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A Comparison of Morphological Traits in Three Ornamental Species of *Cyclamen, Primula* and *Viola* in Nature (Forest Lands) with Their Cultured Samples in West Mazandaran Province

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Abstract

The attitude of policymakers and designers of green space is increasing toward to native-ornamental species to plant in the urban space because of their adaptation and resistance against severe weather and ecological conditions which can result in cost minimization and long-term survival in green spaces. Hence, the current study was carried out in the west of Mazandaran Province on three wild and domestic species, including *Cyclamen, Primula*, and *Viola*. Morphological traits were the appearance of blossom, length and width of leaf, pedicel, petiolate, and flower. Homogeneity of variance was done by Levene test and two groups, including wild and domestic species, were also compared by independent t-test. Results showed that all measured traits were higher in the domestic species than in wild species except wild species of *Viola* which had higher length, width, and area than the domestic one. All domestic species showed longer flowering period than wild ones. Two species of domestic and wild Primula enable to be green after flowering period, but domestic *Viola* and wild *Cyclamen* disappeared after the period. Moreover, wild *Viola* and domestic *Cyclamen* survived after flowering finalization.

Keywords: *Cyclamen*, Morphologic, Ornamental, *Primula, Viola*, West Mazandaran, Wild.

INTRODUCTION

The biological form of a plant species is a fixed characteristic created based on morphological adaptations of the plant to environmental conditions (Zarei *et al.*, 2008). Different biological forms in various plant populations shape the basis for their structure (Asri, 1999).

Frequent droughts and shortage of water resources in different areas of the country in recent decade have led to the introduction of new approaches toward the use of genetic and native resources instead of the species with high ecological requirements. In other words, the native species with climatic origins all over the country can be recommended to be applied for cultivation and propagation in urban green spaces and the spaces around the city, so that the efforts to domesticate wild species have become pervasive in most countries affected by drought and water shortage in recent decades. For instance, wild grasses (*Dactylis glomerata* L., *Festuca ovina* L., *Phleum phleoides* (L.) Karsten, and *Aristida abnormis* Chiov.) have been studied to be domesticated in order to be used in green spaces and gardening in New Mexico (Allred Kelly, 1998), Nevada (Badertscher and Leslie, 2006), and Colorado (Wilson, 2014).

In order to localize wild species, some field studies have compared the morphological traits of the species. For instance, in a study on apparent traits of two types of sage in Europe, Scheepens *et al*. (2011) showed that flowering started from top to bottom in the wild species *Companula thyrsoides* and from bottom to top in the wild species *C. corniolica*. *C. thyrsoides* grows in the meadows and has an earlier blooming and the flowers bloom quickly within a few days, but *C. thyrsoides* has a later blooming, grows alongside the roads and it takes several weeks to flourish. According to the studies on two species of *Salvia* genus, the elliptical and egg-shaped leaves in the *S. quezelii* are more than *S. bllsiana* (Celep *et al.*, 2014). According to a research by Andini *et al.* (2013), the wild *Amaranthus hybridus* species has internodes with lots of branches and a low height, but in A. tricolor ornamental species, the number of branches and internodes is low and the height is higher. Also, the leaves with the highest width have been observed in *A. hybridus* and the ones with the lowest width in *A. tricolor*. Studies on two wild species of *Festuca clytonii* and *F. pilgeri* has shown that they are morphologically very similar to each other, with the exception that the leaves of the former are smoother and those of the latter are is stiffer and rougher (Namaganda *et al.*, 2006). *Ostrowskia magnifica* wild plant grows in the open air in Saint Petersburg and the distance between the nodes is 2-3 cm, while this distance in greenhouse or the native habitat of the plant in Central Asia reaches up to 10 cm or even more. But the ornamental species *Musschia wollastonii* is in the form of a rosette, with 70 cm long leaves and the height of the plants reaches up to 1.5 metres, but *Musschia ourea* has a low height reaching 40-70 cm (Tatyana *et al*., 2003). *Primula vanensis* is an ornamental perennial plant with a straight stem and a flower diameter of 10-11 mm and the flowers appear in June and July and the appearance of this species is like the ornamental species *P. gilanica* (Wagenitz, 1980); with the exception that the stem length in *P. vanensis* is 13-20 cm but in P. gilanica it reaches up to 25-40 cm. Colour of the flower is pink-purple in *P. vanensis* and pink-crimson in *P. gilanica* (Dogan *et al.*, 2015).

In this study, the morphological traits of three natural and morphological species of primula, cyclamen and violet native to the northern forests were compared. Also, the flowering period and stay-green term of the studied species were studied under natural and cultured conditions.

MATERIALS AND METHODS

Studied area

The study area for the wild species was Safaroud forest park and the area for ornamental species was Maranta greenhouse. The greenhouse is located in western extreme of Ramsar County. The ornamental species were kept in a cold frame under a plastic cover. The wild species are located in Safaroud forest park, 7 kilometres from southwest of Ramsar County, on the road to Javaherdeh (Fig. 1).

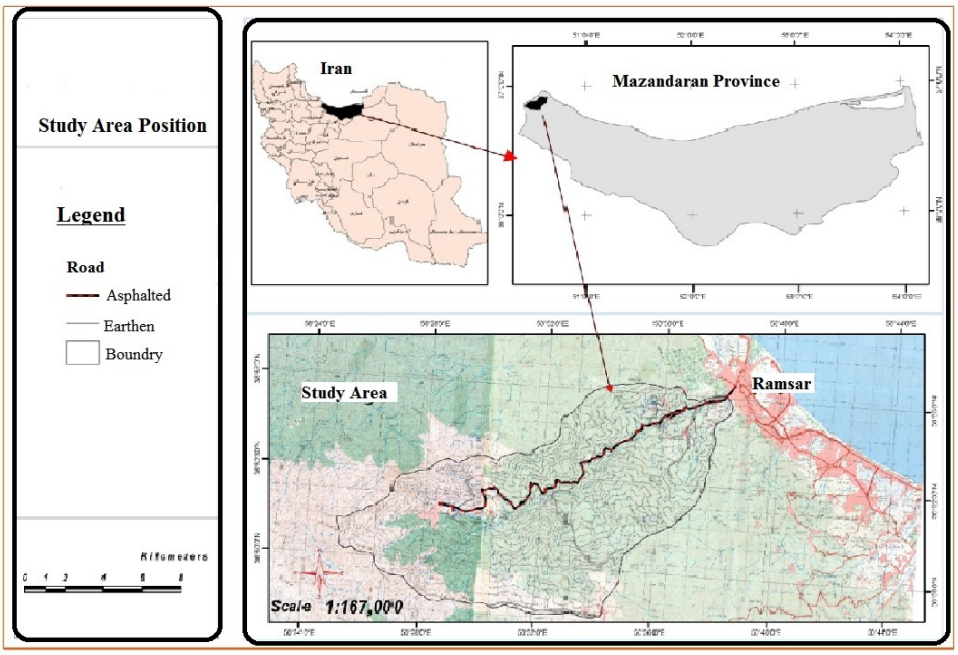

Fig. 1. Location of Safaroud forest park basin.

The total area of about 55 hectares is located around the Safaroud river (Khazaeipour, 1996). The studied area of the wild species is placed in the foothill of a slope leading to the Safaroud River. According to the 20-year statistics of the Ramsar weather station, annual precipitation of the region is 1148.5 mm, average annual temperature of the area is 9.15°C, and average monthly temperature varies between 6.9 and 25.3°C (Anonymous, 2006).

Study methodology

Survey and sampling were done from the early growth period in early January to the mid-June, from three forest species of *Primula heterochroma, Viola odorata,* and *Cyclamen coum* and three ornamental species of *Primula polyantha*, *Viola tricolor,* and *Cyclamen persicum*, randomly selected from each tripod (sample). All forest species were placed within an area of about 200 m^2. The vegetation indices, including the leaves, petioles, flowering stems and flowers were measured by a ruler and caliper. Also, the flowering period and stay-green period for the studied species were evaluated every week.

EC and pH of the soil around the wild species were compared to the soil of the ornamental species. The soil pH in Safaroud forest park area (6.61) and Maranta greenhouse (6.60) was similarly in acidic category. Also, EC of Safaroud forest park and in Maranta greenhouse were reported to be 393 and 373 (mho/cm) which had a slight difference. Leven's test was used to study of variance homogeneity of the recorded quantitative data and independent t-test in critical 5% level was used to compare the measured traits of wild and ornamental species. All processing and preparation steps of the data were done by MS-Excel, and SPSS v.22 software package was used for data analysis.

RESULTS

The results of data analysis for cyclamen species showed that the data variance for petiole peduncle was homogeneous and it was heterogeneous for other traits, but apparent traits of these two groups showed a significant difference at the 5% level (Table 1).

Also in *Viola* plant, given that the critical levels for leaf area and petal width were greater than 5%, they had homogeneous variances and the rest had heterogeneous variances (Table 2).

In all traits except leaf length, there was a difference between the two ornamental and wild species. Also, in primula plant, given the heterogeneity of all measured traits and also the second row of all variables it was shown that there was a difference among all cases in the two wild and

Table1. Levene's test for equality of variances for *Cyclamen* species.

Statistics parameter	Homogeneity of variance	F	Sig.
Leaf length	Homogeneous	25.7	0.000**
	Heterogeneous	25.7	0.000**
Leaf width	Homogeneous	22.28	0.000**
	Heterogeneous	22.28	0.000**
Leaf area	Homogeneous	39.49	0.000**
	Heterogeneous	39.49	0.000**
Leaf stalk	Homogeneous	0.498	0.483
	Heterogeneous	0.498	0.483
Pedicel	Homogeneous	3.097	0.082
	Heterogeneous	3.097	0.082

**: significant at the 1% level.

Table 2. Levene's test for equality of variances for Viola species.

Statistics parameter	Homogeneity of variance	F	Sig.
Leaf length	Homogeneous	17.79	0.000**
	Heterogeneous	17.79	0.000**
Leaf width	Homogeneous	7.30	0.008**
	Heterogeneous	7.30	0.008**
Leaf area	Homogeneous	1.83	0.178 N
	Heterogeneous	1.83	0.178 N
Leaf stalk	Homogeneous	6.75	0.010
	Heterogeneous	6.75	0.010
Flower length	Homogeneous	20.03	0.000**
	Heterogeneous	20.03	0.000**
Flower width	Homogeneous	2.95	0.088 N
	Heterogeneous	2.95	0.088 N
Pedicel	Homogeneous	20.25	0.000**
	Heterogeneous	20.25	0.000**

**: significant at the 1% level , N: insignificance.

ornamental plants at the critical level of 5%, except the width and leaf area which had no differences (Table 3).

The field observations for flowering period showed that in cyclamen ornamental plant, flowering began on 21th February and continued until mid-May; while the wild type began flowering from February 9th and persisted under difficult environmental conditions until late-April (Fig. 2).

Table 3. Leven's test for the two wild and ornamental species of Primula.

Statistics parameter	Homogeneity of variance	F	Sig.
Leaf length	Homogeneous	8.9	0.004**
	Heterogeneous	8.9	0.004**
Leaf width	Homogeneous	19.19	0.000**
	Heterogeneous	19.19	0.000**
Leaf area	Homogeneous	7.67	0.007**
	Heterogeneous	7.67	0.007**
Flower length	Homogeneous	5.84	0.018*
	Heterogeneous	5.84	0.018*
Flower width	Homogeneous	5.45	0.022*
	Heterogeneous	5.45	0.022*
Pedicel	Homogeneous	71.16	0.000**
	Heterogeneous	71.16	0.000**

*: significant at the 5% level , **: significant at the 1% level.

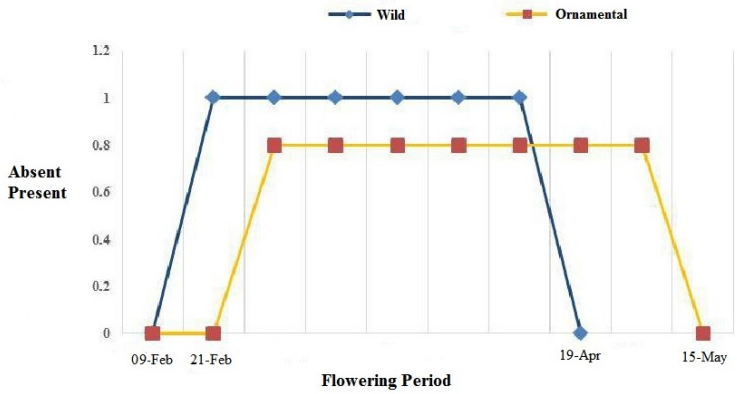

Fig. 2. Line graph of cyclamen's flowering period.

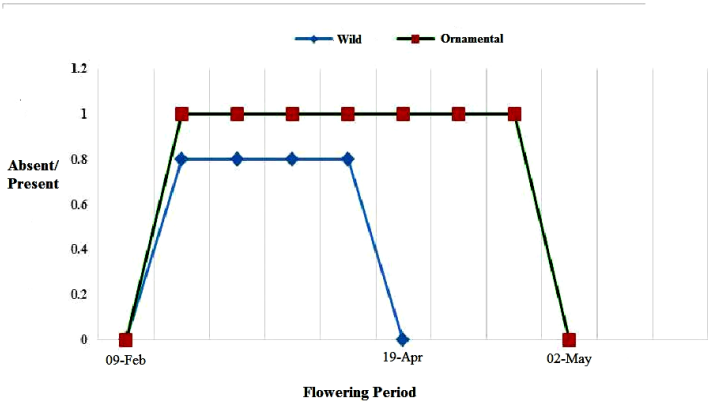

Fig. 3. Line graph of primula's flowering period.

In ornamental primula plants, the flowering period started from early-February and continued until early-May, while in the wild species the flowering started from February 9th until late-April (Fig. 3).

Finally, in viola ornamental plant, the flowering started from mid-February and continued to the late-May (Fig. 4).

The average flowering period (70 days in wild *Cyclamen* species, 70 days in *Primula*, 63 days in *Viola* and 84 days in *Cyclamen* ornamental species, 83 days in *Primula*, and 100 days in Viola) shows significant differences among the ornamental and wild species. The plants grew on steep areas and cliffs and irrigation of the plants depended on precipitation (Fig. 5).

In terms of quality, *Cyclamen coum* was totally lost and died in mid-May but *Cyclamen persicum* had significantly retained its greenness, so that despite the reduction in the number of leaves, the few remaining leaves had retained their greenness. *Viola tricolore* lost its greenness

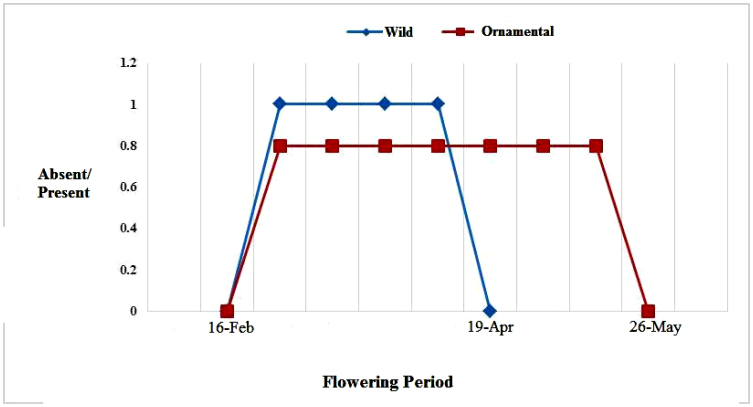

Fig. 4. Line graph of viola's flowering period.

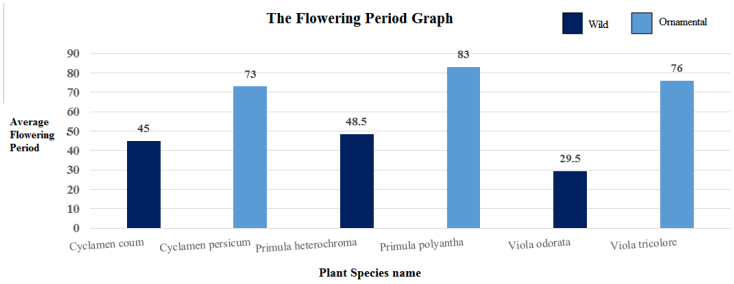

Fig. 5. The flowering period graph of the studied plants.

from early to mid-June. But, *Viola odorata* continued to grow after the end of flowering and retained its greenness until early summer. *Primula heterochroma* barely produced leaves after the end of flowering and retained its greenness for a long time. But, Primula polyantha continues to produce leaves after the flowering was finished and rarely entered into the reproductive growth and it retained its greenness until the end of survey time.

DISCUSSION

The ecological and maintenance conditions are two factors involved in morphological differences of the wild and ornamental species. Despite the differences in morphological traits and somehow superiority of these traits in ornamental plants over the wild type, it is noteworthy that the ornamental species are faced with the greenhouse environment and conditions with minimum climate change and nutritional conditions of the soil, while their wild counterpart species are in harsh environmental conditions such as steep slopes and high water drainage on these slopes as well as sudden changes in weather. Also, considering that the mentioned plants grow in the depth of the forest, thus they benefit from a low light which shortens the flowering period to reach the reproductive stage.

Scheepens *et al*. (2011) also pointed the short flowering period of wild species as compared to the domestic species. Celep *et al*. (2014) pointed the high number of leaves in Salvia ornamental species as compared to the wild type. The high number of internodes and branches in *Amaranthus hybridus* plants compared to its wild species was also reported by Andini *et al*. (2013). These results are consistent with our findings. Taking a closer look at the charts, it can be observed that the flowering period and stay-green period of the wild plants are placed in a higher position. In other words, despite experiencing difficult environmental conditions, they managed to stay green longer, even if this stay-green was in the form of minimizing the surface or number of leaves. Ejtehadi *et al*. (2008) also reported similar results in a field study. Also, considering the importance of flowering time to different phenological stages of the plant, the results of the present research imply the importance level and difference between flowering times in the study plant species. On the other hand, the results reported by Yavari *et al*. (2011) about different populations of *Thymus pubescens* showed a significant difference between the two populations in their natural habitat in the emergence of flowering which is consistent with the results of this research. The results of this research showed that both ornamental and wild types retained their stay-green, which can be mentioned as the similarity of these two species. On the other hand, it has been stated that the release scope of each species may be limited or wide depending on biological conditions and its tolerance and compromise with the environment.

Mozaffarian (2008) states that the plants are very different in terms of morphological and phenological traits and flowering pattern. Of course, great variation of the observed morphological traits is expected considering the different sources of the studied populations. Studies on different plant species showed a correlation between the environmental conditions and morphological diversity of a plant species, so that the species deployed in a larger habitat range, exhibited a greater morphological diversity (Backer, 1974; Sultan, 2001; Richard *et al.,* 2005).

CONCLUSION

Considering the stay-green period of the studied wild plants as compared to the ornamental species, it can be expressed that despite withstanding the very harsh environmental conditions, these plants can be good representatives for introducing to be used in the urban green spaces design and their application causes reduction in maintenance costs (such as irrigation, fertilization, soil composition, and also pesticides). High tolerance of this species in environmental conditions causes it to be able to stay green in different situations (in terms of slope, soil type and very low lighting) and be proposed for almost all urban areas of northern Iran.

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