Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 11, p. 154-160, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Studying relationship between soil and increment of *Cupresuss sempervirens* L.*var horizontalis* plantation at geographical directions in behshahr (north) of Iran

Hassan Kalantari*, Asghar Fallah, Seyyed Mohamad Hojati

Department of Forestry, Sari University of Agricultural Sciences and Natural Resources, Sari, Iran

Article published on November 22, 2013

Key words: *Cupresuss sempervirens,* Increment, Geographical directions, Moisture, Nitrogen, Fine roots.

Abstract

The 40 ha -pure stand of *Cupresuss sempervirens* with 100*75 m inventory network using random-systematic sampling was selected. 50 sample plots with area of 200m² for this study were measured in geographical directions. Diameter of all trees and height of main four trees were recorded in each sample plot and also statistical analysis was done using SPSS and Pc Ordination. Increment in west, northeast, northwest and southwest was recorded that the maximum increment of diameter; basal area, volume and height were found in west direction. Soil analysis showed bulk density, moisture, nitrogen and calcium of litter fall, soil calcium, acidity and fine roots in different layers of soil are the main characteristics that have high correlation with increment in geographical directions in this region.

***Corresponding Author:** Hassan Kalantari ✉

Introduction

About 35% of global wood needs are provided by afforestation but these supplies just cover about 3% of the global forest area and it is expected that afforestation will meet 46% of wood demand by 2040(Booth *et al.*,2002). Increasing need for wood and timber resources and also reducing wood resources causing create the willingness for planting by fast growth species such as most conifers (Swamy *et al.*, 2006). Today, plantation is the main instrument for improving wood production and keeping ecological balance in developing countries (Sidhu and Dhillon, 2007). Among all conifers, *Cupressus sempervirens* is the only spices that have a high potential for producing wood resources (Mosavi *et al.*, 1995; Mosavi, 1997). This species can appear in adverse condition of environment and soil so that it has a high potential for soil stabilization and adjust adverse environmental conditions (Mohammadpour, 1381). Rezaie (1992) showed that the mean increment of *Cupressus sempervirens* in Chalos and Gorgan, the cities in north of Iran, were 1.3 and 2 mm/year, respectively. Jozi (2000) indicated 57.5% of *Cupressus sempervirens* reserve in Chalos is natural and 42.5% is planted species with conifers such as *pinus eldarica* and *Cupressus sempervirens* and also the maximum trees of *Cupressus sempervirens* have appeared in the slope class 50-75% and the minimum of them have appeared in the class of more than 75% and also most trees have become in north zone. Abdollazadeh *et al.* (2003) concluded slope had a significant effect on diameter at breast height (DBH) but both slope and DBH had significant effect just on height. The best condition of DBH and height of *pinus eldarica* using linear regression based on Stepwise were observed in southwest direction with height>900m above sea level and slope<25% (Kialashki, 2006). Najafi (2008) concluded that site requirements of *Cupressus sempervirens* in two sites in Fars province, center of Iran, for diameter at breast height and height of tree were 97cm and 14.08m for one site and for another were 79cm and 9.57m, respectively and this species usually observed in north and northeast with 30-60% of slope on calcareous and shallow soil. Dowling *et al.*, 1986 showed increasing K, P, Ca, N led to enlarge canopy of *Acasia harphophylla* and also it is concluded that available nitrogen is the one of the main strict factors in *Acasia harphophylla* site (Doe scher *et al.,* 1990). Chandler (1982) indicated that *pinus eldarica* depended on soil, slope and climate and also Boisseau (1996) showed temperature, precipitation and soil depth are the significant factors on growth of *pinus eldarica*.

There was found a desire relationship between fine root biomass and forest output in cold moderate regions and there were R^2= 0.64 and R^2= 0.57 for fine root less than 2 mm and 5 mm, respectively (Wenjun *et al.*, 2004). Successful management of forest can be obtained by precise information of volume, increment and the number of trees (Namiranian, 1991). *Cupressus sempervirens* is one of the indigenous and valuable species in Iran and it has planted in various areas of this country. Therefore considering the increment of this species is essential in Iran. The goal of this research is the study of *Cupressus sempervirens* increment in geographical directions in Behshahr of Iran.

Material and methods

Site description

Studied area located in east of Behshahr city and ranges from 36 ° 36 ' to 36 ° 45 ' of latitude and 53 ° 35 ' to 53 ° 38 ' of longitude (figure1). This plantation derives of forestry plan and forest park of Abas-Abad that covers 40 ha. The age, early distance among trees and height at above sea level of this case study were 26 years, 2*2m and 450 meter, respectively. The meteorological data taken from the nearest meteorological station to the case study indicates that this area has semi-humid climate according to Domarton method of climate classification. The maximum and minimum rainfall is in autumn and summer, respectively. Summer is driest season regarding to climate classifications but it is not ecologically and biologically dry so that it

can't usually damage forest species (forestry plan of Abas-Abad, 1999).

Method

The case study was observed at the first step and then the area of each sample plot (200 m^2) was determined regarding to economic and temporal limitations using 10-15 trees in each sample plot (Zobairi, 1994). Random-systematic method of inventory was used regarding to the potential of the area (Zobairi, 1994). i.e., the first point randomly was found on the map then network with dimension of 100*75 m was applied. According to distance among trees (2*2m), 50 circular sample plots were recorded in this study. Diameter of trees were measured by caliper and also height of four trees, two trees with the most diameter and two centrist trees to center of sample plot, were recorded in each sample plot. Some physical factors including density and moisture and chemical factors including carbon in mineral and organic layers, nitrogen, alkaline cations (Ca, Mg and K) in organic layers, alkaline cations in mineral layers in depth of 0-5cm, 5-10cm and 10-15 cm were studied. The effects of *Cupressus sempervirens* on soil and fine root biomass were evaluated in this research.

Results

Statistical parameters of measured factors have been shown in table1.the maximum increment of diameter; basal area, volume and height were found in directions of west, west, northeast and southwest, respectively. Comparing increment in different directions was done using LSD for mean comparison after diameter, height, basal area and volume increment had been recorded in different direction. There were found significant differences of diameter increment between northwest and northeast, northeast and southwest and also northwest and west (table2). There were found significant differences of height increment between northwest and northeast, northwest and west and also this value was found for basal area and volume increment between northwest and northeast, southwest and northeast ($P<0.05$).

Table 1. The increment of Cupresuss sempervirens in geographical directions in Abas-Abad.

Increment	northwest	west	Northeast	Southwest
Mean diameter increment (cm)	481.0	53.0	479.0	5.0
Mean height increment (m)	49.0	53.0	52.0	53.0
Mean basal area increment (m^2/ha)	76.0	87.0	82.0	81.0
Mean volume increment (silve/ha)	88.3	4	6.3	89.3

The results of PCA (Principle Component Analysis)

The mean of all variables in all geographical directions were recorded for analyzing soil and environmental variables and then PCA (i.e. analyzing principle components) was used for obtaining main environmental variables that have significant effects on increment in geographical directions. Environmental variables and their abbreviations used in PCA have been shown in table 2.

Correlation chart of increments in directions with respect to first and second components

Distribution and spatial situation of increments at geographical directions in planted stand of *Cupressus sempervirens* in Abas-Abad respecting first and second components in PCA have been illustrated in figure1. According to second axis, the most correlation belongs to diameter, height, basal area and volume respectively, that shows the characteristics of second axis. Basal area and volume have high correlation in upside and diameter and height in downside of second axis and also there were correlations between northwest and southwest with first axis in right-hand side, northeast with first

axis in left-hand side and west direction with second axis in downside.

The chart of environmental variables with respect to first and second components

Distribution and spatial situation of environmental variables in planted stand of *Cupressus sempervirens* in Abas-Abad respecting first and second components in PCA have been illustrated in figure 2. pHa, Cab and Slope made a group in right-hand side of axis and have most correlation around first axis and Mc, OM, Ma WBa made an independent group in left-hand side of first axis and they have shown soil characteristics. NP, WBc and pHKb created an independent group in upside of first axis while FRa, FRc, CaP, FRb made an independent group in downside of second axis.

Table 2. Environmental and incremental factors and their abbreviations used in PCA.

Row	Soil variables in layers of a, b and c	Unit	Considerations
1	WBa, WBb, WBc	-	Bulk density in layers of 0-5cm, 5-10cm and 10-15cm
2	pHa, pHb, pHc	-	Acidity in layers of 0-5cm, 5-10cm and 10-15cm
3	pHKa,pHKb, pHKc	-	pHkcl in layers of 0-5cm, 5-10cm and 10-15cm
4	Na, Nb, Nc	%	N in layers of 0-5cm, 5-10cm and 10-15cm
5	OMa, OMb, OMc	%	Organic material in layers of 0-5cm, 5-10cm and 10-15cm
6	OCa, OCb, OCc	%	Organic carbon in layers of 0-5cm, 5-10cm and 10-15cm
7	Ka, Kb, Kc	-	K in layers of 0-5cm, 5-10cm and 10-15cm
8	Mga, Mgb, Mgc	-	Mg in layers of 0-5cm, 5-10cm and 10-15cm
9	Caa, Cab, Cac	-	Ca in layers of 0-5cm, 5-10cm and 10-15cm
10	Ma, Mb, Mc	%	Moisture in layers of 0-5cm, 5-10cm and 10-15cm
11	FRa, FRb, FRc	-	Fine roots in layers of 0-5cm, 5-10cm and 10-15cm
12	NP	%	N of litter fall
13	KP	%	K of litter fall
14	CaP	%	Ca of litter fall
15	MgP	%	Mg of litter fall
16	CP	%	C of litter fall
17	Slope		Slope
18	Diameter		Diameter
19	Height		Height
20	Basal area		Basal area
21	Volume		Volume

Table 3. The results of PCA for environmental factors in geographical directions in Abas-abad of Behshahr.

Row	Principle components	First principle component	second principle component	Third principle component	Row	Principle components	First principle component	second principle component	Third principle component
1	Bulk density 1	144.0	105.0	249.0	21	K 3	07.-0	12.0	30.-0
2	Bulk density 2	22.-0	013.0	004.0	22	Mg 1	17.-0	16.0	127.0
3	Bulk density 33	14.-0	21.0	04.-0	23	Mg 2	20.-0	103.0	093.0
4	$pHh_2o,1$	206.0	113.0	04.-0	24	Mg 3	22.-0	013.0	040.0
5	$pHh_2o,2$	173.0	159.0	11.-0	25	Ca 1	19.-0	09.-0	145.0
6	$pHh_2o,3$	191.0	124.0	11.-0	26	Ca 2	212.0	09.-0	02.-0
7	pHkc,1	138.0	189.0	15.-0	27	Ca 3	134.0	21.-0	10.-0
8	pHkcl,2	126.0	229.0	08.-0	28	Moisture 1	20.-0	09.0	08.-0
9	pHkcl,3	184.0	154.0	08.-0	29	Moisture 2	19.-0	138.0	001.0
10	N 1	20.-0	04.-0	13.-0	30	Moisture 3	20.-0	127.0	05.-0
11	N 2	16.-0	19.-0	04.-0	31	Fine root 1	113.0	21.-0	16.0
12	N 3	013.0	19.-0	27.-0	32	Fine root 2	059.0	26.-0	08.-0
13	Organic material 1	20.-0	09.0	12.-0	33	Fine root 3	097.0	24.-0	12.-0
14	Organic material 2	16.-0	19.-0	04.-0	34	N of litterfall	16.-0	200.0	013.0
15	Organic material 3	01.0	19.-0	27.-0	35	K of litterfall	082.0	030.0	-0/34
16	C 1	21.-0	03.-0	13.-0	36	Ca of litterfall	027.0	25.-0	162.0
17	C 2	16.-0	19.-0	04.-0	37	Mg of litterfall	190.0	09.-0	15.-0
18	C 3	01.-0	19.-0	27.-0	38	C of litterfall	14.-0	16.-0	18.-0
19	K 1	03.-0	18.0	27.-0	39	slope	222.0	009.0	064.0
20	K 2	04.-0	16.0	29.-0	40				

1, 2 and 3 cods belong to cited variables show first, second and third layers of soil samples. Respectively.

Discussion

The results showed the effects of environmental factors on increment characteristics of *Cupressus sempervirens* in Abas-Abad were significant and this value was more significant in west direction. This value due to low slope of west direction than other directions that have poor fertility and shallow soil (Borhani, 2004; Sabeti, 1976, Mosadeg, 1996). The results of this research is similar to that obtained by Chandler, 1982 on *Pinus eldarica* that conclude this species had a good increment on slope of 5-15% than 40-60% and also our results like that got about *pinus pinea* by Boisseau (1996) in France as well as Randall (1998) about *pinus halepensis* in America. Kialashki (2006) conclude that the best condition of diameter and basal area of *pinus eldarica* would get in southwest with slope<25%. Joazi (2000) showed that most trees of *Cupressus sempervirens* were located in middle class of slope. These results can prove the results obtained in this research by similar species.

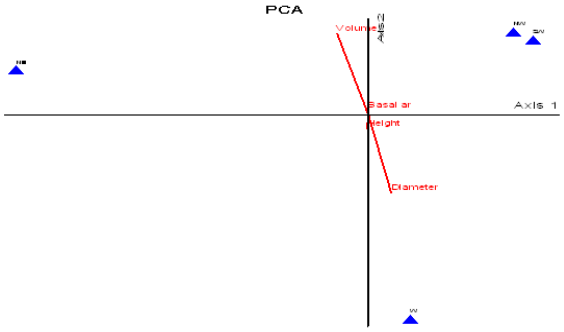

Fig. 1. Spatial situation of geographical directions in PCA analysis (first factor: eigenvalue-19, variance associate with agent-50, cumulative variance-50; second factor: eigenvalue-12, variance associate with agent-31, cumulative variance-81).

Physical and chemical characteristics of soil

Recognizing soil features is one of the good factors for managing forest that covers most components in silviculture such as species selection, site productivity, increment and viability (Aliarab *et al.*, 2005; Habibikaseb, 1985; Mohammadisamani, 2005).Therefore, interaction between forest species and soil had been studied in order to maintain and develop forest resources. For instance there have been done many studies in Europe about the effects of physicochemical features of in all directions.

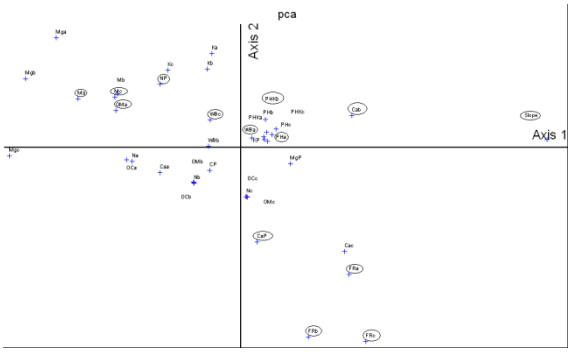

Fig. 2. Spatial situation of environmental variables in PCA analysis (first factor: eigenvalue-19, variance associate with agent-50, cumulative variance-50; second factor: eigenvalue-12, variance associate with agent-31, cumulative variance-81).

PCA (Principle Component Analysis)

Bulk density, moisture, calcium and nitrogen of litter fall, acidity and fine roots in different layers of soil are the main components associate with increment rate in geographical directions in this given region. Results of principle component analysis on 39 environmental variables showed that first and second principle components covered 50% and 39% of increment variations in geographical directions, respectively.

-Diameter and height increment have correlation with left-hand side of second axis and also have correlation with FRb, Cap, FRc, Fra.

-Basal area and volume increment have correlation with right-hand side of second axis and pHkb, WBc, Np.

Relationship between directions and environmental factors (i.e., slope and soil) was analyzed by PCA in order to more precise results including.

-Northwest and southwest directions have a correlation with first axis in right-hand side and it would be defined by right-hand characteristics such as Slope, Cab, pHa.

-Northeast direction has a correlation with first axis in left-hand side and it would be defined by left-hand characteristics such as WBa, Mc, OM, Ma.

-West direction has a correlation with second axis in left-hand side and it would be defined by left-hand characteristics such as pHkb, WBc, NP.

References

Borhani A, brimani H, Kiasari Sh. 2004. Analyzing canopy disease of *Cupressus sempervirens* in Altapeh plantation of Behshahr in Iran. Journal of Watershed Management Research **16,** 22-63.

Binam A. 1999. Forestry plan in Abas Abad of Iran. 270p.

Sabeti H. 1976. Synecology. Dehkhoda press. 492p.

Joazi A. 2000. Studying degradation of *Cupressus sempervirens* forest reserve in Hasan-Abad (Chalos) of Iran. Mojeh sabz journal **1,** 26-30.

Habibi H, Lesani MR. 1985. The study of soil condition and the quality of forest stands *taxus baccata* in Iran. Natural resources journal of Iran **39,** 13-26.

Rezaie E. Ecological study of natural sites of *Cupressus sempervirens* in North of Iran. Thesis for degree of M.Sc. Agriculture and Natural Resources of Gorgan University. 220p.

Zobairi M. 2002. Bioassays in forest. Tehran university press. 411p.

Zobairi M. 1994. Forest inventory. Tehran university press. 401p.

Abdollazadeh B, Tabari M, Saghebtalebi Kh, Zobairi M. 2003. The diameter and height respond of *pinus eldarica* to slope and direction in Lavizan forest park of Iran **30,** 35-60.

Aliarab A, Hosaini SM, Jalali S. 2005. The effects of *Acer vlutinum*, *Robinia pseudoacacia* and *Cupressus sempervirens* on some physicochemical characteristics of soil in Haraz plantation. The journal of Soil and Water sciences **19,**

Kialashli A. 2006. The effects of natural factors on quantitative characteristics of *Pinus eldarica* in Mazandaran of Iran. The journal of agriculture sciences **1,** 23-31.

Mohamadpour R. 2002. Forest reserves of *Cupressus sempervirens* in Rodbar. Forestry office of Gilan. Iran. 69p.

Mohammadisamani k. 2005. Studying some physical and chemical characteristics of soil associate to Zagros forest. Thesis for degree of M.Sc. Mazandaran University, 91 p.

Mosadegh SA. 1996. Silviculture. Tehran university press. 481p.

Mosavigarmestani A. 1997. Comparing tolerate species faced to drought in semiarid area of Mazandaran of Iran. Final report of researching plan. Research center of natural resources of Mazandaran 27 p.

Mosavigarmestani SA, Rasoli SM, Nazari H. 1995. Studying conifers planted in north of Iran. Forest and rangeland office of Iran, 35-87.

Najafi T. 2008. Studying site needs of *Cupressus Semper virens* in Fars province, Iran. Thesis for degree of M.Sc. Agriculture and Natural Resources University of Sari. 68p.

Namiranian M. 1991. The study of increment models in forest. The journal of natural resources of Iran **45,** 93-102.

Boisseau W. 1996. Kronenbilder mit Nadel-und Blattverlust prozenten. Erich Muller, EAFV, 98 p.

Swamy SL, Alka M, Puri S. 2006. Comparison of growth, biomass and nutrient distribution in five promising clones of Populus deltoides under an agrisilviculture system. Bioresource Technology **97,** 57–68.

Booth TH, Jovanovic T, New M. 2002, A new world climatic mapping program to assist spacies selection For Eco **163**, 111-117.

Chandler JW. 1982. Growing Christmas Trees in Texas. Ithaca, Ny: Cornell University, Cornell Agricultural Experiment Station, 15 p.

Dowling AY, webb AA, Scanlan YC. 1986 , Surface Soil Chemical and Physical Patterns in a Brigalow-Dawson Gom Forest Central Careens land dray of Ecology **12,** 155-182.

Randall W. 1998. The impact of environment and nursery on survival and early growth of Douglas fir, noble fir and white pine- a case study. Western Journal of Applied Forestry **13(4),** 137-143.

Sidhu DS, Dhillon GPS. 2007, Field Performance of ten Clones and two Sizes of Planting Stock of Populus deltoides on the Indo-Gang etic Plains of India New Forests, Springer Science Business Media B.V.10.1007/**s11056**-007-9042-y.

Wenjun C, Quanfa Z, Josef C, Jürgen B, David T. 2004, Estimating fine-root biomass and production of boreal and cool temperate forests using aboveground measurements: A new approach. Plant and Soil **265,** 31–46.

Zhang AL, Hsiung WY. 1993, Evaluation and diagnosis of tree nutritional status in Chinese- fir (Cunninghamia lanceolata (Lamb) Hook) plantation, Forest Ecology and Management **62(1-4),** 245-270.