

THE AUTECOLOGY STUDY OF *Pervoskia abrotanoides* IN KASHAN REGION, IRAN

H. Azarnivand¹, M Jafari², M Alikhah Asl³, H Dastmalchi⁴, J Safari⁵

1. Assistant Professor, Faculty of Natural Resources, University of Tehran 2. Professor, Faculty of Natural Resources, University of Tehran

Abstract

There are many medicinal plants in Iran but there is lack of information about plants' growth condition and application. Autecology is a science which can help us to investigate seasonal and morphological changes and condition that effect on plant distribution.

*In this study, the autecology and phonological studies for *P.abrotanoides* were done. At first, vegetation habitats of this plant were chosen in different regions of Kashan and six sites were selected. The observation and recording of plant in dormancy and activity periods were done every 15 and 7 days, respectively. All samples for measurement were selected randomly.*

This research revealed the temperature, air humidity and soil condition necessary for plant growth and development. During the two years of study, no pest or diseases were seen. This can be attributed to the existence of high amounts of plant essence.

No ecological study has been done on this plant yet in Iran. Regarding to its vast distribution in Iran, other autecology studies are needed for comparing different habitats of this plant species.

Key words: *Iran, Kashan, autecology, Pervoskia abrotanoides*

Introduction

The main problem in plant study is knowledge of plant ecological condition in order to assemble favorite condition for planting. There are many medicinal plants in Iran but there is lack of enough information about plants condition and their application.

Autecology is a science which can help us to investigate seasonal and morphological changes and condition that effect on plant distribution (1).

Kashan and especially the studied area, have different ecological and climatic conditions. This area has different plant vegetation and diversity. Many of those plants have been use as drug for many years. There are many distillation equipments in this area for medical usage.

Outside of Iran, about 281 plant species were investigated from view of point of autecology and in these researches, main investigated aspects include life form, phonology, method of reproduction, growth habitat, flowering stage, altitude of habitat, land slope, germination, soil characters in site and phyto-sociology. Other studies were done by a group of scientists at western universities of USA such as California one in 1972.

Meanwhile, some studies have been done on *Atriplex*, from autecology view of point in Iran. The aim of autecology researches on *P.abrotanoides* is to find a correct methodology for phonological study and the effect of environmental condition on distribution, formation, germination and growing. This study helps to find the best time for growing, reproduction and usage.

Materials and Methods

Autecology and phonological studies for *P.abrotanoides* were done for one year. At first, vegetation habitats of this plant were chosen in different regions of Kashan and six sites were selected. The observation and recording of plant in dormancy and activity periods was done every 15 and 7 days, respectively. All samples for measurement were selected randomly.

Study area

The study area is located between 33° 30' to 34° 30' N and 51° 45' E. Its area is about 500000 hectares and located on Isfahan province.

Method of investigation

- Vegetation cover investigation

In this research, the nearest neighborhood method was used for assessment of parameters such as density, vegetation cover and plant biomass.

For this purpose, six sites were selected in which ten 50m transects were done randomly. After that, for each 10m distance, the nearest plant species was determined and the nearest neighborhood was chosen. Some parameters like height, fresh weight, large diameter, small diameter and distance between two plants were measured. Clipping method was used for estimating of plant yield.

Density: Following formula was used for assessing density:

$$D = \frac{10000}{r(d^2)}$$

D= density (plant per hectares)

D= Average of distance between two plants (m)

r= constant number (1.67)

- Percentage of vegetation cover

For this purpose, large and small diameter and plant height in addition to distances between plants were measured. the following formulas show next steps.

$$d = \frac{d_1 + d_2}{2}$$

$$r = \frac{d}{z}$$

$$s = \pi r^2 = 3.14r^2$$

d₁ and d₂= plant diameter

r= average of crown diameter

s= area of same circle for vegetation cover

$$S^{-} = \frac{S_1 + S_2 + \dots + S_n}{n}$$

$$C = D \times S$$

$$\%C = \frac{C}{10000} \times 100$$

S⁻: Mean of plant cover area

C: Allocated area for each individual plant

D: Density

%C: Percentage of plant cover, percentage of cover was determined using of 10*10m plots.

- Plants biomass

To calculate plant biomass, 30 plants were harvested and plant biomass (underground and aboveground biomass) were calculated using following formula:

$$BW = W \times D$$

BW= plant biomass per hectare

D= Density

W= mean weight of 30 plants

- Phonological investigation of *P.abrotanoides*

In order to investigate phonological stage of *P.abrotanoides*, using pervious experiences and climate condition, different vegetative and reproductive stages were photographed. In active plant growth stage, it was controlled regularly.

- Soil study and its chemical composition

In each site (6 sites), five profiles were used. Sampling was done for three different depth 0-20, 20-50 and 50-100. The statistical analyzing didn't show any difference between samples therefore for each site, the average of parameters was calculated. Penetration depth of roots and soil layers were also determined.

Analyzing of soil samples was based on common methods which are done in Soil and Water Research Institute laboratories (Journal vol. 168). For example, soil texture was assessed by hydrometric method, carbonate by titration method, percentage of gypsum by Astone and potassium by Asetat Ammonium method.

Results and Discussion

The Flora of study area is rich composed of annual and perennial plants. This area is categorized as good rangelands. Other plants include *Acanthophyllum* sp, *Artemisia aucheri*, *A. Sieberi* and *Astragalus* sp.

P.abrotanoides has long vertical roots. These roots can penetrate up to 2 meters depending on soil condition. This plant can tolerate dry condition for a long period.

The soil of habitat of this plant is mainly formed from sediments that are transported by rivers. These soils are shallow to deep. The percentage of stone in surface and deep layer is between 5-75%. Soils are deeper in vallies. The results of soil investigation are shown in tables 1 to 6.

Table 1. The analysis results of soil of Frizhend region, 2500 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	33.4	22.9	24.3	19.3	1.5	7.6	0.14	0.016	6	422	16	-
20-50	29.5	25.1	19.9	25.4	0.9	7.7	0.06	0.021	2	252	19	-
50-100	41.3	10.1	8.1	40.5	2.7	7.4	0.03	0.011	1	196	11	26.6

Table 2. The analysis results of soil of Jahagh region, 2000 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	26	26.8	25.4	21.8	1.1	7.5	0.58	0.083	7	254	26	-
20-50	20.3	30.5	25.5	23.7	1.2	7.5	0.29	0.04	5	73	52	-
50-100	38.6	26.4	6.4	28.6	1.9	7.6	0.11	0.021	5	61	30	-

Table 3. The analysis results of soil of Tatmaj and Taherabad region, 2000 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	40	23.6	22.6	13.8	0.9	7.4	0.24	0.045	4	272	11	-
20-50	32.8	21.1	36.2	9.9	0.7	7.4	0.2	0.04	0	230	19	-
50-100	39.7	16.4	14.7	29.1	0.8	7.5	0.2	0.022	1	170	14	-

Table 4. The analysis results of soil of Chimehrood region, 1850 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	32.4	38.1	23.8	5.7	2	7.3	0.86	0.118	44	205	41	2.5
20-50	31.4	34.7	25.7	8.2	1.2	7.6	0.62	0.088	6	169	43	2.2
50-100	34.3	29.8	25.2	10.7	1.4	7.6	0.26	0.025	2	76	38	4.9

Table 5. The analysis results of soil of Ghahrood region, 2350 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	29.2	37.3	23.6	9.9	1.9	7.5	0.9	0.12	22	200	20	5
20-50	39.6	8.5	11	40.8	4	7.2	0.1	0.02	2	180	16	1.3
50-100	40	8.6	11.4	40	4	7.1	1	0.02	2	180	16	1.2

Table 6. The analysis results of soil of Barzrood region, 2300 m height

Depth (cm)	Mechanical Analysis of Soil				EC	pH	% C	% Total N	P (pp m)	K (pp m)	CaCO ₃	CaSO ₄
	Sand %	Silt %	Clay %	Gravel %								
0-20	28.3	26.8	28.2	16.7	2.9	7.7	0.95	0.138	64	180	29	1.7
20-50	35.3	25.8	22.2	16.7	1.5	8	0.92	0.136	50	152	30	2.6
50-100	28.9	33.9	21.2	16	1.5	7.7	0.42	0.015	0	132	37	2.9

Phonology

Initiation of growth: This plant starts to grow from early of April and its primary leaf buds appear.

Vegetative stage: This stage starts from middle of April to last May. In this stage, new branches and buds appear.

Flowering stage: Flowers of this plant appear in middle of June to September.

Seed formation stage: Seeds of this plant are formed in fall (September) and become ripened at the end of fall (November).

Seed release stage: Some seeds are separated from plant on September and October and distributed during November.

Dormancy stage: This stage starts from end of fall to end of winter.

Plant cover

- Density

The density of plants in six sites including Jahagh, Chime, Ghahrood, Farizhend, Tatmaj, Abyaneh were counted as 3821, 265, 503, 450, 997 and 265 per hectare, respectively. Means of density in these six site is 1046 plant per hectares.

- Percentage of cover

Percentage of cover for this plant in six areas is as 1252 m²/ha (Jahagh), 1120 m²/ha (Chime), 1090 m²/ha (Ghahrud), 972 m²/ha (Farizhand), 785 m²/ha (Tatmaj) and 857 m²/ha (Abyaneh). These amounts are 12.52, 11.2, 10.9, 9.72, 7.85 and 8.5 percent of whole area. Mean of vegetation cover for six areas is 10.13%.

- Plant biomass

Biomass of this plant in six areas are 12834 (Jahagh), 2842 (Chimel), 1327 (Ghahrud), 819 (Farizhand), 1207 (Tatmaj) and 640 (Abyaneh) plant per hectare.

- Palatability of *P.abrotanoides*

This plant has too much essence and fragrant and is not suitable for grazing but similar to *Artemisia* which can be used by livestock after raining.

Conclusion

The results showed that the density of this plant was 1046 per hectare, mean vegetation cover was 10.13% and mean biomass was 3278 kg/ha.

The soils of this plant habitat have high level lime varying between 11 to 52%. The soil EC level was low to moderate level from 0.7 to 4 dsm/m. The best condition for growth occurs in low EC level. PH was varied 7.2 to 8. Organic carbon was low in soil and decreased in deep layer. This level varied 0.03% to 0.95%. The phosphor level in some areas was low in surface and very low in sub-surface layers and in some parts, it was higher in surface and moderate in sub-surface ones. The potassium level was very high in soil surface layer and medium in sub-surface one. Regarding to nitrogen, the studied soils were very poor. Soil texture was shallow to very shallow having stones and marvels.

Precipitation rate is between 140 to 255mm and altitude is varied between 1500 to 2700m. This plant is hygrophyte plant. It mostly grows around seasonal rivers, farms and gardens. It can be duplicated by reproductive (seed) or vegetative (cutting) methods. This plant has vertical root system and these roots can penetrate to 1m in soil layer.

This research revealed the temperature, air humidity and soil condition necessary for plant growth and development (Table 7).

Based on this information we can use this plant without any occurring damages to its reproduction. These results showed that in spite of its high essence, this plant can be used by live stock especially for winter and spring.

Table 7: Temperature, air humidity and soil conditions necessary for different phonological stages of *Perovskia abrotanoides*

Growth stages	Ecological parameters							
	Air max temp. (C)	Air min Temp. (C)	Soil max temp. (C)	Soil min Temp. (C)	Air max humidity (%)	Air min humidity (%)	Soil max humidity (%)	Soil min humidity (%)
Initiation	15	0	12	2	97	18	20	8
Vegetative growth	28	4	33.5	5.5	90	15	25	7

Flowering	39	8	41.5	10.5	85	9	12	7
Seed formation	30	2	35	7	95	13	11	3
Seed release	28.5	1.5	25	7	97	15	12	4.5
dormancy	18	-5	28.5	4	96	8	15.5	7.5

This plant has also profound branches and durable beautiful flowers and therefore, it can be used in parks and green spaces. During the two years of study, no pest or diseases were seen. This can be attributed to the existence of high amounts of essence.

No ecological study has been done on this plant yet in Iran. Regarding to its vast distribution in Iran, other autecology studies are needed for comparing different habitats of this plant species.

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