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RESPONSE OF *CROCUS* L. (IRIDACEAE) TO ECOLOGICAL CHARACTERISTICS

ALI ÖZDEMIR[1], YURDANUR AKYOL[2*], ALPEREN YAŞAR ÖZDEMIR[3] AND CANAN ÖZDEMIR

Department of Biology, Faculty of Science and Art, Celal Bayar University, Manisa, Turkey

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Abstract

Three subspecies of *Crocus speciou*s (subsp. *speciosus*, subsp. *ilgazensis*, subsp. *xantholaimos*) two of them being endemics Blacksea region) were investigated for ecological characteristics. It has been observed that these subspecies usually prefer the soil which is acidic and has no salt in it. No statistical difference in per cent N and P was observed in all the three subspecies except in per cent K.

Introduction

Iridaceae family included the *Crocus speciou*s and is a large part of the geophyte plants. *Crocus* taxa have different interesting phenological properties such as to blossom in autumn and the leaves emergence after flowers. There are some reports on the anatomical and karyological aspects of these species (Rudall *et al.* 1991, Rudall 1994, Ozdemir *et al.* 2010, Erol *et al.* 2010, Akyol *et al.*2014). But, any ecological studies have not been done on these taxa. The most important elements in the soil (nitrogen, potassium and phosphorus) are important for their development. Studies on these elements are important to natural plant as well as cultured plant. Some researchers indicated that plants are grown better in high nitrogenous soil and have positive interaction between microorganisms and plants (Qiu *et al.* 2008). So, this work was designed to evaluate the ecological features of *Crocus speciosus* available in Turkey.

Materials and Methods

The soil and plant samples were collected in flowering period of September, October and November months in a spread area (Table 1). Collected plant samples were planted in pots filled with soil taken from their same localities. Phenological development was observed under laboratory conditions (Table 2).

Parts of the plants, cut into small pieces, were dried at 80°C in an oven for 24 hrs. Then grinding in a hammer mill was done for analysis. Nitrogen, phosphorus and potassium analyses were done using standard methods (Kacar 1972, Allen *et al.* 1976, Bayraklı 1987). Analysis of data was made according to Kacar (1972) (Tables 4, 5). The soil samples were air-dried under laboratory conditions and were passed through a 2 mm sieve. Both plants and soil samples were analyzed for P using the ammonium-molybdate-stannous colorimetric method, K by Perkin Elmer 2280 atomic absorption and N by semimicro Kjeldahl metod with a Kjeltec Auto 1030 Analyser (Bayrakli 1987).

*Author for correspondence: <yurdanur45@gmail.com>. [1]Department of Mathematics, Faculty of Science and Art, Celal Bayar University, 45110, Muradiye, Manisa, Turkey. [2]Manisa Hasan Türek Anatolian High School, Yunusemre, 45120, Manisa/Turkey. [3]Department Economy, Rochester University, New York, America.

The pH was measured by Beckman pH-meter with electrolyte in saturation mud. Calcium carbonate (%) has been determined by Scheibler calcimeter. Total salt analysis was determined by measuring the electrical conductivity of saturation mud by Conductivity Bridge Apparatus. Organic matter was determined by a modified Wakley-Black method. Results of the analysis are presented in Tables 6, 7 and 8 (Uslu 1977, Pirdal 1989, Soil Survey Staff 1993).

Table 1. Locality and time periods of the investigated samples.

Taxon	Localities	Time period	Altitude (m)
Subsp. *speciosus*	Samsun - Kocadağ	27.09.2009	1310
		25.10.2011	
		23.09 2013	
	Trabzon - Zigana Mountain	23.10.2009	2010
	Trabzon - Karadağ	26.10.2011	2000
Subsp. *xantholaimos*	Sinop - Dranaz Mountain	21.09.2011	1350
		13.10.2013	
	Sinop - İsfendiyar Mountain	21.09.2009	1455
		24.10.2010	
Subsp. *ilgazensis*	Amasya - Akdağ	25.09.2009	1800
		17.10.2011	
	Çankırı - Ilgaz Mountain	19.10.2013	1850

Results and Discussion

Phenological studies showed that one *Crocus* species bloom in spring while others bloom in autumn (Table 2). In *Crocus* species the flowers occur before the leaves. Leaves with corm and scape forms leaf drafts at the flowering time of cold season. After complete disappearance of aerial parts of the plant which consists of flower and flower tube, leaves of plants have grown in pots during the period of February, March, April and May. During this time the sides and the middle of former bulb formed a new one and was found to be completely closed tepals in snow-covered areas.

Table 2. Observations on phehological features of subspecies.

	Subsp. *speciosus*	Subsp. *ilgazensis*	Subsp. *xantholaimos*
Leaf out	February-March-April-May	February-March	February-March-April
In blossom	September-October-November	September-October	September-October
In seed	March-April-May	March-April	March-April

Depending on the altitude of the regions some morphological changes in subsp. were observed (Table 3).

In aerial and underground parts of subspecies %N and K are between sufficient limits. P% values only are sufficient level at locality of belonging to subsp. *speciosus*. In other localities there is a deficient values of P (Table 4). No significant difference at each of the three subspecies of

aerial and under ground parts of subspecies % N, P and K was observed. But there is an important difference in each of the three subspecies (aerial and underground parts) % N, P and K was observed.

Table 3. Morphological features of subsp. of *Crocus* of different localities.

Subspecies	Locality	Perianth tube (cm)	Tepal length (cm)	Tepal width (cm)	Corm diameter (cm)	Anther length (cm)	Filament length (cm)
Subsp. *speciosus*	Kocadağ	9.2	3.3	1.8	1.0	1.3	2.3
	Zigana Mount.	13.5	4.6	1.4	1.4	1.4	2.0
	Karadağ	13.5	4.5	1.5	1.2	1.3	2.1
Subsp. *ılgazensis*	Ilgaz Mount.	8.5	3.7	1.2	1.1	1.4	2.1
	Akdağ	5.1	3.3	1.1	1.4	1.3	1.8
Subsp. *xantholaimos*	Dranaz Mount.	7.5	3.6	1.3	1.0	1.1	1.7
	İsfendiyar Mount.	8.5	3.2	1.2	1.0	1.3	1.9

Table 4. Content (%) of N, P and K of aerial and ground parts of plants.

Subspecies	Locality	% N aerial/ground	% P aerial/ground	% K aerial/ground
Subsp. *speciosus*	Kocadağ	1.77/1.37	0.025/0.017	0.883/0.566
	Zigana M.	1.84/1.38	0.095/0.007	0.816/0.566
	Karadağ	2.12/1.79	0.021/0.002	0.879/0.494
Subsp. *ilgazensis*	Akdağ	2.18/1.48	0.034/0.007	0.883/0.566
	Ilgaz M.	1.94/1.81	0.001/0.011	0.799/0.566
Subsp. *xantholaimos*	Dranaz M.	1.16/0.95	0.014/0.015	0.883/0.266
	İsfendiyar M.	1.53/1.04	0.033/0.015	0.949/0.266

Table 5. Content (%) of N, P and K of aerial and underground parts of plants.

Subspecies	Mineral element	Mean aerial/ground	Significance
Subsp. *speciosus*	N	1.91/1.51	NS
	P	4.70/8.66	NS
	K	0.85/0.54	**
Subsp. *ilgazensis*	N	2.06/1.69	NS
	P	1.75/9.00	NS
	K	0.84/0.56	*
Subsp. *xantholaimos*	N	1.34/0.99	NS
	P	2.35/1.53	NS
	K	0.91/0.26	**

NS: Not significant, *p < 0.05, **p < 0.01.

Table 6. Physical and chemical properties soil samples.

Subsp.	Localities	pH	Texture	$CaCO_3$ (%)	Total salinity EC mmhos/cm	Moisture (%)	Organic matter (%)	N (ppm)	P (ppm)	K (ppm)	C/N
Subsp. *speciosus*	Kocadağ	5.1	Sandy-loam	0.159	0.025	6.5	9.40	67	7.89	40	8.1
	Zigana Mount.	5.9	Sandy-loam	0.079	0.225	8.9	4.42	56	11.35	70	4.6
	Karadağ	4.8	Sandy-clayey loam	0.198	0.100	4.0	8.73	89	64.14	20	5.7
Subsp. *ilgazensis*	Akdağ	6.2	Sandy-loam	0.516	0.250	2.6	5.93	56	89.91	130	6.2
	Ilgaz Mount.	5.5	Clayey-loam	0.159	0.150	3.5	4.92	72	6.86	30	4.0
Subsp. *xantholaimos*	Dranaz Mount.	4.9	Loamy	0.119	0.150	1.4	3.22	50	0.23	50	3.7
	İsfendiyar Mount.	5.7	Sandy-loam	0.079	0.088	4.9	6.43	28	12.62	50	13.4

Subsp. *speciosus* usually prefer sandy-loam soil but also can be found in sandy-clay loam soil (Table 6). The plant preferred very strong and moderately acidic soils. The values of $CaCO_3$ varies between 0.079 and 0.198 %. It also prefers less calcareous soils. EC vary from 0.025 to 0.225 mmhos/cm. Plants grow well in non-saline and moderate acidic soil with an EC of 0.025 to 0.215 mmhos/cm. Subsp. *xantholaimos* prefers lime, non-saline, a very strong acid and moderately acidic soils of loamy to sandy loam soil. Subsp. *ilgazensis* prefers non-saline, medium and less calcareous soils and grows well in sandy loam to clay loam soils. The soils of subsp. *speciosus* area are rich in terms of N % and poor in P and K %. The soils of subspecies are rich in % organic matter (Table 6).

Subsp. *xantholaimos*, which grows in soils that are rich in terms of N % and organic matter; poor in % P and K. The soils of distributed area's of subsp. *ilgazensis* are rich in terms of % N, and poor in % P and K. The soils on which the subspecies distribute are rich in terms of % organic matter. Variations in all three subspecies were not significant % P between plant parts and grown in soil. But a significant difference in concentrations of % N and K were observed (Table 7).

Table 7. Comparison of N, P and K concentrations in plant and soil parts by ANOVA test.

Subspecies	Mineral element	Mean plant/soil	Significance
Subsp. *speciosus*	N	1.910/0.756	**
	P	0.047/0.026	NS
	K	0.859/0.040	**
Subsp. *xantholaimos*	N	1.340/50.39	*
	P	0.02/0.0005	NS
	K	0.916/0.050	**
Subsp. *ilgazensis*	N	2.060/0.640	*
	P	0.017/0.004	NS
	K	0.841/0.008	**

NS: Not significant, *$p < 0.05$, **$p < 0.01$.

ANOVA test between ratios of C/N grown in soil s of subspecies and N concentration of plant parts are shown in Table 8. No significant difference was observed in all three subspecies between C/N ratio and concentration of N at parts of plant.

Table 8. Comparison of C/N ratios in soils with % N in plant.

Subspecies	Mean C/N ratio N%	Significance
Subsp. *speciosus*	6.14 / 1.91	NS
Subsp. *xantholaimos*	8.54 / 1.34	NS
Subsp. *ilgazensis*	5.05 / 2.06	NS

NS: Not significant.

The autumn *Crocus* plants which are the cold season flowering periods distributed in areas that were difficult to reach. Two of investigated plants are endemic have different features in terms of blooming in fall and not having leaves in flowering period. Subsp. *ilgazensis* and subsp. *xantholaimos* are endemic to a narrow spread over an area. At the snowy season which is flowering time of collected plant samples of underground parts showed that the stem with together leaves remain dormant. Plant flowering period in the cold season, the plant samples collected in parts of the underground (Mathew and Brighton, 1977), the stem with the leaves in dormancy is observed. Results of the ecological properties showed that all the three subspecies generally prefer sandy soils.

Subsp. *speciosus* and subsp. *xantholaimos* prefer low calcareous soils and subsp. *ilgazensis* prefers medium calcareous soils. Ozyurt (1978) has found similar results for *Gladiolus atroviolaceus* Boiss. Generally the soils investigated in this study on which subspecies grow are rich in organic matter. According to electrical conductivity, soils to grow up in all three subspecies are into the group of salt free (< 4 mmhos/cm) soils. When it is compared with the soils on plants grown; subsp. *speciosus* and subsp. *xantholaimos* grow in strong acidic and moderately acidic, subsp. *ilgazensis* grows in slightly acidic and acidic soils. This condition is because of more rainfall in the areas of plant distributed due to washed basic elements.

It is observed that the concentration of % nitrogen and potassium are sufficient in both aerial and underground parts of the investigated samples of subspecies. Generally P % concentrations of plants are insufficient at both of aerial and underground parts. Studies about the *Leucojum aestivum* L. and *Galanthus rizehensis* Stern. that are geophyte vary from our results in terms of plants of aerial and underground parts of % N, P and K values (Kutbay and Kılınc 1993, 1995).

No significant difference between concentrations of % N and P in each of the three subspecies of aerial and underground parts was observed except % K (Table 8). Kutbay and Kılınc (1999) said that Panvini and Eickmeier (1993) point out potassium is a very mobile ion in comparison to nitrogen and phosphorus.

Many environmental factors that affect growth of the plants varies depending on localities. Some changes were observed depending on height at morphological properties of plants. It was observed that increase in length of perianth tube depends on altitude, length of perianth and diameter of corm whereas Gonuz and Ozorgucu (1999) stated that, depending on the height, length of stem, petal and width of sepal of *Origanum onites* L. was increased. Gol *et al.* (2010) reported that in study at Black Sea region; physical and chemical properties of soil was to be associated with vegetation and altitude.

Results suggest that all the three sub-species show increasing cortex cell diameter, trachea diameter of root and stem, pith area of root with an increase in altitude. Gonuz and Ozorgucu (1999) observed that similar correlation between stem length and altitude whereas parallel correlation between diameter of stem and altitude contrast to our findings. This might be attributed to wind at height altitudes. Jaffe (1981) has stated that an increase in the diameter of stems against the effects of wind. However, the stem of the plants in the present study was being under the soil and lack of wind.

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