has 48 taxa in Turkey and 27 of them are endemic to Turkey. *Silene cserei* Baumg. *ssp. aeoniopsis* (Bornm.) Chowdhuri, *Alyssum floribundum* Boiss. & Bal. , *A. constellatum* Boiss. , *A. murale* Waldst. & Kit. , *A. dudleyi* N. Adıgüzel & R. D. Reeves, *Thlaspi elegans* Boiss. *and Cochlearia sempervivum* Boiss. et. Bal. are some of the serpentine endemic plants which can accumulate very high amounts of Nickel in their structure. According to the studies carried out in the serpentine rich regions reveal that the amount of Nickel may reach up to 2% in plants such *Alyssum, Thlaspi and Cochlearia* (Kruckeberg et.al., 1999; Davis et.al., 2001; Reeves et.al., 2001; Avcı, M., 2005).

Low plant production, high endemism and the difference between the vegetation of the neighboring regions are the three main characteristics of the serpentine regions (Whittaker, 1954). The high heavy metal concentration (Chrome, Nickel, Cobalt and Manganese), low Ca/Mg ratio and lack of Nitrogen, Phosphorous and Potassium creates very unfavorable medium for the growth of other plants (Proctor and Woodell, 1975; Kruckeberg, 1984; Proctor, 1999; Robinson et. al., 1997). Serpentine soil is a ferromagnetic silicate and contains a high concentration of intakable Nickel and high amount of Chrome and Cobalt. Nickel has a very adverse effect upon the growth of the plants (Krucekberg, 1984). The serpentine soils are usually dry is due to its low organic content and its weak physical structure (Brooks, 1987) and the plants which live on serpentine soils are adapted to the extremely unfavorable edaphic factors and very high concentration of heavy metals (Kruckeberg, 1984). The physical conditions of the serpentine soils are not suitable most of the plants and this results are very scarce but highly endemic vegetation in those areas (Baker et.al., 1992; Batianoff and Singh, 2001). The weak vegetation causes erosion and increases the temperature of the soil. In serpentine soil the levels of sand and clay are very low (Brady et. al., 2005). According to Kruckeberg (1954; 1984) the characteristic chemistry of serpentine soils has a deterministic effect on the appearance of serpentine endemism as with rich but small vegetation and low number of species. The plants which are grown on serpentine soils have to develop endurance against drought as well as the adverse chemical conditions (Proctor and Woodel, 1975; Brady et.al., 2005).

2. Materials and methods

The sample of the study is constituted by the Flora of Turkey and The East Aegean Islands vol. I-XI and new taxa reported after the publication of Flora of Turkey. The study is based upon the newly published taxa and site visit to Flora of Turkey. The taxa endemic to serpentine were determined by site surveys and observations. The taxa endemic or rare found are indicated. The distribution of the taxa growing on serpentine are given in tables and graphs according to families, phytogeographical regions and IUCN threatened categories. The taxa which take its epithet from serpentine were separately indicated. The taxa endemic to serpentine were separated into Serpentinophyt (obligate) and Serpentinovag (facultative) species according to the surveys. The area where the taxa are grown, its phytogeographical region, IUCN threatened category and whether they are serpentinophyt or serpentinovag are indicated.

3. Results

Ultramaphic rocks are widely present in many parts of the country except Eastern and South Eastern regions. They are located in Kütahya and Balıkesir, Antalya and Muğla, and Hatay and Adana regions, Amanos Mountains, eastern Taurus, North and South East of Mersin, between Niğde and Adana, in Aladağ massive and a hundreds of kilometers of line extending from Adana to Erzincan. They are also locally observed in Ankara and Çanakkale regions.

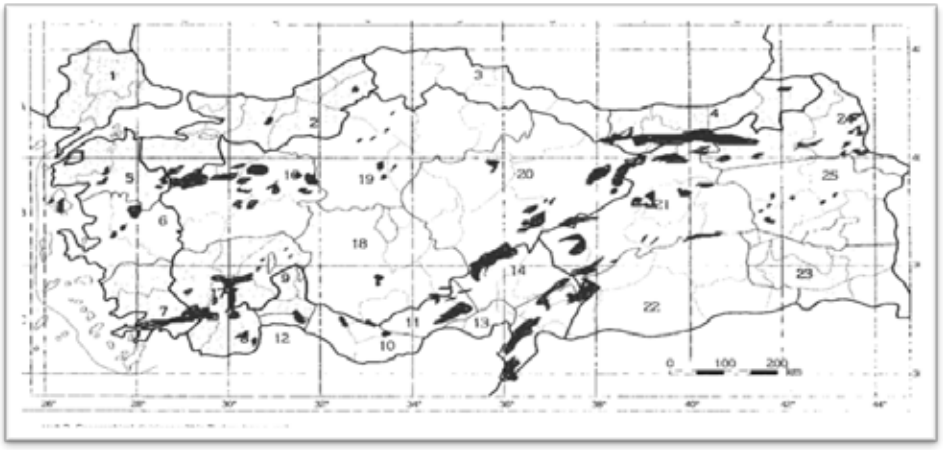

Figure 1. The distribution of the ultramaphic rocks in Turkey (R., D., Reeves, N., Adıgüzel, 2004 changed version).

Serpentine habitats are among the most important centers of endemism. According to the published data about the flora of Turkey, check- lists (Özhatay N, Kültür fi & Aksoy N 1994; Ozhatay, N., Ş. Kültür & N. Aksoy 1999; Ozhatay, N. & Ş. Kültür 2006; Ozhatay, N. , Ş. Kültür & S. Aslan 2009; Ozhatay FN, Kültür Ş & Gürdal MB 2011), field surveys and habitat information of the newly found taxa, there are 223 taxa which were directly related to serpentine, adapted to it extreme conditions or in other words became specific to these habitats. Among these taxa 142 of them are endemic and 8 taxa are highly rare in national or global scale.

FILICALES

Cheilanthes marantae (L.) Domin
Rock crevices (often serpentine),30-2700 m. Serpentinovag.

1. *Asplenium cuneifolium* Viv.
A3: Sakarya: Hendek, Czeczott. B2 Kütahya: Murat Da. , 2000 m, D. 36821A! C2 Muğla: Sandras Da., 2200 m, On serpentine rocks, 2000-2200 m. Serpentinophyt.

BRASSICACEAE

2. *Isatis pinnatiloba* Davis
Limestone sea cliffs, rocky serpentine hills and macchie,50-300 m. E. Medit. Element, Endemic, LR (cd), Serpentinovag.
3. *Biscutella didyma* L.
Rocky slopes, often limestone or serpentine, from s.1.-400 m. Serpentinovag.
4. *Alyssum masmenaeum* Boiss.,
*Serpentine, with Pinus nigra, 1200-2200 m. Endemic, L*R(lc). Serpentinovag.
5. *Alyssum discolor* Dudley & Hub.-Mor
Serpentine, limestone and sandstone, s.L-300 m, E. Medit. element, endemic, VU. Serpentinovag.
6. *Alyssum caricum* Dudley & Hub.-Mor.
[Turkey C2 Muğla] Muğla to Fethiye, Kalkgeröll linkes Ufer des Namlam Çay, 42 km südöstlich Muğla, 100 m, 20 vi 1954, Huber-Morath 12824 (holo. Hb. Hub.-Mor. iso. A! E!) Caria. C2 Muğla: 8 miles S of Muğla, 600 m Serpentine screes and scrub, 40-300 m, E. Medit. Element, endemic, EN. Serpentinophyt.
7. *Alyssum lesbiacum* (Cand.) Rech
[Lesbos] Maleae Olympiaeque, Candargy. Is. : Lesvos: Ajassos to Magali Limni, 200-300 m, Rech. 5507!Serpentine, 200-300 m, E. Medit. Element, endemic, DD. Serpentinophyt.
8. *Erysimum echinellum* Hand.-Mazz.
[Turkey B7 Elaziğ] zwischen Serpentinfelsen auf dem niedrigen Gipfel des Hasarbaba Dagh am Goldschik (Quellsee des Tigris), 2400-2450 m, 29 vii 1910. Handel-Mazzetti 2608.On serpentine rock, Ir.-Tur. Element, endemic, EN. Serpentinophyt.
9. *Aethionema speciosum* Boiss. & Huet in Boiss.
Turkey C2 Muğla: Sandras Dağ, W. of the summit, 1970 m, slightly sloping stony flat (snowbed) near a small creek close to timberline, serpentine, lat. 37°04'N, long. 28°50'E, 7 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23339 (holo. C,iso. E! EGE, G).Stony flats (snowbeds) nr tree-line, on serpentine, 1970 m, E. Medit. Element, endemic. Serpentinophyt.
10. *Thlaspi cariense* A. Carlström.
Turkey [C2] Muğla: 1 km E. of Marmaris. In pine forest on serpentine, 19 iv 1983, Carlström 9293 (holo. LD).Clearings in Pinus brutia forest on serpentine, to 100 m, E. Medit. element, endemic, EN. Serpentinophyt.
11. *Alyssum pogonocarpum* A. Carlström.
[Islands] Rodhos: 5 km E.N.E. of Agios Isidores, c. 200 m, 3 v 1982,Carlström 5347b (holo. LD).Open places on serpentine, c. 200 m., E. Medit. element., endemic to Rodhos., DD. Serpentinophyt.
12. *Barbarea minor* var. *anfractuosa* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, W. side of the summit area, 2100-2200 m, lat. 37° 04'N, long. 28° 50'E, 7 vii
1984, P. Hartvig, Ö. Seçmen & A. Strid 23347 (holo. C. iso. E! EGE, G). Snowbed meadows and rocky slopes on serpentine, 2100-2200 m, E. Medit. Element, endemic variety, EN. Serpentinophyt.
13. *Erysimum vuralii* Yıld.
Turkey, C2 Muğla: Koyceğiz, Hamitkoy-Ekincik arası, Paratype: Turkey, C2 Muğla: Koyceğiz, Hamitkoy, Domuzdireği tepesi, 17.iii.1991, A.Güner 8198,H.Duman & H.Şağban (HUB, Hb. Yıldırımlı); ibid., 15.iv.1991, A.Güner 8652, M.Vural, H.Duman, A.A.Dönmez & B.Mutlu (GAZI); Fethiye, Dalaman,
between kısık dere and Dalaman cayı. Kızılcam ormanı, başkalaşımlı taşlı yerler, 75 m, yangın alanı, 20-50 m, serpentine rocks, 100 m, endemic, new takson for science, CR. Serpentinophyt .

14. *Erysimum serpentinicum* Polatschek.
Turkey, C1 Muğla: 28 km W Marmaris,150 m, vulkanisches Gestein. endemıc, new takson for science, CR. Serpentinophyt.
15. *Hesperis anatolica* A. Duran.
Turkey, C5 Adana: Pozantı, betw. Hamidiye and Karakuz (Camlıbel), 4 km, serpentine pebbly slopes, open Pinus forest, scrub, 1400 m, 37°32.30'N,34°00.38'E,serpentine pebbly slopes, open Pinus forest, scrub, 1400 m, endemıc, new takson for science, CR. Serpentinophyt.
16. *Thlaspi leblebicii* Gemici & Görk.
[Turkey C2 Muğla] Köyceğiz, summit of Sandras Dağı, rocky peridotite slopes, 2000-2100 m, 7 vi 1992, Y. Gemici 6656 & al. (holo. EGE!).Rocky peridotite (serpentine) slopes, 2000-2100 m, E. Medit. (mt.) element, endemic, EN. Serpentinophyt.
17. *Alyssum mughlaei* Orcan.
(Turkey) C2 Muğla: Marmaris-Muğla, 10 km to Marmaris, 52 km to Muğla roadside, serpentine, 100 m, endemıc, new takson for science, CR. Serpentinophyt.
18. Hesperis kuerschneri Parolly et Kit Tan.
(Turkey) C2 Denizli: Fethiye-Çameli, N Fethiye, unterhalb des (below) Tuzla Beli 300 m, Serpentinhang (serpentine slope), endemic, new takson for science, CR. Serpentinophyt.
19. *Physoptychis purpurascens* Çelik et Akpulat.
serpentine, chalky steppe and slopes, endemıc, new takson for science, CR. Serpentinovag.
20. *Hesperis ozcelikii sp. nova* A.Duran.
C3 Isparta: in Sütçüler 17th km from Ayvalıpınar to kesme Landslipped places, open forest, roadsides and serpentine, pebbly slopes with Pinus nigra 1025m, E.M. element, endemic. Serpentinophyt.
21. *Bornmuellera kiyakii* Aytac¸ & Aksoy.
C4 Konya: Derebucak; Camlık kasabası, Kızıldag, 1400–1600 m, clearing
Open Pinus nigra forest on serpentine rocks, Ir.-Tur. element, endemic, LR(cd). Serpentinophyt.
CARYOPHYLLÀCEAE
22. *Arenaria rhodia* var. *macropetala* McNeill
Turkey [C2] Muğla: distr. Fethiye, between Kizil Dere and Dalaman Çay, 100 m, serpentine scree, annual, 1 iv 1956, Davis & Polunin, D. 25543 (holo.E! iso. K!)Rocks and screes, 30-300 m, E. Medit. element, Endemic, EN. Serpentinophyt.
23. *Minuartia garckeana* (Aschers. & Sint. ex Boiss.)
Serpentine and micaceous gravel, 600 1800 m, Rare, DD. Serpentinovag.
24. *Cerastium Iigusticum* Viv.
On serpentine & perhaps elsewher, rare, VU. Serpentinovag.
25. *Gypsophila graminifolia* Bark,
Turkey B9 Van, distr. Başkale, ispiriz Dağ, 2700 m, serpentine screes, 31 vii 1954, Davis & Polunin, D. 23675 (holo. E! iso. K).Serpentine screes, 2700 m. Ir.-Tur. Element, endemic, CR. Serpentinophyt.
26. *Gypsophila sphaerocephala var. cappadocica* Boiss. ,
Dry slopes, limestone and serpentine rocks, 800-1900 m, Ir.-Tur. element, endemic, LR(lc). Serpentinovag.
27. *Silene surculosa* Hub.-Mor.
Turkey [B7] Tunceli, Pülümür-Mutu, Serpentinschutt 8 km ob Mutu, 1760 m, 26 vi 1951, Huber-Morath 11170 (holo. Hb. Hub.-Mor.!). B7 Tunceli: above Pülümür, 1850 m, D. 29289!Serpentine rock, 1760-1850 m., Ir.-Tur. Element, endemic, EX. Serpentinophyt.
28. *Arenaria ledebouriana* var. *grandiflora* Hartvig & Strid.
Rocky limestone, schistose and serpentine slopes, 1950-2450 m, E. Medit. Element, endemic variety, LR(nt). Serpentinovag.
29. *Minuartia verna* subsp. *brevipetala* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, W. of the summit, 1970 m, slightly sloping stony flat (snowbed) near a small creek close to timberline, serpentine, lat. 37°04'N, long. 28°50'E, 7 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23336 (holo. C,iso. B, E! EGE, G). Moist gravelly or stony flats (snowbeds) on serpentine, c. 2000 m, E. Medit. Element, endemic subspecies, EN. Serpentinophyt.
30. *Bolanthus stenopetalus* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, W. side of the summit area, 2100-2200 m, lat. 37°04'N, long. 28°50'E, 7 vii
1984, P. Hartvig, Ö, Seçmen & A. Strid 23375 (holo. C, iso. B, E!~EGE, G).Snowbed meadows and rocky slopes, 2100-2200 m, E. Medit. Element, endemic, EN. Serpentinophyt.
31. *Silene araratica* subsp. *davisii* (Chowdh.) Ghazanfar.
Crevices of limestone, conglomerate and serpentine rocks, 1620-2700 m, Ir.-Tur. element, endemic, EN. Serpentinovag.
32. *Silene brevicalyx* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, S.W. side along road between the village of Ağla and the fire watehtower, 1250 m, open Pinus nigra forest, lat. 37°04'N, long. 28C49'E, 6 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23274 (holo. C, iso. El).Open Pinus nigra forest, on serpentine, 1250 m., E. Medit. Element, endemic, EN. Serpentinophyt.
33. *Silene cserei* Baumg. *ssp. aeoniopsis* (Bornm.) Chowdhuri
[Turkey A4 Ankara, Kalecik in valle Keci Deresi, 700-800 m, 7 vii 1929, Bornmüller 13884 (K!). Serpentine steps. Endemic, VU. Serpentinophyt.
34. *Silene salamandra* Pamp.
Serpentine rocks and sandy stream beds, 200-350 m., E. Medit. element, endemic to Rodhos, DD. Serpentinovag.
35. *Silene ruscifolia (*Hub.-Mor. & Reese) Hub.-Mor.
On serpentine,1300m Serpentinovag.
36. *Silene cariensis* subsp. *muglae* Vural & Donmez.
(Turkey) C2 Muğla: Koyceğiz, Sultaniye, Kersele stream, 15-30 m, in stream bed, metamorphic, Paratype: (Turkey) C2 Muğla: Koyceğiz, between Hamitkoy, Domuzdire. i hill and Kersele bay, 80-130 m, macchia, serpentine Paratypes, 80-130 m, macchia, serpentin, endemıc, new takson for science, LR(cd). Serpentinophyt.
37. *Silene koycegizensis* Donmez & Vural.
(Turkey) C2 Muğla: Koyceğiz, Candır village, Horozlar district, 20 m, fallow field, Paratypes: (Turkey) C2 Muğla: Koyceğiz, between Hamitkoy and Kersele bay, C2 Muğla: Marmaris National Park, Nimara Island, macchia, 100 m,Paratypes,

80-130 m, macchia, serpentine, endemıc, new takson for science, CR. Serpentinophyt.

LINACEAE

38. *Linum arboreum* L.
Macchie on rocky serpentine slopes, or on limestone cliffs, 200-700 m, E. Medit. element, nadir, VU Serpentinovag.
39. *Linum boissieri* Aschers. & Sint. ex Boiss.
Limestone and serpentine screes, 1700-2200 m, E. Medit. Element, endemic, EN. Serpentinovag.
40. *Linum virgultorum* Boiss. & Heldr.
Rocky serpentine and calcareous slopes, and in Pinus brutia forest, 50-400 m, E. Medit. element. Serpentinovag.

FABACEAE

41. *Astragalus zahlbruckneri* Hand.-Mazz.
On serpentine, etc., 1060-2450 m., Ir.-Tur. Element, endemic, VU. Serpentinovag.
42. *Trifolium mesogitanum* Boiss.
Serpentine slopes, s.L-600 m., E. Medit. Element. Serpentinovag.
43. *Trifolium rhizomatosum* O. Schwarz.
[Turkey C2 Muğla] Sandras Dağ Anatoliae austro-occidentalis, solo serpentina, c. 1500 m,On serpentine, c. 1500 m, endemic. Serpentinophyt.
44. *Cytisopsis dorycniifolia* Jaub. & Spach.
Stony ground on chalk or serpentine, often in macchie, 50-1700 m, E. Medit. Element, endemic, LR(nt). Serpentinovag.
45. Genista sandrasica Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, S.W. side, along road between the village of Ağla and the fire watchtower, 1750 m, open Pinus nigra forest, lat. 37°04'N, long. 28°49'E, 6 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23292 (holo. C, iso. B, E!EGE, G).S.W. Anatolia; local. C2 Muğla: Sandras D a , 1700 m, D. 13491 ! ibid, Contandr. et al. !Open Pinus nigra forest, on serpentine, 1700-1750 m., E. Medit. Element, endemic, EN. Serpentinophyt.
46. *Hedysarum antitauricum* Hub.-Mor. & Yurdakulol.
Turkey C5 Adana: Distr. Karaisali, Karsanti am Südfuss des Antitaurus, Şamadan Beli, QuercusjPinus pallasiana — Gehölz auf Serpentin, 1200 m, 30 v1973, Yurdakulol 91 (holo. Hb. Hub.-Mor., iso. ANK).
S. Anatolia. C5 Adana: d. Karaisali, Karsanti, Şamadan Beli, 1100 m, Yurdakulol 54Mixed Quercus/Pinus forest on serpentine, 1100-1200 m, E. Medit. element, endemic, EN. Serpentinophyt.
47. *Chamaecytisus gueneri* H.Duman, Başer & Malyer.
[Turkey] C2 Muğla; Köyceğiz, Sandras Dağ, between Ağla and Eskere, 1700 m, 25 vii 1992, open Pinus nigra forest, serpentine slopes, A. Güner 10760-A.A. Dönmez & H. Şağban, (holo. HUB!, iso. GAZI!, E!). SW. Anatolia, rare. C2 Muğla: Köyceğiz, Sandras Dağ, above Ağla, H. Duman 5716, K.H.C. Başer & A. Altıntaş'.: Muğla: Sandras Dağ, SW. side, along road between the village of Ağla and the fire watchtower, P. Hartvig 23277, Ö. Seçmen & A. Strid Open Pinus nigra forest, serpentine slopes, 1450-1700 m, E. Medit. element, endemic, CR. Serpentinophyt.
48. A*stragalus serpentinicola* H.Duman & Ekim.
Turkey C2 Burdur: Yeşilova, S. of Salda lake, clearings in Pinus nigra and Quercus forest, on serpentine, 1170-1200 m, 11 vii 1993, H. Duman 5078 & F.A. Karavelioğullan, (holo. GAZI!; iso. ANK!, B!, ISTE!); ibid. 12 vii 1993, H. Duman 5090 & F.A. Karavelioğullan (para. GAZI!). S. Anatolia. C2 Burdur: Yeşilova, S. of Salda lake, F.A. Karavelioğullan 2073! Denizli: Acıpayam, Olukbaşı (Abbas) village, Geyran Y., 1400-1650 m, Z. Aytaç 7635 & F.A. Karavelioğullan!Pinus nigra and Quercus sp. forest, on serpentine. 1150-1650 m, E. Medit. element, endemic, VU. Serpentinophyt.

APIACEAE

49. *Eryngium thorifolium* Boiss.
[S.W. Anatolia] in montibus Lyciae, aest. 1843, Pinard. S.W. Anatolia. Lycia: Nif Da, 5 vi 1881, Luschan. CI Muğla: between Datça and Marmaris, 6 km from Emecik, D. 35449! C2 Muğla: Sandras Da, above Ağla, 1520 m, D. 13591! C3 Antalya: d. Kemer, Tekirova, c. 1950 m, Heilbronn & Başarman. Rocky serpentine slopes, often in open Pinus forest, 50-1950 m, E. Medit. Element, endemic (A serpentine endemic, without near allies), LR(cd). Serpentinophyt.
50. *Scandix australis subsp. grandiflora (L.)* Thell.
Granite, serpentine or limestone slopes, steppe, fields and roadsides, 30-1300 m. Serpentinovag.
51. *Bupleurum anatolicum* Hub.-Mor. & Reese.
Open Pinus brutia forest, at least partly on serpentine, 70-1100 m., E. Medit. element, endemic, LR(nt). Serpentinovag.
52. *Microsciadium minutum* (d'Urv.) Briq.
Rocky limestone and serpentine slopes and screes, 10-1200 m, E. Medit. element, endemic, VU. Serpentinovag.
53. *Ferulago sandrasica* Peşmen & Quézel.
Turkey C2 Muğla: Sandras Dağ, rocaifies, 2000 m, J. Contandriopoulos, A. Pamukçuoğlu, P. Quézel (holo. E! iso. MARS).Rocky serpentine slopes, 2000 m, E. Medit. Element, endemic, EN. Serpentinophyt.
54. *Ferulago mughlae* Peşmen.
Macchie and forest, usually on serpentine, 20-880 m, E. Medit. Element, endemic (A distinctive endemic species.), LR(cd). Serpentinovag.
55. *Peucedanum arenarium* subsp. neumeyeri (Vis.) Stoj. & Stef.
Cl/2 Muğla: 20 km from Emicik, Datça to Marmaris,100 m, Dudley, D. 35452! 25-30 km from Hisarönü, Marmaris to Datça, 250 m, Dudley, D. 35420! Yugoslavia, Albania, Bulgaria, subsp. urbanii (Freyn & Sint. ex Wolff) Chamberlain, comb, et stat. nov. Syn: P. urbanii Freyn & Sint. ex Wolff in Feddes Rep. 20: 68 (1924). Steep slopes. Type: [Turkey Bl Balikesir] Troas; in monte Ida (Kaz Da.), circa fontes
Scamandri, 29 vii 1883, Sintenis 494 (iso. BM! E! K! LD!). Bl Çanakkale/Balikesir: Kaz Da., 1500 m, 1968, Quézel et al.Serpentine cliffs. 100-250 m., endemic, VU. Serpentinophyt.
56. *Eryngium pseudothoriifolium* Contandr. & Quézel.
On marly soil, c.100 m, E. Medit. element, endemic *(E. thorifolium* being a serpentine endemic.), VU. Serpentinovag.
57. *Eryngium trisectum* A. Worz & H.Duman.
(Turkey) Mittl. Taurus. Konya: Kızıl Da. zw. Beyflehir und Akseki, Zufahrt zu Gipfel, 37°21'17.5"N,
31°4'1.9"E, gerollreicher Abhang, Serpentin [=Turkey, Central Taurus, Konya: Kızıl Da.

between Beyflehir and Akseki, access road to the summit, stony slope, serpentine],access road to the summit, stony slope, serpentine, endemic, new takson for science, CR. Serpentinophyt.

58. *Eryngium davisii* Kit Tan & Yıldız.
Calcareous and serpentine steppe, 950-2100 m., E. Medit element, endemic, LR(cd). Serpentinovag.
59. *Ekimia bornmuelleri* (Hub.-Mor. & Reese) H.Duman & M. F. Watson.
[Turkey C2 Burdur] Pisidien, Dirmil-Tefenni, 34 km nach Dirmil, 26 km vor Tefenni, Trift, Rand eines Weizenackers, 1000 m. 9 vi 1938, Reese. Renz & Huber-Morath 5668 (holo. G-Herb. Hub.-Mor.!).
SW. Anatolia. C2 Burdur: d. Yeşilova, S. of Salda lake, 1150 m, H. Duman 5071 & F.A. Karavelioğulları; ibid., N. Özhatay, E. Özhatay & H. Duman (İSTE 72127!); Tefenni-Çavdır, 15 km from Tefenni, 1100 m, H. Duman 5944-M. Ekici & A. Duran\; Denizli: Acıpayam, around Gölhisar road junction, 1000 m, 37°16.5'N, 29°33.8'E, A. Güner 12778 & al A On serpentine, Quercus scrub, stony slopes, 1000-1250 m., E. Medit element., endemic, VU. Serpentinophyt.
ASTERACEAE
60. *Helichrysum stoechas (L.)* Moench.
Macchie on limestone, Pinus brutia forest on serpentine, chalky cliff-tops, s.L-700 m. Serpentinovag.
61. *Helichrysum orientale* (L.) DC.
Limestone cliffs, macchie and Pinus brutia woods on serpentine, 30-700 m, Aegean. Medit. Element. Serpentinovag.
62. *Senecio sandrasicus* P.H.Davis.
[Turkey C2] Prov. Muğla, dist. Köyceğiz (Caria). Sandras Dağ above Ağla, 1300 m, 22 vii 1947, Davis & Bilger [Karamanoğlu], D. 13561 (holo. E! iso. Kİ). S.W. Anatolia. C2 Muğla: Sandras Da. , 1600 m, 1968, Quézel et. al. :Marmaris,30 m, D. 25382Rocky slopes on serpentine, nr S.I.-1600 m, E. Medit. Element, endemic, LR(cd). Serpentinophyt.
63. *Anthemis cretica L. subsp. leucanthemoides* (Boiss.).
Cliffs, rocky serpentine slopes and pine woods, 200-1600 m. Serpentinovag.
64. *Achillea sipikorensis* Haussk. & Bornm.
Steppe, gypsum and serpentine hills, 1450-1800 m, Ir.-Tur. Element, endemic, LR(cd). Serpentinovag.
65. *Cousinia sivasica* Hub.-Mor.
Serpentine hills, limestone slopes, steppe, 950-1700 m, endemic, VU. Serpentinovag.
66. *Ptilostemon chamaepeuce* (L.) Less.
Limestone cliffs, rarely on serpentine soil, s.l-850 m. Serpentinovag.
67. *Serratula kurdica* Post.
[N.W. Syria] in monte Kurd Dagh Syriae borealis, vi 1891, Shepard 58(BEI!).S. Anatolia (Amanus & Kurd Da.). C6 Adana: d. Osmaniye, Yağlipinar S. Of Yarpuz, 1150-1350 m, Hub.-Mor. 15853! Hatay: Amanus Da., W. of Achagi Zarkoun (Aşağı Zerkum), 1400-1700 m, vi 1932, Delbèsl Meşelik mevkii,
burunsuzun tepesi, Arsuz to Amanus Da., c. 800 m, Akman 212!Pinus brutta woods, on gabbro & serpentine, 800-1700 m., E. Medit. Element. Serpentinophyt.
68. *Centaurea ensiformis* P.H.Davis.
Turkey C2 Muğla: Dist. Köyceğiz (Caria), Sandras Da. above Ağla, nr
Gökçe Ova, 1700 m, on serpentine in open Pinus nigra subsp. pallasiana forest,
23 vii 1947, Davis Sc Bilger [Karamanoğlu], D. 13510 (holo. E! iso. GOET! K).Pinus nigra forest, c. 1700 m, E. Medit. (mt.),endemic, VU. Serpentinophyt.
69. *Echinops pungens* var. *pungens* Trautv.
Rocky limestone, serpentine and igneous slopes in steppe, fallow fields, roadsides, 1100- 2700 m., Ir.-Tur. Element. Serpentinovag.
70. *Echinops pungens* var. *polyacanthus* (Iljin) Hedge.
Rocky limestone, serpentine and igneous slopes in steppe, fallow fields, roadsides, 1100-2700 m., Ir.-Tur. Element, nadir, DD. Serpentinovag.
71. *Echinops pungens* var. *adenoclados* Hedge.
Rocky limestone, serpentine and igneous slopes in steppe, fallow fields, roadsides, 1100- 2700 m., Ir.-Tur. element., Endemic, LR(nt). Serpentinovag.
72. *Echinops pungens* var. *transcaucasicus* (Iljin) Hedge.
Rocky limestone, serpentine and igneous slopes in steppe, fallow fields, roadsides, 1100- 2700 m., Ir.-Tur. Element, nadir, VU. Serpentinovag.
73. *Scorzonera suberosa subsp. suberosa* C.Koch.
Loamy banks, steppe, hillsides on gypsum and serpentine, 1000-2500 m., Ir.-Tur. Element, endemic. Serpentinovag.
74. *Scorzonera argyria* Boiss.
endemic, DD. Serpentinovag.
75. *Scorzonera cinerea* Boiss.
Rocky calcareous or serpentine slopes,1200-2800 m., Ir.-Tur. element. Serpentinovag.
76. *Scorzonera acantholimon* Hand.-Mazz.
Rocky slopes on calcareous soil or serpentine, 1500-2400 m., Ir.-Tur. element, endemic, LR(lc). Serpentinovag.
77. *Scorzonera kotschyi* Boiss.
Among Quercus scrub, on limestone and serpentine, nr s.L-1250 m., Ir.-Tur. element. Serpentinovag.
78. *Crepis foetida* subsp. *Commutata* (Spreng.) Babcock.
Quercus and Pinus woods, serpentine, igneous or limestone slopes, steppe, fieldsides, s.L-1200 m. Serpentinovag.
79. *Scorzonera pisidica* Hub.-Mor.
Turkey C2 Burdur: Distr. Tefenni, Quercus coccifera—Bestand 3 km. nördlich von Dirmil (Altinyayla), 1200-1270 m, 27 vi 1948, A. Huber-Morath 8485& H. Reese (holo. Hb. Hub.-Mor). S.W. Anatolia. C2 Burdur: 6 km S. of Dirmil, 1600-1650 m, Hub.-Mor. 8486 & ReeseQuercus scrub, serpentine slopes, 1200-1650 m., E. Medit. element., endemic,VU. Serpentinophyt.
80. *Scorzonera sandrasica* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, W. of the summit, 1970 m, slightly sloping stony flat (snowbed) near a small creek close to timberline, serpentine, lat. 37°04'N, long. 28°50'E, 7 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23342 (holo. C,iso. E! EGE).Moist gravelly or stony flats (snowbeds) on serpentine, c. 2000 m, E. Medit. Element, endemic, VU. Serpentinophyt.
81. *Tragopogon oligolepis* Hartvig & Strid.

Turkey C2 Muğla: Sandras Dağ, W. of the summit, 1970 m, slightly sloping stony flat (snowbed) near a small creek close to timberline, serpentine, lat. 37=04'N, long. 28C50'E, 7 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23341 (holo.C). S.W. Anatolia. C2 Muğla: Sandras Da. nr Gökçe ova, 1700 m, D. 13495! Sandras Da., 1525 m, D. 13616Moist gravelly or stony flats (snowbeds) on serpentine, with sufficiently deep mineral soil, 1500-2000 m., E. Medit. Element, endemic to Sandras Da, EN. Serpentinophyt.

82. *Pilosella sandrasica* Hartvig & Strid.
Turkey C2 Muğla: Sandras Dağ, S.W. foothills, c. 4 km S.W. of the village of Ağla, 500 m, opening in Pinus brutia forest, serpentine, lat. 37°03'N, long. 28°47'E, 6 vii 1984, P. Hartvig, Ö. Seçmen & A. Strid 23256 (holo. C, iso. E! EGE, G)Clearing in Pinus brutia forest, on serpentine, 500 m, E. Medit. (mt.) element, endemic, EN. Serpentinophyt.
83. *Senecio leucanthemifolius* Poir.
Rocky slopes, dry river beds, dry pastures, coastal sands and salt marshes, olive groves, ruderal places, on serpentine,0 -400 m. Serpentinovag.
84. *Anthemis karacae* Güner.
Turkey C2 Muğla: Köyceğiz, Ekincik Köyü, Pinus brutia forest, on serpentine, O^tO m, 17 iv 1991, A. Giiner 8764a-M. Vural, H. Duman, A.A. Dönmez & B. Mutlu (holo. AIBU!; iso. GAZI'., E!)Pinus brutia forest, metamorphic rock, 0-40 m., E. Medit.element, endemic. Serpentinophyt.
85. *Cirsium dirmilense* R.M.Burton.
Open Pinus nigra and/or Cedrus libani forests, mountain steppe, calcareous or serpentine slopes, 1250-1850 m, E. Medit. (mt.) element, endemic, EN. Serpentinovag.
86. *Tragopogon sinuatus* Avé-Lall.
Rocky and sandy places by sea, cultivated or fallow fields, vineyards, olive groves, on a variety of substrates (limestone, schist, serpentine), s.L-700 m. Serpentinovag.
87. *Achillea sivasica* Celik & Akpulat.
Turkey, B6 Sivas: Ulaş, Distr. of Kovalı, Ziyarettepe, serpentine steppe, '4699;32 37°01'18"E, 1350-1400 m serpentine steppe, 1350-1400 m, endemıc, new takson for science, CR. Serpentinophyt.
88. *Centaurea aksoyi* Hamzaoğlu & Budak.
Turkey, B5 Yozgat: between Şefaatli and Yerkoy, Karanlıkdere valley, Adatepe, '2899;34 34°40'23"E, 850 m a.s.l., serpentine rocks, 6.vii.2006, Hamzaoğlu & Budak 850 m a.s.l., serpentine rocks, endemic, *new takson for science,CR.* Serpentinophyt.
89. *Centaurea yaltirikii* N. Aksoy, H. Duman & A.Efe.
Turkey, A3 Duzce: Golyaka, Elmacık Dağı, upper side of Eft eni Lake, the road of Guzledere waterfall, slopes of basalt rocks in maquis area, 568 m a.s.l., Paratype: Turkey, A3 Duzce: Elmacık Dağı, Konaş Ardi, Melkikderesi, serpentine rocks, 1085 m a.s.l., under and beside Pinus sylvestris forest paratype, serpentine rocks, 1085 m a.s.l.,under and beside Pinus sylvestris forest, endemic, *new takson for science, CR.* Serpentinophyt.
90. *Centaurea serpentinica* A.Duran & B.Doğan.
Turkey, C5 Kayseri: Yahyalı, between Kapuzbaşı and Aladağ, 15 km, 1080 m a.s.l., endemic, *new takson for science, CR.* Serpentinophyt.
91. *Jurinea tortumensis* A.Duran & B.Dogan.
Turkey, A8 Erzurum: Tortum to Erzurum, 7 km, serpentine stony place, 1880 m a.s.l., 40°15.08 'N, 41°31.59'E Serpentine stony place, 1880 m, endemic, *new takson for science, CR.* Serpentinophyt.
92. *Caucasalia kizildaghensis* E.Uzunhisarcıklı, E.Doğan et H. Duman (caucasalia new genus for Turkish flora), *(Turkey) C3 Konya: Derebucak, Camlık, Kızıl Dağ, 1600-1700 m, serpentine rocky slopes, open area of a Pinus nigra forest, endemıc, new takson for science, CR.* Serpentinophyt.
93. *Scorzonera coriacea* A. Duran & Aksoy.
TURKEY. C3 Konya: Derebucak, Çamlık district, Kızıldağ, serpentine stony places, 1400 m, 37º21.869'N 31º40.501'E, 12.VI.2009open Pinus nigra forest and on the serpentine stony slopes, 1400m, endemic. Serpentinophyt.
94. *Centaurea anthemifolia* Hub.-Mor.
C5 Konya: Ereğli, Aydos Dağı, Deli-mahmutlu village, rocky serpentine slopes, 1600 m rocky serpentine slopes, 1600m. Serpentinophyt.
95. *Psephellus coruhensis* A.Duran & M.Öztürk *sp. nova*
Turkey. A8 Artvin: between Yusufeli-Sarıgöl, 2th km, 630 m, 31.v.2003, stony slopes, 40°50.820'N,41°32.339'E, eroded serpentine stony slopes, endemic. Serpentinophyt.

CAMPANULACEAE

96. *Campanula strigillosa* Boiss.
On limestone and serpentine rocks, c. 1350-1800 m, E. Medit. (mt.) element, endemic, LR(cd). Serpentinovag.
97. *Campanula oligosperma* Damboldt.
Turkey B7] Tunceli, d. Pülümür, Pülümür-Mutu, Serpentinschutt am Pass, 8 km ob Pülümür, 1760 m, Huber-Morath 11074 (holo. Hb. Hub.-Mor. iso. E!). E. Anatolia; local. B7 Erzincan/Tunceli: on Pülümür pass, 1950 m, Holtz et al. 00.768!Alpine pastures, serpentine screes, 1760-1950 m., Ir.-Tur. Element, endemic, LR(cd). Serpentinophyt.

ERICACEAE

98. *Erica manipuliflora* Salisb.
Open places, macchie, under Pinus brutia, limestone, serpentine and schistose rocks, s.L-1530 m,
E. Medit.element. Serpentinovag.
99. *Arbutus andrachne* L.
Macchie Pinus brutia forest, on igneous, serpentine and limestone substrata, s.L-800 m. Serpentinovag.

LENTIBULARIACEAE

100. *Pinguicula crystallina* Sm. in Sibth. & Sm..
In spray zone of permanent springs, rivulets and waterfalb, rocky mossy places in Pinus brutia and P. nigra belts, on serpentine and limestone,1050-1700 m, E. Medit. element. Serpentinovag.

PRIMULACEAE

101. *Androsace armeniaca* var. *macrantha* (Boiss. & Huet) Martelli.
Limestone and igneous rocks and screes, serpentine and schistose rocky slopes,alpine pastures, 900-2600 m., Ir.-Tur. element., endemic, LR(lc). Serpentinovag.

102. *Cyclamen trochopteranthum* O.Schwarz.
Stony ground underbushes, Pinus brutia forest, on limestone or serpentine, 350-1100 m., E. Medit. element., endemic, LR(lc). Serpentinovag.
103. *Lysimachia linum-stellatum* L.
Open Quercus aegilops scrub, on serpentine and rocky limestone slopes, clay soil, s.l.-1200 m, Medit. element. Serpentinovag.
CONVOLVULACEAE
104. *Convolvulus aucheri* Choisy.
Stony limestone slopes, Pinus forest, on gabbro and serpentine, 50-1700 m., E. Medit. element. Serpentinovag.
105. *Convolvulus oleifoiius* Desr.
Macchie, limestone and serpentine cliffs, s.1.-250 m, Medit. element. Serpentinovag.
106. *Convolvulus compactus* Boiss.
Open Pinus nigra woodland, Quercus coccifera macchie, steppe, screes, chalky and serpentine slopes, eroded hills, grazed fields, 200-2135 m, This species grows in both Medit. and Ir.-Tur. Territory. Serpentinovag.
107. *Convolvulus libanoticus* Boiss.
Mountain pastures on limestone and serpentine, 1600-2670 m, E. Medit. Element. Serpentinovag.
108. *Convolvulus carduchorum* Davis.
[Turkey B9] Bitlis-Tatvan, 1700 m, disturbed steppe, 30 vi 1954, Davis & O.Polunin, D. 23382 (holo. E! iso. K!). E. Anatolia. B/C6 Malatya: Malatya to Kahta, Hand.-Mazz. 2226 (type of C. anatolicus)\ B7 Tunceli: d. Pülümür, pass between Pülümür and Mutu,1780 m, Hub.-Mor. 15657 (type of C. glabrescens)! B7 Elaziğ: Hasanbaba Da,2100 m, Hand.-Mazz. 2572 (type of C. orophilus)l B7/8 Eiaziğ/Muş: Elaziğ toMuş, 4 vii 1963, M.Zoharyl C7 Adiyaman: between Kumik and Bekikara (Malatya to Kahta), 1900 m, Hand.-Mazz. 2226 (as C. cataonicus)\Alpine pastures, Astragalus steppe, disturbed steppe, on serpentine, 1700-2100 m., Ir.-Tur. Element, endemic. Serpentinophyt.
109. *Convonvulus pseudoscammonia* C.Koch.
[Turkey A8 Erzurum] im Gaue Sber auf Porphyr und Kalk, 1067-1219 m, C.Koch (B, destroyed).
Mainly N.E. Anatolia. A6 Sivas: 32 km from Suşehri to Zara, 1300 m, Stn. & Hend. 5763! A7 Gümüşane: Ardas (Torul) to Beşkilise, Sint. 1889:1335 (syntypeof C. cappadocicus) ! A8 Çoruh: Çoruh river between Tzria (Sirya) and Ordshoch, Woronow 271! Erzurum: 8 km N.E. of Tortum, 1450 m, Hub.-Mor. 15654.A9 Çoruh: Ardanuç, 500-600 m, D. 30166! B7 Erzincan: Eğin (Kemaliye), Sint.1890:2864 (isolectotype of C. Stony slopes, serpentine screes, eroded shaly clay hills, 450-1450 m, Ir.-Tur. element, endemic. Serpentinophyt.
BORAGINACEAE
110. *Rochelia disperma* var. *microcalycina* (Bornm.) Edmondson.
Sandy fields, alpine grassland on schist and serpentine, 1550-2100 m, Ir.-Tur. Element, Endemic, LR(lc). Serpentinovag.
111. Asperugo procumbens L.
Limestone and serpentine slopes, among rocks, fields and field margins, 80-2200 m, Euro-Sib. element. Serpentinovag.
112. *Paracaryum ancyritanum* Boiss.
Steppe, slate, serpentine, chalk and mudstone slopes, fallow fields, stony disturbed ground, 500-1500 m, Ir.-Tur. element, endemic, LR(lc). Serpentinovag.
113. *Onosma sericeum* Willd.
Quercus scrub, serpentine, limestone slopes and screes, etc., 400 -2290 m., Ir.-Tur. Element. Serpentinovag.
114. *Onosma cappadocicum* Siehe ex H.Riedl.
Turkey C5 Adana: Masmutli Dagh (Ala Da.), 1800 m, vii 1907, Siehe [107] (holo. W! iso. E! GE!). Assigned to Niğde in original publication. S. Anatolia (Taurus). C5 Niğde: Bereketli Maden (Çamardi), 1800 m, Siehe
s.n. Adana: Karsanti, Akinek, 1550 m, Yurdakulol 45! Hizar pass, 1800 m, Yurdakulol (ANK 10026).Serpentine rocks,clearings in Pinus nigra forest, 1550-1800 m., E. Medit. (mt.) element, endemic, LR(cd). Serpentinophyt.
115. *Onosma mite* Boiss. & Heldr.
[Turkey C3 Antalya] in pinetis apricis ad radices montis Taktalu (Tahtali Da.) Lyciae supra portum Tcherali, [13 v 1845,] Heldreich [1088](holo. G). S.W. Anatolia. C2 Antalya: Katran Da. to Kaş, Kasaba Ovasi, Bozakman & Fitz 1970:320! C3 Antalya: Adrasan Körfezi between Çirali and Finike,Hub.-Mor. 9745; Kayran, N.E. of Antalya, Bozakman & Fitz 1970:175!Serpentine rocks, Pinus brutia forest, nr s.L-1900 m, E. Medit. element. Serpentinophyt.
116. *Anchusa strigosa* Labili.
On serpentine, limestone banks, waste places, 150-1300 m. Serpentinovag.
SCROPHULARIACEAE
117. *Verbascum serratifolium* (Hub.-Mor.) Hub.-Mor.
[Turkey B3] Eskişehir: Eskişehir - Kütahya, Wegrand 25 km südwestlich Eskişehir, 950 m, 13 vi 1954, Huber-Morath 12297 (holo. Hb. Hub.-Mor.!).C. Anatolia. B3 Eskişehir: 41 km from Eskişehir to Saricakaya, 320 m,
Buttler 13348! Kütahya: 64 km S.W. from Eskişehir to Kütahya, 900 m, Hub.-Mor. 12298! B4 Ankara: Elma Da., Hisar Köy, Kilinç 153!Pinus forest, phrygana,roadsides,dry slopes, serpentine rocks, 300-950 m., Pinus forest, phrygana,roadsides,dry slopes, serpentine rocks, 300-950 m., endemic, LR(cd). Serpentinophyt.
118. *Verbascum serpenticola* Hub.-Mor.
[Turkey C2] Burdur: Serpentinschutt auf dem Pass 6 km südlich obDirmil (Altinyayla), 1600 m, 28 vi 1948, Renz & Huber-Morath, Hub.-Mor. 8249 (holo. Hb. Hub.-Mor.! iso. Hb. Basier Bot. Ges.!).Serpentine scree, 1600 m, E. Medit. (mt.) element., endemic, CR. Serpentinophyt.
119. *Verbascum adenophorum* Boiss.
[Turkey C2 Muğla/Denizli] in Caria, aestate 1843, Pinard (holo. G!). S.W. Anatolia. C2 Muğla: Sandras Da, S.W. side above Ağla, Fitz & Spitz.758! Burdur: pass 6 km S. above Dirmil (Altinyayla), 1600 m, Hub.-Mor. 8032!Serpentine rubble, c. 1600 m., E. Medit. Element, endemic, LR(cd). Serpentinophyt.
120. *Verbascum heterobarbatum* Hub.-Mor.
[Turkey B4] Ankara: d. Çankaya, Wegrand 9 km südlich Gölbaşi, 870 m, 1 vi 1956, Huber-Morath 14075 (holo. Hb. Hub.-Mor.!).C. Anatoiia. A4

Ankara: Kaleçik, nr Çukur Köy, Kilinç 1975:141 ! B4 Ankara:
Beynam, D. 13005Roadsides, steppe, fallow fields, serpentine slopes, 870-1020 m., Ir.-Tur. Element, endemic, LR(cd). Serpentinophyt.

121. *Verbascum trichostylum* Hub.-Mor.
[Turkey B7] Erzincan: d. Refahiye, Refahiye - Suşehri, Weizenfeldrand 19 km N.W. Refahiye, 1600 m, 7 vii 1955, Huber-Morath 13060 (holo. Hb. Hub.-Mor.!). E. Anatolia. A7 Sivas/B7 Erzincan: 18-22 km N.W. of Refahiye, 1560 m, Hub.-Mor. 14754! B7 Erzincan: 52 km from Erzincan to Refahiye, 2000 m, Rech. 15188!Roadsides,wheat-fields, serpentine slopes, 1560-2000 m., Ir.-Tur. Element, endemic, EN. Serpentinophyt.

122. *Verbascum renzii* Hub.-Mor.
Pinus forest,macchie, limestone rocks and scree, and on serpentine, s.L-1500 m., E. Medit. Element, endemic, LR(cd). Serpentinovag.

123. *Verbascum eriorrhabdon* Boiss.
Picea orientalis forest, serpentine slopes, roadsides, 300-1400 m, Euxine element, endemic, VU. Serpentinovag.

124. *Verbascum chazaliei* Boissieu.
[Turkey C3 Antalya] Lycie, à Chiralu (Çirali), en montant à la Chimère, 1894, H. de Boissieu (holo. P). S.W. Anatolia. C3 Antalya: Tekirova bay, E. foot of Tahtali Da, s.l.-100 m, Hub.-Mor. 5934 Pinus brutia forest, macchie,serpentine rocks, s.L-300 m., E. Medit. Element, endemic, LR(cd). Serpentinophyt.

125. *Scrophularia pegaea* Hand.-Mazz.
Limestone and serpentine rocks, alpine steppe, 1900-2200, Ir.-Tur. Element. Serpentinovag.

126. *Scrophularia lucida* L.
Limestone and serpentine cliffs, rocky slopes and scree, dry riverbeds, l.0-2200 m, Medit. element. Serpentinovag.

127. *Chaenorhinum litorale* (Bernh.) Fritsch.
Valleys, screes, sandy soil and on serpentine, 1000-1650 m, E. Medit. Element, endemic, LR(lc). Serpentinovag.

128. *Digitalis cariensis* Boiss. ex Jaub. & Spach.
In coniferous forests(Cedrus, Abies cilicica, Pinus nigra), Quercus woods, rocky slopes (limestone and serpentine), rarely screes, 800-1700 m., E. Medit. Element, endemic, LR(lc). Serpentinovag.

129. *Veronica balansae* Stroh.
[Turkey CS içel] circa pagum Ala Dagh sex leucis ('7 Heues') ad septentrionem portus Mersina in Cilicia sito, 16 v 1855, Balansa 688 (holo. G, iso. G!JE! W!). Mainly S. Anatolia; rare. B5 Kayseri: Erciyas Da, Tekir Y , 2200 m, 30 vi 1902, Zederbaueri CS Adana: Kassan Oghlu (Hasanoğlu), nr Gorumse (Gürümze), c. 1400 m, Kotschy 1859: 59 p.p. (type of V. gorumsensis)'. C5/6 Adana: Sis (Kozan) to Hadjin (Hacin, = old Saimbeyli), 4 vii 1906, G. & B.Post! C6 Hatay: 8 km S. of Dörtyol, 100 m, Coode & Jones 519! Maraş: Çatak (13 km
S. of Andirin), 900 m, Coode & Jones 1158B! C7 Urfa: Kainar (Kaynak?) nr Siverek, Sint. 1888:691 p.p.!Moist places in alpine pastures, abandoned alpine fields,serpentine gravel, deciduous foresti ?), 100-2200 m., E. Medit. element(?)., endemic, LR(lc). Serpentinophyt.

130. *Verbascum basivelatum* Hub.-Mor.
Turkey B3 Eskişehir: Türkmen Da, Porsuk baraji, auf Serpentinfelsen, zirka 900 m, 16 vi 1976, T. Ekim ANK 2071 (holo. Hb. Hub.-Mor, iso. ANK).Serpentine rocks, c. 900 m, Ir.-Tur. element., endemıc, LR(cd). Serpentinophyt.

131. Verbascum tuna-ekimii.
Turkey B7 Erzincan: between Erzincan and Kemaliye Calcerous and serpentine stony slopes and along roadsides 1150m, Ir.-Tur. Element, endemic, Recommended, EN. Serpentinovag.

GLOBULARIACEAE

132. *Globularia trichosantha* Fisch. & Mey.
*Rocky and grassy slopes, forest clearings, on limestone, serpentine and volcanic rocks, steppe, 200-2470 m., ,endemic,*EN. Serpentinovag.

LAMIACEAE

133. Teucrium sandrasicum O. Schwarz.
[Turkey C2 Muğla] dist. Fethiye, in pinetis apertis lapidosis inter monte Caldağ et Pirnasdağ ad. jugum Kirkpinar solo serpentinico, c. 1200-1500 m, 15 viii 1938, Schwarz 416 (holo. JE).
S.W. Anatolia. C2 Muğla: 43 km from Muğla to Fethiye, 70 m, Dudley (D.35142)! Köyceğiz to Fethiye, T. Baytop (İSTE 11138)! Kizübel, 1966, Peşmen & Aydar! Sandras Da. above Köyceğiz, 1100-1500 m, D. 13559!Open Pinus nigra forest and. macchie, on serpentine, 70-1800 m, E. Medit. Element, endemic, LR(cd). Serpentinophyt.

134. *Teucrium alyssifolium* Stapf.
[Turkey C2 Muğla] Lycia, ad Chertek (Kertek), 8 vi 1882, Luschan (holo. WU!) S.W. Anatolia. C2 Muğla: Fethiye to ÇameU, Göztepe, 1600 m, Contandriopoulos & Quézel 73-41 (!).On serpentine rocks, c. 1600 m., E. Medit. Element, endemic, LR(cd). Serpentinophyt.

135. *Teucrium chamaedrys* subsp. *lydium* O. Schwarz.
Pinus nigra forest, macchie, stony serpentine slopes, open slopes, 500-1700 m., E. Medit. Element. Serpentinovag.

136. *Scutellaria orientalis* subsp. *orientalis* Syn: *S. caucasico* A. Ham.
Rocky igneous (incl. serpentine) and shaley hillsides, 450-1500 m., Ir.-Tur. Element. Serpentinovag.

137. Scutellaria orientalis subsp. bornmuelleri (Hausskn. Ex. Bornm.) Edmonson.
Lectotype (chosen here): N. Iraq, Riwandous (ad fines Persiae) in monte Händarin, 1200 m, 21 vi 1893, Bornmüller 1691 (BM! E!). S.E. Anatolia. B9 Van: Artos Da. above Gevaş, 2135 m, D. 22692! ibid.,
1800-2000 m, Ehrend, et al. 787-92-1! Gurundaşt, Şatak (Çatak) to Van, 1900 m, Nâbelek 1609! C9/10 Hakkari: Cilo Tepe, 3000 m, D. 24028 (a rather dwarf alpine form)! CIO Hakkari: 40 km from Yüksekova to Başkale,1650 m, A. Baytop (ISTE 41276)!Montane steppe, on serpentine rocks, 1600-3000 m, Ir.-Tur. Element. Serpentinophyt.

138. Phlomis bourgaei Boiss.
Macchie, Quercus scrub, Pinus woods, calcareous and serpentine rocks, s.l.-lOOO m, E. Medit. Element, endemic, LR(nt). Serpentinovag.

139. *Phlomis lycia* D. Don.
[S.W. Turkey] in sylvis montanis, Lycia septentrionalis, Fellows. S.W. Anatolia, Islands. CI Aydin: Söke, 1962, Regel! Muğla: 5 km from Milas

to Bodrum, 130 m, Hub.-Mor. 16539! C2 Muğla: 4 km above Muğla, 900 m, Hub.-Mor. 12289! Antalya: Fethiye to Kale, above Kalkan, 80 m, Simon 69-830! (Greece) Is: Kastellorizo, Insula Strongili, 70-100 m, Greuter 11710! C3 Antalya: Termessus, 600 m, D. 15448! Is: Kalimnos, Gathorne-
Hardy 342! Tilos, 190 m, Gathorne-Hardy 136! Simi, 300 m, Rech. 8462.Macchie, Quercus scrub, Pinus brutia forest, serpentine cliffs, s.L-900 m, E. Medit. Element, endemic, LR(lc). Serpentinophyt.

140. *Phlomis angustissima* Hub.-Mor.
*Dry slopes, limestone and serpentine scree, 1100-2170 m,*endemic, *VU.* Serpentinovag.

141. *Lamium sandrasicum* P.H. Davis.
[Turkey C2] Muğla: distr. Köyceğiz (Caria), Sandras Dağ, 2200 m, 23 vü 1947, P.H. Davis 13548 (holo. K! iso. E!). S.W. AnatoUa. C2 Muğla: Sandras Da., E. Özhatay (İSTE 19448! 20278!).Serpentine gulliesnr snow line, c. 2200 m, E. Medit. (mt.) element., endemic, EN. Serpentinophyt.

142. *Sideritis leptoclada* O. Schwarz & P.H. Davis.
Pinus brutia forest, serpentine rocks, conglomerate ledges and scree, s.L-800 m, E. Medit. Element, endemic, LR(cd). Serpentinovag.

143. *Stachys cretica* subsp. *lesbiaca* Rech. fil.
Rocky ruins on mountain slopes, on serpentine,trachyte etc. , 220-400 m., E. Medit. Element, endemic, LR(nt). Serpentinovag.

144. *Stachys iberica* Bieb.
Sloping limestone or serpentine rocks and screes, streams and riversides, steppes and igneous banks, 800-2400 m. Serpentinovag.

145. *Stachys iberica* subsp. *stenostaehya* (Boiss.).
Igneous rocky slopes and serpentine screes, sometimes in field banks, 450-1900 m, Ir.-Tur. Element. Serpentinovag.

146. *Stachys arvensis* (L.) L.
Fallow fields, on serpentine soil, open sward in Pinus brutia forest, s.l.-lOO m. Serpentinovag.

147. *Nepeta fissa* C.A. Meyer.
Volcanic and serpentine rocks, screes, slopes, steppe, dry or moist banks, (540-jll00-1950 m, Ir.-Tur. Element Serpentinovag.

148. *Origanum hypericifolium* O. Schwarz & P.H. Davis.
Calcareous and serpentine rocks and slopes, sometimes in Pinus nigra forest,1300-2000 m, E. Medit. Element, endemic, LR(cd). Serpentinovag.

149. *Acinos troodi* (Post) Leblebici.
[Turkey C2 Muğla] Sandras Da. nr Gökçe ova, on serpentine, 1700m, 23 vii 1947, Davis 13499 (holo. E!).
S.W. Anatolia. C2 Muğla: Sandras Da., 2200 m, D. 13553! Sandras Da., Beşparmak, 1900 m, N. & E. Özhatay s.n.!Rocky slopes on serpentine,1700-2200 m., E. Medit. (mt.) element, endemic. Serpentinophyt.

150. *alvia blepharochla*ena Hedge & Hub.-Mor.
Limestone and serpentine slopes, 1000-1620 m, Ir.-Tur. element., endemic, LR(nt). Serpentinovag.

151. *Salvia vermifolia* Hedge & Hub.-Mor.
Igneous and serpentine slopes, c. 1450 m, Ir.-Tur. Element, endemic, VU. Serpentinovag.

152. *Stachys sivasica* Kit Tan & Yıldız.
Calcareous and serpentine rocks, 1400 -1500 m, Ir.-Tur. Element, endemıc, EN. Serpentinovag.

153. *Sideritis ozturkii* Z. Aytaç et A. Aksoy.
B3 Konya: Derebucak, Kızıldag, 3 km N of Çamlık town 1450-1700 m, serpentine rocky place and clearings of Pinus nigra forest, endemic, *EN.* Serpentinophyt.

PLUMBAGINACEAE

154. *Goniolimon collinum* (Griseb.) Boiss.
Steppe, fallow fields, chalky and serpentine hills, stream beds, 100-750 m, E. Medit. element. Serpentinovag.

155. *Acanthalimon spirizianum* var. *spirizianum.* Mobayen.
Rocky limestone and serpentine slopes, mountain steppe,1180-2700 m, Ir.-Tur. element. , endemic, LR(cd). Serpentinovag.

156. *Acanthalimon spirizianum* var. *multiflorum* Bokhari.
Rocky limestone and serpentine slopes, mountain steppe,1180-2700 m, Ir.-Tur. element. , endemic, LR(cd). Serpentinovag.

157. *Acanthalimon ulicinum* var. *ulicinum.* Ic: Jaub. & Spach.
Stony slopes, on limestone and serpentine, exposed mountain tops, screes, 1200-3000 m, E. Medit. element. Serpentinovag.

158. *Acanthalimon ulicinum* var. *creticum* (Boiss.) Bokhari & Edmondson.
Stony slopes, on limestone and serpentine, exposed mountain tops, screes, 1200-3000 m, E. Medit. element. Serpentinovag.

159. *Acanthalimon ulicinum* var. *purpurascens* (Bokhari) Bokhari & Edmondson.
Stony slopes, on limestone and serpentine, exposed mountain tops, screes, 1200-3000 m, E. Medit. element, endemic, LR(cd) Serpentinovag.

160. *Acanthalimon ulicinum* subsp. *lycaonicum* (Boiss. & Heldr.) Bokhari & Edmondson.
Stony slopes, on limestone and serpentine, exposed mountain tops, screes, 1200-3000 m, Ir.-Tur. Element. Serpentinovag.

161. Acantholimon capitatum subsp. *sivasicum* Dogan et Duman.
(Turkey) B6 Sivas: Ulaş, between Kutlukaya and Boğazdere village 1400-1500 m, serpentine, steppe,, endemıc, new takson for science, CR. Serpentinophyt.

162. *Acantholimon koycegizicum* Doğan & Akaydın.
Turkey C2 Muğla: Köyceğiz around Sultaniye, serpantin slopes Serpentine mountain slopes 20m, Medit. element, endemic. Serpentinophyt.

THYMELAEACEAE

163. *Daphne sericea* Vahi.
On limestone, serpentine and shale, open Pinus brutta forest, Quercus coccifera-Arbutus macchie, s.1.-1500m, , E. Medit. Element. Serpentinovag.

164. *Thymelaea tartonraira* var. *linearifolia* K. Tan.
*Uncultivated slopes, macchie on serpentine, 100-250 m.S*erpentinovag.

ARISTOLOCHIACEAE

165. Aristolochia guichardii Davis & Khan,.
Pinus brutia forest, serpentine hills, limestone slopes, and in shady Quercus coccifera macchie, s.l-610 m, E. Medit. Element, endemic, VU. Serpentinovag.

EUPHORBIACEAE

166. *Euphorbia acanthothamnos* Heldr. & Sart. ex Boiss.

Dry rocky limestone slopes, serpentine slopes under Pinus brutia, 30-300 m, E. Medit. Element. Serpentinovag.

167. *Euphorbia apios* L.
Metamorphic rocks, serpentine, limestone, clay in Quercus and Pinus brutia forest, Corylus & Crataegus scrub, macchie, field margins, 150-1200 m, E. Medit. Element. Serpentinovag.

168. *Euphorbia austroanatolica* Hub.-Mor. & M.S. Khan.
Pinus brutta forest on serpentine, macchie, limestone cliffs, 50-1600 m, E. Medit. element., endemic, LR(cd). Serpentinovag.

169. *Euphorbia aleppica* L.
Dry stony slopes, serpentine hills, steppe, streamsides, fields and roadsides, 150-1350 m. Serpentinovag.

170. *Euphorbia herniariifolia* var. *herniariifolia.*
Rock crevices (limestone, serpentine, quartzite etc.), rocky slopes and screes, often in conifer belt, stony steppe, 50-3050 m. Serpentinovag.

171. *Euphorbia herniariifolia* var. *glaberrima* Hal.
Rock crevices (limestone, serpentine, quartzite etc.), rocky slopes and screes, often in conifer belt, stony steppe, 50-3050 m. Serpentinovag.

RUBIACEAE

172. *Asperula tenuifolia* Boiss.
Dry rock ledges on limestone or serpentine, 700-2200 m., E. Medit. (mt.) element., endemic, LR(lc). Serpentinovag.

173. *Galium sieheanum* Ehrend.
[Turkey C5 Adana] Gerölle des MasmutU dagh, 2300 m, Antitaurusim Norden von Bozanti (Pozanti), Vilayet Konia, vi 1906, Siehe 347(holo. W! iso. E!). S. Anatolia; rare. C5 Adana: Karsanti, Akinek Da., 1760 m, Yurdakulol 86-12!Alpine scree, on serpentine (always?), 1760-2300 m., Endemic to Ala Daglari, VU. Serpentinophyt.

174. *Galium tmoleum* Boiss.
[Turkey C2 Denizli] ad rivulos alpinos montis Tmoli ad Bozdag, vii 1842, Boissier (holo. G!). S.W. Anatolia. C2 Muğla: Nif Da., 5 vii 1881, Luschan (type of G. pulchellum)! Köyceğiz, Sandras Da. nr Gökçe ova, D. 13507a! ibid., D. 13507! C3 İsparta: Dedegöl Da., 2300 m, D. 16025!Open alpine habitats (sometimes on serpentine), c. 1500-2300 m.,endemic, VU. Serpentinophyt.

175. *Galium dieckii* Bornm.,
[Turkey C5 Niğde] Taurus Ciliciae in rupibus vulcanicis (dioriticis) haud procul a portis Ciliciae, supra Tschift-Han (Çiftehan), 1400 m, vi 1906, Dieck (holo. B!). C. & S. Anatolia. C5 Niğde: Ovacik, nr Tyana (Kemerhisar), c. 1400 m, Siehe! 4 km W. from Çiftehan to Ulukişla, c. 1000 m, Ehrend. 62-1/67-27! 25
km from Ulukişla to Pozanti, 1130 m, Hub.-Mor. 16435!Serpentine rocks, 1000-1400 m., endemic, LR(cd). Serpentinophyt.

176. *Galium setuliferum* Ehrend. & Schönb.,
Turkey C6 Adana: Amanus, mt. Düldül, 1500-2000 m, Haradjian 3906 (holo. W!). S. Anatolia (Amanus). C6 Adana: Amanus, Düldül Da., 1500-2000 m, Haradj. 3842Serpentine rocks, 1500-2000 m, endemic, DD. Serpentinophyt

177. *Galium galiopsis* (Hand.-Mazz.) Ehren.
[Turkey B7 Elaziğ] Gesteinfluren auf Serpentin des HosarbabaDagham Göldschik (Quellsee des westUchen Tigris), 1800-2450 m, 29 vü 1910,Handel-Mazzetti 2578 (holo. W!). E. Anatoüa. B7 Elaziğ: above S.W. slope of Hazar G , c. 5 km E. of Sivrice, Ehrend, et al. 787-68-Serpentine scree, 1200-2450 m., Ir.-Tur. Element, Serpentinicolous endemic, EN. Serpentinophyt.

178. *Galium floribundum* subsp. *airoides* Hub.-Mor. ex Ehrend. & Schönb.,
Turkey C3 Antalya: bay of Tekirova at E. foot of Tahtali Da, on serpentine, 0-50 m, 25 v 1950, Huber-Morath 10079 (holo. Hb. Hub.-Mor.!). S.W. Anatolia. C2 Mugla: N.W. of Marmaris, 20-50 m, Runem. & Bentzer
29409! C3 Antalya: Perge, W. of theatre, Sorger 66-9-4! İsparta: Dedegöl Da. between Daribükü and Selköse, D. 15967!Steppe hills, gravel, s.L-50 m., E. Medit element, endemic, LR(nt). Serpentinophyt.

ARACEAE

179. *Arum elongatum* subsp. *detruncatum* (C.A. Meyer ex Schott) H. Riedl in Rech.
Limestone and serpentine rocks and slopes, steppe, Juniperus scrub, 400-1800 m. Serpentinovag.

LILIACEAE

180. *Allium cupani* subsp. *hirtovaginatum* (Kunth) Stearn.
Pinus nigra forest, among Quercus, phrygana, alpine and grey steppe, rocky places on limestone, serpentin and schist, fallow fields, s.L-2200 m. Serpentinovag.

181. *Allium callidictyon* C.A. Meyer ex Kunth.
Quercus scrub, alpine steppe, rocky slopes on limestone and serpentine, cornfields, 400-2800m. Serpentinovag.

182. *Muscari macrocarpum* Sweet.
Rocky macchie and on serpentine and limestone slopes near the sea, 10-800 m, E. Medit. Element, nadir, VU. Serpentinovag.

183. *Muscari tenuiflorum* Tausch.
Pinus nigra and P. brutia forest, Juniper scrub, Artemisia steppe, pastures, rocky slopes, on limestone, serpentine, gypsum and volcanic soils, nr s.L-2400 m. Serpentinovag.

184. *Muscari armeniacum* Leichtlin ex Baker.
Limestone slopes, rock outcrops, sometimes on serpentine or schist, often in Juniperus scrub, Pinus brutia forest with Quercus, Pinus sylvestris woods, Sarcopoterium spinosum phrygana, pastures, sand dunes, s.L-2 750 m. Serpentinovag.

185. *Muscari inconstrictum* Rech.
[Transjordan] Arabia Petraea, Petra, Felsen, 1000 m, Davis 10371(holo. S!). S. Anatolia. C6 Hatay: iskenderun to Haleb (Aleppo), nr Kyryk Han at foot of Amanus, c. 180 m, Hand.-Mazz. 24!Phrygana on serpentine, c. 180 m., Ir.-Tur. Element, rare, VU. Serpentinophyt.

186. *Muscari bourgaei* Baker.
Mountain pastures, stony slopes, on calcareous and igneous substrata, 1500-3000 m., Medit. (mt.) element, endemic, LR(lc). Serpentinovag.

187. *Fritillaria forbesii* Baker.
[Turkey C2 Muğla] Lyeia in dumetisrupestribusadMacri(Fethiye), [s.l.-lOOO m, 1842], E. Forbes 626 (holo. K!). S.W. Anatolia. C2 Muğla: Marmaris to Emecik, 350 m, D. 25375!

Fethiye, 100 m, D. 25408Pinus brutia forest, macchie on serpentine, s.I.-1000 m, E. Medit. Element, endemic, EN. Serpentinophyt.

188. *Fritillaria carica* subsp. *serpenticola* Rix.
Turkey C2 Antalya: between Karaçulha and Altinyayla, in bare Brown scree, 1700 m, 5 iv 1980, O. S^nderhousen 680 (holo. E!).Serpentine screes with Pinus and Juniperus, c. 1 700 m, E. Medit. element., endemic, EN. Serpentinophyt.

189. *Colchicum lagotum* K.Perss
(Turkey) B8 Erzurum: Çat to Bingöl, 73 km from Erzurum, 7 km before Cirisli Geçidi Steep unstable serpentine slopes, 1900 m, endemıc, new takson for science, CR. Serpentinophyt.

190. *Merendera figlalii* Varol.
(Turkey) C2 Muğla: Sandras Dağ, around Kartal Gölü 1900-2100 m serpentine rocks, open stony places endemıc, new takson for science, CR. Serpentinophyt.

191. *Allium karacae* M.Koyuncu.
Turkey. C4 Konya: between Hadim-Taşkent, open forest and steppe, 1450 m, 22 vii 1993, H. Karaca, T. Ekim, M. Koyuncu & A. Güner (holo. AEF 182001). S. Anatolia. C3 Antalya: Akseki, Geyran Yaylası, 1250 m, H. Duman 5632-Z. Aytaç & A. Duranl C4 Konya: between Taşkent-Ermenek, 1650 m, Koyuncu & Coşkun (AEF 12642); Taşkent-Sanveliler, 4 km, 1650 m, Koyuncu & Güner (AEF 182461Steppes, dry slopes, open places and serpentine sa;1250-1650, E. Medit. element, endemic, LR(cd). Serpentinophyt.

192. *Allium koyuncui* H.Duman & N.Özhatay.
Turkey. C4 Konya: Bozkır, between Korualan-Akdam Yaylası, 18 km, serpentine; high mountain steppes, 2000-2100 m, 19 vii 1996, H. Duman 6202-A. Duran & M. Dadandı (holo. GAZI; iso. ISTE, AEF, K). High mountain steppe, serpentine rocky places, 2000-2100 m, E. Medit. element (mt.), endemic. Serpentinophyt.

193. *Fritillaria sibthorpiana* subsp. *enginiana* Byfield & N.Özhatay.
Pinus brutia and Platanus orientalis woodland and wood margins on limestone, serpentine and shales, 50-1450, E. Medit element, endemic, EN. Serpentinovag.

194. *Fritillaria byfieldii* N.Özhatay & Rix.
Stony slopes, loose and mobile limestone screes. 1700-1900 m, E. Medit element, endemic. Serpentinovag.

195. *Colchicum lingulatum* subsp. *rigescens* K.M.Perss.
Turkey C2 Muğla: 25 km from Marmaris to Datça, bare brown stony soil (serpentine) among Pinus, 140 m, 21 iv 1991, fid. in cult. 31 viii 1992, K. Persson 515 (holo. GB'; iso. K!). SW. Anatolia. C2 Muğla: Datça peninsula, Runemark & Wendelbo bulb coll. no. 191; Marmaris to Datça, 200 m, T. Baytop, Mathew & Brickell (ISTE 31367) ! ; 48 km from Datça to Marmaris, 50 m, T. Baytop & Leep (ISTE 36234)!Open stony places among Pinus and Erica; on ultramafic ground; 50-200 m., E. Medit. element, endemic subspecies. Serpentinophyt.

196. *Muscari sandrasicum* Karlén.
Turkey [C2] Muğla: Sandras Dağ, W. side of the summit area, 2100-2200 m, snowbed meadows and rocky slopes, serpentine, 7 vii 1984, Strid et al. 23379 (holo. C, iso. EGE, LD). S.W. Anatolia. C2 Muğla: S.W. side of Sandras Da. between Ağla village and fire watchtower, 1750 m, 6 vii 1984, Hartvig et al. s.n. (bulbs cult. LD as KE 351Snowbed meadows and rocky slopes on serpentine, 1750-2200 m, E. Medit. element, endemic. Serpentinophyt.

CYPERACEAE

197. *Scirpoides holoschoenus* (L.) Sojak.
Marshes, wet meadows, streamsides, river valleys and flats, volcanicash by crater lake, serpentine or siliceous rock, coastal dune slacks, edge of saline canals, s.1.-3050 m. Serpentinovag.

198. *Schoenus nigricans* L.
Peaty places, serpentine rock by streams, damp flushes, open stony slopes, saline marshes, thermal springs, open limestone heath, meadows, maritime sand, S.I.-2000 m. Serpentinovag.

POACEAE

199. *Brachypodium kotschyi* Boiss.
[Turkey C5 Niğde] in arenosis dioriticis Tauri Cilicici ad Bulgar Mağara, 2440 m, Kotschy 233 sub B. ramoso var. (holo. G!). S. Anatolia. C4 Konya: Bozkir to Haydar Da., 2000 m, Çetik et al. 60! C5 Adana: Karsanti to Pos ormani, Hizar Bölgesi, Hizar Y. civari, 1300 m, Yurdakulol 1409! Taurus mts., Kotschy 536!On diorite and serpentine, 1300-2440 m., Ir.-Tur. Element, endemic, VU. Serpentinophyt.

200. *Secale montanum* Guss.
In massive stands on non-arable steppe, on limestone, volcanic slopes, serpentine, in Quercus cerris forest, as weed with Triticum turgidum on arable land, spilling over to roadsides, 800-3050 m. Serpentinovag.

201. *Secale ciliatoglume* (Boiss.) Grossh.
[Iran] in monte Zagros Kurdistaniae Persicae, Haussknecht (holo. G). E. Anatolia. B7 Tunceli: 17 km S. of Tunceli, 1100 m, 8 viii 1972, Spencer 0407! Elaziğ: Hazar G, c. 5 km E. of Sivrice, 1200 m, Ehrend, et al. 787-68-3! B9 Bitlis: Nemrut Da, A. Baytop (İSTE 31086)! Süphan Da, 2500 m, D 24716! C8 Mardin: Mardin, Sint. 1888:1192! Bakakri (Bakirkiri), Sint. 1888:1326 (as S. montanum)\ Mountain slopes, growing with Aegilops and Triticum, on serpentine, 1100-2700 m., Ir .-Tur. Element, rare, VU. Serpentinophyt.

202. Polypogon maritimus Willd. subsp. *maritimus.*
Sand dunes, serpentine cliffs, s.1,-400 m., Euro-Sib. Element. Serpentinovag.

203. *Festuca ziganensis* Markgr.-Dannenb.
[Turkey] A8 Gümüşane : Bayburt, Kop Dağ, Quellmoor südlich des Strassenpasses mit Sefw/ß-Büschen, feuchter Mergel, 2300 m, 15 vü 1958,1. & F. Markgraf s.n. (holo. Z!). N.Anatolia. A4 Kastamonu: Kara Su, N. of İlgaz Da, 1050m, Simon! A8 Gümüşane: Kop Da, E. slope, Çankule roadmen's house, Buttler 14303Streams, fens, sometimes on serpentine, 1050-2300 m.,endemic, VU. Serpentinophyt.

204. *Briza minor* L.
Edge of Quercus forest, marshy grassland, springs on serpentine debris, etc., nr s.L-30 m. Serpentinovag.

205. *Sesleria alba* Sm. in Sibth. & Sm.
Stony slopes and screes above tree-line, on limestone or serpentine, at edge of or in open Pinus brutia, P. nigra, P. sylvestris, Cedrus libani, Abies,

Juniperus or Carpinus-Fagus forest, 50-3125 m. Serpentinovag.

206. *Melica ciliata* L. subsp. *ciliata.*
Pinus nigra forest, rocky slopes, gorges, steppe, fallow fields, dry river beds, on limestone, serpentine, gypsum, lava, etc., 400-2800 m. Serpentinovag.

207. *Piptatherum miliaceum* subsp. *thomasii* (Duby) Freitag.
Cliffs, on serpentine, Pinus brutia woods, macchie, shady banks, edge of fields, rocky knolls nr sea, s.L-900 m. Serpentinovag.

208. *Piptatherum* coerulescens (Desf.) P. Beauv.
Steep ridges, rocky limestone slopes, conglomerate (serpentine) rocks in river and on cliffs, open Quercus and Pinus brutia forest, waste places with rubble, nr s.l.-1420 m. Serpentinovag.

209. *Piptatherum holciforme* var. *holciforme.*
Mixed or open Pinus forest, granitic rock, serpentine, limestone slopes and screes, by lakes, river valleys and gorges, s.L-3200 m. Serpentinovag.

210. *Eragrostis minor* Host.
On serpentine, limestone cliffs with thermal pools, gravelly screes, valleys and dried up river beds, wet places, by lake shores, salt pans, under Populus, at edge of and in cultivated fields, ditches, roadsides. Serpentinovag.

211. *Bromus regnii* H. Scholz.
Liquidambar orientalis forest, serpentine, c. 100 m, open ground on serpentine, phrygana on serpentine, serpentine, limestone, new record for Turkish Flora. Serpentinovag.
CRÂSSULACEAE

212. *Sedum caricum A. Carlström.*
On limestone, granite and serpentine, s.L-1000 m, E. Medit. Element, endemic. Serpentinovag.

213. *Prometheum serpentìnicum (Werdermann) 't Hart var. giganteum (Eggli) 't Hart.*
Turkey C2 Muğla: between Muğla and Marmaris, in a narrow ravine, serpentine, ann. 1984, A. Carlström s.n.(holo Z; iso ISTE!). SW. Anatolia. C2 Muğla, 3 km N. of Marmaris, E. of the road to Muğla, 150 m, 't Hart, HRT 30205!; Marmaris, Balan Dağı. c. 100 m, H. Şağban 1860 & H.Dumani On serpentine, 100-150 m, endemic. Serpentinophyt.

214. *Rosularia sempervivum* subsp. *amanensis* Eggli.
[Turkey C6 Hatay:] monts Amanus, 1520 m, vii 1906, Haradjian 536 (holo.G, iso. K). S. Anatolia. C6 Hatay: Erzin, Amanos Dağ, Ufacık Y., 1700 m, Akman 201 ! Monts Amanus, 1200-1800 m, Haradjian 4637!; Adana: 28 km S. of Osmaniye, above Zorkun, 1700 m, K.Alpmar & H. vt Hart (İSTE 60971 !).Serpentine rocks, 1500-1800 m., E. Medit. element, endemic, EN. Serpentinophyt.

215. *Sedum ursi't* Hart.
endemıc, LR(lc). Serpentinovag.

216. *Sedum eriocarpum* subsp. *caricum* (Carlström) 't Hart.
On serpentine, also on limestone, endemic, EN. Serpentinovag.

217. *Rosularia serpentinica* (Werdermann) Muirhead
[Turkey C2 Muğla] distr. Köycegis, Sandras Da., in rupibus serpentinicis cacuminis Çiçkli Buba, c. 3000 m, 18 vii 1938, Schwarz 557.S.W. Anatolia. C2 Muğla: Sandras Da. , 2200 m, D. 135571 Antalya: Ak Da. ,
2000 m, Sorger 68-26-80Serpentine rocks, 2000-3000 m. Serpentinophyt.
GENTIANACEAE

218. *Centaurium serpentinicola* A.Carlström.
Turkey [CI] Muğla: Datça peninsula, 8 km N.W. of Orhaniye, c. 100 m, 18 V 1983, Carlström 10671 (holo. LD). S.W. Anatolia. CI Muğla: Kuruca adasi, 8 km E.S.E. of Emecik, Carlström 10961. C2 Muğla: 43 km from Muğla to Fethiye, 70 m, D. 35147!Open places on serpentine, c. 70-100 m, E. Medit. Element, endemic, VU. Serpentinophyt.
OROBANCHACEAE

219. *Orobanche rechingeri* Gilli.
On Alyssum sect. Odontarrhena (incl. A. masmenaeum Boiss.), in open Pinus nigra forest and on rocky limestone slopes, serpentine rock and snowbed meadows, 1500-2200 m. Serpentinovag.
SINOPTERIDACEAE

220. *Cheilanthes maderensis* Lowe.
Spores ripe 4-7.Dry rocky places, serpentine outcrops, old walls, s.L-100 m. Serpentinovag.
POLYGONACEAE

221. *Polygonum karacae*i Ziel. & Boratynski.
Turkey C2 Muğla: Massif of Sandras Dağı, summit area of Çiçekli Büyük Kızıldağ, 1900-1950 m, 20 vi 1989, Boratynski & Zielinski 6900 (B, iso. KOR!). S W. Anatolia. C2 Muğla: Köyceğiz, Sandras Dağı, Serçe pass, 1650 m, N. & E. Özhatay (ISTO 20669!); Burçova, 1800 m, N. & E. Özhatay (ISTO 20639!); Burdur:
Korkuteli, SE. of Altınyayla, Dirmil Pass, 1600 m, N. & E. Özhatay, M. Johnson (İSTE 67376!Open forests, serpentine rocks, 1650-1950 m, endemic, LR(cd). Serpentinophyt.
PINACEAE

222. *Pinus nigra* subsp. *pallasiana* Lamb. (Holmboe)
Deep weathered serpentine rocks. Serpentinovag.

When we examine the taxa which are specific to serpentine soils according to their families the first place is occupied by Asteraceae with 36 taxa. It was followed by Lamiaceae with 21 taxa, Brassicaceae with 20 taxa, Liliaceae with 17 taxa, Caryophyllaceae with 16 taxa; Scrophulariaceae with 15 taxa; Poaceae with 13 taxa; Apiaceae with 11 taxa; Plumbaginaceae with 9 taxa; Fabaceae with 8 taxa; Boraginaceae and Rubiaceae with 7 taxa, and Crassulaceae, Convolvulaceae and Euphorbiaceae with 6 taxa. Other families have 25 taxa in total.

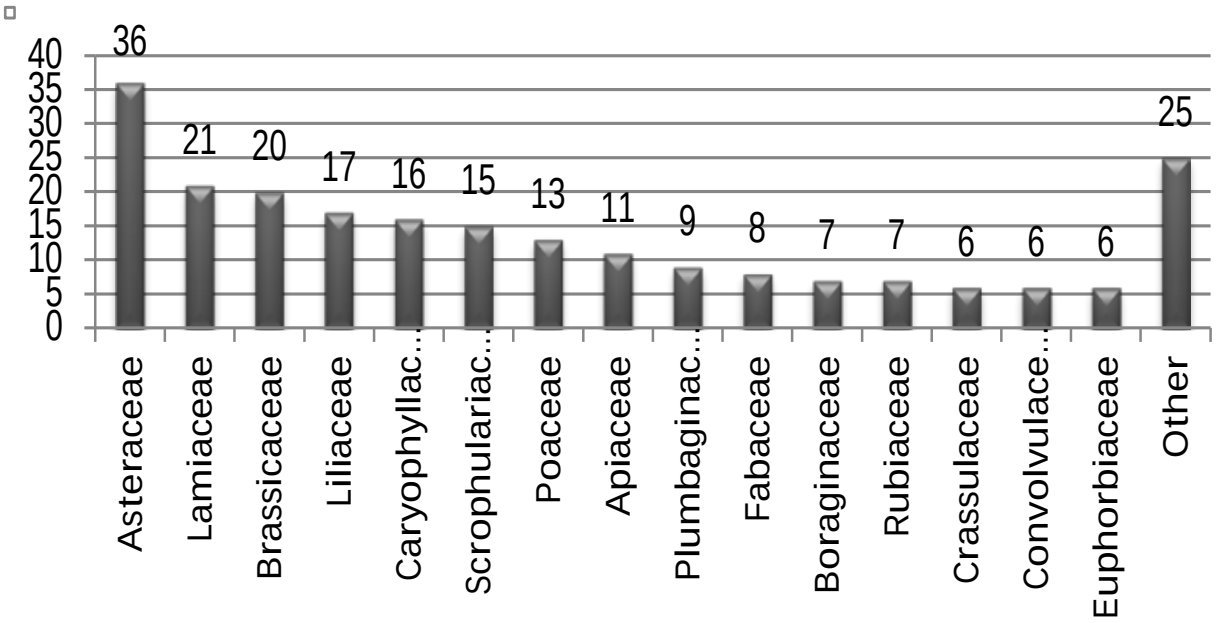

Figure 2. The distribution of the serpentine specialist taxa according to their family.

When we classify the serpentine species there are 142 endemic and 8 rare taxa observed in national or global scale. According to IUCN threatened categories among these rare taxa 2 of them attached to be in DD and 6 of them in VU categories. The distribution of the endemic taxa according to IUCN threatened categories are as follows EX, 1; CR, 20; EN, 29; VU, 21; LR(cd), 27; LR(nt), 8; LR(lc), 14; DD, 2 (Ekim et all. 2000)

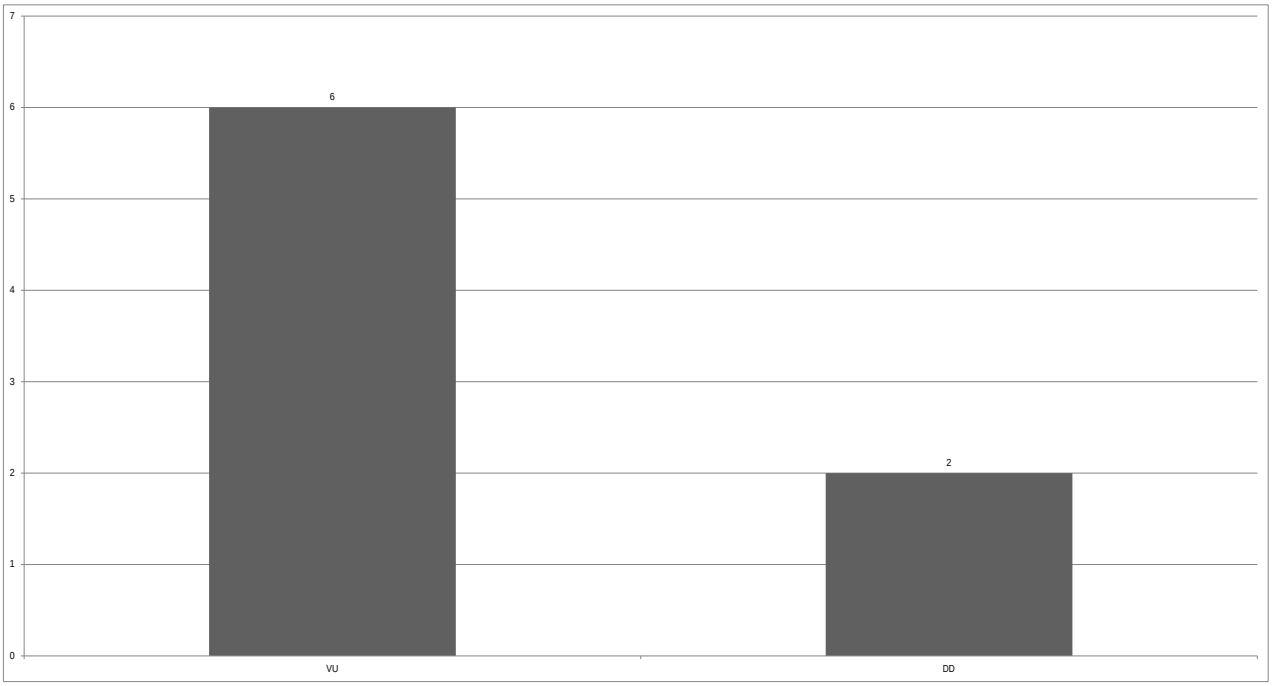

Figure 3. : The disribution of the serpentine specialist nationally or globally rare taxa according to IUCN threatened categories.

The distribution of 223 taxa specific to serpentine soil according to phytogeographical areas are as follows: 91 taxa in East Mediterranean element, 5 taxa Mediterranean element and 42 taxa in Irano-Turanian phytogeographical region. The number of taxa in Euro-Siberian and Euxin element is 3. The reason for the high density of taxa in Mediterranean and Irano-Turanian regions is related to the geological processes and the intensification of these metamorphic rocks in this phytogeographic region.

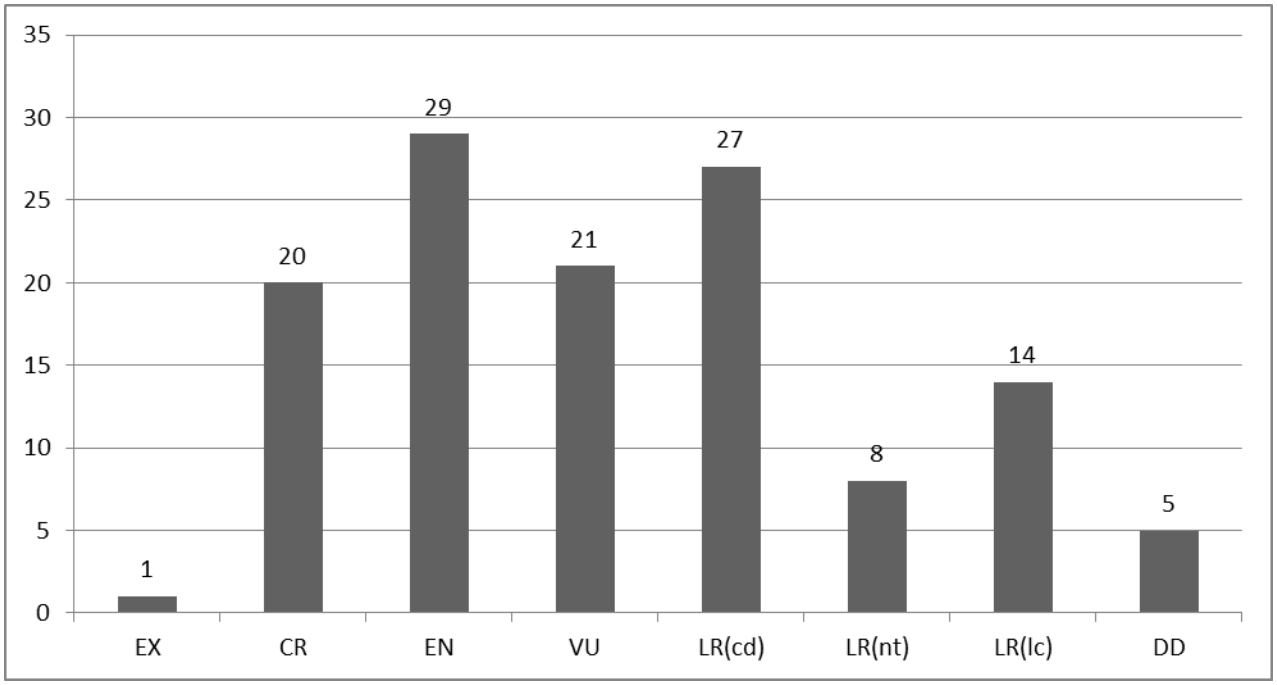

Figure 4. The distribution of serpentine specialist endemic taxa according to IUCN threatened categories

There were 8 taxa found in Flora of Turkey which take its epithet form serpentine. These are :

CRASSULACEAE
Rosularia serpentinica (Werdermann) Muirhead
Serpentine rocks, 2000-3000 m.
SCROPHULARIACEAE
Verbascum serpenticola Hub.-Mor.
Serpentine scree, 1600 m
LI L I A C E A E
Fritillaria carica subsp. *serpenticola* Rix
Serpentine screes with Pinus and Juniperus, c. 1700 m
GENTIANACEAE
Centaurium serpentinicola A.Carlström
Open places on serpentine, c. 70-100 m

FABACEAE
A*stragalus serpentinicola* H.Duman & Ekim
Pinus nigra and Quercus sp. forest, on serpentine. 1150-1650 m
CRASSULACEAE
Prometheum serpentìnicum (Werdermann) 't Hart var. *giganteum* (Eggli) 't Hart
On serpentine, 100-150 m
ASTERACEAE
Centaurea serpentinica A.Duran & B.Doğan
BRASSICACEAE
Erysimum serpentinicum Polatschek

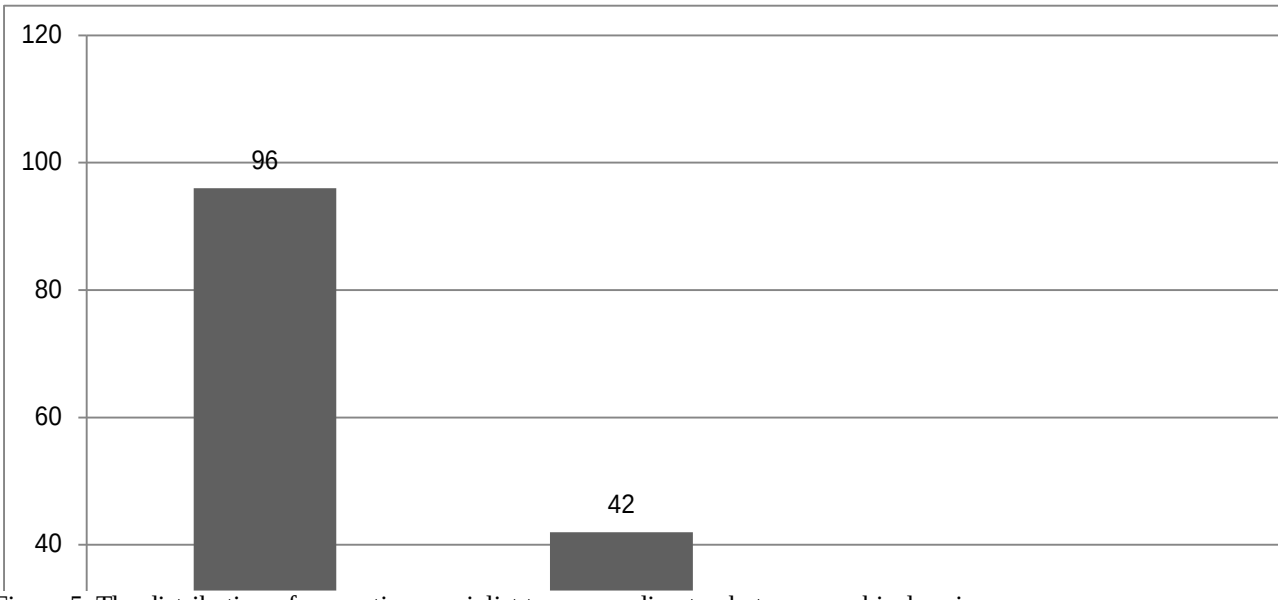

Figure 5. The distribution of serpentine specialist taxa according to phytogeographical regions

4. Conclusions

The Flora of Turkey has been published in 9 volumes between 1965-1988. The newly found taxa were added as two supplementary volumes. In spite of this almost a new taxon is reported every week. Although the floristic studies in Turkey are far from completed the studies should be directed to the edaphic diversity which is the most important region for the biological diversity. The floristic studies related to the parent rock are partially started.

The ecology of the serpentine system is of special importance due to the high endemism and the morphological structures of serpentine specialist species and their adaption to extreme conditions (Brady et. al., 2005). The research carried out on the difference between the vegetation and the endemism of the high and low regions of the large serpentine regions in eastern Australia showed the number of endemic species in higher region are twice the endemic species observed in lower regions (Batianoff and Singh, 2001). Serpentine habitats are the most important endemic regions in the world. The serpentine regions in Turkey extends from the western parts of the country to Muğla and Hatay regions of the Mediterranean part, in Bilecik, Bursa and Kütahya regions in the junction point of Marmara and Aegean parts and the large areas between Ankara and Erzincan (Reeves and Adıgüzel, 2004).

Although the inventory of the plants which grow on serpentine has not been completed yet it as assumed that there would at least be 100 species endemic to serpentine due to the fact that The Flora of Turkey contains more than 9000 species with an endemism ratio of %25 (Reeves and ark., 2001). The studies carried out in serpentine regions the western part of Turkey (Çanakkale, Balıkesir, Ankara, Antalya and Muğla, İçel, Niğde and Seyhan, Kütahya regions) revealed 8 new nickel accumulator species (*Alyssum murale* Waldst. et. Kit. subsp. *murale* var. *haragjianii* (Rech.) Dudley, *A. sibiricum* Willd., *A. aff. Cassium* Boiss. *(*probably a new taxon*), A. dudleyi* N. Adıgüzel & R. D. Reeves, *Aethionema spicatum* Post, *Thlaspi perfoliatum* L. , *Th. cariense* A. Carlström *and Centaurea ptosimopappoides* Wagenitz *).*

There are 223 taxa which develop adaptability to the extreme conditions on serpentine rocks which are one of the ultramaphic rocks widely distributed in Turkey. 142 of these taxa are endemic and 8 of them are rare in national or global dimensions.

When we examine the distribution of serpentine rocks they are seen to be concentrated on the Anatolian Diagonal and it there was another reason for the higher endemism on it.

Although the Flora of Turkey is seen to be extensive with 11 volumes the fact that there are nearly 50 taxa found every year and most of these taxa are seen to be located on serpentine rocks makes the further floristic studies an absolute necessity (Figure 6.).

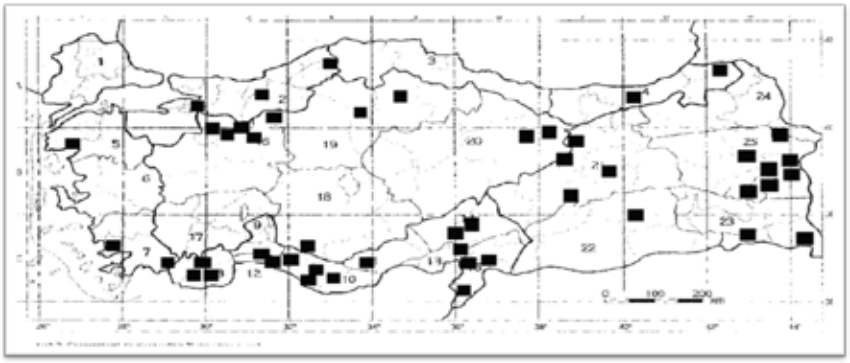

Figure 6. : The distribution of the taxa discovered in Turkey after 2000 (Avcı, M., 2005 abridged).

When we investigate the regions where 223 taxa which adapted to the extreme serpentine systems, 97 of them are regarded as ***serpentinophyt*** (obligative serpentine plant i.e obligate) and remaining 126 ones are regarded as ***serpentinovag*** (grown on both serpentine and non-serpentine habitat i.e facultative). The data needs further verification by further studies regarding the genetic solutions and life strategies which the plants developed to adapt these extreme conditions.

The serpentine system which constitutes an important part of Flora of Turkey is the extreme habitats for the growth of plants. Some of the taxa which adapted to these extreme conditions which are also known as "***geological islands*** " or the "***edaphic islands***" show limited distribution within these areas. The reason that most of these taxa have high IUCN threatened categories (EX, 1; CR, 20; EN, 29; VU, 27 and etc.) is attributed to the extreme conditions. It is necessary that the serpentine systems which are the most important endemic fields of the world are to be regarded as the high priority protection areas.

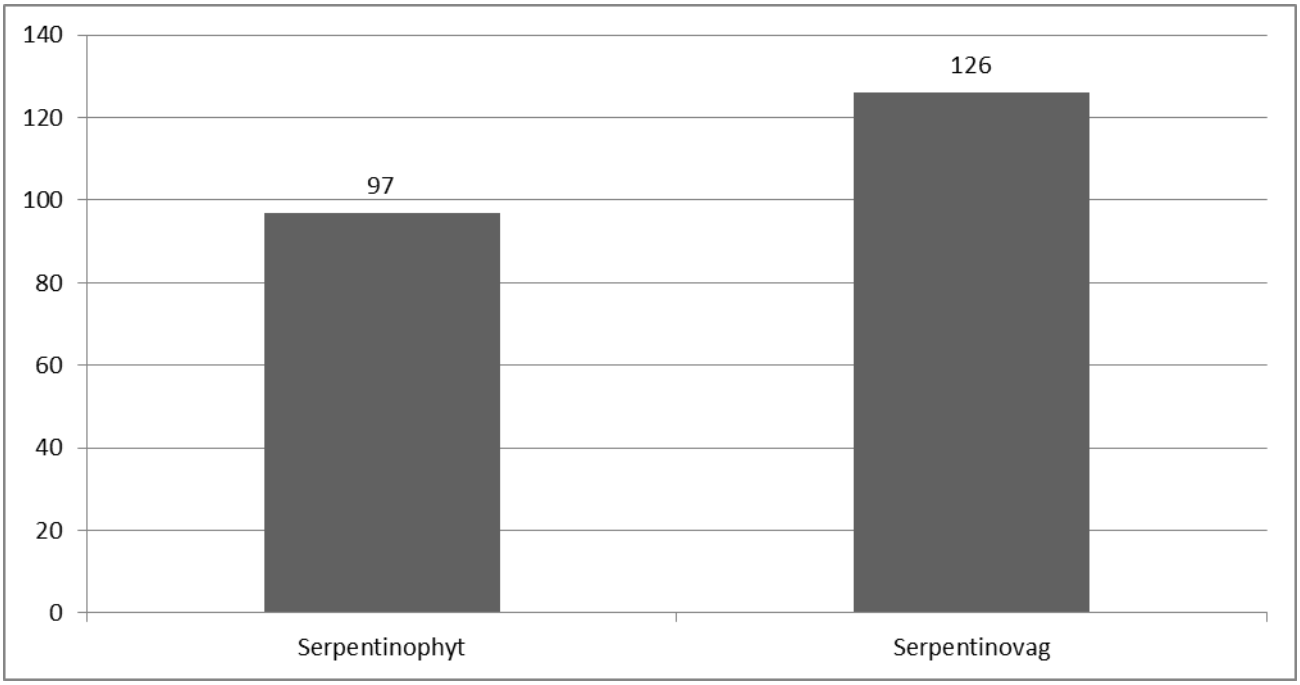

Figure 7. : The distribution of serpentinophyte and serpentinovags which developed resistance to serpentine conditions.

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(Received for publication 01 March 2013; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 153-160

Research note/Araştırma notu

Some notes on *Galanthus cilicicus* and *Galanthus peshmenii* (Amaryllidaceae)

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Abstract

Galanthus cilicicus Baker and *Galanthus peshmenii* A.P. Davis & C.D. Brickell are taxonomically problematic species. In this study, they were morphologically examined in detail and their chromosomes were counted. Moreover, descriptions, illustrations and distribution areas are given; in addition to the SEM observations of seed coats and pollen grains.

Key words: Amaryllidaceae, *Galanthus*, Morphology, Palynology, Taxonomy

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Galanthus cilicicus and *Galanthus peshmenii* (Amaryllidaceae) hakkında bazı notlar

Özet

Galanthus cilicicus Baker ve *Galanthus peshmenii* A.P.Davis & C.D.Brickell taksonomik açıdan problemli türlerdir. Bu çalışmada bu türlerin morfolojik yapıları detaylı olarak incelenmiş ve kromozomları sayılmıştır. Ayrıca, tohum yüzeyi ve polen tanelerinin SEM görüntülerine ek olarak, betimleri, şekilleri ve yayılış alanları verilmiştir.

Anahtar kelimeler: Amaryllidaceae, *Galanthus*, Morfoloji, Palinoloji, Taksonomi

1. Introduction

Galanthus L. (kardelen) is a member of the family Amaryllidaceae which has c. 60 genera and 850 species throughout the world. The family is occurs mainly in the tropics and subtropics, although there are several representatives in temperate areas in Europe and a few in Asia (Heywood et al., 2007). The genus is confined to Europe, Asia Minor, and the Near East (Davis, 1999).

There are 19 *Galanthus* species (22 taxa) in the world; 12 of them and one natural hybrid are distributed in Turkey, a center of species diversity. Among the 14 taxa in Turkey, five of them and one hybrid grow solely in Anatolia. These are: *G. plicatus* M.Bieb. subsp. *byzantinus* (Baker) D.A.Webb (İstanbul kardeleni), *G. cilicicus* Baker (İçel kardeleni), *G. elwesii* Hook.f. var. *monostictus* P.D.Sell (kardelen), *G. koenenianus* Lobin, C.D.Brickell & A.P.Davis (garipçe), *G. trojanus* A.P.Davis & N.Özhatay (Truva kardeleni) and *G.* x *valentinei* Beck nothosubsp. *subplicatus* (N.Zeybek) A.P.Davis (melez kardelen), (Brickell, 1984; Davis et al., 1988; Davis, 2000; Davis, 2001; Davis and Özhatay, 2001; Davis et al., 2001; Demir, 2010).

In the present study, *G. peshmenii* (bey kardeleni) and *G. cilicicus* (İçel kardeleni) were comprehensively investigated in terms of morphology and taxonomy. These are considered to be closely related. *G. cilicicus*, initially introduced to the world of science by Baker (1897), was transferred as subspecies to *G. nivalis* L. as *G. nivalis* subsp. *cilicicus* (Baker) Gott.-Tann. by Gottlieb-Tannenhain (1904). In 1999, the independent status of *G. cilicicus* was

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accepted by A.P. Davis who prepared the monograph of the genus. According to Zonneveld et al. (2004), *G. cilicicus* is clearly different from *G. nivalis* with its DNA, which confirms that it is not a subspecies of the latter as suggested by Stern (1956) and later discounted by Davis (1999). *G. peshmenii* samples were taken from various places at different times and named as *G. cilicicus*, *G. nivalis* subsp. *cilicicus* and *G. reginae-olgae* Orph. However, these samples were introduced to the world of science as *G. peshmenii* (Davis and Brickell, 1994).

The present study was to determine morpho- and cyto-taxonomic similarities and differences between *G. cilicicus* and *G. peshmenii*. Key characters used to distinguish species in *Galanthus* are always easy to determine satisfactorily on the living material but are not easy to determine on herbarium specimens. Arrangement of leaves in the bud known as vernation is a good character that can be observed in the early stage of the flowering. However, it is very difficult to observe this feature in dry specimens and those in the late stage of flowering. Another important character is the leaf colour, which was impossible to detect with the herbarium materials. The other important character is the type of coloring in the inner perianth segment, which can easily be observed in the herbarium samples.

The species in this study are clearly different from the other species of the genus in their flowering time. *G. peshmenii* which flowers in November and December is found within the borders of Antalya province, and it extends to the border of Kaş peninsula in the west and cannot be found towards the east of the city center. *G. cilicicus* flowers in December and January and its distribution is more limited than *G. peshmenii*; it is found only within the borders of Mersin province. The other taxon which flowers in late autumn-early winter period is *G. elwesii* var. *monostictus*. In the light of data obtained so far now, its distribution area was concluded to be in Antalya-Mersin provinces. This variety flowers in November-April depending on the altitude. Since *G. elwesii* var. *monostictus* has supervolute vernation, it clearly differs from *G. peshmenii* and *G. cilicicus* which have applanate vernation. In these three taxa, only apical coloration can be seen in the inner perianth segment.

2. Materials and methods

Plant specimens were collected during the field-works between the years 2002-2007. All plant specimens used in the present study were dried according to the standard herbarium techniques and deposited in the herbaria of ISTE. Morphological features of *G. cilicicus* and *G. peshmenii* were described based on field-works, observations and measurements of herbarium specimens.

The seed morphology of both species was examined using SEM (Scanning electron microscopy) techniques. For this, the seeds were covered with gold on stubs. The micro-photographs were taken with a Zeiss LEO 1430 Scanning Electron Microscope.

The pollen morphology of *G. cilicicus* and *G. peshmenii* was examined by light microscopy (LM) and SEM. For the LM, the pollen grains were first treated with 96% alcohol to remove the oily substances; subsequently, they were embedded in glycerin-jelly and stained with basic fuchsine (Wodehouse, 1935). The following parameters were measured: the polar axis (P), the equatorial axis (E), as well as the exine and the intine thickness. The measured pollen diameters were based on 50 samples. To examine the exine sculpture in detail, scanning electron microscopy (SEM) was also used. For SEM study, pollens was first treated with 70% alcohol, and then dried before mounting on stubs with gold. The micro-photographs were taken with a Zeiss LEO-1430 Scanning Electron Microscope. Pollen shapes and ornamentation were classified according to Punt et al. (1994).

Cytological investigations were limited to mitotic studies using a root-tip squash technique. The root tips were placed in α-monobromonapthalene and kept for 24 hours at +4°C. Afterwards, they were fixed in a 3:1 (v/v) absolute alcohol: glacial acetic acid mixture and stored in 70% (v/v) alcohol at +4°C. The root tips were hydrolyzed in 1 N HCl for 10 minutes at +60°C and stained with Schiff reagent. The squashed preparations of root tips were made with 45% (v/v) aceto-orcein on permanent slides. Chromosomes at the metaphase stage of the mitosis were counted and photographed (Brighton et al., 1973; Zeybek and Sauer, 1995).

Red list categories of taxa were revised according to IUCN Red List Categories (IUCN, 2001).

3. Results

1.1. *Morphological study*

Galanthus cilicicus Baker in Gard. Chron. ser. 3, 21: 214 (1897). (Figure 1).

Type: Cilicia [Cilician Taurus], 560 m, 1896, Siehe (holotype K!- *cf*. A.P. Davis, 1999)

Bulb ±ovoid, (1.4-)1.6-2.1 × (1-)1.2-1.5(-1.8) cm. Sheath (2-)4-6.5(-8.8) × 0.4-0.6 cm. Vernation applanate. Leaves linear, at flowering (3.5-)5.7-9.5(-20.5) × (0.4-)0.5-0.7(-0.8) cm, after flowering developing to 16.5-25(-43) × 0.5-0.8 cm, midrib conspicuous; margins flat; apex acute to acute-obtuse, flat to very slightly hooded; upper and lower surfaces ± the same color, glaucous or rarely glaucescent, matt, upper surface with or without a faint grayish median stripe. Scape (7-)8.5-18.6(-25) cm long, glaucous. Spathe always longer than pedicel, 2.2-3.6(-4.6) cm long. Pedicel (1.1)1.5-2.2(-2.5) cm long. Outer perianth segments, ±elliptic-obovate, (1.7-)2-3(-3.3) × 0.75-0.95(-1.3) cm, slightly unguiculate, inner perianth segments ±narrowly obovate-obtriangular, (0.9-)1-1.3(-1.5) × 0.5-0.7 cm, emarginate,

narrow to broad, ±Λ to ∩ shaped, or ±heart-shaped green mark, usually covering (1/3-)1/2-2/3 of segment; inner face of each segment with a faint green mark covering 2/3-3/3 of segment. Anthers tapering to a long point, 5-6.6 mm long. Filaments 1.5-2 mm long. Style 6.5-8(-10) mm long. Stigma acapitate or capitate. Capsule globose-ellipsoid, 1.2-1.8 × 1-1.4 cm. Seeds broadly ovate to rounded, 2.5-4 × 2.2-4 mm, pale brown; seed surface rugose.

Examined specimens: C5 Mersin: Mersin-Arslanköy road, Yeniköy, SW side of Çaltık hill, rocky areas, *Quercus coccifera* beneath, 892 m, 28.12.2002, *S.Yüzbaşıoğlu*, ISTE 93271. ibid., 13.01.2007, *S.Yüzbaşıoğlu* ISTE 93274. ibid., 08.01.2009, *S. Yüzbaşıoğlu*, ISTE 93275. Mersin: Doruklu, Dalakdere, rocky areas, *Quercus coccifera* beneath, 440 m, 13.01.2007, *S. Yüzbaşıoğlu,* ISTE 93272. Mersin: Mersin-Arslanköy road, Kayrakkeşli, rocky areas, *Quercus coccifera* beneath, 620 m, 08.01.2009, *S.Yüzbaşıoğlu*, ISTE 93276; ibid., 11.03.2009, *S.Yüzbaşıoğlu*, ISTE 93277. Kagiraki, 560 m, 1896, *Siehe*, (K 000464080!). Mostly restricted to limestone.

Conservation status: CR [B1 ab(i, ii, iii, v) + 2ab (i, ii, iii, v)]

Zeybek & Sauer (1995) reported that *G. nivalis* subsp. *cilicicus* also grew in two other localities, namely Çanakkale and Mersin. However, as a result of the field-works for the present study, the sample obtained from Bayramiç (Çanakkale) was proved as *G. trojanus* and published by A.P. Davis and N. Özhatay (2001).

Baker (1897) stated that the living specimen used in the description of *G. cilicicus* was sent to him by the nurseryman T.S.Ware at January 7, 1897. Dried samples were collected by W.Siehe from the Cilician Taurus at 560 m in 1896 were reported in the same publication. In the studies carried out by Stern (1956) and Brickell (1984), the T.S.Ware plant was said to be in the Kew herbarium and suggested as the type specimen of *G. cilicicus*. However, no T.S.Ware specimen was found by the first author while working for his Phd thesis in the Kew herbarium. In the monographic study of A.P.Davis (1999), the Siehe gathering (1896) was regarded as the holotype.

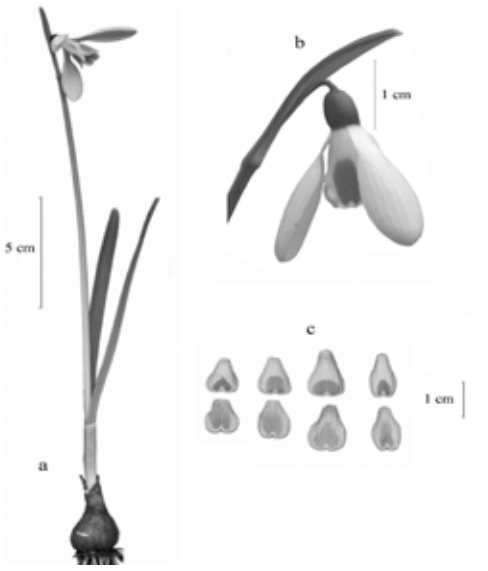

Figure 1: *Galanthus cilicicus*. a) general view b) spathe and flower c) inner perianth segments (outer surfaces on the upper row and inner surfaces on the lower row).

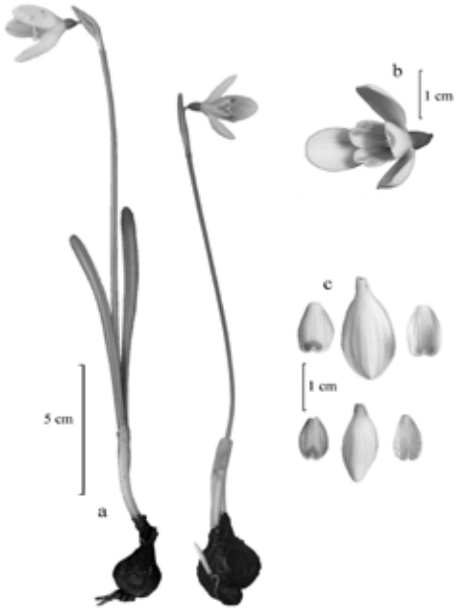

Figure 2: *Galanthus peshmenii*. a) general view b) flower c) inner and outer perianth segments (from left to right: inner perianth segments outer surfaces, outer perianth segments, inner perianth segments inner surfaces)

Galanthus peshmenii A.P. Davis & C.D. Brickell in New Plantsman 1: 14, fig. 1 (1994). (Figure 2).

Type: Turkey, [C3 Antalya] Kemer, Kesmeboğazi-Gedelma Köyü arasi, c. 300 m, 3.11.1978, *Peşmen*, *Yıldız* & *Güneş* 4125 (holotype HUB!; isotype E photo!).

Bulb ± globose-ovoid, 1.5-2.4 × (0.8-)1.2-2 cm. Sheath (1-)2.5-7(-9.5) × (0.3-)0.4-0.65 cm. Vernation applanate. Leaves linear, at flowering absent or much shorter than the scape, (0-)1-5.5(-9) × 0.2-0.4(-0.6) cm, after flowering developing to 15-27(-33) × 0.4-0.6 cm, midrib conspicuous; margins flat or slightly rolled under near the base; apex acute to acute-obtuse, flat; upper and lower surfaces slightly different in colour or ± the same, upper surface glaucescent to almost glaucous, usually with a faint grayish median strip, lower surface glaucescent to ± glaucous, matt. Scape 7-13(-20) cm long, glaucescent. Spathe always longer than pedicel, (1.5-)2.1-2.5(-2.9) cm long. Pedicel (1-)1.5-1.7(-2.1) cm long. Outer perianth segments narrowly obovate, elliptic-broadly elliptic, (1.1-)1.5-1.8(-2.1) × 0.4-0.5 cm, slightly unguiculate, inner perianth segments ± obovate, 0.8-1.1(-1.3) × 0.45-0.7(-0.85) cm, emarginate, ±∩ to Λ, heart-shaped green mark or two small green spots (either side of the sinus) usually covering 1/3(-1/2) of segment; inner face of each segment with a faint green mark covering 2/3-3/3 of segment. Anthers tapering to a long point, 4-4.7 mm long.

Filaments 0.7-1 mm long. Style 6-8 mm long. Stigma acapitate or capitate. Capsule globose-ellipsoid, 0.9-1.2 × 0.8-1.2 cm. Seeds broadly ovate to rounded, 2.5-4 × 2.2-3.5 mm, pale brown; seed surface rugose.

Examined specimens: C3 Antalya: Geyikbayırı, light *Pinus brutia* forest and *Quercus coccifera* beneath, 600 m, 09.11.2006, *S. Yüzbaşıoğlu*, ISTE 93267. Antalya: Finike, Sahilkent Municipality, Alakır dam way, inside of valley, 50 m, 13.11.2006, *S.Yüzbaşıoğlu*, ISTE 93268. Antalya: Kaş, Peninsula entrance, 5 m, 01.12.2007, *S.Yüzbaşıoğlu*, ISTE 93269. Antalya: Kemer, Kesmeboğazı, *Pinus brutia* forest, 600 m, 29.03.2009, *S. Yüzbaşıoğlu*, ISTE 93270. Not: The species is also in Greece-island of Kastellorhizo [Megisti] (Davis, 1999).

Conservation status: EN [B1 ab (i, ii, iii, v) + 2ab (i, ii, iii, v)]

During the revision of the genus *Galanthus* L. in Turkey, numerous field trips have been made by the first author. Living specimens were collected from all around Turkey. Collected bulbs were planted for observation Nezahat Gökyiğit and Alfred Heilbronn Botanic Gardens in İstanbul, Turkey. Based on these studies *G. cilicicus* is known only in a few localities of Mersin province. The field-works demonstrated that *G. cilicicus* is the rarest *Galanthus* species and endangered in the wild. The natural distributions of *G. cilicicus* and *G. peshmenii* do not overlap (Figure 3). Between Antalya and Mersin, there is no locality found that these two species grow together. Morphological differences between *G. cilicicus* and *G. peshmenii* are given in Table 1.

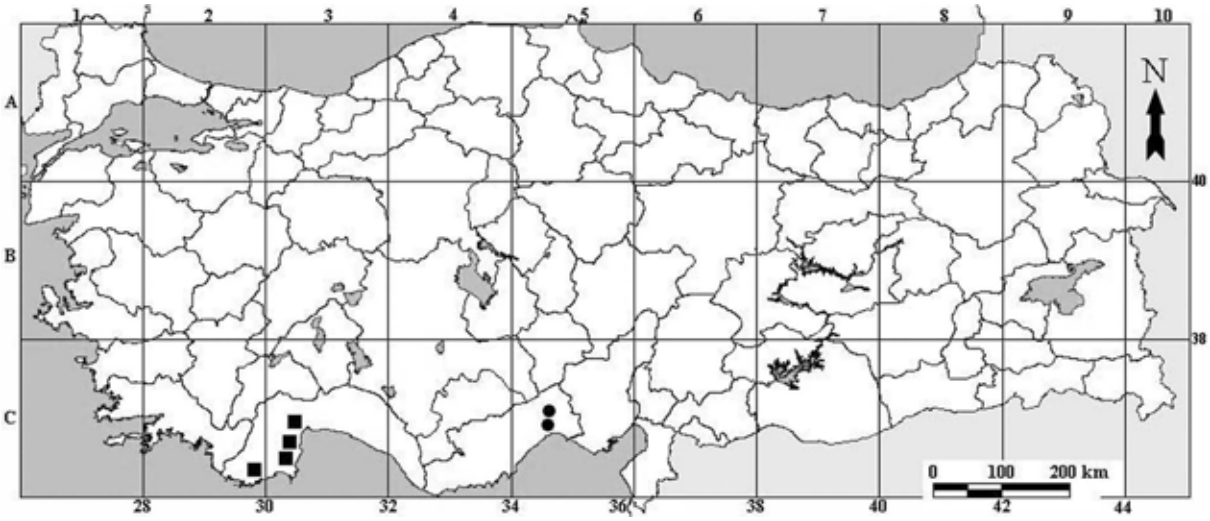

Figure 3. Distribution areas of *G. cilicicus* (●) and *G. peshmenii* (■) in Turkey

Table 1. Comparison of some diagnostic morphological and palynological characters of *G. cilicicus* and *G. peshmenii*

		G. peshmenii	*G. cilicicus*
Morphological characters	Flowering period	October-December	December-February
	Leaves	absent or (0-)1-5.5 cm × 0.2-0.4 cm at start of flowering	(3.5-)5.7-9.5 cm × 0.5-0.7 cm at start of flowering
	Leaf colour	Adaxial surfaces glaucescent with a faint underlying median stripe, abaxial surface glaucous	Leaves surfaces ± same colour, glaucous, adaxial surfaces usually without a faint underlying median stripe
	Inner perianth segments	Apex and margins flat	Apex usually flared and margins wavy
	Inner segment markings on the outer surface	± ∩ to Λ, heart-shaped or two small green spots either side of the sinus, usually covering (-1/2)1/3 of segment	± ∩ to Λ or heart shaped, usually covering (1/3-)1/2-2/3 of segment
	Outer perianth segments	(1.1-)1.5-1.8(-2.1) × 0.4-0.5 cm	(1.7-)2-3(-3.3) × 0.75-0.95 (-1.3) cm
Palynological characters	Polar axis (P)	26.16 ± 0.68 µm	26.32 ± 0.64 µm
	Equatorial axis (E)	18.94 ± 0.78 µm	19.71 ± 0.53 µm
	P/E	1.38	1.33
	Shape	prolate	prolate
	Aperture	monosulcate	monosulcate
	Ornamentation	micro-rugulate	micro-rugulate
	Exine	0.77-1.28 µm	0.76-1.13 µm
	Intine	0.5-0.75 µm	0.5-0.75 µm

Seed morphologies of *G. cilicicus* and *G. peshmenii* were examined. Seed size, colour and seed surface of these species were found similar. The seed shapes of *G. cilicicus* and *G. peshmenii* were broadly ovate to rounded; the colours were pale brown with size ranging from 2.5-4 mm in length and 2.2-4 mm in width; the seed surfaces were rugose. The details of the seed shape and seed surface are given in Figure 4.

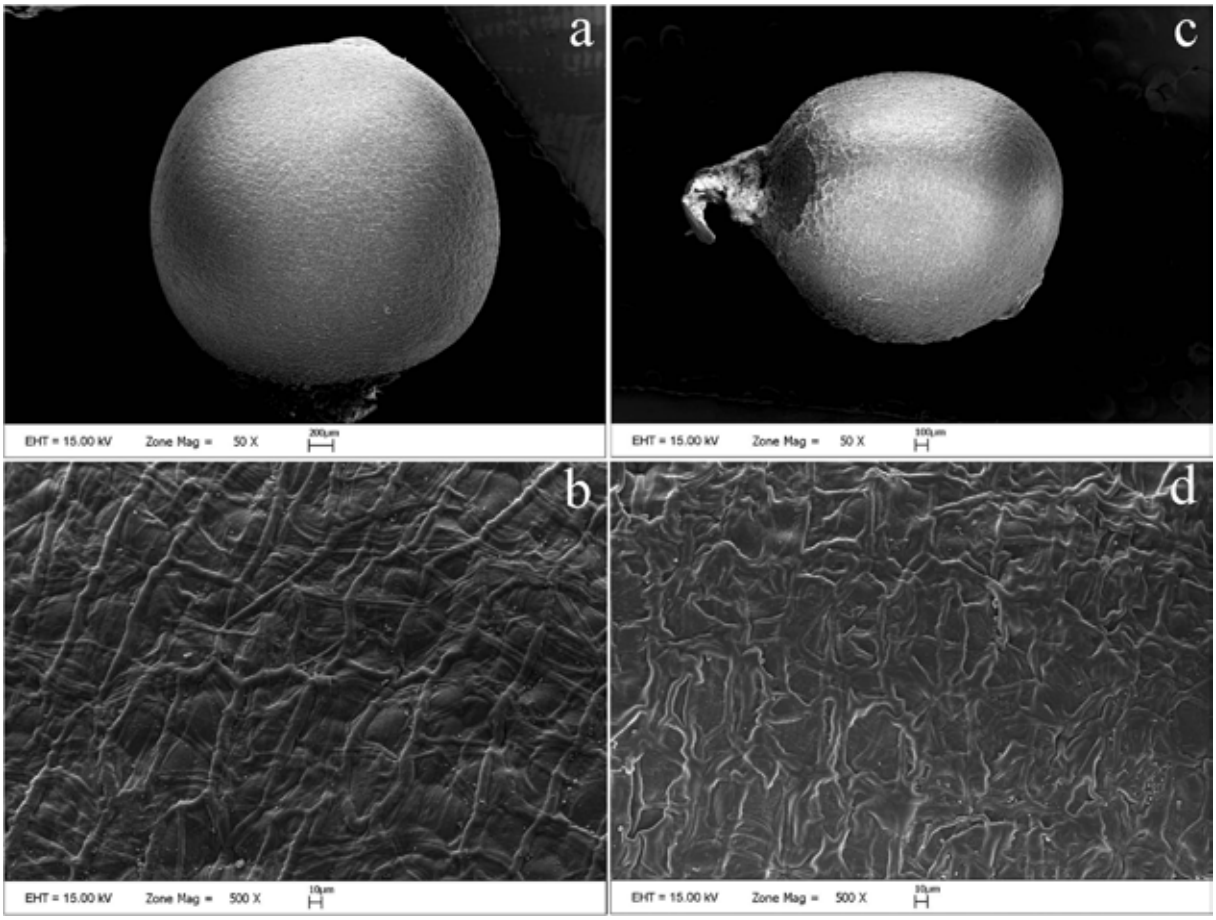

Figure 4. SEM micro-photographs of seeds. (**a**, **b)** *G. cilicicus*; (**c, d)** *G. peshmenii*

1.2. *Palynological study*

The main palynological features of *G. cilicicus* and *G. peshmenii* are summarized in the Table. It was established from the LM (Figure 5) and SEM (Figure 6) investigations that, the pollen grains are monad, monosulcate and heteropolar; they are medium in size (26-50 µm). The pollen shapes (based on P/E ratio) are prolate and elliptical in polar view. These results are similar to those of earlier studies (Dönmez & Işık 2008; Şahin et al., 1997).

The pollen grains of *G. cilicicus* were prolate, polar axis was 25.63-(26.32)-27.68 µm, and equatorial axis was 18.45-(19.71)-21.03 µm. Ornamentation was micro-rugulate; exine was 0.76-1.13 µm; and intine was 0.5-0.75 µm. The pollen grains of *G. peshmenii* were prolate, polar axis was 25.63-(26.16)-27.68 µm, and equatorial axis was 18.45-(18.94)-20.5 µm. Ornamentation was micro-rugulate; exine 0.77-1.28 µm, and intine 0.5-0.75 µm. The results showed that the pollen grains of *G. cilicicus* and *G. peshmenii* were morphologically similar.

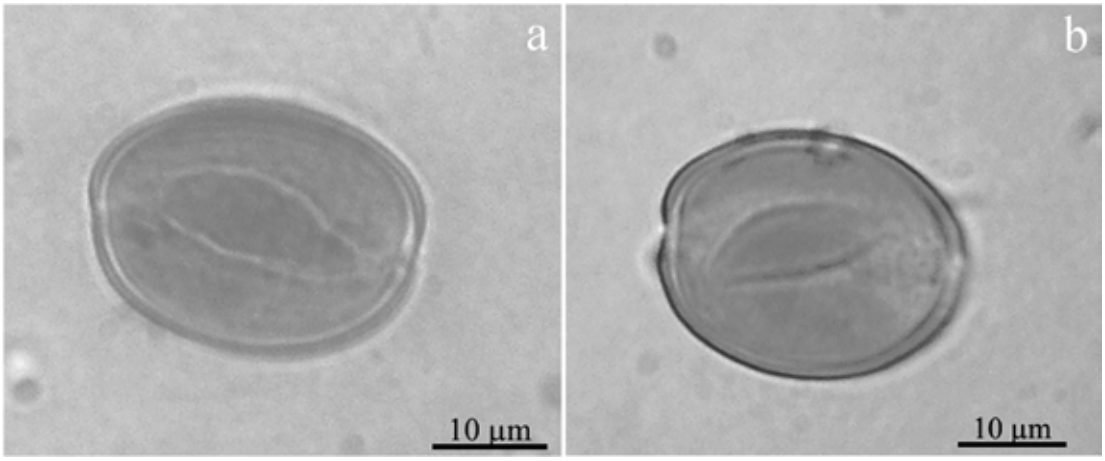

Figure 5: LM photographs of the pollen grains. **a)** *G. cilicicus*; **b)** *G. peshmenii*

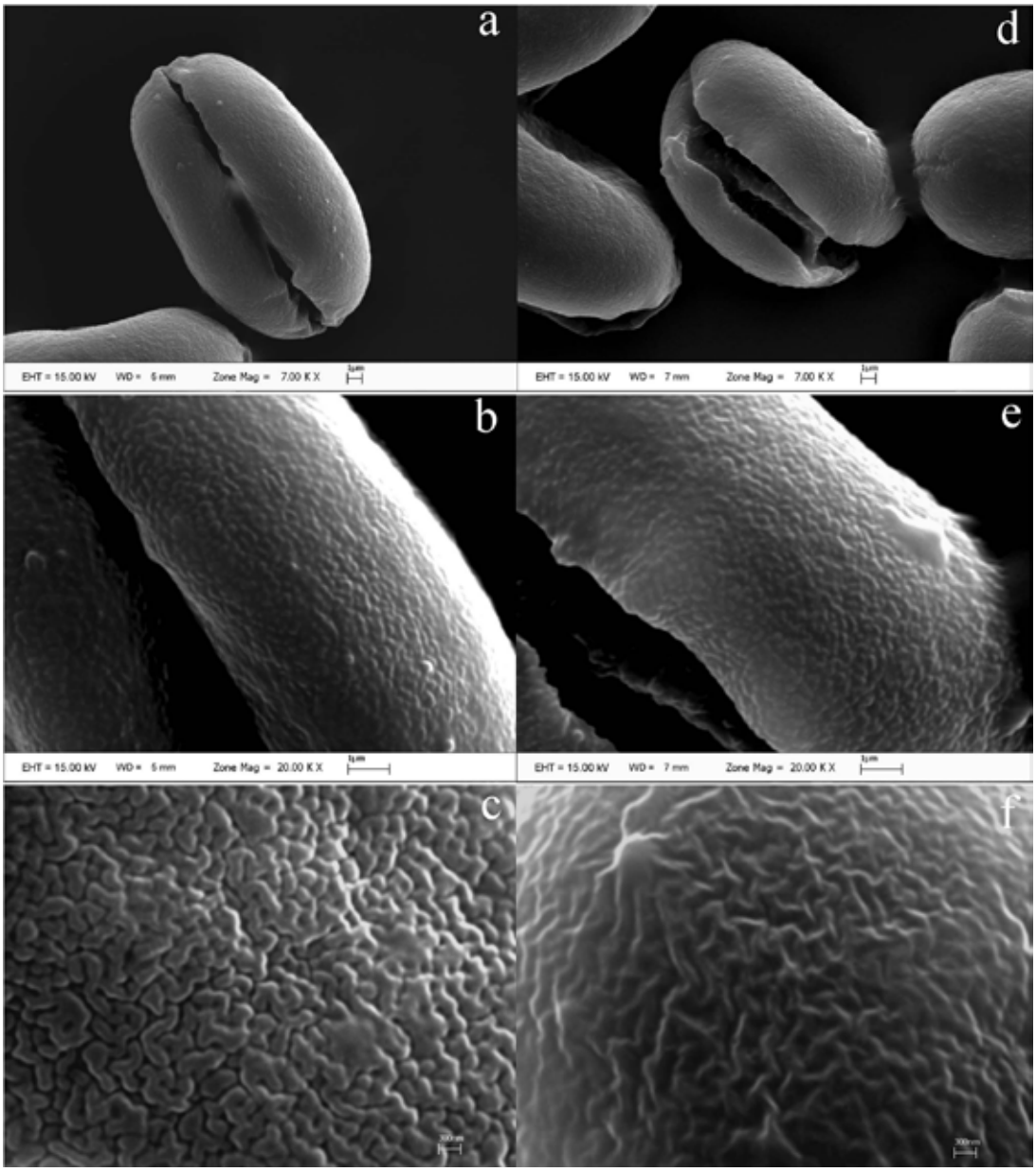

Figure 6: SEM micro-photographs of the pollen and pollen surfaces. **a**, **b, c)** *G. cilicicus*;**d, e, f)** *G. peshmenii*

1.3. *Chromosome counts*

All species of *Galanthus* counted (with exception of the polyploid clones) have the same basic chromosome number, 2n = 2x = 24 (Sveshnikova, 1965). There are different studies in literature reporting the chromosome number of *G. peshmenii.* (i.e. Özhatay, 2002).

According to our chromosomal studies, chromosome number of *G. peshmenii* was counted as 2n = 24 and this result is with suitable previous reports for concerning species. But, *G. cilicicus* had to triploid (2n= 3x=36) chromosome numbers (Figure 7). This chromosome number for *G. cilicicus* may be used as diagnostical characters. Therefore, this ploidy level own to the species can be used taxonomically to separate it from closely related species *G. peshmenii.*

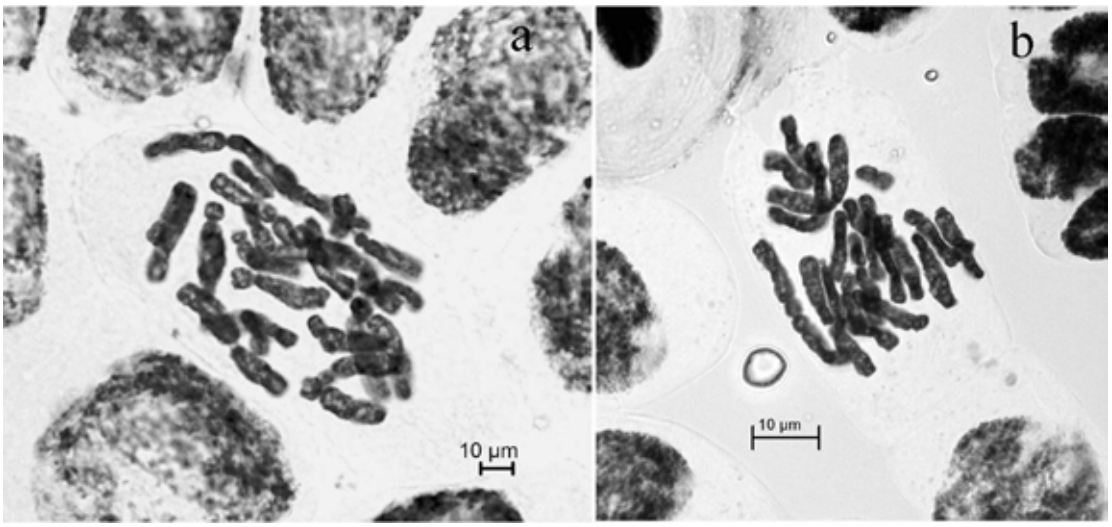

Figure 7: Mitotic metaphase chromosomes of **a)** *G. cilicicus* 2n = 36; **b)** *G. peshmenii* 2n = 24.

4. Conclusions

G. cilicicus and *G. peshmenii* are closely related to each other and share applanate vernation, linear leaves and a single green mark on each inner perianth segment. *G. cilicicus* is an autumn to winter-flowering plant. The leaves of *G. cilicicus* are several centimeters longer and several millimeters wider than *G. peshmenii* at flowering time. *G. peshmenii* is an autumn-flowering plant. The flowers are produced before the leaves emerge from the soil, or when the leaves are only 1-5.5 cm long. *G. cilicicus* is taller than *G. peshmenii* and has larger leaves and flowers. In *G. cilicicus* apex of the inner perianth segments are often flared with wavy margins, whereas flared inner perianth segments and wavy margins were not observed in *G. peshmenii* during field-studies. The leaves of *G. peshmenii* usually have a faint stripe on upper surfaces, but this faint stripe is very rare in *G. cilicicus.*

In our palynological studies, pollen grains of both species were shown to be prolate shaped, and the size and the ornamentations of the grains were similar. The sample named as *G. cilicicus* [H. Sümbül 2229 (HUB)] by Dönmez and Işık (2008) was considered to be *G. elwesii* var. *monostictus* Based on these results, pollen structures of these three taxa were found morphologically quite similar to each other's.

In addition, seeds of the species were quite similar in terms of size, shape and surface.

Acknowledgements

We are indebted to TÜBİTAK (Project no. TBAG-105T341), Istanbul University (T-62/15122006) and Akdeniz University Scientific Research Project Unit for financial support. The authors gratefully thank Ian Hedge and Professor Dr. Tuna Ekim for checking the manuscript.

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(Received for publication 07 June 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 161-168

Research article/Araştırma makalesi

Morphological and anatomical investigations on endemic *Hyacinthella acutiloba* in Turkey

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Abstract

Morphology and anatomy of *Hyacinthella acutiloba* K.Press. & Wendelbo (Sivri sümbül) an endemic species for Turkey, belong to Asparagaceae have been investigated. The specimens collected from two populations of natural habitat in Sivas province. In morphological studies, biometric measurements of the plant organs such as bulb, scape, leaf and flower have been carried out and pollen morphology has been studied. Pollen shape is prolate and ornamentation is reticulate. For anatomical investigations the hand cross-sections of root, scape and leaf were taken with a razor blade. The adventive root, scape and leaf anatomies of species display the common properties of monocotyledons. The leaves are amphistomatic and mesophyll is isolateral.

Key words: Anatomy, Asparagaceae, Endemic, *Hyacinthella acutiloba*, Morphology

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Türkiye'ye endemik olan *Hyacinthella acutiloba* üzerinde morfolojik ve anatomik araştırmalar

Özet

Türkiye'ye endemik bir tür olan Asparagaceae familyası üyesi *Hyacinthella acutiloba* K.Press. & Wendelbo (Sivri sümbül) türünün morfolojisi ve anatomisi incelenmiştir. Bitki örnekleri Sivas ilindeki iki doğal yayılış ortamından toplanmıştır. Morfolojik çalışmalarda bitkinin soğan, skapus, yaprak ve çiçek gibi organlarının biyometrik ölçümü gerçekleştirilmiştir ve polen morfolojisi incelenmiştir. Polen şekli prolat ve ornamentasyonu retikülattır. Anatomik araştırma için jilet kullanılarak bitkinin kök, skapus ve yaprağından enine kesit alınmıştır. Türün adventif kök, skapus ve yaprak anatomileri monokotil bitkilerin ortak özelliklerini göstermektedir. Yapraklar amfistomatik ve mezofil izolateraldir.

Anahtar kelimeler: Anatomi, Asparagaceae, Endemik, *Hyacinthella acutiloba*, Morfoloji

1. Introduction

Asparagaceae family has 143 genera and 3632 species which are distribute naturally in temperate, sub-tropical and tropical, and contains ornamental, vegetable, aromatic and medicinal plants (The Plant List, 2010). The family is represented in 19 genera and 182 species in the Flora of Turkey (Güner et al., 2012). *Hyacinthella* Schur is a genus of 17 species distributed in mainly Mediterranean regions (The Plant List, 2010). Genus is represented 12 species, which 10 of them are endemic, in Turkey (Güner et al., 2012). *H. acutiloba* K.Perss. & Wendelbo is an endemic species distributed in Kayseri, Sivas, Malatya and Erzincan province within B6 and B7 square in Turkey. The chromosome number is known as 2n=18 (Persson and Wendelbo, 1984). According to Red Data Book of Turkish Plants, threat category of species is lower risk/conservation dependent (LR/cd) (Ekim et al., 2000). *Hyacinthella* genus is constantly changing place between families (Liliaceae, Hyacinthaceae, recently Asparagaceae). Therefore, determination of morphological and anatomical characteristics of all species in detail will contribute to state of systematically place of the genus.

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There are some studies on the morphology and anatomy of this genus. *Hyacinthella micrantha* (Boiss.) Chouard (Kandemir et al., 2000), *H. lineata* (Steudel) Chouard (Selvi et al., 2008), *H. lazulina* K. Persson et J. Persson, *H. heldreichii* (Boiss.) Chouard and *H. campanulata* K.Press. & Wendelbo (Atayeter, 2007) and *H. glabrescens* (Yetişen et al., 2012) endemic species for Turkey, have been investigated morphologically and anatomically. *H. acutiloba* is closely related to *H. lineata* by morphological characters (Persson and Wendelbo, 1984). There is no report on anatomical characters of a Turkish endemic *H. acutiloba.* In this study, the morphological and anatomical characters of the species have been reported here in detail.

2. Materials and methods

Examined specimens were collected from natural habitats in Sivas (Turkey). Locality 1: Sivas province, from Sivas to Gürün, near Böğrüdelik village, (N 38° 57’ 26” ; E 37° 16’ 15”, 1966 m), 16.04.2011, M. Tekin 1064. Localite 2: Sivas province, from Sivas to Ulaş, near Ziyarettepe, (N 39° 33’ 08.9” ; E 37° 01’ 12.1”, 1400 m), 12.06.2012, M. Tekin 1246. Apart the seed, for state of morphological and anatomical properties were used the specimes which collected from both locality. For state of seed morphology properties were used the specimens which collected from locality 2. Some plants were prepared as herbarium materials and voucher specimens were deposited in the Cumhuriyet University Herbarium, Faculty of Science, Department of Biology (CUFH). Others were fixed in 70% ethyl alcohol for anatomical studies. Taxonomic descriptions of the plants were carried out according to Persson and Wendelbo (1984). Seeds were observed an Olympus SZ61 Stereomicroscope and images were taken with a ProgRes C12 Plus digital camera. For pollen morphology, slides prepared were as described by Wodehouse (1935). Measurements were taken from 50 pollen grains derived from the herbarium materials. For anatomical studies, hand sections from fixed samples were taken with a razor blade and some sections were stained with Alcian blue (Sigma) for pectic substances, Safranin (Sigma) for lignin (20 µl Alcian Blue + 20 µl Safranin in 10 ml 25% glycerin for four hours) and Sudan III (Sigma) for suberin (Jensen, 1962). The stained and unstained sections were mounted in glycerin-gelatin to make permanent preparations (Jensen, 1962). Pollen slides and anatomical sections were examined using an Olympus BH2 microscope fitted with a digital camera. Images were taken with a ProgRes C12 Plus digital camera and selected images were processed in PhotoShop 7.0. The anatomical drawings were performed with the aid a camera lucida system coupled light microscope.

3. Results

3.1 Morphological Properties

Hyacinthella acutiloba K.Perss. & Wendelbo in Candollea 36:524

Perennial, 8-15 cm. Adventive roots pale brown and 1-7.5 cm. Bulbs subglobose to ovoid, 1.2-3.2x1.5-2.7 cm. Tunics greyish-brown and thickened membranous. Leaves 3, oblong-elliptic, 5-9.5x0.4-2.3 cm and generally shorter than scape. Lamina surface glabrous, margin ciliolate-scabrid particulary at base. Scape single, occasionally paired, 6-13 cm, erect, glabrous and greenish, tinged or spotted purplish. Raceme cylindrical with 8-35 flowers, rachis green- purplish. Bracts 0.8-1.1 mm, membranous, faintly bilobed, medium violet. Pedicels 1.5-6 mm at anthesis. Perigon 4-6 mm, violet blue, tubular-campanulate; tubes 2.5-3.6 mm, lobes triangular, 1.5-2.5 mm and lobes apex subacute to obtus. Stamens attached to perigon tube. Filaments 0.7-1 mm, hairless, slender and shorter than anthers. Anthers 1.3-1.8 mm, dorsifixed, longitudinal dehiscent and deep violet. Pollen grains are monosulcate, 27-32 x 37-42 µm (E-P), prolate (P/E ratio = 1.34). Exine sculpture is reticulate (Figure 2 A,B). Style 1.8-2.4 mm. Ovary 1.5-2x1.7-2.4 mm, ovoid to subglobose and light green. Fruit 3.2-4 x 4.2-5 mm and subglobose and usually bearing 6 seeds. Seeds 1.4-2 x 2.1-2.7 mm and black colored (Figure 2 C). Table 1 shows the morphological measurements obtained from *H. acutiloba* and literature knowledge.

Figure 1A. *H. acutiloba* in natural habitat
Şekil 1A. Doğal yaşam ortamında *H. acutiloba*

Figure 1B. Raceme of *H. acutiloba*
Şekil 1B. *H. acutiloba* rasemusu

Figure 2. Pollen and seed properties of *H. acutiloba.* A. Pollen grain in optical section (Prolate). B. Exine ornamentation (Reticulate). Scale bar= 10µm. C. Seed morphology. Scale bar= 1 mm
Şekil 2. *H. acutiloba*'nın polen ve tohum özellikleri. A. Optik kesitte polen tanesi (Prolat). B. Ekzin ornamentasyonu (Retikülat). C. Tohum morfolojisi

Habitat: Quercus scrub, rocky limestone slopes, gypsaceous hills, 1550-2100 m.
Flowering period: April-May.
Phytogeographic region: Irano-Turanian element.
Distribution in the World: Turkey (Endemic).
Distribution in Turkey: Central Anatolia. Sivas, Kayseri, Malatya, Erzincan.

3.2 Anatomical Properties

3.2.1 Root: The root of *H. acutiloba* displays common features of monocotyledons (Figure 3 A,B,C,D). Epidermis is composed of oval or spherical shaped, single layered cells. The cell walls of epidermal cells are suberised and its outer wall is thicker than the other walls. Exodermis is made up of big suberised, single layered cells. They do not contain intercellular space (Figure 4). Cortex is 8-10 layered and consists of parenchymatous cells with intercellular space and thin walls. Some cells contain calcium oxalate (CaOx) raphide crystals (Figure 3 C,D). The single layered endodermis circularly is arranged central cylinder which follows the cortex. Endodermal cells have not secondary wall thickness and Casparian strip is distinct (Figure 5). Pericycle is single layered and thin walled. Protoxylem ridges are 7 or 8 and these are alternate with the phloem. The centre of the vascular cylinder is occupied by parenchyma cells (Figure 3 C,D).

Table 1. Morphological mesurements of *H. acutiloba* and their comparisons with literature knowledges
Tablo 1. *H. acutiloba*'nın morfolojik ölçümleri ve bu ölçümlerin literatür kayıtları ile karşılaştırılmaları

	Tekin and Meric (present study)	Persson and Wendelbo, 1984 (*H. acutiloba*)	Selvi et al., 2008 (*H. lineata*)
Plant length(cm)	8-15	Not recorded	10-18
Bulb (width x length) (cm)	1.2-3.2x1.5-2.7	Not recorded	1.2-2.5x2-2.5
Root length (cm)	1-7.5	Not recorded	1.5-5
Leaf width (mm)	4-23	(5-)10-20(-35)	8-15
Leaf length (cm)	5-9.5	Not recorded	5.5-6.5
Scape length (cm)	6-13	Not recorded	8-15
Bract length (mm)	0.8-1.1	Not recorded	Not recorded
Pedicel length (at anthesis) (mm)	1.5-6	Not recorded	2-7
Perigon length(mm)	4-6	Not recorded	4.5-6
Perigon tube length (mm)	2.5-3.6	Not recorded	Not recorded
Perigon lobe length (mm)	1.5-2.5	Not recorded	1.5-2.1
Filament length(mm)	0.7-1	Not recorded	0.5-0.8
Anther length (mm)	1.3-1.8	Not recorded	1.5-2
Style length (mm)	1.8-2.4	Not recorded	2.2-2.5
Ovary (width x length) (mm)	1.5-2x1.7-2.4	Not recorded	1-1.5x1-2
Fruit (width x length) (mm)	3.2-4 x 4.2-5	Not recorded	Not recorded
Seed (width x length) (mm)	1.4-2 x 2.1-2.7	Not recorded	Not recorded
Pollen (E x P) (μm)	27-32 x 37-42	Not recorded	Not recorded

3.2.2 Scape: Transverse sections taken from the stem are observed as follows (Figure 6 A,B,C,D): Epidermis with cuticle is composed of single layered, ovoid or spheroid cells. The outer tangential wall of epidermal cells is thicker than radial and inner tangential walls. Cortex is 5-6 layered and consists of parenchymatous cells with intercellular space and thin walls. Some cells of the cortex contain CaOx raphide crystals. The 6-7 layered sclerenchyma tissue is on the inner side of the cortex (Figure 6 C,D). Scape contains about 23-25 vascular bundles of different sizes in vascular cylinder. Vascular bundles consist of xylem and phloem are collateral type and they begin under sclerenchyma tissue. In inner circles, the bundles are bigger than outer ones (Figure 6 C,D). The pith consists of parenchymatous cells. Epidermis of scape has a few anomocytic type stomata. The stomata cells are located at the same level with the other epidermal cells.

3.2.3 Leaf: There is a single layered epidermis on both surface of leaf. Both epidermises are covered with a thin cuticle. The outer walls of epidermal cells are undulate and thickened. The leaf is amphistomatic. Stoma cells are equally present on the surfaces of both sides. They located on the same level with the other epidermal cells (mesomorphic). Stoma type is anomocytic. The mesophyll is isolateral and differentiated as palisade and spongy parenchyma. Under upper epidermis, the mesophyll contains 1-2 layers of palisade which is comprised of oval-shaped cells with intercellular spaces. Under lower epidermis, palisade parenchyma is composed of two layers of elongated cells. Lacunae are absent in the mesophyll. Mesophyll has a few raphide crystal idioblast. Vascular bundles of different sizes are arranged in one row and located in the spongy parenchyma cells. The xylem faces towards the upper surface while the phloem faces the lower epidermis. The big bundles have sclerenchyma fibers cap which is situated over phloem and xylem (Figure 7 A,B,C). Both epidermises do not contain trichomes.

4. Conclusions

In this study, morphological and anatomical features of *H. acutiloba* have been investigated, and the morphological features of species have been compared with Persson and Wendelbo (1984). There are very limited data with respect to the morphological features of species in Flora of Turkey and the East Aegean Islands (Persson and Wendelbo, 1984; vol: 8, pp. 278). The morphological characters and biometric measurement of most organs have been reported in this study. Persson and Wendelbo (1984) have been reported that *H. acutiloba* is like *H. lineata* for morphological properties. Our morphological results are also compared with *H. lineata* (Selvi et al., 2008) in table 1. There are a few differences related to morphological characters between both species.

Anatomical features of the root are similar with studied *Hyacinthella* species (Kandemir et al., 2000; Atayeter, 2007; Selvi et al., 2008; Yetişen et al., 2012) and *Bellevalia mathewii* Özhatay & Koçak (Asparagaceae) (Doğu et al, 2011). In root cortex of *H. lineata,* sand crystals have been reported by Selvi et al. (2008). In root cortex cells of *H. glabrescens* have been observed raphide and sand crystals by Yetişen et al., 2012. *H. acutiloba* have calcium oxalate (CaOx) raphide crystals in root cortex.

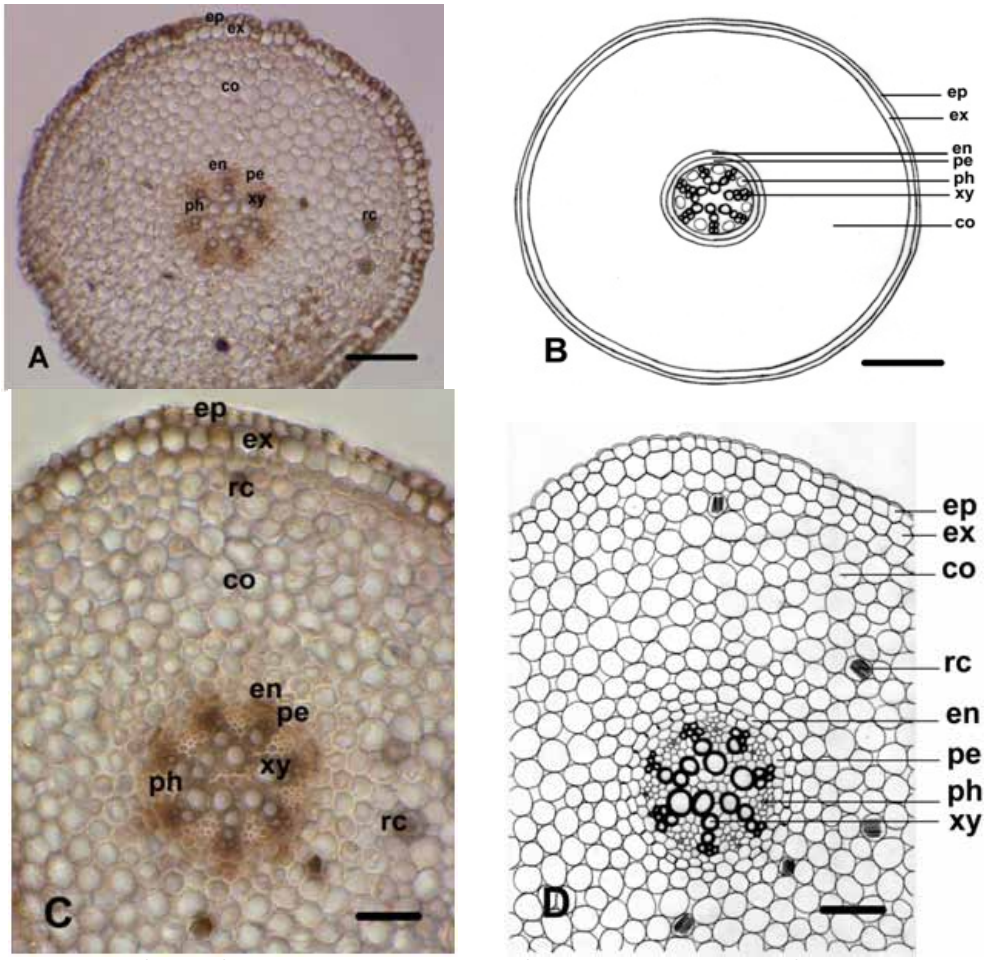

Figure 3. The cross-section of root of *H. acutiloba*. A. Low magnification microphotograph of root section. B. Diagram of root section. Scale bar= 100 µm. C. The microphotograph of root cross-section. D. Camera lucida drawing of root cross-section. co, cortex; en, endodermis; ep, epidermis; ex, exodermis; pe, pericycle; ph, phloem; rc, raphide crystals; xy, xylem. Scale bar= 50 µm

Şekil 3. *H. acutiloba*'nın kökünden enine kesit. A. Kök kesitinin düşük büyütmedeki mikrofotoğrafı. B. Kök kesiti diyagramı. C. Kök enine kesiti mikrofotoğrafı. D. Kök enine kesitinin Camera lucida çizimi. co, korteks; en, endodermis; ep, epidermis; ex, ekzodermis; pe, perisikl; ph, floem; rc, rafit kristalleri; xy, ksilem

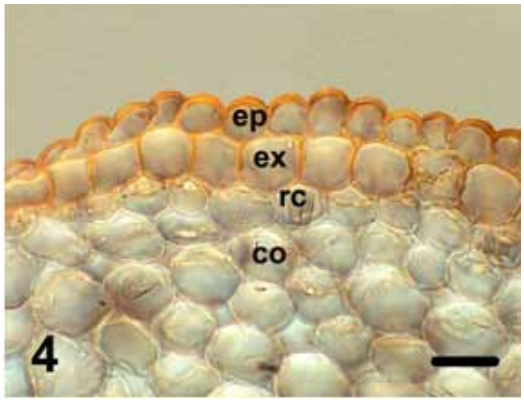

Figure 4. Epidermis and exodermis in root (stained with Sudan III). co, cortex; ep, epidermis; ex, exodermis; rc, raphide crystals. Scale bar= 20µm

Şekil 4. Kökte epidermis ve ekzodermis (Sudan III ile boyalı). co, korteks; ep, epidermis; ex, ekzodermis; rc, rafit kristalleri

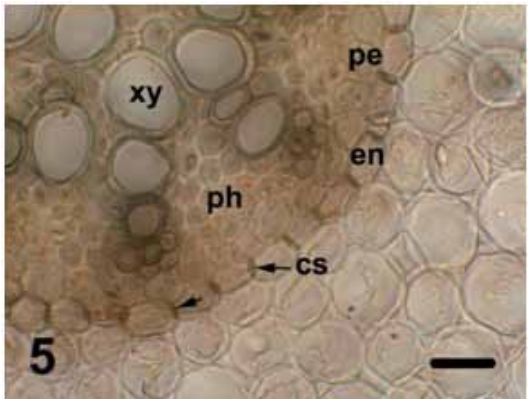

Figure 5. Endodermis with Casparian strip in root. cs, Casparian strip (arrows); en, endodermis; pe, pericycle; ph, phloem; xy, xylem. Scale bar= 20µm

Şekil 5. Kökte kaspari şeritli endodermis. cs, Kaspari şeridi; en, endodermis; pe, perisikl; ph, floem; xy, ksilem

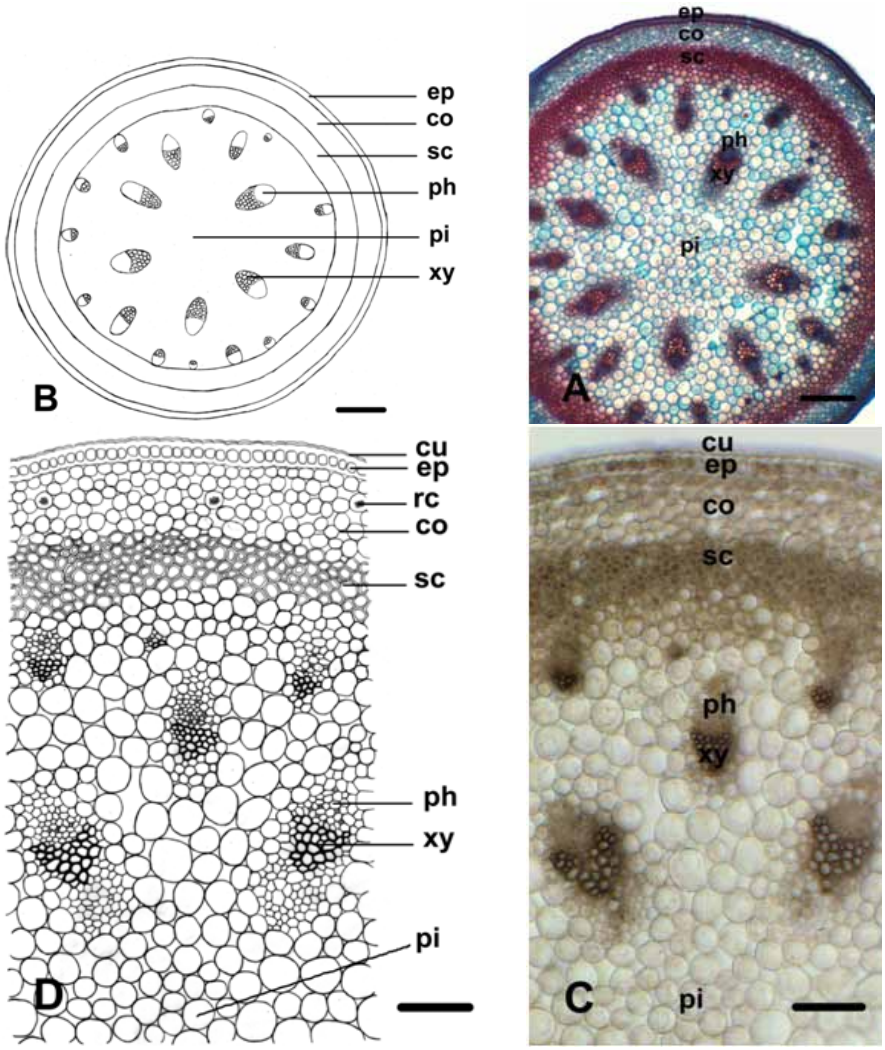

Figure 6. The cross-section of scape of *H. acutiloba.* A. Low magnification microphotograph of scape section (Stained with Alcian blue and Safranin). B. Diagram of scape section. Scale bar= 200. C. The microphotograph of scape cross-section. D. Camera lucida drawing scape cross-section. co, cortex; cu, cuticle; ep, epidermis; ph, phloem; pi, parenchymatic pith; rc, raphide crystals; sc, sclerenchyma; xy, xylem. Scale bar=100 µm.
Şekil 6. *H. acutiloba*'nın skapus enine kesiti. A. Skapus kesitinin düşük büyütmedeki mikrofotoğrafı (Alcian blue ve Safranin ile boyalı). B. Skapus kesitinin diyagramı. C. Skapus enine kesiti mikrofotoğrafı. D. Skapus enine kesitinin Camera lucida çizimi. co, korteks; cu, kutikula; ep, epidermis; ph, floem; pi, parenkimatik öz; rc, rafit kristalleri; sc, sklerenkima; xy, ksilem

In *H. micrantha*, *H. lazulina*, *H. heldreichii* and *H. campanulata* have not crystals in their roots (Kandemir et al., 2000; Atayeter, 2007). It has been reported that some endodermal cells have suberized thickness in roots of *H. micrantha* (Kandemir et al., 2000), *H. lazulina*, *H. heldreichii*, *H. campanulata* (Atayeter, 2007) and *H. lineata* (Selvi et al., 2008), and Casparian strip is not distinct in these species. In *H. acutiloba*, endodermal cells have not suberised wall thickness, and Casparian strip is distinct.

The scape of *H. acutiloba* contains monolayer epidermis, 5-6 layered parenchymatic cortex, multilayer sclerenchyma tissues, various sized vascular bundles and parenchymatic pith. These features of stem are similar with *H. lineata*, *H. lazulina*, *H. heldreichii*, *H. campanulata* and *H. glabrescens* (Atayeter, 2007; Selvi et al., 2008; Yetişen et al., 2012). However, *H. micrantha* is not sclerenchyma tissues in its stem (Kandemir et al., 2000). Although *H. acutiloba* have calcium oxalate raphide crystals in scape cortex, *H. glabrescens* have sand crystals it's in the cortex cell (Yetişen et al., 2012). The other studied *Hyacinthella* species have not crystals in their stems (Kandemir et al., 2000; Atayeter, 2007; Selvi et al., 2008).

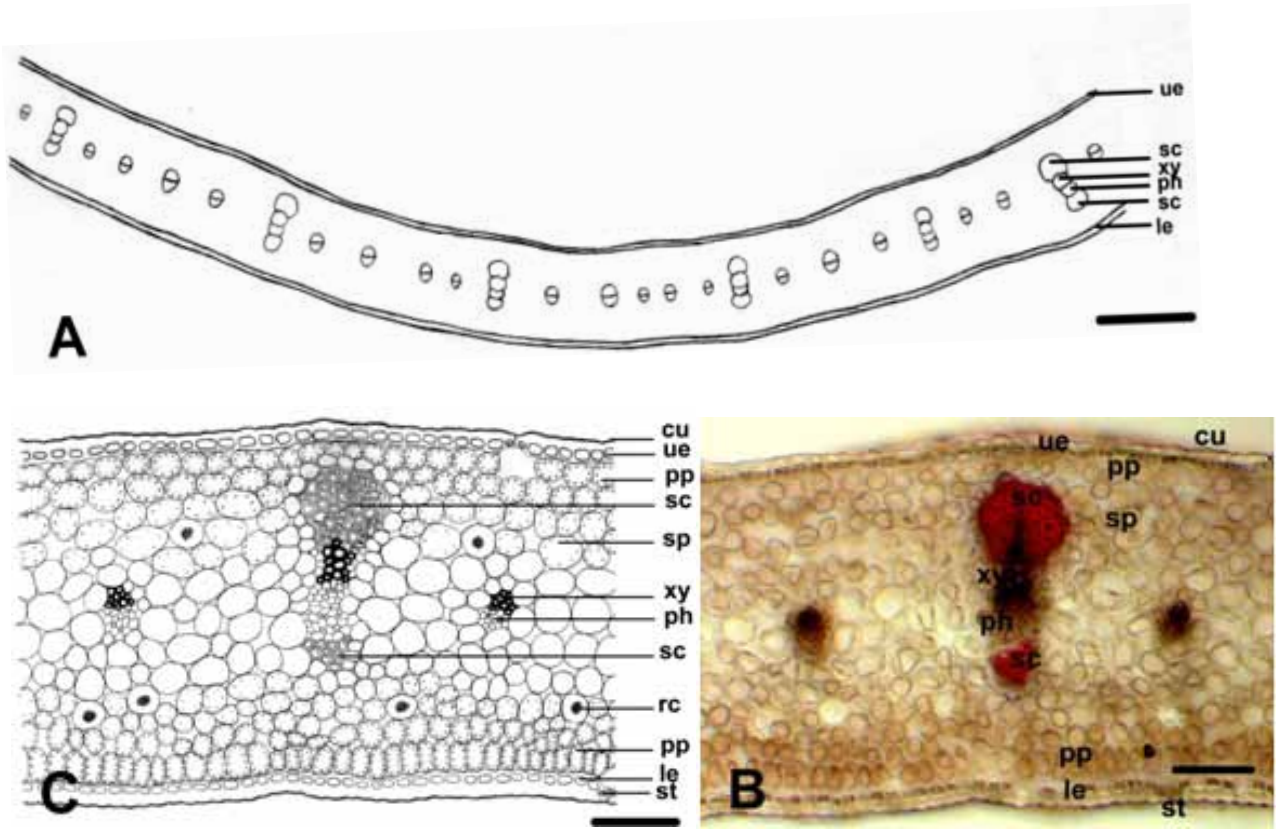

Figure 7. The cross-section of leaf of *H. acutiloba.* A. Diagram of leaf section. Scale bar= 500 µm. B. The microphotograph of leaf cross-section (Stained with Safranin). C. Camera lucida drawing of leaf cross-section. cu, cuticle; le, lower epidermis; ph, phloem; pp, palisade parenchyma; rc, raphide crystals; sc, sclerenchymatic cap; sp, spongy parenchyma; st, stoma; ue, upper epidermis; xy, xylem. Scale bar= 100µm
Şekil 7. *H. acutiloba*'nın yaprak enine kesiti. A. Yaprak kesiti diyagramı B. Yaprak enine kesiti mikrofotoğrafi (Safranin ile boyalı). C. Yaprak enine kesitinin Camera lucida çizimi. cu, kutikula; le, lower epidermis; ph, floem; pp, palizat parenkiması; rc, rafit kristalleri; sc, sklerenkimatik lifler; sp, sünger parenkiması; st, stoma; ue, üst epidermis xy, ksilem

Anatomical properties of the leaf in *H. acutiloba* are observed similarly with studied *Hyacinthella* species (Kandemir et al., 2000; Atayeter, 2007; Selvi et al., 2008). Mesophyll of *H. acutiloba* is isolateral and has got calcium oxalate raphide crystals. The raphide crystals are also present in *H. campanulata,* while *H. lazulina, H. heldreichii, H. micrantha* and *H. lineata* has not raphide crystals in their leaf mesophyll (Kandemir et al., 2000; Atayeter, 2007; Selvi et al., 2008).

The results are show that studied *Hyacinthella* species are almost similar with regard to their general anatomical features. However, the present/absent, location and morphology of the CaOx crystals is different in these species.

The functional significance of CaOx crystals within the plants remains unclear, although various functions have been them such as protection against foraging animals (Molano-Flores, 2001), detoxification of heavy metals or toxic oxalate (Franceschi and Nakata, 2005), calcium regulation in plant cells (Franceschi, 1989; Kostman and Franceschi, 2000; Volk et al., 2002), light gathering and reflection (Kuo-Huang et al., 2007), tissue support and plant rigidity (Franceschi and Horner, 1980). Specially, the raphide crystals are very important to defence against herbivores, because the sharp ends of them irritate the mucous membrane of animals' mouth (Vogel, 2004). However, the location, shape and present or absent of calcium oxalate crystals are controlled genetically and they can be used as an anatomical feature together with morphological characters.

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(Received for publication 14 September 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 169-177

Research article/Araştırma makalesi

Flora of Dervişli (Eşme, Uşak/Turkey) and its surroundings

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Abstract

The research area is situated in Eşme district of Uşak province. In this study, during the period 2011 - 2012 440 plant specimens, 48 families, 163 genera, 240 specific and infraspecific taxa were collected and identified. The number of endemic plants is 10 (4,16%). The distribution rates of the specimens into phytogeographical regions are as follows: Mediterranean elements 36 (15%), Irano-Turanian elements 29 (12,08%) and Euro-Siberian elements 9 (3,75%). Unknown or cosmopolits 166 (69,16%).

Key words: Dervişli, Flora, Eşme, Uşak, Turkey

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Dervişli ve çevresinin (Eşme, Uşak) florası

Özet

Araştırma alanı Uşak ilinin Eşme ilçesinde yer alır. Araştırma alanında 2011-2012 yılları arasında toplanan 440 bitki örneğinin değerlendirilmesi ile 48 familya, 163 cins, 240 tür ve türaltı takson tespit edilmiştir. Endemik bitkilerin sayısı 10 (%4,16)'dur. Taksonların fitocoğrafik bölgelere göre dağılımı şu şekildedir: Akdeniz elementleri 36 (% 15), Iran-Turan elementleri 29 (% 12,08) ve Avrupa-Sibirya elementleri 9 (% 3,75). Geniş yayılışlı ve yayılış alanları belli olmayan taksonların sayısı 166 (% 69,16). En yüksek taksona sahip üç *Fabaceae, Brassicaceae* ve *Asteraceae* familyalarıdır.

Anahtar kelimeler: Dervişli, Flora, Eşme, Uşak, Türkiye

1. Giriş

1.1 Alanın coğrafi konumu ve özellikleri

Araştırma alanı İç Batı Anadolu'da Manisa iline bağlı Kula ve Uşak iline bağlı Eşme ilçesi 38°30' kuzey enlemi ve 28°50' doğu boylamında yer alır (Şekil 1).Çalışma alanı olarak seçilen Dervişli köyü, Eşme İlçesi'nin güneybatısında yer alır. Yükseltisi 750 m.'dir. Eşme Uşak ilinin bir ilçesi olup, Uşak'ın güneybatısında bulunmaktadır. Batısında Kula (Manisa) ilçesine bağlı Eroğlu Köyü, doğusunda Eşme ilçesine bağlı Oymalı Köyü, güneyinde Eşme ilçesine bağlı Alahabalı Köyü bulunmaktadır. Çalışma alanımız bitki coğrafyası açısından Davis (1965)'e göre Akdeniz flora bölgesi içine girmekte olup Davis (1965)'in kareleme sistemine göre B1 karesinde yer almaktadır.

1.2. Jeolojik yapı ve toprak özellikleri

Uşak ili Ege Bölgesinin İç Batı Anadolu bölümünde yer alır. Sahanın genel görünümü akarsular tarafından yarılmış hafif dalgalı plato yüzeyi şeklindedir. Uşak ili Eşme ilçesi Dervişli Köyü genel olarak engebelidir. Uşak ilinin

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 BioDiCon. 277-0912

ortalama yüksekliği 906 m.'dir. Dağlar il alanının kuzeydoğu ve doğu kısımlarında kümelenmiştir. İlin %37,5'ini teşkil eden dağlık alanlar, kapladığı alan itibariyle platolardan sonra ikinci sırada gelmektedir (Anonim, 2002).

Uşak ve yakın çevresi Menderes Masifinin kuzeydoğusunda yer alır. Jeolojik açıdan kompleks bir yapı sunar. Uşak ve yakın dolayında stratigrafik olarak en yaşlı kaya birimlerini Menderes masifine ait; gnays, şist ve mermerlerden oluşturmaktadır. Paleozoik yaşlı bu birimlerin yaşının Triasa kadar çıktığı bölgede yapılan çalışmalarla tespit edilmiştir. Menderes masifine ait, bu birimler üzerinde Jura yaşlı metakumtaşı, metasilttaşı vedolomitik kireçtaşları uyumsuz olarak yer almaktadır. Bu dolomitik kireçtaşları üzerinde Üst Kretase'de ofiyolitik bir melanj yerleşmiştir. Bu dönemden sonra masifine son şeklini veren metamorfizma ve yersel granit oluşumları gözlenmiştir. Alt Miyosende bölge Ege sisteminin gerilme sisteminin etkisinde kalmış ve bölgede Neojen havzaları ve Neojenvol kanitleri gelişmiştir. Daha sonra bölgede gölsel kireçtaşları çökelmiş ve bu göller kuruyup çekildikten sonra oluşan alüvyal yelpazelerde ve akarsu ortamlarında ise çakıl taşlarının hakim olduğu karasal çökeller oluşmuştur. Günümüzde ise dere yataklarında alüvyon çökellerinin gelişimi devam etmektedir (Aysal, 2001).

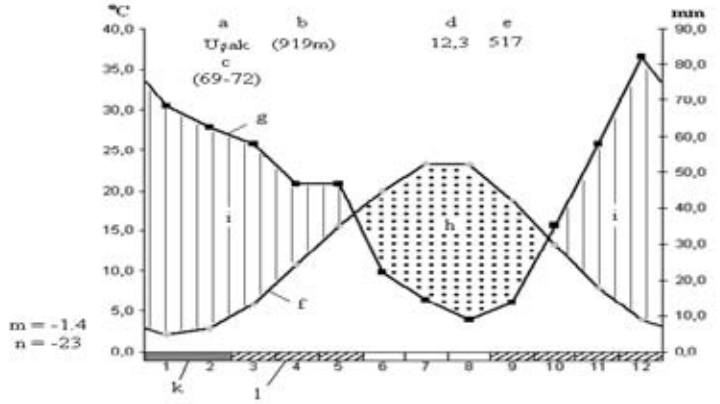
1.3. İklim

Uşak ili coğrafik bakımdan Ege Bölgesi ile İç Anadolu Bölgesi arasında yer almaktadır. Bu konumun doğal sonucu olarak ilde geçit iklimi karakterleri hüküm sürmektedir (Anonim, 1997a). Ege bölgesine göre daha sert, İç

Şekil 1: Çalışma bölgesinin görüntüsü

Anadolu bölgesine göre daha yumuşak bir iklim tipi karşımıza çıkmaktadır (Anonim, 2002). Kıyı bölgelerinde görülen Akdeniz iklimine benzemeyen bu iklim tipinde yaz ve kış sıcaklıkları arasındaki fark oldukça yüksektir (Darkot ve Tuncel, 1995). Geçiş koşullarını yansıtan özelliklerin baskın olduğu bu iklimde karasallık da belirgin bir şekilde kendini hissettirmektedir. Ege kıyılarında görülen Akdeniz ikliminden bazı yönleriyle ayrılan bu tip, iç bölge iklimi olarak adlandırılmaktadır (İzbırak, 1984). Yaz mevsiminde bölgede etkili olan subtropikal hava kütlesinden dolayı güneşli, sıcak ve yağışsız günler etkili olmaktadır. Bölge Ekim ayından itibaren ise, Orta ve Doğu Avrupa üzerinden gelen kontinental polar hava kütlesinin etki alanına girmektedir (Koçman, 1993). Bu durum ise, sıcaklık değerlerinde düşüşe, basınç değerlerinde yükselmeye yol açmaktadır (Dönmez, 2005).

Kış aylarının oldukça yağışlı ve yaz aylarının ise nispeten kurak geçmesi nedeniyle, bölgenin yağış özellikleri daha çok Akdeniz yağış rejimine benzemektedir. Bununla birlikte yörede kış yağışlarının oranı, karakteristik Akdeniz yağış rejimi kadar yüksek değildir. Aynı şekilde sahada, yaz yağışlarının da nispeten yüksek olduğu görülür. Bu nedenle sahada görülen yağış rejimi, değişikliğe uğramış bir Akdeniz yağış rejimi tipidir (Günal, 1995). Uşak meteoroloji istasyonundan alınan verilere göre çizilen Walter (1955) iklim diyagramı Şekil 2'de verilmiştir.



Şekil 2. Uşak ilinin biyoiklimsel özelliklerini gösteren Walter (1955) klima diyagramı.

2. Materyal ve yöntem

Araştırma materyalini 2011-2012 yılları arasında Dervişli köyü ve yakın çevresinden periyodik aralıklarla toplanan bitki örnekleri oluşturmaktadır. Toplanan örnekler herbaryum tekniklerine uygun olarak preslenip kurutuldu. Kurutulan bitki örnekleri Celal Bayar Üniversitesi Fen - Edebiyat Fakültesi Biyoloji bölümü Herbaryumu'nda teşhis edildi. Bitki örneklerinin teşhisi için "Türkiye ve Ege Adaları Florası Cilt 1-9" (Davis, 1965-1985), "Türkiye ve Ege Adaları Florası (ek. 1) Cilt 10" (Davis ve ark, 1988), "Türkiye ve Ege Adaları Florası (ek. 2) Cilt 11" (Güner ve ark., 2000) eserlerinden yararlanılmıştır. Otör isimlerinin doğru ve standart olarak yazılması için Brummitt ve Powel' ın "Author of Plant Names" adlı eserinden yararlanılmıştır (Brummitt ve Powell, 1999).

Çalışma alanının haritası için *Google Earth* programından yararlanılmıştır. Uşak ve Eşme iklimi ile ilgili meteorolojik veriler *Devlet Meteoroloji İşleri Genel Müdürlüğü*'nden alınmıştır (Anonim, 2006). İklim ile ilgili verilerin yorumlanmasında "*İklim ve Biyoiklim*" kitabından yararlanılmıştır (Akman, 1999). Endemik bitkilerin tehlike kategorilerinin yazılmasında Türkiye Bitkileri Kırmızı Kitabı'ndan yararlanılmıştır (Ekim ve ark, 2000).

Araştırma alanı Davis'in belirlediği Grid sistemine göre B2 karesi içinde yer almaktadır. Toplama yerleri verilirken "B2 Uşak: Eşme" kısmı tekrarlanmamıştır. Bitki taksonlarının düzenlenmesinde alfabetik sıra takip edilmiştir.

2.1 Kısaltmalar

End. **:** Endemik,
IUCN **:** Dünya Koruma Birliği,
LC **:** En az endişe verici (Least Concern),
NT **:** Tehlike altına girebilir (Near Threatened),
İ. K. **:** İbrahim Kesim.

2.2 Vejetasyon yapısı

Araştırma alanında step, çalı, sulak alan ve orman vejetasyonu görülmektedir. Araştırma alanımızdaki çalı vejetasyonunu *Cistus laurifolius* L. ve *Quercus coccifera* L. toplulukları oluşturur. Bu birliklerin dışında *Juniperus oxycedrus* L. subsp. *oxycedrus, Crataegus monogyna* Jacq. subsp. *azarella* (Gris.) Franco toplulukları bulunur.

Sulak alan vejetasyonu çalışma alanındaki Karaağaç göleti kenarında yayılış gösteren türlerden oluşmaktadır. Baskın türler olarak; *Mentha pulegium* L. var**.** *hirsuta* Guss., *Mentha spicata* L., *Alisma lanceolatum* With. gibi türler görülmektedir.

Step vejetasyonuna ait baskın türler; *Astragalus hamosus* L., *Astragalus lydius* Fischer, *Centaurea depressa* Bieb., *Medicago minima* (L.) Bart. var. *minima, Poa bulbosa* L., *Trigonella coerulescens* (Bieb.) Hal., *Hordeum geniculatum* All., *Hypericum perforatum* L., *Aegilops triuncialis* L. subsp. *persica* (Boiss.) Zhuk. olarak görülmektedir.

Araştırma alanının büyük bölümünü oluşturan orman vejetasyonunda dominant türler; *Quercus cerris* L. var. *cerris* ve *Quercus pubescens* Willd. birlikleridir. Orman vejetasyonu altında *Thymus sipyleus* Boiss. subsp. *sipyleus* ve *Centaurea depressa* Bieb. türleri yayılış göstermektedir.

2.3 Bitki toplama istasyonları

1-2 Dervişli köyü girişi, yol kenarları, 800-820 m, 05.07.2011
3-6 Dervişli köyünün batı yönü çıkışı, orman vejetasyonu, 800-820 m, 08.07.2011
7-25 Dervişli köyünün doğu kısmında bulunan içme suyu tesisinin güney kesimi, dere içi, kuzeyinde bulunan meşe toplulukları, 780-800 m, 08.08.2011
26-35 Dervişli köyünün doğu kesiminde bulunan Kepez mevkii, 760-800 m, 15.10.2011
36-45 Dervişli köyü girişinde bulunan okulun hemen yanından başlayarak güney batı yönüne doğru yaklaşık 3 km çapındaki alan, 740-790 m, 16.10.2011
46-48 Dervişli köyü çevresi meşe ormanları,730-780 m, 26.11.2011
51-60 Dervişli köyünün güney kısmında Albazın önü mevkiinde bulunan Hapılı anne çeşme civarı, 790 m, 27.11.2011
61-74 Dervişli köyünün kuzey kısmında köy çıkışından başlayıp Topuz mevkii adı verilen yaklaşık 2 km çapındaki alan, 780-820m, 07.01.2012
75-93 Dervişli köyünün güney kısmanda bulunan Taşlı Bölük mevkii, 760-780 m, 28.01.2012
94-120 Dervişli köyünün güney kısmanda bulunan Payırt mevkii, 770 m, 03.03.2012
121-132 Dervişli köyünün kuzey kısmında bulunan Kebir mevkii, 750 m, 24.03.2012
133-145 Dervişli köyünün kuzey kısmında bulunan Taşlık mevkii, 790 m, 31.03.2012
146-167 Dervişli köyünün kuzey batı kısmında bulunan Ildırımlı mevkii, 750 m, 01.04.2012
168-184 Dervişli köyünün mezarlığının güney kesimleri, step alanlar, 790-820 m, 07.04.2012
185-200 Dervişli köyünün doğu kısmında bulunan dere yatağı ve çevresi, 770 m, 08.04.2012
200-205 Dervişli köyünün batı kısmında bulunan dere yatağı ve çevresi, 770 m, 21.04.2012
206-224 Dervişli köyünün kuzey doğu kısmındaki Karaoğlanlı mevkii, 790 m, 21.04.2012

3. Bulgular

Divisio: ***PTERIDOPHYTA***

Familya: ***ASPIDIACEAE***
Dryopteris pallida (Bory) Fomin. İ. K. 111

Familya: ***ASPLENIACEAE***
Asplenium onopteris L. İ. K. 171
Ceterach officinarum DC. İ. K. 25

Familya: ***EQUISETACEAE***
Equisetum telmateia Ehrh. İ. K. 112

Divisio: ***SPERMATOPHYTA***
Subdivisio: ***GYMNOSPERMAE***

Familya: ***CUPRESSACEAE***
Juniperus oxycedrus L. subsp. ***oxycedrus*** İ. K. 1
Cupressus sempervirens L. İ. K. 2

Familya: ***PINACEAE***
Pinus brutia Ten.İ. K. 3
Pinus nigra Arn. subsp. ***nigra*** subsp. ***pallasiana*** (Lamb.) Holmboe İ. K. 4
Pinus pinea L. İ. K. 5
Pinus sylvestris L. İ. K. 6

Subdivisio: ***ANGIOSPERMAE***
Ordo: ***DICOTYLEDONES***

Familya: ***ALISMATACEAE***
Alisma lanceolatum With. İ. K. 113, 200

Familya: ***ANACARDIACEAE***
Pistacia terebeinthus L. İ. K. 172

*Familya:****APIACEAE (UMBELLIFERAE)***
Caucalis platycarpos L.İ. K. 114, 75
Ferulago aucheri Boiss. İ. K. 115 **End.**
Scandix pecten-veneris L. İ. K. 173
Scandix stellata Banks & Sol. İ. K. 7, 49, 98
Torilis japonica (Houtt.) DC. İ. K. 8, 49, 89
Turgenia latifolia (L.) Hoffm. İ. K. 23

Familya: ***APOCYNACEAE***
Vinca herbacea Waldst. & Kit. subsp. ***grandiflora*** A.DC. İ. K. 116

Familya: ***ASTERACEAE***
Achillea Phrygia Boiss.& Bal. İ. K. 9 **End.**
Acroptilon repens (L.) DC. İ. K. 117
Anthemis tinctoria L.İ. K. 10
Anthemis wallii Hub.-Mor. & Reese, İ. K. 11 **End.**
Carduus nutans L. İ. K. 223
Centaurea depressa Bieb. İ. K. 118
Centaurea solstitialis L. İ. K. 12
Chardinia orientalis (L.) O. Kuntze İ. K. 119
Chondrilla juncea L. İ. K. 13
Cichorium intybus L. İ. K. 174
Conyza canadensis (L.) Cronquist İ. K. 224
Inula montbretiana DC. İ. K. 14
Jurinea consanguinea DC. İ. K. 120
Logfia arvensis (L.) Holub İ. K. 121
Senecio vernalis Waldst. & Kit. İ. K. 122
Xanthium spinosum L.İ. K. 15
Xanthium strumarium L.İ. K. 16

Familya: ***BORAGINACEAE***
Anchusa azurea Miller İ. K. 17, 37
Anchusa undulata L.İ. K. 18
Buglossoides arvensis (L.) Johnstonİ. K. 19
Buglossoides incrassata (Guss.) Johnston İ. K. 123
Cerinthe minör L.İ. K. 124
Echium italicum L.İ. K. 20
Lappula barbata (Bieb.) Gürke İ. K. 21
Myosotis stricta Link ex Roemer & Schultes İ. K. 175
Onosma aucheranum DC.İ. K. 125
Onosma tauricum Pallas ex Willd. var. ***brevifolium*** DC İ. K. 126 **End.**

*Familya:****BRASSICACEAE (CRUCIFERAE)***
Alyssum desertorum Stapf İ. K. 22
Alyssum huetii Boiss. İ. K. 23 **End.**
Alyssum linifolium Steph. ex Willd. İ. K. 176
Alyssum murale Waldst. & Kit. İ. K. 127
Alyssum pateri Nyár. İ. K. 177
Arabis nova Vill. İ. K. 128
Boreava orientalis Jaub. & Spach İ. K. 192
Camelina rumelica Vel. İ. K. 24
Cardaria draba (L.) Desv. İ. K. 129
Cardaria draba (L.) Desv. İ. K. 130
Descurainia sophia (L.) Webb ex Prantl İ. K. 25
Erophila verna (L.) Chevall İ. K. 131
Eruca sativa Miller İ. K. 179
Hymenolobus procumbens (L.) Nutt. ex Torrey &Gray İ. K. 26
Lepidium sativum L. İ. K. 27
Malcolmia africana L.İ. K. 28
Matthiola longipetala (Vent.) DC.İ. K. 132
Neslia apiculata Fisch. İ. K. 219
Raphanus raphanistrum L. İ. K. 29
Rorippa sylvestre (L.) Bess. İ. K. 220
Sinapis arvensis L. İ. K. 133
Sisymbrium altissimum L. İ. K. 30
Thlaspi perfoliatum L. İ. K. 31

Familya: ***CAMPANULACEAE***
Legousia falcata (Ten.) Fritsch İ. K. 32
Legousia speculum – veneris (L.) Chaix İ. K. 33

*Familya:****CAPPARACEAE***
Capparis ovata Desf. İ. K. 34

Familya: ***CARYOPHYLLACEAE***
Agrostemma githago L. İ. K. 180, 220
Cerastium banaticum (Roch.) Heuffel İ. K. 134
Cerastium perfoliatum L. İ. K. 35, 48, 78
Dianthus caryophyllus L. İ. K. 36, 98
Dianthus zonathus Fenzl İ. K. 135, 14, 104
Silene cappadocica Boiss. & Heldr. İ. K. 37
Silene dichotoma Ehrh. İ. K. 38
Silene subconica Friv. İ. K. 39
Vaccaria pyramidata Medik. İ. K. 40, 77, 99

Familya: ***CHENOPODIACEAE***
Chenopodium albumL. var. ***album*** İ. K. 136
Chenopodium foliosum (Moench) Aschers. İ. K. 41

Familya: ***CISTACEAE***

Cistus laurifolius L. İ. K. 137, 174, 210
Helianthemum nummularium (L.) Miller subsp. ***nummularium*** İ. K. 42, 198

Familya: ***CONVOLVULACEAE***
Convolvulus arvensis L. İ. K. 182, 45
Convolvulus holosericeus Bieb. subsp. ***macrocalycinus*** Hausskn. & Bornm. ex Bornm. İ. K. 138,12 **End.**
Convolvulus lineatusL. var. ***angustifolius*** Kotschy İ. K. 181

Familya: ***DIPSACACEAE***
Scabiosa rotata Bieb. var. ***porphyrostephana*** Boiss. İ. K. 43
Knautia integrifolia (L.) Bert. İ. K. 221

Familya: ***EUPHORBIACEAE***
Euphorbia exigua L. İ. K. 222, 18, 90
Euphorbia helioscopiaL. var. ***haussknechtii*** (Boiss.) Boiss. İ. K. 44
Euphorbia muricata Bieb. İ. K. 45, 167

Familya: ***FAGACEAE***
Quercus cerris L. var. ***cerris*** İ. K. 46, 73, 113, 145
Quercus coccifera L. İ. K. 47, 128, 170
Quercus pubescens Willd. İ. K. 48

Familya: ***FABACEAE***
Astragalus hamosus L. İ. K. 49
Astragalus lydius Fischer İ. K. 50
Coronilla emerusL. subsp. ***emeroides*** (Boiss. & Sprun.) Uhrova İ. K. 199, 42
Dorycnium pentaphyllum Scop. subsp. ***anatolicum*** (Boiss.) Gams İ. K. 139
Hedysarum varium Willd. İ. K. 140, 56
Lathyrus aphaca L. var. ***pseudoaphaca*** (Boiss.) Davis İ. K. 51
Lathyrus nissolia L. subsp. ***amanus*** Rech. fil. İ. K. 52
Lathyrus ochrus (L.) DC.İ. K. 53
Lotus corniculatus L. İ. K. 183
Medicago sativa L. İ. K. 141
Medicago minima (L.) Bart. İ. K. 142
Medicago xvaria Martyn İ. K. 143
Melilotus officinalis (L.) Desr. İ. K. 210
Onobrychis hypargyrea Boiss. İ. K. 58
Onobrychis montana DC. İ. K. 70
Onobrychis oxyodonta Boiss. İ. K. 57
Onobrychis sativa Lam. var. ***subinermis*** Boiss. İ. K. 56
Robinia pseudocacia L. İ. K. 200
Trifolium angustifolium L. İ. K. 184, 45
Trifolium campestre Schreb. İ. K. 145, 70
Trifolium pratense L. İ. K. 58
Trigonella coerulescens (Bieb.) Hal. İ. K. 59
Trigonella velutina Boiss. İ. K. 60, 91
Vicia cracca L. subsp. ***incana*** (Gouan) Rouy İ. K. 218
Vicia hybrida L. var. ***linearifolia*** Pop. İ. K. 185
Vicia narbonensis L. var. ***narbonensis*** İ. K. 146
Vicia pannonica Crantz İ. K. 61, 221
Vicia sativa L. subsp. ***sativa*** İ. K. 62
Vicia villosa Roth subsp. ***microphylla*** (d'Urv.) P. W. Ball İ. K. 63

Familya: ***GERANIACEAE***
Erodium acaule (L.) Becherer & Thell. İ. K. 201
Erodium cicutarium (L.) L'Herit. İ. K. 86
Geranium macrostylum Boiss. İ. K. 64
Geranium tuberosum L. var. ***macrostylum*** (Boiss.) Boiss. İ. K. 56, 65
Geranium columbinum L. İ. K. 66

Familya: ***GLOBULARIACEAE***
Globulaxia orientalis L. İ. K. 67
Globulaxia trichosantha Fisch. & Mey. İ. K. 68, 211

Familya: ***HYPERICACEAE***
Hypericum perforatum L. İ. K. 116

Familya: ***LAMIACEAE***
Acinos rotundifolius Pers. İ. K. 69
Ajuga chamaepitys (L.) Schreber İ. K. 148
Lamium amplexicauleL. var. ***aleppicum*** (Boiss. & Hausskn.) Bornm. İ. K. 188
Mentha pulegium L. var. ***hirsuta*** Guss. İ. K. 70, 134
Mentha spicata L. İ. K. 202
Prunella laciniata (L.) L. İ. K. 71
Rosmarinus officinalis L. İ. K. 72
Salvia sclareaL. İ. K. 203
Salvia tomentosa Miller İ. K. 204
Sideritis montana L. subsp. ***remota*** (d'Urv.) P.W. Ball ex Heywood İ. K. 150
Thymus sipyleus Boiss.subsp. ***sipyleus*** İ. K. 97 **End.**

Familya: ***LINACEAE***
Linum bienne Miller İ. K. 73
Linum hirsutum L. subsp. ***anatolicum*** (Boiss.) Hayek İ. K. 74 **End.**

Familya: ***LORANTHACEAE***
Viscum albüm L. İ. K. 151

Familya: ***MALVACEAE***
Malva sylvestris L. İ. K. 75
Malva neglecta Wallr. İ. K. 76

Familya: ***PAPAVERACEAE***
Fumaria kralikii Jord. İ. K. 205, 56
Glaucium leiocarpum Boiss. İ. K. 152, 89
Hypecoum imberbe Sibth. & Sm. İ. K. 77
Hypecoum pendulum L. İ. K. 78,94
Papaver argemone L. İ. K. 153
Papaver dubium L. İ. K. 145
Roemeria hybrida (L.) DC. subsp. ***dodecandra*** (Forssk.) Maire İ. K. 217

Familya: ***PLANTAGINACEAE***
Plantago major L. İ. K. 207, 34
Plantago lanceolata L. İ. K. 79
Plantago lagopus L. İ. K. 155

*Familya:****POLYGALACEAE***
Polygala anatolica Boiss. & Heldr. İ. K. 208

*Familya:****POLYGONACEAE***
Polygonum arenastrum Bor. İ. K. 80
Polygonum bistorta L. İ. K. 212
Rumex crispus L. İ. K. 209

*Familya:****PRIMULACEAE***
Anagallis arvensis L. İ. K. 210
Primula vulgaris Hudsonİ. K. 81

*Familya:****RANUNCULACEAE***
Adonis aestivalis L. İ. K. 156

Consolida orientalis (Gay) Schröd. subsp. ***phrygia*** (Boiss.) Chater İ. K. 82
Consolida regalis S.F. Gray subsp. ***paniculata*** (Host) Soó İ. K. 84
Ranunculus arvensis L. İ. K. 211
Ranunculus gracilis Clarkeİ. K. 49

*Familya:**RESEDACEAE***
Reseda luteaL. var. ***nutans*** Boiss. İ. K. 158

*Familya:**ROSACEAE***
Crataegus monogyna Jacq. subsp. ***azarella*** (Gris.) Franco İ. K. 84, 158
Crataegus orientalis Pallas ex Bieb. İ. K. 160
Potentilla rectaL. İ. K. 85
Pyracantha coccinea Roemer var. ***kuntayi*** Kasapligil İ. K. 86
Pyrus amygdaliformis Vill.İ. K. 96, 121
Pyrus eleagnifolia Pailas var. ***kotschyana*** (Boiss. ex Decne) Boiss. İ. K. 87
Rosa canina L. İ. K. 90
Rosa hemisphaerica J. Herrm. İ. K. 91, 200
Sanguisorba minor Scop. İ. K. 93

*Familya:**SAPINDACEAE***
Aesculus hippocastanum L. İ. K. 187

*Familya:**SCROPHULARIACEAE***
Euphrasia pectinata L. İ. K. 162
Linaria corifolia Desf. İ. K. 206 **End.**
Veronica hederifolia L. subsp. ***triloba*** (Opiz) Čelak. İ. K. 92
Veronica multifidaL. subsp. ***orientalis*** (Miller) Elenevsky İ. K. 161 **End.**
Veronica persica Poiret İ. K. 93

*Familya:**SOLANACEAE***
Hyoscyamus niger L. İ. K. 163
Hyoscyamus pusillus L. İ. K. 94

*Familya:**URTICACEAE***
Urtica dioica L. İ. K. 164

*Familya:**VALERIANACEAE***
Valerianella vesicaria (L.) Moench İ. K. 95

*Familya:**VIOLACEAE***
Viola kitaibeliana Roem. & Schult. İ. K. 96

*Familya: **ZYGOPHYLLACEAE***
Tribulus terrestris L. İ. K. 96,34

*Ordo: **MONOCOTYLEDONES***

*Familya: **LILIACEAE***
Allium rotundum subsp. ***waldsteinii*** (G, Don) K.Riehter. İ. K. 213
Gagea peduncularis (J. & C. Presl) Pascher İ. K. 95
Merendera attica (Spruner) Boiss. & Spruner İ. K. 98
Muscari comosum (L.) Miller İ. K. 214
Muscari neglectum Guss. İ. K. 166
Ornithogalum armeniacum Baker İ. K. 99
Ornithogalum montanum Cyr. var. ***platyphyllum*** (Boiss.) Boiss. İ. K. 100
Ornithogalum nutans L. İ. K. 167
Ornithogalum pyrenaicum L. İ. K. 216, 23
Tulipa agenensis DC. İ. K. 101

*Familya:**POACEAE***
Aegilops geniculata Roth İ. K. 103
Aegilops triuncialis L. subsp. ***persica*** (Boiss.) Zhuk. İ. K. 104
Avena barbata Pott ex Link İ. K. 105
Bromus japonicus Thunb. İ. K. 168
Bromus sterilis L. İ. K. 169
Cynodon dactylon (L.) Pers. var. ***villosum*** Roshev. ex Grossh. İ. K. 215
Dactylis glomerata L. subsp. ***hispanica*** (Roth) Nyman İ. K. 106
Echinaria capitata (L.) Desf. İ. K. 216
Festuca valesiaca Schleicher ex Gaudin İ. K. 107
Hordeum geniculatum All. İ. K. 110, 170
Koeleria cristata (L.) Bertol. İ. K. 109
Poa bulbosa L. İ. K. 108.

4. Sonuçlar ve tartışma

Araştırma alanında 2011−2012 yılları arasında yaklaşık 440 bitki örneği toplanmıştır. Toplanan bitkilerin teşhis edilmesi sonucu 48 familya ve 163 cinse ait 240 takson tespit edilmiştir. Çalışma alanından toplanan bitkilerden 4'ü Pteridophyta, 236'sı Spermatophyta'dır. Spermatophyta bölümü üyelerinin 6'sı Gymnospermae alt bölümünde 230'u Angiospermae alt bölümüne aittir. Angiospermae üyelerinin 202'si Dicotyledones, 28'i Monocotyledones alt sınıfına aittir. Floradaki Pteridophyta üyelerinin toplam floraya oranı %1,66, Spermatophyta üyelerinin toplam floraya oranı ise %98,34'tür. Spermatophyta üyelerinin % 95,9'u Angiospermae, %2,5'i Gymnospermae ise alt bölümüne aittir. Araştırma alanındaki taksonların bölüm ve sınıflara göre tasnifi Tablo 1'de gösterilmiştir.

Tablo 1. Araştırma alanındaki bitki taksonlarının bölüm ve sınıflara göre dağılımı

	Takson sayısı	***Oran(%)***
Pteridophyta	4	1.66
Gymnospermae	6	2. 5
Angiospermae	230	95.83
Dicotyledones	202	84.16
Monocotyledones	28	11.66

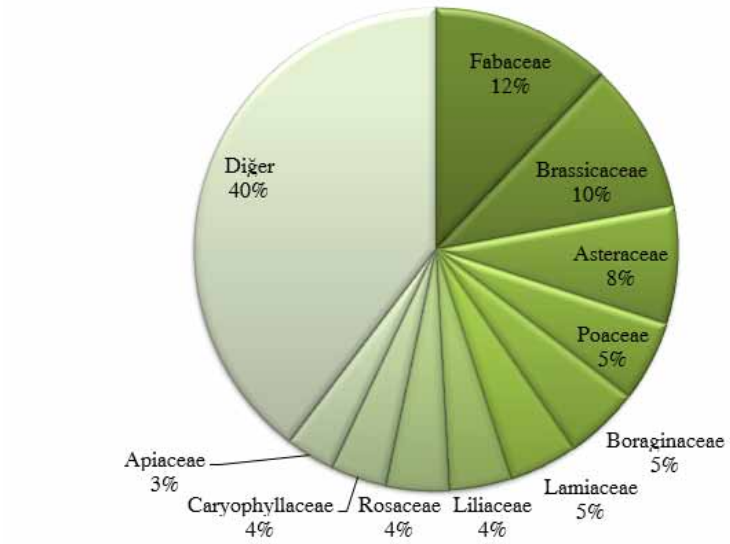
Araştırma alanında en fazla taksona sahip familyalar; 29 takson ile *Fabaceae*, 24 takson ile *Brassicaceae*, 19 takson ile *Asteraceae*, 13 takson ile *Poaceae*, 11 takson ile *Lamiaceae*, 12 takson ile *Boraginaceae*, 11 takson ile *Liliaceae*, 10 takson ile *Caryophyllaceae* ve 10 takson ile *Rosaceae*'dır (Şekil 3). Alandaki en çok taksona sahip familyaların takson sayısı ve yüzde oranı Tablo 2'de gösterilmiştir. Cins sayısı bakımından en zengin familyalar *Brassicaceae* 19 cins, *Asteraceae* 15 cins, *Fabaceae* 14 cins, *Poaceae* 11 cins ve *Lamiaceae* 11 cinse sahiptir (Tablo 3).

Tablo 2. Araştırma alanında takson sayısına göre en zengin 10 familya ve oranları

Familyalar	***Takson sayısı***	***Oran (%)***
Fabaceae	29	12.5
Brassicaceae	24	9.8
Asteraceae	19	7.9
Poaceae	13	6.25
Boraginaceae	12	5.0
Lamiaceae	11	4.9
Liliaceae	10	4.58
Rosaceae	10	4.16
Caryophyllaceae	9	4.1
Apiaceae	8	3.9
Toplam	146	55.9
Diğer 35 familya	76	39.1

Tablo 3. Araştırma alanında cins sayısına göre en zengin 10 familya ve oranları

	Cins	
Familyalar	***Sayı***	***Oran (%)***
Brassicaceae	19	11.6
Asteraceae	15	9.2
Fabaceae	14	8.5
Poaceae	11	6.7
Lamiaceae	11	6.7
Boraginaceae	8	4.9
Liliaceae	7	4.2
Apiaceae	7	4.2
Caryophyllaceae	6	3.6
Rosaceae	6	3.6
Toplam	104	63.8
Diğer 35 familya	59	36.2
Genel toplam	163	100

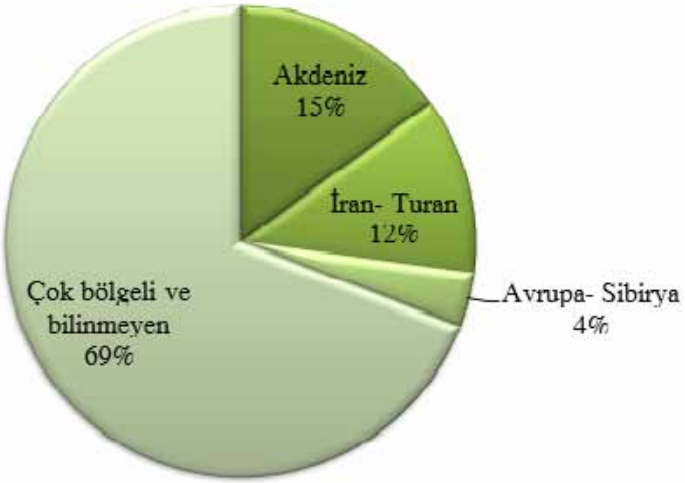


Şekil 3. Araştırma alanında en fazla takson içeren familyalar spektrumu.

Araştırma bölgesinde toplanan bitki örnekleri 36 tür ile (%15) Akdeniz elementi, 29 tür ile (%12.08) Iran-Turan elementi, 9 tür ile (%3.75) Avrupa-Sibirya elementi olduğu tespit edilmiştir. Bu oranlara bakıldığında araştırma alanının bitki coğrafyası bakımından Akdeniz eğilimli olduğu, aynı zamanda İran- Turan ve Avrupa Sibirya bölgelerinin de etkisinde bulunduğu görülür. Bunun yanında 166 tür ile (%69.16) hangi bölgeye ait olduğu bilinmeyen ve çok bölgeli bitkiler yer almaktadır (Şekil 4). Araştırma alanından toplanan taksonların floristik bölgelere göre dağılımı Tablo 4'te verilmiştir. Araştırma alanında 10 endemik takson tespit edilmiştir. Endemizm oranı %4,16'dır. Endemik taksonlar ve IUCN tehlike kategorileri Tablo 5'te verilmiştir. Araştırma alanındaki taksonların çevresinde yapılmış olan çalışmalarla fitocoğrafik bölgeler bakımından karşılaştırılmış Tablo 6'da gösterilmiştir. Araştırma alanında en çok türe sahip olan familyalar yakın bölgelerle kıyaslanarak Tablo 7'de verilmiştir.

Tablo 4. Araştırma alanında yayılış gösteren taksonların fitocoğrafik bölgelere göre dağılımı.

Fitocoğrafik bölge	***Takson sayısı***	***Oran (%)***
Akdeniz	36	15
İran- Turan	29	12.08
Avrupa- Sibirya	9	3.75
Çok bölgeli ve bilinmeyen	166	69.16
Toplam	240	100



Şekil 4. Araştırma alanında yayılış gösteren taksonların fitocoğrafik bölgelere göre dağılımı.

Tablo 5. Endemik taksonlar ve IUCN tehlike kategorileri

Takson	***IUCN Kat.***
Onosma tauricum Pallas ex Willd. var. *brevifolium* DC	LC
Ferulago aucheri Boiss.	LC
Achillea phrygia Boiss.& Bal.	LC
Anthemis wallii Hub.-Mor. & Reese	NT
Alyssum huetii Boiss.	LC
Convolvulus holosericeus Bieb. subsp. *macrocalycinus*Hausskn. & Bornm. ex Bornm.	NT
Thymus sipyleus Boiss. subsp. *sipyleus*	NT
Linum hirsutum L. var. *anatolicum* (Boiss.) Hayek	LC
Veronica multifida L. subsp. *orientalis* (Miller) Elenevsky	LC
Linaria corifolia Desf.	LC

Tablo 6. Araştırma alanındaki taksonların çevresindeki çalışmalarla fitocoğrafik bölgeler bakımından karşılaştırılması

Araştırma alanı	***Akdeniz (%)***	***Iran-Turan (%)***	***Avrupa-Sibirya (%)***
Dervişli (Eşme-Uşak)	15	12.08	3.75
Şaphane Dağı	14.9	13.1	9.4
Murat Dağı	13.3	10.7	13.1
Bulkaz Dağı	15.0	12.0	8.0

Tablo 7. Araştırma alanında en çok türe sahip olan familyalar ve yakın bölgelerle karşılaştırılması

Familyalar	***Dervişli (Uşak/Eşme)***	***Şaphane Dağı (Tel., A., Z., 2011)***	***Murat Dağı (Çırpıcı., 1988)***	***Simav Dağı (Yayıntaş., 1985)***
Fabaceae	12.08	9.60	7.30	13.37
Brassicaceae	10.00	5.67	6.74	6.00
Asteraceae	7.91	14.62	12.69	11.62
Poaceae	5.41	5.67	3.03	5.81
Boraginaceae	5.00	3.71	3.03	4.84
Lamiaceae	4.58	8.29	5.84	6.20
Liliaceae	4.16	3.93	3.59	3.68
Rosaceae	4.16	4.36	4.71	2.90
Caryophyllaceae	3.75	3.93	6.17	4.84
Apiaceae	3.33	3.93	3.82	2.51

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(Received for publication 18 September 2012; The date of publication 01 April 2013)

www.biodicon.com Biological Diversity and Conservation

ISSN 1308-8084 Online; ISSN 1308-5301 Print 6/1 (2013) 178-181

Research article/Araştırma makalesi

A new record for the Flora of Northern Cyprus: *Solanum angustifolium* Mill. (Solanaceae)

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Abstract

Solanum angustifolium Mill. collected in the fields between Yıldırım and Geçitkale villages, (Solanaceae) is reported as a new record (in Division 5) for the Northern Cyprus. The diagnostic characters of *S. angustifolium* Mill. are described and illustrated. In addition, Its habitat was indicated.

Key words: Solanaceae, *Solanum angustifolium*, new record, Geçitkale- Yıldırım, Cyprus

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Kıbrıs Florası için Yeni Bir Kayıt: *Solanum angustifolium* Mill. (Solanaceae)

Özet

Yıldırım ve Geçitkale köyleri arasında kalan tarım alanlarından toplanan *Solanum angustifolium* Mill. (Solanaceae) Kuzey Kıbrıs florası için yeni bir kayıt olarak bildirilmiştir. *S. angustifolium* Mill. türünün ayırt edici özellikleri açıklanarak fotoğrafları verilmiştir. Ayrıca yetişme ortamı belirtilmiştir.

Anahtar kelimeler: Solanaceae, *Solanum angustifolium*, Yeni kayıt, Geçitkale- Yıldırım, Kıbrıs

1. Introduction

Specimens of *Solanum angustifolium* Mill. (saraç itüzümü) (Güner, 2012), which were collected around agricultural fields and olive orchard between Yıldırım and Geçitkale villages, were easily distinguished from specific spiny structure. This species, which is different from other Solanum species in Cyprus, was first noticed by experienced botanist Mustafa Kemal Meraklı in August 2006. We were not able to identify these specimens using "Flora of Cyprus" (Meikle, 1977- 1985), "An Illustrated Flora of North Cyprus" (Viney, 1994) and Flora of Turkey and East Aegean Islands" (Davis, 1978). Afterward, the plant specimens were identified as *Solanum angustifolium* Mill. (Syn:*Solanum cornutum* Lam). according to Flora Europaea (Boissier, 1879) and Supplements of Flora of Turkey (Güner et al., 2000). This plant first reffered to by Della and Iatrou (1995), collected only from Zyghi and Near Yeri that located in the southern Cyprus and this record is the fiirst for Northern Cyprus. At the same time, it has a very localised and limited distribution to be particularly edge of the cultivated area.

2. Materials and methods

Specimens of *S. angustifolium* were collected from cultivated areas near roadsides and around olive orchard between Yıldırım and Geçitkale villages (Famagusta/Cyprus) in August 2011. Photographs of plant specimens and plant parts were taken at herbarium and natural habitats. Morphological characters were measured by a milimetric ruler under a trinoculer stereo zoom microscope (BAB-SZ45). Our measurements and their comparisons with other published studies (Hawkes and Edmonds, 1964; Erik and Akaydın, 1995) have been given in Table 1.

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 BioDiCon. 268-0912

3. Results

Different localities and description of species is as follows (Figure 1; Table 1):

Solanum angustifolium Mill. in Gard. Dict.ed 8, no15 (1768). (Syn.: *Solanum cornutum* Lam. in Tabl. Encycl. 2:25 (1794), *Nycterium cardaminifolium* Vent. in Jard. Malm. tab 85 (1805), *N. cornutum* (Lam.)Link in Enum. Hort. Berol. Alt. 1:189 (1821), *S. angurium* Dunal in Hist. Nat. Solanum 243 (1813), *Solanum rostratum* L'Hér. ex Dunal, nom. nud. in DC., Prodr. 13(1):328 (1852), *S. macroscolum* Fernald in Proc. Amer. Acad. Sci. 35:570 (1900), S. heudesii H.Lev. in Report. Spec. Nov. Regni Veg. 11:295 (1912).

Much branched annual 30- 60 cm high plant. Petioles and leaves ribbed. Stems terete, dusty greyish, densely clothed with stipitate stellate and simple hairs intermixed with wide-based pale yellow prickles, up to 1cm. Leaves alternate, leaf blades ovate- oblong, 8-10 cm in lenght, pinnatisect almost to midrib, with many prickles densely on both sides; lobes rounded, usually 4 paired, sinuate; petioles 1-5 cm, spiny like as the stem. İnflorescence racemose, solitary, extra- axillary; pedicels 4-10 mm; at first peduncles short (2- 3 cm), later elongating 3- 6 cm. corolla yellow, 10-20 mm in diameter, with lanceolate- ovate lobes. Calyx lobes ovate- lanceolate, enlarged and nearly globular in fruit; tightly surrounding fruit; calyx tube covered with prickles, accretess to enclose berry. Stamens 5, yellow, filaments short, 4 anther equal (5-7 mm), one longer than the others distinctly (10-12 mm). Fruits 1 cm in diameter a unilocular globular, semidry berry, covered with prickly calyx on mature (Figure 2 and Figure 3).

Type: Mexico. Veracruz:sin.loc., 1729, Houstoun s.n. (Holotype, BM! Photos of BM speciment at US WIS), Chine. Liaoning Provience, Chang-Hai, 08.1891, Bodinier and Marie s.n. (Holotype, NY!) ; 1977, Nuttall-Thomas s.n. (type 2056878, MO!)

Solanum specimens were collected in the fifth Division of Cyprus which is divided into 8 area by Meikle (1977, 1985), considering the differences in geographical features and vegetation (Şekerciler et al., 2011). Samples from edges of the cultivated fields between Geçitkale and Yıldırım villages were examined. The plant specimens are deposited in ANK Herbarium (Figure 3). This species is a native of United States (Northern and Central Mexica) and widespread in eastwards to Europe.

3.1 Specimens collected

Cyprus: Division 5: Kıbrıs/Yıldırım-Geçitkale köyleri arası, tarım arazileri kenarı, 147 m 13.08.2011 Şekerciler 2789.

3.2 Previous records

Zyghi, in cucumis melo field, June 1991, A.Della in ARI 3713; Near Yeri, cultivated and fallow land, 150 m, July 1992, V. Pantelas in FD 1437.

Şekil 1: *Solanum angustifolium* Mill., Kıbrıs'taki dağılışı
Figure 1: The distribution of *Solanum angustifolium* Mill. in Cyprus

Şekil 2. *Solanum angustifolium* Mill., arazideki genel görünüşü
Figure 2. A view of *Solanum angustifolium* Mill. (saraç itüzümü) from field

Şekil 3. *Solanum angustifolium* Mill.'un herbaryum örneği
Figure 3. Herbarium material of *Solanum angustifolium* Mill.

Şekil 4. *Solanum angustifolium* Mill.'in çiçek örtüsü, anterleri ve çiçek durumunun görünüşü
Figure 4. View of perianth, anthers and indumentum of *Solanum angustifolium* Mill.

4. Conclusions

The genus Solanum L. is represented in Cyprus by 2 native and 5 cultivated taxa (Meikle, 1977-1985). This taxon resemble perennial plant *Solanum sisimbriifolium* Lam. inasmuch as spiny leaves and stems; however can be distinguished its spiny fruits and from that it is an annual plant (Karaer and Kutbay, 2007).

This tropical plant has been spread much of the world (Tanji and Talch, 1977). Usually, located in Australia, Bangladesh, Mexico, New Zealand and South Africa in cultivated ground and waste places. Researches have shown

that, locally naturalized in Bulgaria, France, Germany, Greece, Hungary and Russia. However, this species is South West United States originated. *Solanum angustifolium* has been founded as alien in Turkey, in many locations around İstanbul (Baytop, 1992) and Ankara (Erik and Akaydın, 1995).

There was some confusion about naming this plant. Especially; *Solanum angustifolium* Mill., *Solanum cornutum* Lam, *Solanum rostratum* L'Hér. ex Dunal were defined as different plant taxa, but the last two are the synonyms of *S. angustifolium* Mill.. Then it was noticed that they represent the same species, and the first nomenclature *Solanum angustifolium* Mill. accepted (Knapp et al., 2012; Güner, 2012).

An identification key for *Solanum angustifolium* Mill. is provided below. Besides; differences between the characters of samples located in Europe, Ankara (Turkey) and Cyprus are given (Table 1).

1.Leaves pinnate or deeply pinnatisect:
2.Tuberous herbs with thick, fleshy stems…….... ***S. tuberosum***
2.Not tuberous herbs:
3.Glabrous plant; woody climbers with slender stems……***S. seaforthianum***
3.Plant stipitate stellate and simple hairs intermixed with wide-based pale yellow prickles……..***S. angustifolium***
1.Leaves simple, entire or variously lobed:

Tablo 1: Avrupa, Ankara (Türkiye) ve Kıbrıs'ta bulunan örneklerin karekterleri arasındaki farklar
Table 1: Differences between the characters of samples located in Europe, Ankara (Turkey) and Cyprus

Characters	**Europe**	**Ankara (Turkey)**	**Cyprus**
Stem	30-60 cm	30-40 cm	15-25 cm
Leaves (length, width)	6-12, 4-8 cm	5-10, 3-7 cm	8-10, 3-6 cm
Indumentum	3-10 floret	2-12 floret	3-12 floret
Peduncle	30-60 mm	15-55mm	15-40 mm
Equal anthers	4-6 mm	6-7 mm	5-7 mm
Longer anther	8-12 mm	9-10 mm	10-12 mm

Acknowledgements

We thank Prof. Dr. Osman KETENOĞLU, Assist. Prof. Dr. A. Emre YAPRAK and Specialist Tuğrul KÖRÜKLÜ for their helpful discussions.

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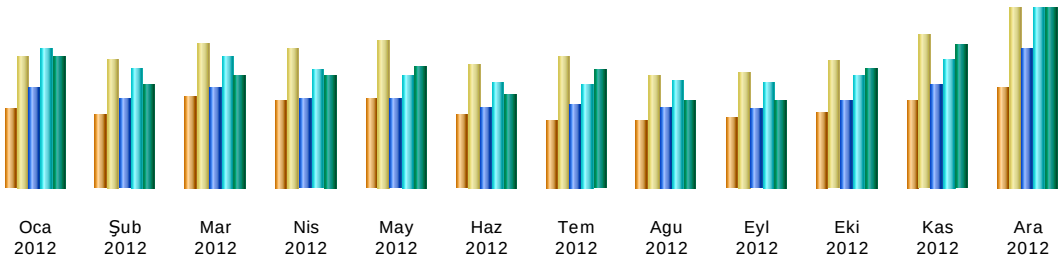

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