Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 12, p. 179-185, 2013
http://www.innspub.net

RESEARCH PAPER **OPEN ACCESS**

Effect of physiographic factors on the distribution of wild Almond (Amygdalusorientalis Mill) in West of Iran

Mousa Rasouli[1*], Mohsen Javanmiri Pour[2], Navid Zamani[3]

[1]*Horticulture Department, Faculty of Agriculture, Malayer University, Malayer, Iran*

[2]*Natural Resource Faculty, University of Tehran,Karaj, Iran*

[3]*College of Natural Resources , Behbahan, Khuzestan, P.O. Box 63615-151, Iran*

Article published on December 20, 2013

Key words: Effect of physiographic factors on the distribution of wild Almond (Amygdalusorientalis Mill) in west of Iran.

Abstract

Habitat needs and requirement of important species in terms of distribution is necessary for natural resources management. Amygdalusorientalisis one of the forest species in west of Iran for food, industries and environmental protection in different climatic conditions.In this research, the effect of physiographic factors such as land form, aspect, altitude and slope on qualitative and quantitative characteristics as height, crown diameter, canopy cover, tree density, regeneration and vitality percent were studied. The results of this study showed: maximum height and crown diameter was observed in northern and eastern aspects. The maximum canopy cover and regeneration was seen in northern aspect, valleys and in altitudes 1700-1900 meters. The maximum tree number was observed in southern aspect, amplitude and valley land forms, in altitudes of 1700-1900 and 1900-2100 meters and in slops of 0-30 and 30-60%.The percentage of almond canopy coverage was 16%. The average percentage of herbaceous coverage was 8%. Almond trees of diameter per hectareat breast height >20 cm numbered 2while average number of almond trees were 11 per hectare. Almondseedlingsper hectare averaged 5. The numbers of other species per hectare were 4trees. Almondhasimportant socio-economic, ecologic and conservation roles in semi-arid areas, therefore it is essential to protect and restore Cheleh forests through participation by government and local people.

***Corresponding Author:** Mousa Rasouli ✉ m.rasouli@malayeru.ac.ir

Introduction

Knowledge about the possible ecological forest habitat and their classification, planning and how to do the appropriate actions regarding optimal management of these rare resources makes them smooth.

Classification of habitat power based on recognition of environmental and ecological a characteristic of habitat is performed (Jozi*et al.*, 2011). The Zagros forest ecosystem is composed of a mixture of deciduous trees and tropical evergreen trees or shrubs. It is important for forest managers to quantify and qualify of forest vegetation (Bordbar*et al.*, 2001).

Semi-arid forests at Zagros play a critical role in regulating climate, conserving soil, affecting vegetation cover, and other ecological functions in west Iran (Mohadjer, 2011). Rainfall fluctuates from 600 mm in the north to 300 mm in the southwest of this region. The climate is semi-arid Mediterranean with cold winters (Mohadjer, 2011). Tree species in this forest include Persian oak (*Quercusbrantii*), Lusitanian oak (*Quercusinfectoria*), Lebanon oak (*Quercuslibani*), Maple (*Acer cappadocicum*), pistachio (*Pistaciaatlantica*), Ash (*Fraxinusrotundifolia*), Wild pear (*Pyrusglabra*), Hawthorn (*Crataegusaronia*), Purple (*Cercisgriffithii*) and various Almonds (*amygdalus*sp) (Mohadjer, 2011).

Wild populations of almond species representing a wide range of morphological and geographical forms have evolved throughout south westand central Asia from Turkey and Syria into the CaucasusMountains, through Iran, into the deserts of Tian-Shanand Hindu Kush Mountains of Tajikistan, Uzbekistan and Afghanistan (Ak*et al.*, 2001; Baninasab&Rahemi, 2006, Sorkhe*et al.*, 2009, Zeinalabedini*et al.*, 2007). Over 30 species have been described by botanists may represent subspecies orecotypes within a broad collection of genotypes which are adapted to a range of ecological niches in the deserts,steppes and mountains of central Asia (Kester*et al.*, 1996,Zeinalabedini *et al.*, 2007).At the ecological level they constitute an efficient tool against soil erosion. On the other hand, the direct utilization of these related almondspecies as a rootstock for peach and almond, mainly under non-irrigated native conditions (Zeinalabedini*et al.*, 2007).

Wild almondspecies commonly grow in areas between 28˚ and38 ˚ N and 41 ˚ and 54 ˚ E and from 1,100 m to2,700 m altitudes (Sorkhe*et al.*, 2009, Mohadjer, 2011). Growing tree species in addition to genetic characteristics depends on environmental factors and habitat such as soil, climate and topography. Therefore in botanical survey of any species should be noted its environmental needs. Vegetation is exploited by continually renewable and is destroyed due to by humans and no specific planning. Therefore, it is necessary to prevent the destruction process having clear plan in natural resource management and planning appropriate for each plant species. Alvaninejad (2000) has reported the most important factor in the geographical distribution of *A. scoparia*in two areas of Fars Province. This species mostly exist in south, east and southeast directions and its highest distribution exist in elevation range of 1600 to 2150 m.

IrannejadParizi(1995) reported distribution the*A. eleagnifolia,A. scoparia* and *A. eburnea* species in ecological studies in Kerman province. *A.scoparia* species distribution is the most extensive than other species and exists in most of the mountains and hills with high density. Arekhi (2010) also reported that is effective elevation on *A.orientalis* distribution.

The research was done in southwestern region of Sicily; Italy indicated that *A.webbi* grows in calcareous until volcanic soils (Alberghina, 1978).
Almond (*Amygdalus*) genus one of the oldest commercial nut crops of the world. From the Middle and west Asia, it has diffused to other regions and continents (Ladizinsky, 1999).

Amygdalusorientalis is spiny shrub that its young branches has white fur felt and year ago branches is gray. Leaves are turning oval, turn spear to elongated ellipse. Petioles are short, less than 5 mm or do not

exist. Below and above the leaf is white felt. The flowers have Short pike and hairiness, pinkish and cylindrical hypanthium. Fruit is oval covered with wool. Nut has shallow grooves and unclear or rather smooth (Sabeti, 2006).

The leaves of *A.orientalis*are hairy and gray coloured and similar to elaeagnus (*Elaeagnusorientalis*). Fruit yield is very good and the nuts are light brown. Fruits have been eaten as greenalmond in spring. Taste of fruits is light bitter (Ak*et al.*, 2001).

Our main objective in this research was to compile data on required ecological conditions for establishing *A.orientalis* species in Cheleh region.

Materials and methods

Our study area was located in northwestern Zagros in Kermanshah Province in west Iran, from 33°57′12″ to 34°6′30″ longitude and 46°01′22″ to 46°18′14″ latitude (Fig. 1).Cheleh forest region has approximately 20000 hectarearea.Average annual rainfall in the Cheleh highlands is 516.7 mm and the climate is Mediterranean. Soils are generally silty-clays to clays. In Cheleh forest, there are three important forest types, including *Quercuspersica* (<1500m, a.s.l.), *Q. persica–P.atlantica* (1500–2170 m), and *Amygdalusorientalis* (>2170 m), (Ghazanfari*et al.*, 2004).

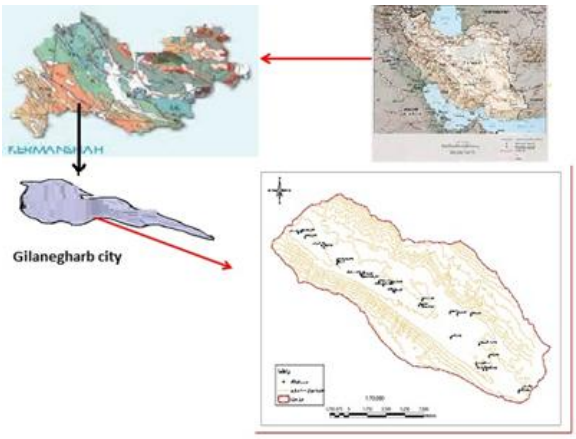

Fig. 1. Location of study area.

We surveyed almond species using a systematic inventory method. Dimensions of fixed sampling plots were 400 × 500 m. each circular plot had 1000 m² area. Quantitative and qualitative sampling was conducted at 70 plots. Seedlings were counted in 60 subplots that each of them has covering 100 m²area, according to sparseness forest (Zobeiri, 2009; ZahediPour, 2007). We recorded total number of almond trees, number of almond species by slope class, number of almond species by height class, canopy coverage percentage, percent herbaceous cover, total almond trunk diameter for trees >20 cm in height, number of almond seedlings and number of other species.

We recorded topographic data, including slope steepness, slope aspect, and elevation at sampling sites. Five slope classes were defined as 0–30%, 30%-60% and >60%.

We also recorded quantitative and qualitative indexes of Cheleh region including total number of trees per hectare, height of trees, minimum and maximum canopy coverage diameter, height of stem, and diameter at breath height.

Results

The frequency of almond tree ranged from a high of 41.65% on northerly aspects to 9.6% onwest aspects (Fig. 2). Maximum (45%) and minimum (24%) number of wild almond trees were recorded on slopes of>60% and respectively 0%–30% (Fig. 3). Maximum (26.3%) and minimum (7%) relative frequencies of almond trees were at elevations of 1700–1800 and 2200–2300 mm, respectively (Fig. 4). Percent almond canopy coverage was 16%, mean percent herbaceous cover was 8% and almond trees with DBH >20 cm was 11 per hectare. Average number of almond species was 2 per hectare, almond seedlings numbered 5 per hectare and number of other species was 4 per hectare (Table 1). There was a significant effect of elevationslope, aspect and land form on almond canopy cover, herbage cover, frequency of almond trees and number of almond seedlings (regeneration), (Tables 2, 3).

Table 1. Ecological characteristics of almond species in plots.

Row	Canopy cover (%)	Herbage cover (%)	Almond frequency	No. of almond trees (>20 cm DBH)	No. of almond seedlings	No. of other species
Means in ha.	16	8	11	2	5	4

Table 2. Analysis of variance of soil factors on the quantitative characteristics of A. orientalis.

		Direction	A.S.L (m)	Slop (%)	Land form
Height of tree	F	2.77*	.21 ns	1.47ns	.24ns
	Sig.	.016	.57	.162	.5072
Diameter of cover	F	3.04**	1.53ns	1.56ns	.03ns
	Sig.	.009	.251	.154	.857
Canopy cover%	F	3.12*	3.15*	.46ns	4.63**
	Sig.	.020	.02	.523	.004
Frequency of tree	X^2	4.18ns	8.56**	9.28*	11.91**
	P	.17	.007	.013	.001
Regeneration	X^2	6.82*	6.2*	1.56ns	11.02**
	P	.037	.015	.51	.001
Herbage cover	X^2	4.21ns	7.46**	7.16*	9.01**
	P	.19	.003	.001	.001

**: Significant at 99% level, *: Significant at 95% level, ns: no significant difference

Number of plots based on the land form factor: valley: 20 plot, range: 25 plot and ridge: 25 plot.

Number of plots based on the direction factor: north: 17 plot, south: 18 plot, east: 15 plot and west: 20 plot.

Number of plots based on the altitude factor: 1500-1700m: 17 plot, 1700-1900 m: 18 plot, 1900-2100 m:17plotand 2100-2300: 18 plot.

Number of plots based on the slope factor: 0-30%: 20 plot, 30-60%:20 plot and > 60%:30 plot.

Table 3. Analysis of variance of soil factors on the quantitative characteristics of A.orientalis.

		Direction	A.S.L (m)	Slop (%)	Land form
Height of tree	F	2.76*	.28 ns	1.43ns	.37ns
	Sig.	.011	.57	.162	.5072
Diameter of cover	F	3.17**	1.01ns	1.18ns	.02ns
	Sig.	.007	.251	.153	.857
Canopy cover%	F	2.11*	3.13*	.46ns	4.63**
	Sig.	.019	.01	.552	.002
Frequency of tree	X^2	4.18ns	8.56**	8.17*	11.05**
	P	.12	.005	.018	.001
Regeneration	X^2	5.82*	5.3*	1.23ns	10.06**
	P	.037	.022	.96	.005
Herbage cover	X^2	4.20ns	6.51**	6.74*	9.07**
	P	.09	.005	.011	.001

**: Significant at 99% level, *: Significant at 95% level, ns: no significant difference

Number of plots based on the land form factor: valley: 20 plot, range: 25 plot and ridge: 25 plot.

Number of plots based on the direction factor: north: 17 plot, south: 18 plot, east: 15 plot and west: 20 plot.
Number of plots based on the altitude factor: 1500-1700 m: 17 plot, 1700-1900 m: 18 plot, 1900-2100 m:17 plot and 2100-2300: 18 plot.
Number of plots based on the slope factor: 0-30%: 20 plot, 30-60%:20 plot and > 60%:30 plot.

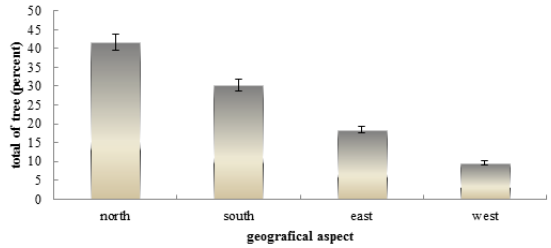

Fig. 2 Distribution of Amygdalusorientalis in the geographic direction

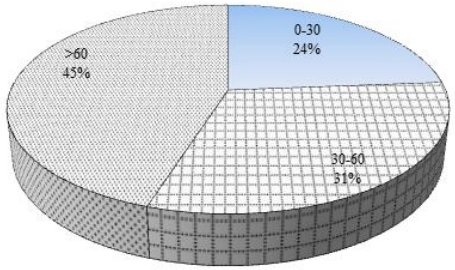

Fig. 3. Frequency of Amygdalusorientalis by slope steepness.

Discussion

Form land (range, valley and ridge) plays an important role in spread and growth of trees. In this study, increasing the frequency of trees and its freshness in the valleys and slopes, higher canopy cover percentage and regeneration In the valleys the results indicate the suitability of these areas for growth of *A.orientalis*. Cover canopy area is increased due to light soil of valleys and ridges, moisture and maintains and lower the amount of light hitting to the trees. Also abundance of canopy cover in the valleys is possible to show compensation mechanism for trees to produce suitable photosynthesis in direction of shadow, so there is maximum shade during the day in north directions and valleys (Goodarzi*et al.*, 2012). For this reason, further spread trees crown and leaves for absorption and access to light (Hardtle et al., 2003).

Significant decreased of tree frequencies,canopy cover percentage and regeneration on the edges is due to severe blowing of wind, overhanging rocks, most drainage and depths of soil(Hokkanen, 2006).

One of the most important factors in the establishment of plant species is geographical directions. North and east directions provide favorable conditions in case of moisture. Western and southern directions provide favorable conditions in

case of light. Wild almond tree species mainly exist in the Cheleh habitat. Trees in this habitat were coppiced by livestock grazing. The highest relative frequency of whole almond trees on north-facing slopes was possibly due to higher soil moisture there. The 25% of almond trees have been established in the South. Thus we can say that the main factor of establishing almond tree is soil moistureand moisture in the air. Almondspecies in the southern directions are more than other species because almond is a typical plant of sunny habitats. It is justified that light and humidity for the almondestablishment are more favorable factors in the south directions (Gourine*et al.*, 2010).Generally, northern direction is more humid than the southern in the Northern Hemisphere (Walter, 1983). Altitude is also another important factor in the development or expansion of plants. Increase or decrease with altitude change habitat conditions, especially climate. Plants according to their ecological requirements are located on a height range.

Natural regeneration of forest tree species is considered a vital process to maintain populations and species richness. Non-biotic factors (light, water, and soil nutrients) and biotic factors (competition and grazing) affect natural regeneration of tree species.

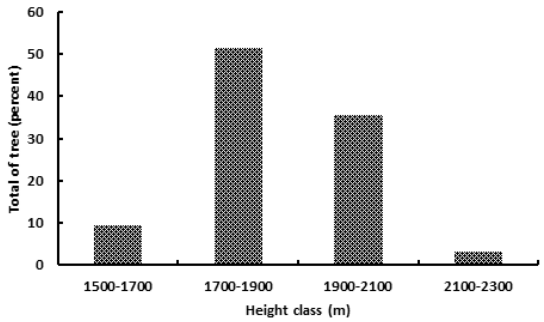

Fig. 4 Frequency Amygdalusorientalis species in elevation class (a.s.l.)

Although almondare placed lower than vegetative strip Quercussp in Zagros and Iran – Turanianaltitude profile but there is not exist this general pattern in Cheleh region. The main reason is due to the lower altitude and most average annual rainfall in this region than other areas of the central plateau of Iran.Wild almondlocated in the higher elevations than Quercussp in Cheleh region because in these elevations the climate is much harder.

Almondcanopy coverage was approximately 16% in Cheleh forests. Traditionally the study area was grazed by livestock in the spring and valuable almondtrees were damaged by grazing each year.

Herbaceous plants on the forest floor are typically found under gaps in the canopy where light intensity is high (Mohadjer, 2011). Zagros forests are generally thin with gaps in the canopy. The understory consisted of grasses and flowering plants due to availability of light and space. Growth of the understory was most lush in the spring. In this research, herbaceous coverage percentage was 8%, because of synchronization of data collection (In summer) with the annual gum production season. Total numbers of almond trees is reduced in Cheleh forests because local people and nomadic tribes harvest almond trees to exploit their economic value.

These wildalmondspecies play a socio-economic and ecological role. In fact, they have been used for different purpose by native peopleincluding direct consumption, grazing of livestock, or oilextraction (Zeinalabedini*et al*., 2007).

\Natural regeneration of forest tree species is considered a vital process to maintain populations and species richness. Non-biotic factors (light, water, and soil nutrients) and biotic factors (competition and grazing) affect natural regeneration of tree species. Cheleh is semiarid and has suitable light and soil moisture conditions for growth of almond trees. However, excessive livestock grazing in Cheleh, has caused severe soil erosion. The bedrock emerged in many areas, causing increased flood erosion risk.

References

Ak BE, Acar I, Sakar E. 2001. An investigation on the determination of pomological and morphological traits of wild almond grown at Sanliurfaprovince **56,** 139-144.

Alberghina O. 1978. The wild Almond,*Amygdaluswebii*, of south west Sicily, Tecnicaagricola **30,** 385-393.

Alvaninejad S. 2000. Effective Factors the distribution of *Amygdalusscoparia*Spach. In two different areas of Fars province, MSc Thesis, Faculty of Natural Resources, TarbiatModarres University, 144 p.

Arekhi S, HeydariM,PourbabaeiH. 2010. Vegetation-environmental relationships and ecological species groups of the Ilam oak forest landscape, Iran, Caspian Journal of Environmental Sciences **8,** 115-125.

Baninasab B, RahemiH. 2006.Evaluation of tree wild species of almond on the basis of their morphological characters, Journal of Central European Agriculture **7,** 620-626.

GoodarziGh,Sagheb-TalebiKh,Ahmadloo.2012. The study of effective factors on Almond (AmygdalusscopariaSpach.) distribation in Markazi province. Iranian Journal of Forest 4, 209-220.

Gourine N, Yousfi M, Bombarda I, Nadjemi B, Stocker P, Gaydou EM. 2010. Antioxidant activities and chemical composition of essential oil of *Pistaciaatlantica* from Algeri. Industrial Crops and Products **31,** 203–208.

Hardtle W, OheimbG,WestphalCh. 2003. The effects of light and soil conditions on the species richness of the ground vegetation of deciduous forests in northern Germany (Schleswig-Holstein), *Forest Ecology and Management* 182, 327-338.

Hokkanen P. 2006. Environmental patterns and gradients in the vascular plants and bryophytes ofeasternFennoscandian herb rich forests. Forest Ecology and Management **229,** 73 - 87.

IrannejadPariziM. 1995. Ecological Investigation natural communitiesalmonds species in Kerman province.MSc Thesis, Faculty of Natural Resources, TarbiatModarres University, p. 145.

Ghazanfari M, Namiranian H, Sobhani H, Mohadjer RM. 2004. Traditional forest management and its application to encourage public participation for sustainable forest management in the northernZagros Mountains of Kurdistan Province, Iran. Journalof Forests Research **19,** 65–71.

Jozi A,MoradiMajd N,Rezaian S,JesmaniTafti N. 2011. Evaluation of Ecological Capability of AmygdalusScoparia Habitat Condition in BolhasanDezfol of Iran Zone by Using of MCDA Method. 2nd International Conference on Environmental Engineering and Applications, Singapore **(17),** 164-167.

Kester DE, Gradiziel TM, Almonds, in: Janick J, Moore JN. (Eds.), Fruit Breeding. Vol. III. Nuts, John Wiley and Sons, New York. 1996, pp. 1-97.

Ladizinsky G. 1999. On the origin of almond Genetic Resources and Crop Evolution, 46: 143-147.

MarvieMohadjer MR. 2011. Silviculture,Tehran University Publications, p. 418.

Sabeti H. 2006. Forests, trees and shrubs of Iran, Yazd University Publication, p. 886. (In Persian)SorkhehK,ShiranB,RouhiV,AsadiE,Jahanbazi H,MoradiH,GradzielT,Martı´nez-Go´mez P. 2009. Phenotypic diversity within native Iranian almond (Almond spp.) species and their breeding potential. Genet Resour Crop Evol 56, 947–961.

Walter H. 1983. Vegetation of the Earth and EcologicalSystems of the Geo-biosphere.Springern-Verlag, Berlin Heidelberg, p. 318.

YücedağC,Gültekin C. 2011. Effects of cold stratification and sowing time on germination of almond (Amygdaluscommunis L.) and wild almond (Amygdalusorientalis L.) seeds. African Journal of Agricultural Research **6,** 3522-3525.

ZahediPour H, Fattah M, MirdavodyAkhavan HR. 2007. Study distribution and Features quantitative and qualitative habitats wild pistachio on Markazi Province mountain, Tafresh. Iran Journal of Biology Geology **20,** 16–27.