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Investigation on Habitat demands of *Malus orientalis* Ugl. in Zagros forests (case study: Divandareh, Kurdestan)

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ABSTRACT: In this study the habitat needs of forest apple (*Malus orientalis* Ugl.) In Zagros forests (Case Study: Kurdistan Divandarah) were studied. Along transects were sampled randomly. The plot features of this species include canopy cover, density, height, largest diameter, shortest diameter, leaf length, leaf width, height, trunk diameter at breast height were measured and regeneration. Soil samples taken at each site and the number of physical and chemical properties were studied. In order to investigate the most effective factors in the establishment of this species in the habitat of the principal component analysis PCA was used with Minitab V.14 software. The results showed that the growth characteristics and environment of sand, seedlings, average maximum and minimum temperature, moisture content, PH and among the largest influence on the separation of re-forested habitat types.

Keywords : Habitat needs, apple, forest, Divandarah, Kurdistan

INTRODUCTION

The Zagros habitat occupies a large part of the Zagros mountain range that extends from northwestern Iran (i.e, from Piranshahr in West Azarbaijan Province) to a location near Firozabad in Fars Province covering an area 1300 kilometers long with an average width of 200 kilometers. The Zagros forests, classified as semi-arid forests, have an area of five million hectares, constitute 40% of the forests in Iran, and exert the greatest influence on water provision, soil preservation, weather modification, and economic and social equilibrium in the whole country. At present, they are considered destroyed forests, with fuel wood gathering and grazing the main reasons for their destruction (Sagheb Talebi *et al.*, 2004). The region of Divandarreh, which is situated in the Zagros Mountains, is considered Mediterranean in DeMartin's classification system and, due to its climate diversity, topographical position, etc., enjoys upland pastures and sparse forests that constitute its rich plant cover. Crabapple (*Malus orientalis* Ugl.) belongs to the phylum Spermatophyta, subphylum angiosperms, class Eudicotyledones ("true dicots"), order Rosales, family Rosaceae, tribe Pomaceae, and genus *Malus*. The trees are 3-5 meters tall and sometimes spiny. The leaves are simple, crenate, and pubescent (especially when they first emerge and start to grow), are covered with dense hairs, and have 2-4 prominent veins. The flowers are white, pink, fragrant, and occur in umbels or corymb-like racemes. The calyx has five small lobes that are complete and long lasting and remain on the fruit after drying up. The flower has five almost circular petals, its anthers are white or yellow, there are five styles joined at the base, and the ovary is epigynous, compound, and continuous. The fruit is relatively large, fleshy, and round (Fig. 1,2), has a deep belly button at the bottom end, the mesocarp is almost without resistant sclerotic masses, the external surface of the epicarp is without hairs, and the endocarp is membranous and cartilaginous (Ghahreman, 1998 Alberghina (1978). In a study on the Cam species (*A. webbii*) in southwestern Sicily of Italy, it is indicated that this species grows on various types of limestone and volcanic soil and is found at a height of 900 meters above sea level. In a study on soil conditions of Pyrusglabra habitat, Huxley (1992) showed that this species grows well in Loamy soils which have good drainage and receive enough light; it also grows in heavy soils and shows tolerance in shade conditions but its fruits grow less in such conditions. Air pollution and high humidity do not significantly affect its growth, yet it also grows in moderately fertile soils. Aas & Riedmille (1993) argued that *P. pyraster* Burgsd species are found from flat areas to central highlands (850 m above sea level) and in mixed broad-leaved forests of relatively dry areas with calcareous soils rich in food and in warm summers.

In a case study of Cerasus Mahaleb mill in the northern Switzerland, Kollmann & Pflugshaupt (2005) investigated the population structure of fleshy-fruit species in the border area of natural forest and indicated that the spread of the species was determined largely by local topography. These trees were distributed on the border between the sparse rocks and beech forests in deep soils. Investigating *Pyruscalleryana dune* species, Anon (2008) remarked that this tree was of chronophyte nature and was tolerant to drought, heat, air pollution, pests and diseases; yet, it was not able to withstand temperatures less than -28 degrees. The purpose of the present research was to study habitat needs of crabapple (*Malus orientalis* Ugl.) in Divandarreh, to observe the behavior and performance of this species, and to investigate its interactions with other biotic and abiotic factors that are considered its autecology. Determination of climatic, soil, and environmental factors that influence the geographical distribution of the species was one of the main objectives in this research.

MATERIALS AND METHODS

Divandarreh is a small city with an area of about 4230 square kilometers and an altitude of 1850 meters in Kurdistan Province, with longitude of from 46:30 to 47:30 north and latitude from 35:35 to 36:20.

A. Identification of crabapple habitats

One of the objectives of this research was to study the ecological needs of this species and to help its preservation as a species that is becoming extinct. Therefore, to achieve the determined goals, soil maps and climatic, local, and meteorological information related to the ecological regions of the city were collected and used to determine the habitats of this plant species. It was found that this species was scattered in most parts of the city in small numbers in cemeteries, areas difficult to pass through, or places away from residential areas.

B. Habitat selection

Field trips were made using topography maps, GPS, Google Earth, and other sources, and three main habitats (Chehel Cheshmeh, Saral or Hezarkanian, and Drasb) were selected (Fig. 2). These habitats were selected mainly because they were located in different regions of the city and had different climatic, geological, soil, etc. conditions. The characteristics of each of these habitats including altitude, percentage of slope and slope direction, geographical coordinates, etc. are presented in the sections below.

RESULTS AND DISCUSSION

A. Plant cover

The largest plant cover percentage and density were observed in the Saral and the smallest in the Chehel Cheshmeh habitats. The tallest trees were found in Drasb and the shortest in Chehel Cheshmeh. As for tree diameter at breast height, the maximum diameter was that of Drasb and the minimum that of Chehel Cheshmeh. Chehel Cheshmeh had the maximum number of seedlings and Drasb the minimum. The largest diameters of suckers belonged to Drasb and the smallest to Chehel Cheshmeh. Drasb had the largest leaves and Saral the smallest.

B. Soils

Tables 1-3 show results of soil analysis in the various habitats. The soil in Chehel Cheshmeh was the most acidic and had the least electric conductivity. The soil in Chehel Cheshmeh contained less silt and clay but more organic matter compared to the other habitats. Percentage sand content was the highest in Chehel Cheshmeh and the lowest in Drasb. Saturation moisture content was greater in Saral than the other two habitats.

Table 1: Soil characteristics in the studied habitats of crabapple in Divandarreh.

Habitat	pH	Saturation moisture content	Organic matter (%)	Sand (%)	Silt (%)	Clay (%)	Soil texture
Chehel Cheshmeh	7.4	38.7	3.9	77.4	15.6	7	Sandy Lome
Drasb	7.5	44.5	2.3	52.4	24	23.6	Sand Clay Lome
Saral	7.5	52.8	2.6	34.7	33	32.3	Clay Lome

Using principal component analysis based on the eigenvalues of the components, the results of the data analysis related to the vegetation characteristics and environmental parameters of species habitat are shown in Table 2. In the first component, tree height, biggest branch length, leaf length, diameter of suckers or shoots, minimum temperature in the coldest month and the average maximum temperature are effective. In the second component, the attributes of crown vegetation, tree height, crown diameter (small diameter), the number of seedlings and organic matter are effective. In the third component, leaf and seedlings width are effective.

In the fourth component, the mean annual temperature and silt are effective. In the fifth component, the absolute maximum temperature of the warmest month and annual rainfall are effective. In the sixth component, crown diameter (large diameter), saturation and sand are effective. In the seventh component, canopy diameter (large diameter), chest-width diameter, acidity and humidity are effective. In the eighth component, density, mean minimum temperature, humidity, saturation humidity and sand are effective.

Table 2: Values of the eigenvectors of each environmental parameter and plant cover in the studied habitats.

Vegetative and environmental variables	Components						
	1	2	3	4	5	6	7
Area coverage	.021	.294	-.007	.016	.141	.128	-.003
Density	-.265	0660/-	2330/-	0420/	2430/	.2150	.283
Tree height	251-0/	113-0/	1200/-	070-0/	0110/	1590/	1700/-
Trunk height	-.129	.260	-.036	.090	-.127	-.058	.133
Length of the tallest branch	.272	.004	.004	.092	.099	.194	.079
Canopy diameter	.056	.288	-.049	.230	-.128	.320	-.222
Canopy diameter (perpendicular to the first one)	-.100	.274	-.042	-.089	-.042	-.260	.136
Leaf length	.256	-.099	.069	-.017	.000	-.037	.221
Leaf width	.246	.127	-.304	.057	.186	-.092	.019
Sucker diameter	.240	.140	-.109	.017	-.042	-.082	.123
Diameter at breast height	.228	.161	-.017	.003	.133	-.249	-.070
Seedling	-.099	-.274	.049	-.045	-.108	.005	.199
Average yearly temperature	.268	-.055	-.004	-.351	.154	.059	-.032
Minimum temperature in the coldest month	.255	-.103	.091	.011	.017	.046	.059
Maximum temperature in the warmest month	.272	-.006	-.010	-.013	-.379	.186	.151
Mean minimum temperature	.269	-.049	.235	-.186	.273	.022	.312
Mean maximum temperature	.272	.017	-.096	.191	.119	-.186	-.145
Annual rainfall	-.255	.103	.006	.156	.562	.206	.259
Acidity	0800/	2820/	0720/	1890/	0360/	4780/-	2550/
Saturation moisture	0870/-	2790/	0100/	0720/	3110/	1790/	4240/-
Organic matter	1860/-	2160/	131-0/	0230/-	196-0/	0390/	0120/
Sand	0350/	292/-0	0600/	009-0/	2410/	034-0/	3520/-
Silt	-.066	.286	-.170	-.790	.035	.054	-.007
Clay	-.013	.294	.811	-.036	-.034	.156	.012
Moisture	.200	.199	-.167	.138	-.108	.463	.207

According to the chart of the spatial distribution of vegetation and environmental variables for wild apple species habitat, it can be concluded that in the separation of Derasb habitat, tree height, mean maximum temperature, leaf width, and the length of the longest branches are the most influential features. In the separation of HezarKanian habitat, organic matter and height of trees are the most influential. In the separation of ChehelCheshmeh habitat, the sand and the number of seedlings have the greatest impact (Fig. 2).

The variance analysis of the vegetative features of forest apple species in three habitats showed that vegetation thickness, tree height, the length of tallest branches, crown diameter (large diameter), chest-width diameter and number of seedlings show at 0.1 percent, Table 3. Also, there is a significant difference at 1% level regarding tree height, crown diameter (small diameter), leaf width and seedling diameter or sprout and there is a significant difference at 5% level regarding leaf length. There was no significant difference regarding the density of this species in three habitats.

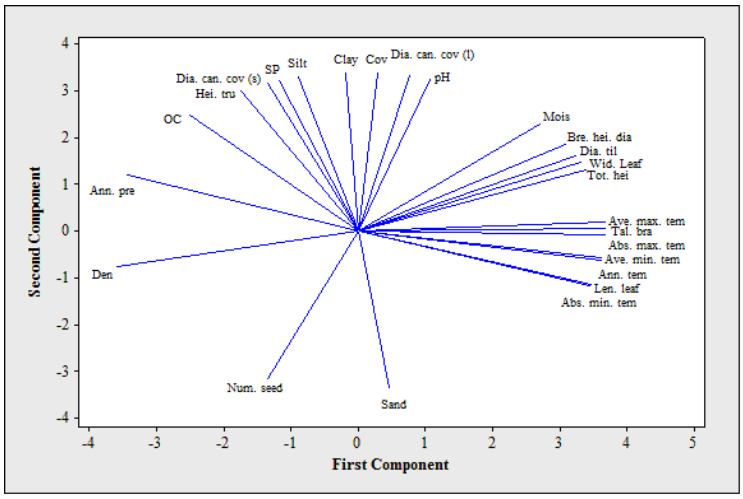

Fig. 1. Spatial distribution diagram of vegetative and environmental parameters in the studied habitats using the PCA analysis.

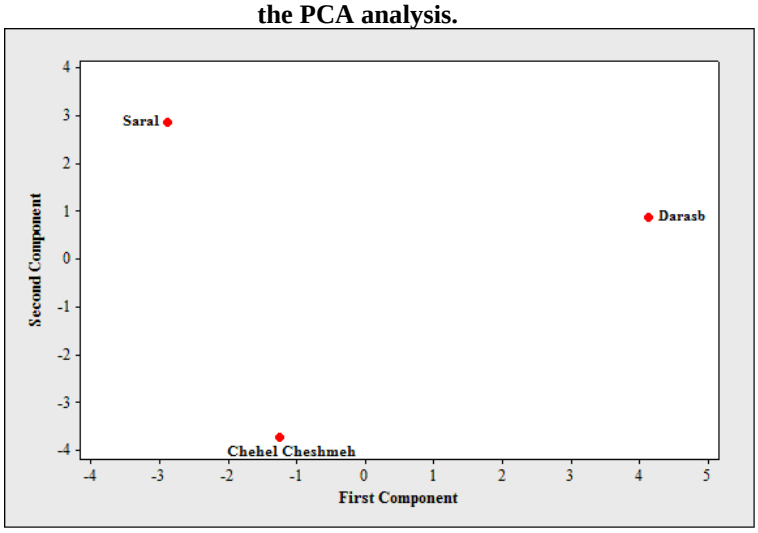

Fig. 2. Spatial distribution diagram of crabapple based on vegetative variables, climate, and soil in the habitats using the PCA analysis.

Table 3.

Results	p-value	MS	SS	Variables
***	.000	2980.16	5960.33	Area coverage
ns	.889	.67	1.33	Density
**	.001	13.8467	27.6933	Tree height
***	.000	26413.24	52826.48	Trunk height
***	.000	268952	537904	Length of the tallest branch
***	.008	24293	48587	Canopy diameter
**	.001	6748.9	13497.8	Canopy diameter (perpendicular to the first one)
*	.01	5.115	10.230	Leaf length
**	.006	1.9295	3.8590	Leaf width
**	.001	16.7307	33.4614	Sucker diameter
***	.000	33.730	67.461	Diameter at breast height
***	.000	60.280	120.560	Seedling

C. General summing up

(i) Topographical study of the region indicates crabapple has formed habitats in steep upland regions about 200 meters above sea level. (ii) The climatic conditions in the habitats show all three have Mediterranean climates according to DeMartin's climate classification and very cold semi-arid climates according to Ambereghe's climate classification. Fieldwork studies in Chehel Cheshmeh revealed that the direction of the mountain range allowed the northern part of the habitat to be more influenced by the Mediterranean currents and, furthermore, snow patches could be seen until the last days of spring due to the height of the mountains. In investigating the vegetative features it was concluded that the maximum vegetation was observed in Saral habitat and the least vegetation was observed in Chehelcheshmeh habitat. Comparing the average number forest apples per hectares in three distinct habitats, it can be concluded that, on average, there are 13 forest apple trees per hectare in the area under study; the maximum presence of forest apple trees can be seen in ChehelCheshmeh and HezarKanian. The greatest tree height is seen in Deraseb habitat and the smallest height is seen in ChehelCheshmeh habitat, in which the effect of height from sea level on tree height can be well observed. Regarding the chest-width diameter, the largest diameter is seen in Deraseb and the smallest diameter is seen in ChehelCheshmeh, which shows that ChehelCheshmeh habitat enjoys better conditions for revitalization including height from sea level, average precipitation and impassable area for livestock. The largest seedling diameter was seen in Deraseb and the smallest diameter was seen in ChehelCheshmeh. In terms of leaf length, the largest leaf length is seen in Deraseb and the smallest leaf length is seen in Saral habitat. Therefore, ChehelCheshmeh habitat has the minimum chest-width diameter and the maximum number of seedlings. This indicates that a certain factor or factors do not allow the trees to grow to their maximum height. With regard to the field investigations in ChehelCheshmeh habitat, it seems that the stones dislodged from the rocks are the main causes of this condition and the brown bears living in the habitat are the contributing agents.

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