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Research Article

An Autecological Study on *Iris histrioides* Foster (*Iridaceae*) Distributed in the Central Black Sea Region

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Abstract: *Iris histrioides* Foster, a Euxinian and endemic element, was investigated in terms of its phenological and ecological properties. Some elements taken from the above-and below-ground parts of the plant in the vegetative and generative growth periods have been analyzed. According to the results of the analysis, N%,P% and K% contets are high in above-ground parts during the vegetative growth phase. In addition, soil samples were collected from 0-20 cm depth and analyzed physically and chemically.

Key Words: *Iris histrioides* Foster, Autecology, Endemic.

Orta Karadeniz Bölgesinde Yayılış Gösteren *Iris histrioides* Foster *(Iridaceae)* Üzerinde Otekolojik Bir Araştırma

Özet: Endemik bir Karadeniz floristik elementi olan *Iris histrioides* Foster fenolojik ve ekolojik yönden incelenmiştir. Türün vejetatif ve generatif gelişme dönemlerinde topraküstü ve toprakaltı kısımlarında bazı besin elementi analizi yapılmıştır. Analiz sonuçlarına göre, vejetatif gelişme döneminde topraküstü, generatif gelişme döneminde ise toprakaltı kısımlarındaki %N,%P ve %K içerikleri yüksektir. Ayrıca 0-20 cm derinlikten alınan toprak örneklerinde bazı fiziksel ve kimyasal analizler yapılmıştır.

Anahtar Sözcükler: *Iris histrioides* Foster, Otekoloji, Endemik

Introduction

The species of *Iris* L. *are* perennial herbaceous plants with a rhizomatous or bulbous, underground stem. These plants are of economic importance since they are used in decoration and medicine. Drugs obtained from the rhizomes of these species are utilized to cure upper respiratory system infections, and to prevent teething problems of babies; rhizomes are also used in the perfume industry (1). Furthermore, *I. histrioides* Foster and *I. persica* L. are consumed as food and used for their flowers in rural areas.

Of the ornamental plant, the species of *Iris* are the most prominent ones grown in gardens and parks and on balconies (2). These plants are popular because of their bright, colourful and pretty flowers, and also because they bloom earlier and grow faster than many other ornamental plants. Many new hybrids have been obtained by crossing some species of *Iris* such as *I. histrioides* x *I. winogradowii*. Since these new hybrid species have nicer and more colourful flowers, and grow faster than their parents, they have great value in today's floristry (3).

The purpose of this study is to investigate *I. histrioides*, an endemic plant, phenologically and ecologically. Since bulbous plants have a short life span, the food element cycle in the above and below-ground parts is different in the vegetative and the generative growth period, which makes them interesting from an eco-physiological perspective. Therefore, *I. histrioides* was selected as research material for this study.

Geography and Climate of Research Areas

I. histroides samples were collected from bushy areas of *Quercus* sp. and from stony parts of steppe areas (Figure 1).

The geological structure of Yeşilyenice-Direkli Village, Çukurören Village, Derebaşalan Village and Değirmendere Plateau are composed of volcanic facies lies in bands of colourful schist and prequartz. On this volcanic facies, the dominant formation is jurassic cretaceous in Yeşilyenice-Direkli Village, neogene in Çukurören Village, and grey-white coloured permian in Derebaşalan Village and Değirmendere Plateau (4). Tavşan mountain-Gelinsini

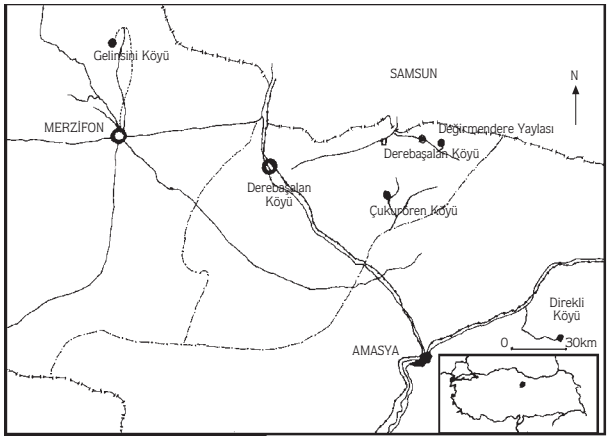

Figure 1. Geographical map of Research Areas

Village has a different geological structure. It is composed of submarine lava, red limentones, and tiny granules and also blocks of white-grey mesozoic limentones (4).

In order to explain the climatical peculiarities of the localities of the samples, data from Amasya, Merzifon, Suluova and Ladik meteorology stations were obtained from the Ministry of the Environment and General Direcrate of National Meteorology Archives (5). Since there are no meteorology stations in Gelinsini (Tavşan mountain), Direkli, Derebaşalan and Çukurören Villages and Değirmendere Plateau, average monthly and annual temperature values were calculated according to the smallest squares method prepared by Doğan (6); average monthly and annual rain values were calculated according to Erinç (7). Climatic diagrams were drawn according to Walter's method (8). Climate diagrams for the plant sampling sites are shown in Figures 2 (a,b,c,d) and 3 (a,b,c,d,e).

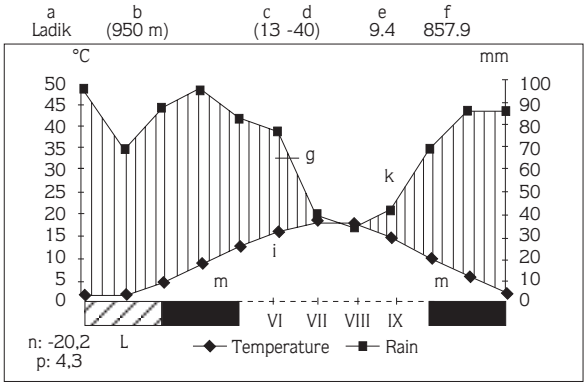

Figure 2a. Climatic diagram pertaining to Ladik meteorology station

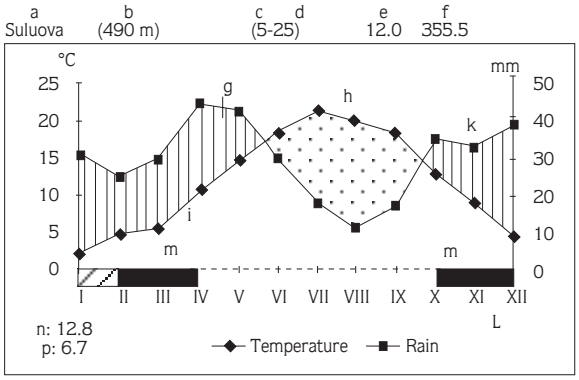

Figure 2b. Climatic diagram pertaining to Suluova meteorology station

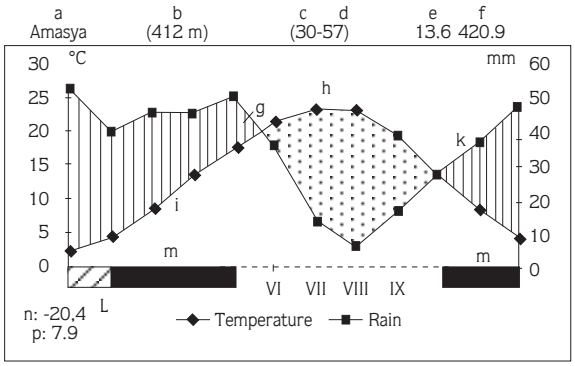

Figure 2c. Climatic diagram pertaining to Amasya meteorology station

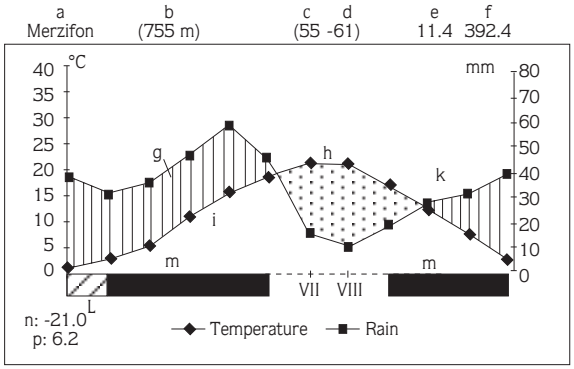

Figure 2d. Climatic diagram pertaining to Merzifon meteorology station

According to Emberger's method (9), it was determined that Ladik has Central Mediterranean (W.A.Sp.Sm), Suluova, Merzifon, Derebaşalan Village, Çukurören Village, Direkli Village, Değirmendere Plateau and Gelinsini Village have East Mediterranean

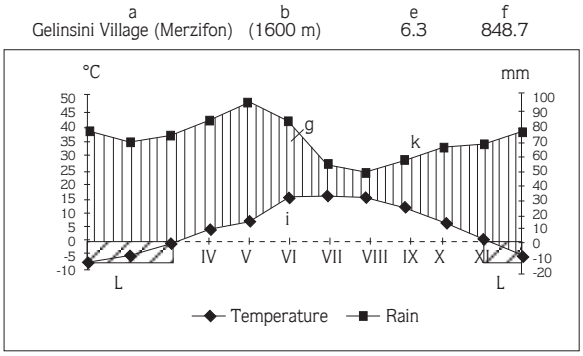

Figure 3a. Climatic diagram drawn according to the value interpolated for Gelinsini Village

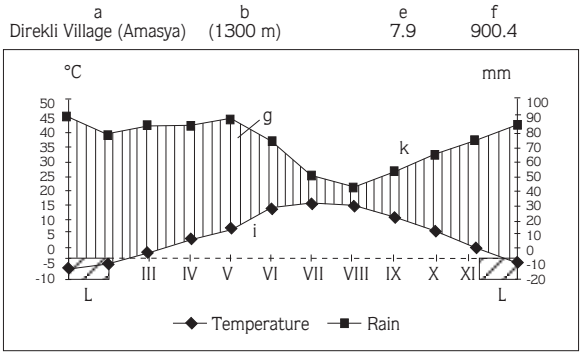

Figure 3b. Climatic diagram drawn according to the value interpolated for Direkli Village

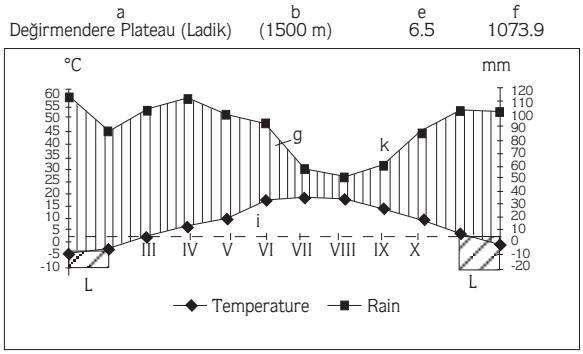

Figure 3c. Climatic diagram drawn according to the value interpolated for Değirmendere Plateau

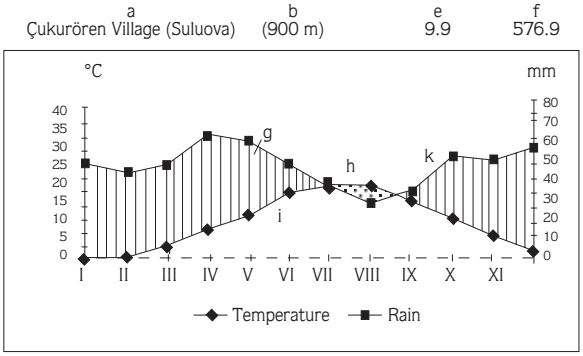

Figure 3d. Climatic diagram drawn according to the value interpolated for Çukurören Village

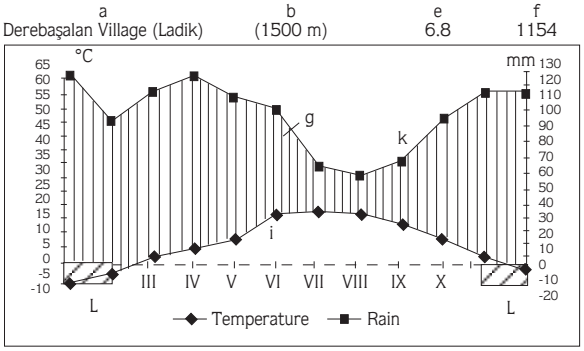

Figure 3e. Climatic diagram drawn according to the value interpolated for Derebaşalan village

precipitation regime second variant (Sp.W.A.Sm) and Amasya has East Mediterranean precipitation regime first variant (W.Sp.A.Sm). Ladik, Derebaşalan Village, Gelinsini Village, Çukurören Village and Değirmendere Plateau are in the rainy Mediterranean Bioclimatic zone; Suluova, Amasya and Merzifon are in the semi-dry Mediterranean Bioclimatic zone; Direkli Village is in the light-rainy Mediterranean Bioclimatic zone (Tables 1,2).

Materials and Methods

1. Localities:

a. A5 Amasya: Suluova, the Village Çukurören, bushy areas in Karakaya district at 900 m (Figure 1).

b. A5 Amasya: Yeşilyenice, the Village Direkli, Quercus bushy areas in Gölocağızıncal district at 1300-1350 m (Figure 1).

c. A5 Amasya: Akdağ, rocky areas of Değirmendere Plateau at 1500 m (Figure 1).

d. A5 Amasya: Merzifon, Tavşandağı bushy areas around the Village Gelinsini at 1600 m (Figure 1).

e. A6 Samsun: Ladik, bushy areas around the Village of Derebaşalan at 1500 m (Figure 1).

Tablo 1. According to Emberger method (1957) Mediterranean Bioclimatic zones of Meteorology Stations where the species are found

Stations	P	PE	S	M	m	Q	Precipitation Regime types	Bio-climatic zones according to Q values
Ladik 950m	857.9	147.1	5.86	25.1	-1.8	111.9	Central Mediterranean (W.A.Sp.Sm.)	Rainy Mediterranean climate
Suluova 450m	355.5	59.5	2.08	28.5	-1.4	43.4	East Mediterranean precipitation regime second variant (Sp.W.A.Sm.)	Semi-dry Mediterranean climate
Amasya 412m	420.9	54.9	1.8	30.4	-0.4	48.2	East Mediterranean precipitation regime first variant (W.Sp.A.Sm.)	Semi-dry Mediterranean climate
Merzifon 755m	392.4	68.7	2.4	27.8	-2.4	45.1	East Mediterranean precipitation regime second variant (Sp.W.A.Sm)	Semi-dry Mediterranean climate

Sp: Spring, W: Winter, A: Autumn, Sm: Summer

Table 2. Precipitation regime types and Bioclimatic zones of study areas that has no meteorological measurements by interpolation

Stations	P	PE	S	M	m	Q	Precipitation Regime types	Bio-climatic zones according to Q values
Derebaşalan Village 1500m	1154	221.5	13.4	16.5	-6.5	180.2	East Mediterranean precipitation regime second variant	Rainy Mediterranean climate
Değirmendere Plateau 1500 m	1074	201.1	12.3	16.3	-6.9	166.5	" "	" "
Çukurören Village 900m	576.9	114.7	5.97	19.2	0	106.2	" "	" "
Direkli Village 1300 m	900	176	10.1	17.4	-26	77.1	" "	Light-rainy Mediterranean climate
Gelinsini Village 1600m	848.7	185.5	11.6	16	-7.3	131.2	" "	Rainy Mediterranean climate

2. Analysis of plant and Soil Samples

Soil samples were taken twice a year from the study areas both in the vegetative and generative periods. Soil samples were taken from 0-20 cm depth after removing the litter, put into polyethylene bag in portions of approximately 1-2 kg, brought to the lab, and dried at room temperature. The soil samples were sifted with a standard 2mm sieve. The pH of air-dried soil samples was measured with a Beckman pH Meter in saturated mud, and the scructure was analyzed by the Bouyoucus hydrometer method. $CaCO_3$ percent was analyzed by Scheibler Calcimeter and total salinity was designated by a conductivity bridge instrument". Nitrogen (N%), phosphorus (P%), potassium (K%) and organic matter contents of the soil samples were analyzed by standard micro-Kjeldahl procedure, ammonium molybdate-tin chloride method, flame photometer (in extract preparing with 1N ammonium acetate) and the Walkley-Black method respectively (10). The results of soil analysis were explained according to Uslu (11), Pirdal (12) and Allen et al. (13).

The plant samples were collected from the study areas both in the generative and vegetative growth periods, brought to the laboratory in polyethylene bags, and cleared. The above- and below-ground parts of the plants were cut into small pieces, and dried at 70 °C in an oven for 48 hours. Then, they were powdered in a hammer mill, and ground in a Wiley mill to pass through a 20-mesh sieve prior to analysis. The samples for N analysis were digested with sulphuric acid and selenium using a Kjeldahl apparatus. Nitrogen analysis of ground plant samples was carried out according to Kjeldahl's method (14). K and P analysis samples were subjected to wet ashed treatment with perohloric acid-nitric acid (1:4), and P was determined by using a Jenway spectrophotometer. P content was determined using the ammonium-molybdate-stannous chloride method. K analysis was carried out by Petracourt PFP one-flame photometer (10,13). According to the values measured in the plant and soil samples, means and standard error were found. The results of plant analysis were explained according to Kaçar (14).

Results

1. Phenological observations

1. Leaf development and primary shoot end of February

2. Leaf maturation middle of March-end of March

3. Flowering middle of April

4. Fruit end of April

5. Seed maturation middle of May

6. Drying of upper part of plant end of May middle of June

The phenological development of the species may vary according to its habitat and altitude. The plant is distributed on the mountain slope and in *Quercus* bushes, in rocky, calcareous places at an altitude of 900-1600 m.

2,N,P,K Contents of the Plant Parts

The N, P and K contents of the below-ground parts of *I. histrioides* are given in Table 3. It was observed during

Table 3. N,P and K (%) contents in below-ground parts (rhizome, root) of *I. histrioides*

Locality	N%		P%		K%	
	*	**	*	**	*	**
Suluova-Çukurören Village	0.672/0.814		0.034/0.049		0.72/0.91	
Yeşilyenice-Direkli Village	0.828/1.020		0.039/0.064		0.83/1.34	
Akdağ-Değirmendere Plateau	1.080/1.212		0.047/0.098		1.52/1.93	
Merzifon-Gelinsini Village	1.064/1.252		0.092/0.142		1.77/1.83	
Ladik-Derebaşalan Village	0.895/1.117		0.067/0.162		0.91/1.24	
Means ± Standard error	0.907/1.083		0.055/0.103		1.15/1.45	
	±0.076/±0.078		±0.011/ ±0.022		±0.208/ ±0.19	

*Vegetative period ** Generative period

Table 4. N, P and K (%) contents in above-ground parts of *I. histrioides*

Locality	N%		P%		K%	
	*	**	*	**	*	**
Suluova-Çukurören Village	1.472/1.065		0.045/0.037		2.99/2.05	
Yeşilyenice-Direkli Village	1.240/1.024		0.049/0.038		1.25/0.83	
Akdağ-Değirmendere Plateau	1.327/1.186		0.152/0.105		1.74/1.27	
Merzifon-Gelinsini Village	1.408/1.152		0.120/0.090		2.67/1.84	
Ladik-Derebaşalan Village	1.215/1.024		0.142/0.089		2.56/2.26	
Means ± Standard error	1.332/1.090		0.101/0.072		2.24/1.65	
	±0.048/±0.033		±0.024/±0.019		±0.322/±0.263	

Vegetative period ** Generative period

Tablo 5. Physical and chemical analysis results on the soil samples of *I. histroides* habitat

Locality	Clay %	Silt %	Sand %	Texture class	Soil pH	Total Salinity %	CaCO3 %	Water Holding Capasity %	N % * **	P % * **	K % * **	Organic matter * **
Suluova-Çukurören Village	35.44	23.96	40.10	Argillaceous-Loamy	7.60	0.06	5.02	55	0.857/0.762	0.008/0.005	0.77/0.38	4.66/4.12
Yeşilyenice-Direkli Village	24.83	32.21	42.96	Loamy	7.10	0.04	2.32	64	0.935/0.720	0.002/0.001	0.49/0.37	5.56/5.10
Akdağ-Değirmendere Plateau	29.82	25.18	45.00	Argillaceous-Loamy	7.10	0.03	2.60	55	0.825/0.657	0.003/0.002	0.61/0.54	3.75/3.02
Merzifon-Gelinsini Village	25.81	36.09	38.10	Loamy	7.05	0.03	2.45	55	0.795/0.522	0.009/0.007	0.43/0.38	5.54/4.98
Ladik-Derebaşalan Village	40.53	19.38	39.49	Argillaceous	7.10	0.09	2.90	60	0.928/0.815	0.008/0.006	0.57/0.49	3.69/3.37
Means±Standard error					7.26± 0.103	0.05± 0.011	3.34± 0.491	57.8± 1.827	0.784± 0.046	0.005± 0.0013	0.50± 0.047	4.375± 0.413

* Vegetative period ** Generative period

the generative period that N, P and K contents are higher in the below-ground parts than in the above-ground parts. The N content was found to be 0.672%-1.080% (0.907 ± 0.076) in the vegetative, and 0.814%-1.252% (1.083 ± 0.078) in the generative period. In the below-ground parts of the plant, phosphate content ranges from 0.034% to 0.092% (0.055 ± 0.011) in the vegetative period, and from 0.049% to 0.162% (0.103 ± 0.022) in the generative period. The content of potassium ranges from 0.72% to 1.77% (1.15 ± 0.208) in the vegetative period, and 0.91% to 1.93% (1.45 ± 0.19) in the generative period.

N, P and K contents of the above-ground parts of the plant during vegetative and generative growth periods are shown in Table 4. In the vegetative growth period, above-ground parts have higher nutrient contents than below-ground parts.

Nitrogen content is 1.215%-1.472% (1.332 ± 0.048) in the vegetative period. It is 1.024%-1.186% (1.090 ± 0.0033) in the generative period. N content was found to be within normal limits for each period. P content ranges from 0.045% to 0.152% (0.101 ± 0.024) in the vegetative period, and from 0.037% to 0.105% (0.072 ± 0.019) in the generative period. The potassium content was found to be 1.25%-2.99% (2.24 ± 0.322) in the vegetative period, and 0.83%-2.26% (1.65 ± 0.263) in the generative period.

3. The results of physical and chemical analysis of the soil samples

The results of physical and chemical analysis of the soil samples taken from localities where *I. histrioides* is distributed are shown in Table 5. According to the results in the table, the plant grows better on argillaceous-loamy and loamy soils. Soil pH values are 7.05-7.60. That is to say, this plant grows better in the light alkaline soil. The proportion of total salinity ranges from 0.03% to 0.09%. The total salinity is very low in all of the localities. The content of $CaCO_3$ ranges from 2.32% to 5.02% in the soil where the species grows. However, $CaCO_3$ content is at medium and low levels. The water holding capacity of the soil is between 55% and 64% (Table 5).

Chemical analysis results of soil samples are given in Table 5. The nitrogen content is 0.795%-0.935% in the vegetative period, and 0.522%-0.815% in the generative period. The phosphorus content is 0.002%-0.009% in the vegetative period, and 0.001%-0.007% in the generative period. The content of potassium ranges from 0.430% to 0.77% in the vegetative period, and from 0.37% to 0.54% in the generative period. The organic matter contents of soil samples are 3.69%-5.56% in the vegetative period, and 3.02%-5.10% in the generative period. Organic matter content is usually high. It may occur on soils rich in organic matter.

Dissussion

In this study, the phenological and ecological properties of *I. histrioides* were researched and its distribution areas around Amasya were determined. *I. histrioides* has been previously reported in the category of R (rare) plants by Ekim et al. (15). This plant has a great economic importance in terms of decoration (3).

According to the result of physical analysis, it can be said that the plant grows better in soil with low salinity and high water holding capacity, slightly alkaline, medium calcareous, argillaceous-loamy and loamy soil (Table 5). It has been observed that Mediterranean plants such as *Myrtus communis* L. (*Myrtaceae*) (16), *Inula graveolens* (L.) Desf. (17), *Inula viscosa* (L.) Aiton (*Asteraceae*) (18), *Pistacia lentiscus* L. (*Anacardiaceae*) (19), *Asphodelus aestivus* Brot. (12), *Iris pseudacorus* L. (*Iridaceae*) (20), *Vicia sativa* L. (*Fabaceae*) (21) and *Capparis ovata* Desf. (*Capparaceae*) (22) prefer slightly alkaline or neutral soils, as does I. histrioides. Species such as *I. pseudacorus* (20) and *Commelina communis* L. (*Commelinaceae*) (23) have been reported to prefer soils with a medium level of $CaCO_3$

The species generally grows well in organic matter and nitrogen-rich soil. It has been reported that *Pistacia lentiscus* (19), *Inula viscosa* (18), *Iris pseudacorus* (20), *Capparis ovata* (22) and *Vitex agnus-castus* L. (*Verbenaceae*) (24) prefer soils that are moderately rich to rich with respect to organic matter content. *Capparis* L. species distributed in West Anatolia have also been reported to prefer nitrogen-rich soils (22). Content P is low in areas 2 and 3. Phosphorus content is at medium level in the other areas during the vegetative period. As for areas 1,4 and 5, it is within low limits during the generative period (Table 5). K. content is within optimal limits for each growth period. Therefore, it can be concluded that *I. histrioides* generally prefers soil deficient in potassium.

N, P and K contents in the above-ground parts are higher in the vegetative period. As for the generative period, there is a decrease in these contents. This may be explained by the intensive physical activities in the above-ground parts in the vegetative period, and by the transportation of elements to the above-ground parts. The elements have been transported to the below-ground parts of plants for survival until the next vegetation period. It is a well-known fact that nitrogen content in plants generally varies between 0.2 and 6 percent (14). N contents in the above-and below-ground parts in *I. histrioides* in the vegetative and generative periods are within optimal limits. The dry-weight phosphorus content of the plant is optimally between 0.05 and 0.43% (14). P content in the below-ground part of the plant has shown deficiency in areas 1,2 and 3 in the vegetative period and only in area 1 in the generative period (Table 3). As for the above-ground parts, there is a deficiency in P content in areas 1 and 2 in the vegetative and generative periods. According to the dry-weight of the plant, content of total K was found to be 0.2-11%. K content in both generative and vegetative periods was found to be sufficient in all localities (Table 4).

There are no differences between the vegetative and generative periods in terms of P and K in the above-ground parts of the plant. N content was higher in the vegetative period than in the generative, which is a significant difference among periods. There are no significant differences in the N,P and K contents in the below-ground between in the vegetative and generative periods. Similar results have also been observed in ecological studies done on various plant species (25-34).

When the climate diagrams are taken into consideration, it is seen that Ladik has Central Mediterranean; Suluova, Merzifon, Derebaşalan Village, Çukurören Village, Direkli Village, Gelinsini Village and Değirmendere Plateau East Mediterranean precipitation regime second variant rain type; and Amasya East Mediterranean precipitation regime first variant rain type. An arid period can be seen in the climate diagrams for Çukurören Village (Figure 3 d). There is a summer trough in the village Çukurören.

It was also determined according to Q values that Ladik, Derebaşalan Village, Gelinsini Village, Çukurören Village and Değirmendere Plateau are in the rainy Mediterranean Bioclimatic zone while Suluova, Amasya and Merzifon are in the semi-dry Mediterranean Bioclimatic zone; and Direkli Village is in the light-rainy Mediterranean Bioclimatic zone (Tables 1,2). It was determined that the pH value and calcareousness of the soil samples taken from these localitions are higher than those taken from other localitions because of the lack of rain.

The fact that some Iris species have also been used in medicine augments the importance of this research. We expect that these autecological findings will help the cultivation of *I. histrioides* in future, and this will prove to be an asset to the economy of Turkey. Furthermore, the distribution of *I. histrioides* has been determined in the Central Black Sea Region in Turkey. Very few ecological studies have been conducted on the plants growing in Turkey.

References

1. Baytop, T., Türkiye'de Kullanılan Tıbbi Bitkiler (Geçmişten Günümüze Türkiye'de Bitkiler ile Tedavi), I.Ü Ecz. Fak. yayını No:40, İstanbul (1984).
2. Baytop, A., Farmosotik Botanik, I.Ü. Ecz.Fak., yayınları No:25, İstanbul (1977).
3. Mathew, B. and Johnson, M., A question of identity, Journal of the Royal Horticultural Society, 115:9,431-494 (1990).
4. Ketin, İ., Arazi ile ilgili bilgilerde Türkiye Jeoloji Haritası, M.T.A., Enstitüsü yayınları, Ankara (1962).
5. T.C. Gıda-Tarım Hayvancılık Bakanlığı Devlet Meteoroloji İşleri Genel Müdürlüğü, Meteoroloji Bülteni (1974).
6. Doğan, S., Türkiye Gerçek Sıcaklık Haritaları, Meteoroloji Gn. Md. yayını, Ankra (1977).
7. Erinç, S., Klimatoloji ve Metodları, İ.Ü. Yayını No: 3278, Deniz Bil. ve Coğr. Ens. Yayın No: 2, İstanbul (1984).
8. Walter, H., Kurak Zamanların Tespitinde Esas Olarak Kullanılacak Klimodiagram (Çev.S.Uslu), İ.Ü. Orman Fak.Der., Seri B, 8(2) (1956).
9. Emberger, L., Sur le quotient pluviothermique, C.R. Acad. Sci., 234:2508-2510 (1952).
10. Bayraklı, F., Toprak ve Bitki Analizleri, Ondokuz Mayıs Üniv. Ziraat Fak. yayınları, yayın No:17, Samsun (1987).
11. Uslu, T., A Plant Ecological and Sociological Research On the Dune and Maquis Vegetation Between Mersin and Silifke, Comm-De La Fac.Sci.D', Ankara C.2,21;1-60 (1977)
12. Pirdal, M., *Asphodelus aestivus* Brot.'un Otekolojisi Üzerinde Bir Araştırma, Doğa TU.Bot.D., 13-89-101 (1989).
13. Allen, S.E., Grimshaw, H.M., Rowland, L.P., Chemical Analysis, In Moore, P.D., Chapman, S.B. (eds.) Methods in plant ecology, 285-344, Blackwell Scientific Publications, Oxford (1986).
14. Kaçar, B., Toprak ve Bitki Analizleri, Ankara Üniv. Basımevi, Ankara (1972).
15. Ekim, T., Erik, S., İlarslan, R., Türkiye'nin Tehlike Altındaki Nadir ve Endemik Bitkileri, Türkiye Tabiatı Koruma Derneği Yayınları, No:18, Ankara (1989).
16. Öztürk, M.A., Preliminary Observation on the Edaphic and Biotic Relations of *Myrtus communis* L. Ege Üniv. Fen Fak. Dergisi, Seri B, III, 1-2-3-4, 137-142 (1979).
17. Öztürk, M., *Inula graveolens* (L.) Desf.'in Ekofizyolojisi, II Edafik İlişkileri, Ata. Üniv. Fen Fak.Der., 2, Özel Sayı 1,480-492 (1982).
18. Pirdal, M., *Inula viscosa* (L.) Aiton Bitkisinin Edafik Etmenlerle Olan İlişkisi. VII. Ulusal Biyoloji Kongresi, 6-10 Ekim Kuşadası-Aydın 657-667 (1980).
19. Öztürk, M.A., Ataç, E., Bazı *Pistacia* Türlerinin Anatomisi ve Ekolojisi Üzerinde Bir Çalışma, Ata, Üniv. Fen Fak. Der., 2, Cilt 1, Özel Sayı, 1, 493-508 (1982).
20. Engin, A., Kandemir, N., Şenel, G., Özkan, M., An Autecological Study on *Iris pseudacorus* L. (*Iridaceae*), Tr.J. of Botany, 22: 335-340 (1998).
21. Kanısanlı, M., Oflas, S., Fiğ (*Vicia sativa* L.)'in Morfoloji ve Ekolojisi Üzerinde Bir Araştırma, Dokuz Eylül Üniv. Buca Eğitim Fak., Eğit.Bil.Der., S.6, 1-14 (1993).
22. Özdemir, F., Öztürk, M., Batı Anadolu'da Yayılış Gösteren *Capparis* L., Türlerinin Bireysel Ekolojisi Üzerinde Araştırma, Tr.J.of Botany, 20, 117-125 (1996).
23. Kutbay G.H., Uçkan, F., Phenotypic Plasticity in Turkish *Commelina communis* L. (*Commelinaceae*) Populations, Tr. J. of Botany 22, 199-204 (1998).
24. Doğan, Y., Mert, H.H., An Autecological Study on the *Vitex agnus-castus* L. (Verbenaceae) Distributed in West Anatolia, Tr.J. of Botany, 22, 327-334 (1998).
25. Gökçeoğlu, M., Untersuchungen Uber Production und Nahsaffumsatz in Rasengeselschaften von *Carex sempervirens* und *C. ferruginea*, Doktoranbeit, Bot. Inst. Tech. Üniv., München (1975).
26. Kılınç, M., Yüksel, Ş., *Pancratium maritimum* L. (*Amaryllidaceae*) Üzerinde Morfolojik, Anatomik ve Ekolojik Bir Araştırma, Tr.J. of Botany, 19,3, 309-320 (1995).
27. Kutbay, H.G., Kılınç, M., Kandemir, A., Phytosociological and Ecological Structure of *Fraxinus angustifolia sbsp. oxycarpa* Forests in the Central Black Sea Region, Tr.J. of Botany, 22, 157-162, (1998).
28. Margaris, N.S., Adamandiadou, S., Siafaca, L., Diamantopoulos, J., Nitrogen and phosphorus content in plant species of Mediterranean ecoystems in Greece, Vegetatio, 55,29-35 (1984).
29. Güleryüz, G., Uludağ (Bursa) Alpin Bölgesinin Bazı Otlak Alan Topluluklarında Fitomas Dağılımı ve Verimlilik Tr. J. of Botany 18, 161-167 (1994).
30. Seçmen, Ö., *Ceratonia siliqua* L.'nın Ekoloji, Ege Üniv. Fen Fak. İlmi Rapor Ser. No:148, 1-26 (1973).
31. Kandemir, N., Engin, A., *Iris nectarifera* Güner (*Iridaceae*) Üzerinde Morfolojik, Anatomik ve Ekolojik Bir Araştırma, XIV. Ulusal Biyoloji Kongresi, Bitki Ekolojisi ve Bitki Sistematiği Seksiyonu, 7-10 Eylül, 283-299, Samsun (1998).
32. Mert, H.H., Doğan, Y., Başlar, S., Studies on the Ecology of *Spartium Junceum* L. In West Anatolia; IV. The Plant Life of Southwest Asia Symposium. 21-28 May., E.Ü., Press Vol: 2, 713-724, İzmir, Turkey (1995).
33. Başlar, S., Mert, H.H., Studies on the Ecology of *Chrozophora tintoria* L. and *Rubia tinctorum* L. In Western Anatolia, Tr.J. of Botany 23, 33-44 (1996).
34. Kutbay, H.G., The Distribution of Nutrients in The Different Strata of a *Quercus cerris* L. var. cerris Forest, Tr.J. of Botany, 21,93-98 (1997).