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Short communication

Investigation on some Ecological and Morphological Factor of *Lagochilus macracanthus* Fisch. & C. A. Mey in Yazd Province

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Abstract

Ecological study of behavior as essential elements of their ecosystems and habitat characteristics in order to find appropriate solutions to maintain, revise and revitalize this important part of the renewable natural resources. This present research is about autecology of *Lagochilus macracanthus* Fisch. & C. A. Mey. Study area is located in near of Nodooshan, Yazd, Iran. Selected sites were within three different elevations; 2300, 2375 and 2450 meters. Sampling was done in a random-systematic way in these elevations. In the site, the studies were climatically characteristic, co-dominant plant, and vegetation variation, physical and chemical analyses of the soil. Results showed that this species is distributed in rangelands with 7.7-7.9 pH, 0.13-0.19 EC ds/m in 2300-2450 meters elevation. According to 10-year statistics, the average rate of rain falls and annual temperature in this habitat is 98.54 millimeters and 14.56 centigrade, respectively. This plant grows as a shrub with the height of 45-60 centimeters. Vegetative growth begins at late-March, flowering occurs in late-May. Seeding happens in mid-July.

Key words: *Lagochillus macracanthus* Fisch. & C. A. Mey, Phenology, Morphology, Ecology, Yazd

Introduction

The Lamiaceae family is rich in secondary metabolites and embodies numerous genera of high economic, medicinal value and essential oils. The genus lagochilus from this family consists of 44 species, 33 of which grow in central Asia. The flora of Iran comprises five species, including four endemics: *L. alutaceus* Bunge., *L. aucheri* Boiss., *L. kotschyanus* Boiss. and *L. macracanthus* Fisch. & C. A. Mey. [1, 2]. It is to be interesting that the genus is represented in Yazd just by one specie *L. macracanthus* Fisch. & C. A. Mey. that is grown in a small part in near of Nadooshan. [3]. The distribution of the plant is in Isfahan (Natanz and Kashan), Semnan (Turan) and Tehran (Saveh Road, Chitgar, Eshtehard, 80 km road from Tehran to Qom) that is varied between 900-3000-meter elevation [4]. Taxa of the genus Lagochilus basically occur throughout the territory of Uzbekistan, starting from the deserts to Tian-Shan and Pamir-Alay mountain systems [5]. The genus Lagochilus is highly drought-tolerant. It provides an excellent system for examining the potential influence of geologic and climatic effects on range fluctuations and diversification of species across the temperate steppe and desert regions. Lagochilus was hypothesized to have a differentiation center along the coasts of Tethys Ocean [6]. The species of this genus are used as a local medicine in treating the skin diseases, helping to control the bleeding, and creating peace for nervous disorders. Lagochilin is a diterpene that forms a grey crystalline solid. It was found in various species of

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the genus Lagochilus, most notably *L. inebrians*, and is thought to be responsible for the sedative, hypotensive and hemostatic effects of this plant [7,8]. These plants are rich sources of Iridoid polysaccharides which are used by human due to its medical importance [9].

Nowadays, as a result of indiscriminate grazing and soil erosion many important species are endangered or extinct. It seems to be more important that *L. macracanthus* Fish. et Mey is the endemic plant species of Iran and is regarded as the endangered species which may be made extinct if it is not protected [10]. Also, due to the distribution of plant species in various areas and their importance in natural resource management are essential to understand the ecological factors affecting those to be taken, this information allows the knowledge for the application of appropriate plant species in different ecosystem and scientific management of ecosystems achieve reform so in this research is mentioned some of them that be done recently. By the same token it could be cited, investigation on vegetation covers of the desert regions in Central Asia and Kazakhstan, listed *L. acutilobus* only in the composition of rare artemisia communities in Mangyshlak [11]. Analysis relationship between the distribution pattern of *Salvia rosifolia* Sm. and the concentrations of N, P, and K in soil was done [12]. An exploration on *Stipa barbata* Desf. show that the loamy-sandy and clay-loamy soils with pH of 8.1 to 8.7 are principal soils in its habitats at semi-arid rangelands of Tehran Province, Iran [13]. An examination revised some biological factor of *L. macracanthus* Fish. et Mey that is grown in Saveh-Hamedan road [14]. Some test was done to give information about ecological significance of *Campanula romanica* savul. in Romania [15]. Ecological character *Tilia rubra* dc. in Turkey examined [16]. The morphology, anatomy and ecology of *Ophrys lutea* cav. in Turkey was probed [17]. So there are insufficient data in the literature on the distribution and contribution in the vegetation cover of *L. macracanthus* Fish. et Mey. Due to lack of geographical distribution of the specie and limited study on this taxa and the necessity of understanding the exclusive species of Iran, the morphological characters of vegetative, phonological and ecological requirement of this plant must be revealed.

Material and Methods

The Selective Site

The study area is located near Nodooshan where is situated in North West of Yazd province that is the only habitat of the plant in Yazd. The average annual precipitation and temperature, mean maximum and minimum temperatures according to meteorological 10 years was determined. On the basis of De martenne and Ambrgeh the climate revealed. Study sites in the zone were selected in three heights 2300, 2375 and 2450 where the distribution was seen.

Soil Parameters

Soil samples were carried out with 5 replications from 0-50 cm depth where the root growth is. The samples were passed through a 2mm sieve and subjected to examination some physiochemical factor. The chemical analysis of the soil samples was about nitrogen, calcium, phosphorus, potassium and its physical properties such as pH, electrical conductivity, organic carbon, lime, sand, silt, clay and soil texture were measured by Kjeldahl, Titration, Olsen, Fleamphotometric, pH meter, Ec meter, Walky and Black method, TNV method and Hydrometric method, respectively.

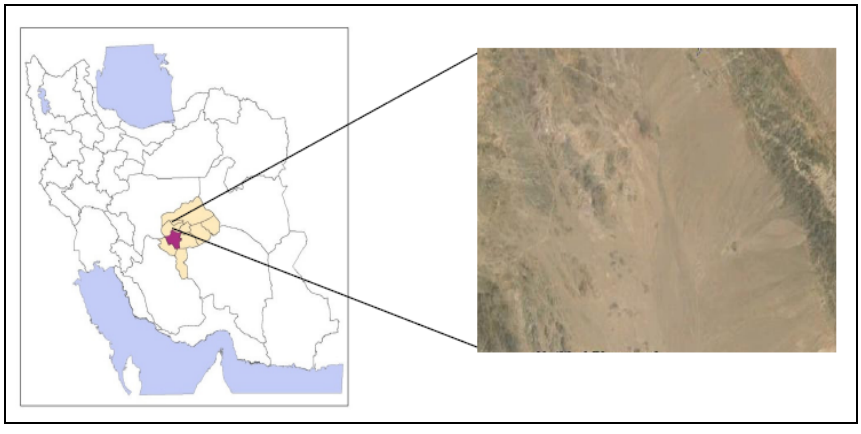

Fig 1. The study area

Plant Parameters

After finding the plant was compared with herbarium specimens to be approved. In following phenology, co-dominant plant and vegetation variation such as canopy cover, density and production were determined. For this purpose, the study area was located on three transect 50 meters apart about one kilometer from each other parallel to the line level were considered. On each transect 10 points with a distance of 5 meters were considered. Depending on the type of vegetation were used the 5 square meters plot to evaluate the characteristics of the plant. To study quantitative morphological characters, 20 morphological feature of *L. macracanthus* Fisch. & C. A. Mey. were examined that was collected from proximity at flowering stage. Selective specimens were similar in terms of age, freshness, soil and canopy cover. To register phenological stages in different periods such as the beginning stages of germination, growth, heading, flowering, seed maturity and seed loss was recorded.

Result

According ten-year meteorological average annual rainfall, temperature, number of frost days, average maximum and minimum temperature is 98.54mm, 14.56 °C, 75 days, 22.04 °C and 7.08 °C, respectively. According to the data and based on Domarten and Emberge the climate of the study area is revealed dry and warm desert.

Soil Outcome

Table 1 shows the characteristics of the soil in the habitat of *L. macracanthus* Fisch. & C. A. Mey. As can be seen, pH, Ec, OC, lime, clay, sand, silt, N, Ca, P and K is 7.8, 0.17(ds/m), 0.450, 15.401, 22.86, 59.94, 17.2, 0.411, 0.73%, 12.58 and 0.76(ppm), respectively. According to soil triangle the soil texture is sandy-clay-loam.

Phenology Outcome

As can be seen on table 3 phenology study showed that the plant starts germination and vegetarian growth in late March due to global warming and reduce moisture.

Table 1 Soil characteristics of the study area

Variation / Height	pH	Ec ds/m	OC %	Lime %	Clay %	Sand %	Silt %
2300	7.9±0.071a	0.19±0.042a	0.488±0.008a	12.760±0.309c	23.4±0.579b	59±1.235b	17.6±0.809b
2375	7.7±0.141b	0.13±0.031b	0.403±0.011c	14.595±0.012b	20.6±0.464c	68.2±0.941a	13.2±0.430c
2450	7.8±0.071ab	0.19±0.034a	0.461±0.002b	18.848±0.046a	24.6±0.316a	52.6±0.707c	20.8±0.464a
Average	7.8	0.17	0.450	15.401	22.86	59.94	17.2

Variation / Height	N %	P (ppm)	Ca %	K (ppm)
2300	0.392±0.003b	12.2±0.41b	0.68±0.08b	0.92±0.08a
2375	0.35±0.01c	11.62±0.05c	0.7±0.07ab	0.55±0.05b
2450	0.49±0.027a	13.91±0.07a	0.81±0.09a	0.82±0.1a
Average	0.411	12.58	0.73	0.76

Vegetation Variation Outcome

Table 2 reveals vegetation variation such as density, coverage, production and frequency.

Table 2 qualitative characteristics of vegetation variation

Variation / Height	Density	Average cover of a base %	Total coverage %	Production of a base (gr)	Total production (Kg/ha)	Frequency %
2300	27	3	1.88	193	9.071	11
2375	32	5	3.12	220	11.44	14
2450	25	2	1.35	177	7.965	9
Average	28	3.3	2.06	196.67	9.440	11.33

The process of growth will continue until the end of May. Then entered the stage of flowering until mid June flowering period lasts. After this stage, the plant produces seeds. Seed production started almost from mid-July until late August continues. Seeds of the plant would be enough to reach the end of August. In mid-September, the seeds can be separated around. After this stage, the plant retains its state until the end of October. From October to mid March the plant enters its dormancy. The study of phenology in three heights (according to the size distribution of plants in the area) was not significantly different.

Morphology Outcome

L. macracanthus Fisch. & C. A. Mey. is a shrub with woody base and multiple branches. Its height varied between 45-60 centimeters, that is nor cracked or covered with short fur and tumor secreted. It must be said that the stems of the plant grow without summit. The length and width of leaves of the plant differed between 15-20 and 7-10 mm, respectively. In *L. macracanthus* Fish. et Mey., different shapes of leaf margins (palmate, laciniate and entire) was seen. The entire leaf often was rectangle or semi-rectangle and had three main veins. Its venation was palmate. The palmate leaf has three lobs and palmate veins. In the laciniate leaf, the leaves had lots of branching. In the tip of all leaves, there was a spine; its length was 1-2mm. At the axle of all leaves, there were 4 thorns on the nod of stem. Its length was varied between 15-22 mm. Calyx was like a tube and had five lobes. Its dimension was 14-19 × 1-3mm. The size and shapes of these lobs were equivalent, 8-12 × 1.5-2.5 mm and their end had a spine that equals 0.5-1 mm. Corolla was light cream with red streaks that had three lobs at the top and two lobs at the bottom. Its length was 25 mm. There were 4 stems in this plant that the two upper stems were longer than the two lower ones. The style was long and had two branches in the end. The length of corolla was more than the calyx and it exits from it.

Co-dominant Plants

The plant species in the habitat can be seen in Table 4.

Table 3 Phenological stage of *L. macracanthus* Fisch. & C. A. Mey

Phonological stage	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Des	Jan	Feb
Vegetarian												
Started flowering												
Full flowering												
Seeding												
Loss of seed												
Recession and slowdown												
Dormancy												

Fig. 2 Leaf

Fig. 3 Flower

Fig. 4 Calyx

Table 4 Co-dominant plants

Row	Plant	Family	Herbarium number
1	*Acantholimon flexuosum* Boiss. & Hausskn.ex Bunge	*Plumbaginaceae*	1560
2	*Acantholimon scorpius* (Jaub. & spach) Boiss.	*Plumbaginaceae*	1432
3	*Acanthophyllum bracteatum* Boiss.	*Caryophyllaceae*	572
4	*Acanthophyllum heratense* Schiman-Czeika	*Caryophyllaceae*	2187
5	*Acanthophyllum laxiusculm* Schiman-Czeika	*Caryophyllaceae*	1233
6	*Acanthophyllum sordidum* Bunge ex Boiss.	*Caryophyllaceae*	560
7	*Achillea wilhelmsii* C. Koch	*Asteraceae*	902
8	*Artemisia aucheri* Boiss.	*Asteraceae*	1376
9	*Artemisia sieberi* Besser.	*Asteraceae*	1187
10	*Centaurea depressa* M.B.	*Asteraceae*	1674
11	*Centaurea ispahanica* Boiss	*Asteraceae*	1605
12	*Crambe orientalis* L.	*Brasicaceae*	466
13	*Crepis sancta* (L.) Babcock	*Asteraceae*	1642
14	*Descurainia Sophia* (L.) Schur.	*Brasicaceae*	793
15	*Echinops ceratophorus* Boiss.	*Asteraceae*	1810
16	*Erodium pulverulentum* (Cav.) Willd.	*Geraniaceae*	1326
17	*Eryngium bungei* Boiss.	*Apiaceae*	2319
18	*Euphorbia heteradena* Jaub. & Spach.	*Euphorbiaceae*	1267
19	*Krascheninnikovia ceratoides* Guldenst.	*Chenopodiaceae*	2781
20	*Gundelia tournefortii* L.	*Asteraceae*	1439
21	*Hertia angustifolia* (Dc.) O.Kuntze	*Asteraceae*	1026
22	*Lallemantia royleana* (Benth.) Benth.	*Lamiaceae*	1356
23	*Marrubium vulgare* L.	*Lamiaceae*	966
24	*Microcephala lamellate* (Bunge) Pobed	*Asteraceae*	1225
25	*Moriera spinosa* Boiss.	*Brasicaceae*	1901
26	*Nepeta persica* Boiss.	*Lamiaceae*	1205
27	*Noaea mucronata* (Forssk.) Aschers et Schweinf.	*Chenopodiaceae*	656
28	*Peganum harmala* L.	*Zygophyllaceae*	657
29	*Scabiosa olivier*i Coult	*Dipsaceae*	1228
30	*Stachys inflata* Benth.	*Lamiaceae*	938
31	*Stipa barbata* Desf.	*Poaceae*	956
32	*Tanacetum lingulatum* (Boiss.) Bornm.	*Asteraceae*	336
33	*Tanacetum paradoxum* Bornm.	*Asteraceae*	1779
34	*Teucrium polium* L.	*Lamiaceae*	1009
35	*Tragopogon caricifolius* Boiss. He	*Asteraceae*	1406
36	*Tragopogon jezdianus* Boiss. & Buhse	*Asteraceae*	1933
37	*Zosimia absinthifolia* (Vent.) Link	*Apiaceae*	1245

Conclusion

This study is done for the first time about *L. macracanthus* Fisch. & C. A. Mey. that provides some information about the limit, tolerance and inferences. The main ecological factors such as climate, soil and altitude range of this species is important. *L. macracanthus* Fisch. & C. A. Mey. called Lab Khargushi in Persian that is belonging to Lamiaceae family. Investigation on this specie in Yazd revealed that is growing in an area where the only habitat in Yazd is. The study area is located near Nodoushan and South West of Sadrabad. The mean annual rainfall is 98.54 mm and temperature is about 14.56 °C, with the bulk of the rains concentrated in winter. Sampling was done in a random-systematic way in these elevations: 2300, 2375, and 2450. Danin stated that the edaphic factor has a high impact on the distribution of plants in desert areas. Soil texture, pH, EC and SAR were more important factors than others among the soil properties [18]. For example, this plant was more abundant on soils with pH that varied from 7.7-7.9 and Ec ranged 0.13-0.19 ds/m. This is different with the findings reported by Kaya (2007) that *Salvia rosifolia* from this family can

tolerate soil pH 6.95-8.01. Also, the plant grows on sandy-loam texture whereas *L. macracanthus* Fisch. & C. A. Mey. matures on sandy-clay-loam texture [12]. As can be seen in terms of lime, clay, sand, silt, nitrogen, phosphorus and organic carbon is a significant difference at all levels while the other difference in varied height are the same it means according to statistical analysis the height of 2375 meters was different with other heights in Ec and potassium. In conditions of pH while the first and second height difference (2300 & 2375 m) shown statistically significant, the other height (2450m) had no significant with both of them. Study vegetation variation of the plant revealed that the best distribution is in 2375 m. Height of the plant is 45-60 cm and the length and width of leaves are 15-20 and 7-10mm, respectively. It should be said that the calyx flower corolla is 14-19 × 1-3mm that is different with the details of Talebi's result [14]. Phenology studies showed *L. macracanthus* Fisch. & C. A. Mey. started germination and vegetarian growth in late March until the end of May. After this period the plant entered the stage of flowering until mid-June. Then the plant produces seeds. Seed production started almost from mid-July to late August continues. In mid-September, the seeds can be separated from the main plants. The results of the present survey about phenology were different with research on *Dracocephalum kotschyi* Bioss. and *Thymus pubescens* Bioss. & Kotschy ex Celak in Iran [19, 20]. It is important that the new plants are reduced in the region. The plant produced large amounts of seeds in its territory, but it was not able to reproduce by seed in the habitat due to having the locally harsh environmental conditions and maybe tiny seeds or consumed by insects. Due to the exclusive nature of this plant, low dispersion and resistance to pests and diseases, more research needs to be done. According to the outcome, domestication and breeding program are urgently required for the conservation of this valuable but endangered species. Native plants that have evolved within these regions are perfectly adapted to thrive in the current climate, soil, and environmental conditions. *L. macracanthus* Fisch. & C. A. Mey. is a native plant in Nodooshan that has adapted perfectly to unfavorable environmental conditions such as periodic drought and seasonal wind. It can be effectively used for rehabilitation of desertified rangeland and improvement of degraded rangeland.

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