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Ecologic evaluation of cypress (*Cupresuss sempervirens* L.*var.horizontalis*) plantation in Abas Abad of Behshahr

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Key words: *Cupresuss sempervirens,* increment, Abas Abad, plantation.

Abstract

The 26th years pure stand of *cupresuss sempervirens* with 40 ha and 2*2 m distance among trees in Abas Abad was selected to study increment of *cupresuss sempervirens*. The 100*75 m net and random-systematic method was used for this research and also increment factors were measured in 50 sample plots. Diameter of all trees and height of four trees were recorded in each sample plot. Results showed that viability was 58.6% after 26 years. Quantitative parameters including mean diameter, height, basal area, and volume were 12.84cm, 13.3m, 20.56 m²/ha and 99.33 silve/ha, respectively and also some parameters about increment including diameter increment, height increment, basal area increment and volume increment were 0.49 m, 0.511m, 0.80 m²/ha and 3.82 silve/ha, respectively.

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Introduction

The economic progress of Iran and growing demand for wood supplies have caused to pressure on north forest and even Oak forests in west of Iran (Darabi, 2009) and forest degradation is more than rehabilitation and development. Therefore, planting with conifers is the main plan that has been done in recent years in north of Iran. This afforestation almost used non-indigenous species such as *pinus eldarica*, *cupresuus arizonica, pinus taeda, abies alba* and *Cupressus sempervirens* for providing wood needs of this country (Kalantari, 2007). About 35% of global wood needs are provided by afforestation but these supplies just cover about 3% of the area of world forests and it is expected that afforestation will meet 46% of wood demand by 2040 (Booth *et al*. 2002). Increasing need to 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; Abdoun, 2005). Today, plantation is the main issue for improving wood production and keeping ecological balance in developing countries. Indigenous forests especially in tropical countries were severely harvested to provide wood, fuel and paper requirements (Sidhu and Dhillon, 2007). *Cupressus sempervirens* is the only spices among all conifers that has a good potential for producing wood resources (Sabeti, 1976; Javanshir, 1975) but unfortunately planting coniferous species in vast area and as pure stand caused to adverse effect on soil and ecologic balance in our forests in north of Iran (Khanna, 1994) and this issue even caused to cynic environmentalists and people to conifers. The plans should be organized basing on ecological needs of species and the potential of sites. *Cupressus sempervirens* is an indigenous conifer in Iran and appears in areas with Mediterranean climate (Rezaee, 2002). The ecological characteristics of *Cupressus sempervirens* are not completely known. This species can appear in adverse condition of environment and soil (Mohamadpour, 2002). The study about some features of *Cupressus sempervirens* in Chalos, north of Iran, was done that volume increment, radial growth and basal area were recorded 0.2-0.7 cubic meter/ha, 1-4 millimeter/year, 6-18 squire meter/ha, respectively (Mostafaie, 1968). Ahmadi (2008) studied some features of *Cupressus sempervirens* in north of Iran and the results showed that viability, H/D, the mean increment of tree's diameter, height increment and increment in volume were 58.72%, 91%, 7mm, 0.64m and 7.15 m^3/ha, respectively. 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(Najafi, 2008). The study about height growth of pure and mixed stands, with Oak, of *Cupressus sempervirens* in north of Iran was done that pure and mixed stands were 0.64 m/Y and 0.62 m/Y, respectively (Mosavi Kohpar, 2000). *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* and its some effective factors in Behshahr of Iran.

Material and methods

Site description

Studied area located in east of Behshahr city and ranging 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*2 and 450 meter, respectively. The meteorological data taken from the nearest meteorological station to the case study indicates that this area has semi wet climate basing on Domarton classification. The maximum and minimum rainfall is in autumn and summer, respectively. Summer is dry season regarding to climate classifications but it is not ecologically and biologically dry so that it cannot damage forest species easily (Binam, 1999).

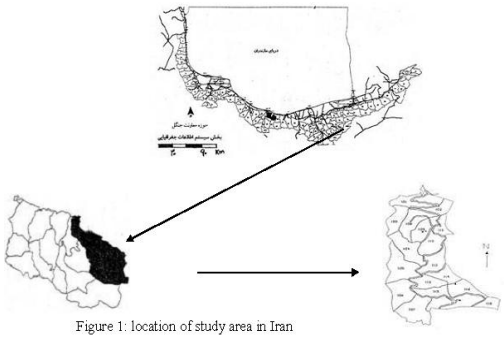

Fig. 1. location of study area in Iran.

Methods

The stand of *Cupressus sempervirens* located in Abas Abad due to favorite age, evenness, pureness and successful results was selected for this study. Random- systematic method of inventory was used regarding to the potential of the area (Zobairi, 1994). It means that 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. Tree distribution in classes of diameter and height was normal. It means tree density in middle classes is more than other classes. Chatrohas (2003) showed that distribution of trees follows the especial order and it almost is normally skewed distribution. Parodan (1965) showed that trees distribution is close to normal distribution in young stands without competition. Rosoot (1991) indicated normal distribution is defined by following function.

$$F(x)=\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2},$$

$$\mu<+\infty,\ -\infty<x<\sigma$$

Following formula would be got when population consisted of N components and data were classified in d classes.

$$f(x)=\frac{N\times d}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

μ= The real mean of population

$\bar{\chi}$ = It is replaced in sampling

σ = Squire root of variance of population

S_{χ} = It is replaced in sampling

χ = The variable that its frequency is expected

$e=2.7183$

N= The total of population in complete inventory

N= The number of samples

Firmness coefficient is valuable tool for managing forest stands. For example it can determine the suitable time of thinning.

$$F_n=\frac{\bar{h}}{\bar{d}}\times 100$$

F_n = Firmness coefficient

$\bar{d}$ = The mean of diameter at breast height

$\bar{h}$ = The mean of tree height

When the Firmness coefficient decreases the resistance of stands face to rainfall and snow as well as other adverse climate conditions will be increased (Namiranian, 2000; Sohaili Esfahani; 2006). Some various factors cause to increase or decrease in increment of tree diameter and height. In young pure and even-aged stands most trees have same characteristics like diameter and height. It means that they are in same classes but gradually by interrupting human being and nature the distribution curve of trees will be changed and they will split into different classes of diameter and height (Zobairi, 1994) so that this value called skewness and also Pierson coefficient is used for counting skewness.

$$M_d=L+\frac{\frac{n}{2}-f_c}{f_i}\times C \qquad b=\frac{3(\bar{x}-M_d)}{S_x}$$

b= Skewness coefficient of Pierson

$\bar{\chi}$ = The mean of population

M_d = Median

S_{χ} = Standard deviation

L = Below class interval containing median

n= Number of trees

f_c = Cumulative frequency of previous class of median class

f_i = Infinite frequency

C= Class interval

If Skewness coefficient of Pierson were positive, stand would be skewing to left and if it were negative, stand would be skewing to right. Considering Skewness can be obtained according to table 2 (Sohaili Esfahani, 2006).

Connection between diameter and height of trees is one of the most important components in forest structure (Peng, 1999). Estimating tree volume and site indicator as well as describing succession of forest needs favorite diameter- height models (Kortiss, 1972; Botkin *et al.* 1996). Many diameter-height models for different species in various sites were applied. For example Fang and Bailie (Fangand Baily, 1998) used 33 models for tropical forests in south of China. 25 non-leaner model of diameter-height were used by Pang (Peng, 1999). Five leaner and non-leaner models of diameter-height shown in table 3 were applied in this study. Each model was evaluated by mean squire error (MSE) and R^2.

For measuring diameter, height and volume increment according to age, following formula were used.

$\bar{d}_i$= mean diameter increment

$\bar{d}$= mean diameter of stand

$\bar{h}_i$= height increment

$\bar{h}$= mean height of stand

$\bar{g}_i$= mean of basal area increment of stand

$\bar{g}$ =mean basal area of stand

$\bar{v}_i$ =mean volume increment of stand

$\bar{v}$ =mean volume of stand

A= stand age

$$\frac{\bar{b}}{A} = {}_1\bar{b} \qquad \bar{h}_t = \frac{\bar{h}}{A} \qquad \bar{g}_t = \frac{\bar{g}}{A} \qquad \bar{v}_t = \frac{\bar{v}}{A}$$

Results

Normality test and skewness in studied stands:

After recording diameter of trees, they would be classified in 2 cm classes of diameter and the frequency of trees in each class was measured (table4).

Table 1. Firmness coefficient of stand or individual tree.

Tree in open field	Good	Poor	Very poor	Firmness
40 ⟨	80 ⟨	80-100	100 ⟩	The amount of coefficient $\left(h/d\right)$

Table 2. Pierson coefficient and Skewness of frequency in stand.

Normal	Low	Sufficient	Skewness
<0/1b	0/1-0/5	>0/5b	Range

After recording frequency, normal curve of trees were created (figure1), then skewness was considered. This distribution covered 0.185 and skewness towards to left. It means that skewness coefficient is positive (Namiranian, 2006).

The number of trees in hectares and their viability percent

The result showed the stand had 1465 trees per ha after 26 years that the viability was 58.6 % regarding to the culture distance (2*2m).

Quantitative characteristics of studied stand

According to applied studies, diameter at breast height of *Cupressus sempervirens* in our case study ranging from 3.8 to 25.1 cm and the mean diameter, annual increment, the mean height of 26 years stand, height increment of 26 years stand were recorded 12.84 cm , 0.494 cm, 13.3m and 0.511m, respectively.

Some other features of *Cupressus sempervirens* including basal area of individual tree, the annually mean increment of basal area, the mean volume of individual tree and the annually mean increment were 0.014014 m^2, 0.80 m^2/ha/year, 0.06780 silve and 3.82 silve/ha/year, respectively.

Table 3. Mathematic model used for determining diameter- height.

Model	Model number
H=Ad2+Bd+C	1
H=aLn(D)-b	2
H=aebd	3
H=aDb	4
H= Ad+b	5

Table 4. the frequency of trees in classes.

Class	Infinite frequency	Cumulative frequency
2	1	1
4	35	36
6	97	133
8	179	312
10	277	589
12	310	899
14	268	1167
16	160	1327
18	80	1407
20	41	1448
22	16	1464
24	1	1465

Quantitative parameters of measured characteristics have shown in table 5.

Relation between diameter at breast height and height of total trees

Considering diameter at beast height and height of 198 trees of *Cupressus sempervirens* showed significant correlation at 1 % level. Some models were used for determining relations between given characteristics and after evaluating following model was used (figure2).

This model with exponential manner and R^2=063 was selected as the best model for *Cupressus sempervirens* in this case study (figure2).

Firmness coefficient (h/d)

Firmness coefficient is an important factor for evaluating forest stands that for *Cupressus sempervirens* in Abas Abad was 83.4. According to Namiranian classification this stand had a poor firmness.

$$F_n = \frac{\bar{h}}{\bar{d}} \times 100 = \frac{13/3}{15/9} = 83/4$$

Error percent	Standard	Standard	Mean	Maximum	Minimum	Parameter
51.1	72003.3	09719.0	843.12	10.25	80.3	Diameter
41.2	25019.2	15991.0	265.13	90.18	30.6	Height
45.1	0078387.0	0002048.0	014041.0	0495.0	0011.0	Basal area
85.0	022076.0	000577.0	06780.0	133.0	015.0	Volume

This value has been shown for individual tree of stand in figure 3.

Discussion

The number of trees in hectare

As the frequency curve shows (figure 1-4), the stand of *Cupressus sempervirens* is even aged and has a poor skewness (0.185). Cited stand has 1465 trees in

ha that its viability according to early 2*2 m culturing distance (early seedlings were 2500 per ha) is 68.6 %. Ahmadi (2008) indicated the viability of *Cupressus sempervirensn* was 58.72 in Kordkoie of Golestan province and his results was close to our results that due to hadn't been done silviculture operations at the suitable time. Two stands have less viability than other stands such as Dolat Abad stand (77%) recorded by Haghi (18).

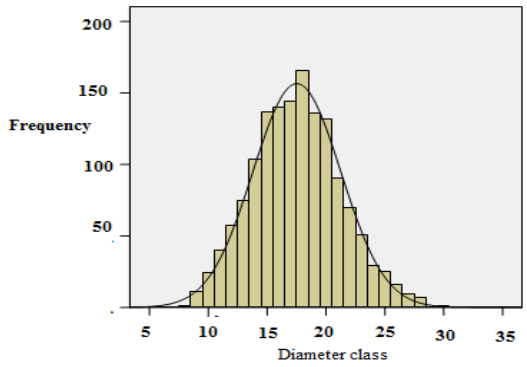

Fig. 2. comparing trees in diameter classes with normal curve.

Firmness coefficient of stand

Firmness coefficient of *Cupressus sempervirens* in Abas Abad according to mean diameter and height was 83.4% and this value in Kordkoie of Golestan was 91% (Ahmadi, 2008). This value is more than its mean amount so that it due to low distance of seedlings and lack of silviculture operations. Firmness coefficient is a good value for managing forests and discussing sustainability of stands. Therefore, early thinning and low distance of planting are good factors for obtaining favorite viability and Firmness coefficient of *Cupressus sempervirensn* stands.

Mean diameter and mean diameter increment of stand

The mean diameter of *Cupressus sempervirens* stand was 12.84mm and also means diameter increment was recorded 4.94mm. Our results were less than that obtained in Kordkoie (7mm) by Ahmadi(2008) that this value due to productive soil and low gradient of slope of Kordkoie than Abas Abad.

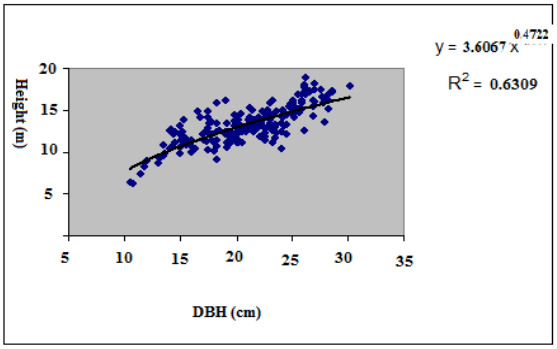

Fig. 3. relations between diameter at beast height and height *Cupressus sempervirens* in Abas Abad.

Mean height and mean height increment

The mean height *Cupressus sempervirens* was 13.265m and mean height increment regarding to stand age (26 years) 0.5m was recorded. Ahmadi (2008) showed the mean height and mean height increment of *Cupressus sempervirens* stand in Kordkoie in its 22nd years were 14.03m and 0.64m, respectively. The results of this study about mean height and mean height increment were close to those obtained by Mosavi kohpar (2000) (0.64m) and Ahmadi (2008).

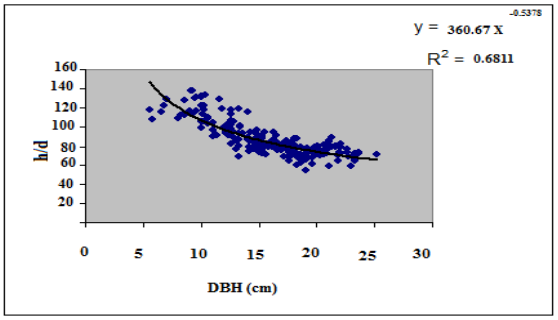

Fig. 4. the curve of firmness coefficient (h/d).

Mean basal area and annually mean increment of basal area

Mean basal area of *Cupressus sempervirens* in Abas Abad and annually mean increment of basal area were 20.56 m²/ha and 0.8 m²/ha/year, respectively. Mean basal area of *Cupressus sempervirens* in kodkoie (29.35 m²/ha) was less than our case study so that this value due to different conditions of sites.

Stand volume and its increment

Mean increment of volume of *Cupressus sempervirens* stand in its 26th age was 3.82

silve/ha/year. Finding of this study about volume is more than that obtained in Chalos (0.2-0.7 silve/ha/year) and less than that recorded in Kordkoie (7.15 silve/ha/year) for *Cupressus sempervirens*. The different values of volume in different sites relate to various conditions of sites, for example Kordkoie site has the better condition for growing *Cupressus sempervirens*.

Some suggestions including following sentences are needed after doing this study:

1. It is suggested that thinning according to especial condition of site and firmness coefficient as well as skewness will be done in a section of stand precisely because each operation without regarding to site causing to create weak stand face to environmental conditions.

2. Fencing is suggested according to over grazing and over cutting.

3. Applying scientific and correct management for *Cupressus sempervirens* stand is essential.

4. Some studied like this one will be recommended in other sites as a comprehensive plan.

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