



Journal of Applied Sciences

ISSN 1812-5654

science
alert

ANSI*net*
an open access publisher
<http://ansinet.com>

Quantitative Survey of *Pinus brutia* Ten. in Different Altitudes of Ghapan Region (North of Iran)

Asghar Fallah, Fazl Allah Emadian, Ali Akbar Rostaghi and Yahya Kooch
Department of Forestry, Faculty of Natural Resources,
University of Agriculture and Natural Resources of Sari, Islamic Republic of Iran

Abstract: In order to investigation of afforestation operation, *Pinus brutia* Ten. (Red pine) in Ghapan region (Golestan province-North of Iran) was selected. Planted stands were classified to three altitude classes of 200-400, 400-600 and 600-800 m. Mentioned afforestation was located in northern aspect with 16 years old, plantation distance of 2×3 m and with 232 ha⁻¹ areas. In this study diameter at breast height, height, form factor, diameter increment and stand volume parameters were calculated. Statistical analysis was done by SPSS and EXCELL software's in order to study the distribution of trees in diameter and height classes. Results of this research showed that diameter mean of trees were 12.40, 12.96 and 14.42 cm at the first, second and third classes also, height mean were 7.06, 7.22 and 8.02 m at the first, second and third classes, respectively. This study showed distribution of diameter mean at breast height and height was similar to normal distribution and also, volume of *Pinus brutia* Ten. were estimated 41, 47.41 and 95.80 silve ha⁻¹ at the first, second and third classes. Mean annual increment of diameter were 0.91, 0.98 and 1.15 cm at the first to third classes, respectively. Totally, Quantitative characteristics showed regular changes with respect to different altitudes and 600-800 m altitude class had best results for quantitative characteristics.

Key words: *Pinus brutia* Ten., diameter increment, Ghapan

INTRODUCTION

Reclamation, regeneration and extension of natural resources should be considered pay attention to dangers reduce of natural resources areas and also, unavoidable necessities of humans. Therefore, it is necessary that reclamation and extension of natural resources should be basis of natural model of vital systems with according to ecological conditions (Zobeiry, 2006; Namiranian, 2007).

With due attention to climate conditions of Iran that 65% area includes arid and semi-arid and degradation rapid of north and west forests, afforestation is necessary of viewpoint resources conservation of water and soil because of degradation of natural resources will cause to degradation agricultural lands and human environmental (Dastmalchi, 1998).

Consideration to settlement large factories of forgery, extension of wood and cellulose industries, it is necessary to plantation of industrial needle leaves species. In afforestation for suitable using of land, during policy of conservation and support of native species viewpoint theirs environmental effects should be attended. Certainly, performing these works are necessity to extension investigations and researches at present and

future (Zobeiry, 2006). In this direction, some of researches were performed in Iran and out.

Fattahi (1994) in investigation of exotic needle leaves species Kurdistan on *Pinus brutia* Ten species in near the other needle leaves species in altitude more than 1600 m were conducted that this species was adapted with site conditions. Mean annual increment of height and diameter were 10.21 and 4.16 cm, respectively. These results have showed that plantation of this species in low altitude than 1600 m is suitable and are not negative effects on this species.

Hemmati (1997) was studied conditions compatibility of needle leaves and broad leaves species in dorood region (Lorestan province). In this research *Pinus brutia* Ten species was planted with distance of 2×2 m. Results of this research have showed that percentage viability of *Pinus brutia* Ten species is good; relatively than to plant the others needle leaves. Height mean of *Pinus brutia* Ten. species was 5.9 m at the age of 27.

Hemmati (1997) was investigated compatibility conditions of needle leaves species in Zagheh region of Lorestan province. *Pinus brutia* Ten. species were planted in 3×3 m distance. Mentioned region includes very hard winter with drought period. In these conditions,

Pinus brutia Ten. species with viability 63% and height mean 4.8 m had good growth conditions and was introduced as success and agreeable species than to the other needle leaves.

Isik and Kara (2000) in their research on *Pinus brutia* Ten. species were determined 600-800 m optimum altitude for this species in southern Turkey. Arbez (2000) in his research on *Pinus brutia* Ten. species afforestation in Turkish with plantation distance of 2×3 and 600 m altitude have conducted pay attention to diameter mean (12.8 cm) and high (7.94 m), this stands had good conditions.

Isik and Isik (2001) in their survey in Turkish have conducted *Pinus brutia* Ten. species is inclined to produce of stems with bad quality and just in 600-1000 m altitude and suitable sites produced straight stems and enable to produce stems with good quality in these regions with perform of pruning operations and or long period.

Also, quantity characteristics of *Pinus brutia* Ten. species are well studied and results for models have been reported by Isik (1999), Arbez (2000), Burdon *et al.* (2000), Isik (2000), Isik *et al.* (2000), Isik and Kara (2000), Kara *et al.* (2000), Atalay *et al.* (2001), Fisher *et al.* (2001), Kaya and Raynal (2002), Kandemir (2003), Eren *et al.* (2005) and Tonbak *et al.* (2006). The aim of this research was achievement to quantity conditions of *Pinus brutia*

Ten. in different altitudes of Ghapan region and achievement to percentage of success of this species in study area.

MATERIALS AND METHODS

Study area: Afforestation area is located in slopes of Arab Dag mountain chain in Ghapan region which is 40 km far from northeast Kalaleh city (Golestan province-North of Iran). Study area is situated between 55°37' to 55°47' North latitude and 37°32' to 37°36' East longitude (Fig. 1). The average slope of forest field is about 10% (Min. 5% and Max. 15%), the height of *Pinus brutia* Ten. stand with 232 ha⁻¹ areas at sea level starts from 250 (m) and continues till about 850 (m). Afforestation areas of Arab Dag have covered of loss sediments, dominant soil type is brown with alkaline soil pH. Electricity Conductivity (EC) is low in these stands. Soil texture of study area is loamy. The average annual temperature of study areas is about 17.9°C (Min. -12°C and Max. 45°C) and mean annual precipitation is 55.08 mm. Region climate was calculated using of classification formula of amperage (Q = 57.2), therefore, site climate was humidity moderate with dry and cold winters (Anonymous, 2003). This research was performed in the summer of 2006.

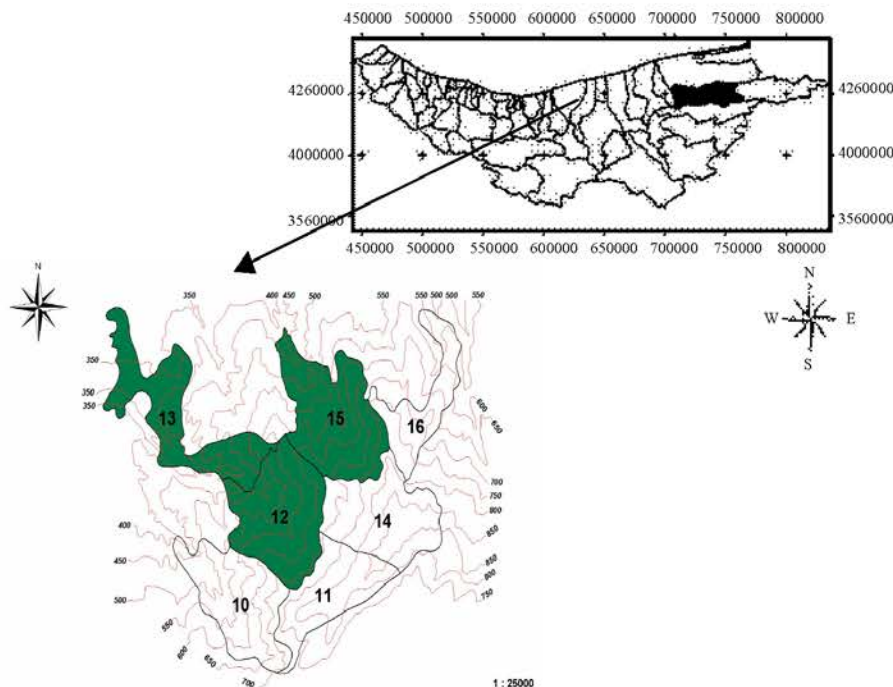


Fig. 1: Position of the study area in the North of Iran-Golestan province

Data collections: In order to, was used topography map on a scale of 1:25000. Inventory network was 4×4 mm on map (100×100 m in nature) and inventory was done with random-systematically method (Zobeiry, 2000). Numbers of 30 sample plots were taken in every altitudes class (200-400, 400-600 and 600-800 m classes). Sample plots were square form with 400 m² areas. Diameter at breast height all of trees were measured (using Caliper) in every sample plots and height some of trees were measured with random method and using of Suunto (one tree of every five trees). Dominant height, artificial form factor, ratio of h/d parameters were calculated, also. In order to calculation of dominant height, stems were classified to five diameter classes with equal number of trees (Zobeiry, 2000) and mean of classes height and or the most diameter classes viewpoint diameter at breast height were used as dominant height. In order to determining of diameter increment in every of altitudes classes, number 20 trees were cut with random method and were separated discs of breast high area and increment-current annual of diameter and increment-mean annual were investigated. Data were analyzed using the SPSS package. ANOVA (analysis of variance) was done and Duncan test was used for comparison of means.

RESULTS

Analysis of variance and Duncan test was done for collected data of Diameter at breast height, height, basal area, volume per hectare and diameter increment parameters. Results of analysis showed significant differences among mean of these parameters (Table 1, 2).

Number per hectare: By reason of equal plantation distance in every height classes, numbers per hectare were similar in every three classes, almost. Number per hectare in the first, second and third classes were 1640, 1624 and 1627, respectively.

Mean of diameter at breast height (DBH): Investigation of collected diameter data showed that diameter structure of stand in every three classes following of distribution inclined to normal (Table 3). Result of analysis showed significant differences in level of 5% among means (Table 2). Also, the third class was in better conditions than the first and second classes.

Mean of trees height: To consideration with even-aged of studied stands, thus diagram of height distribution of trees are according to normal distribution, relatively (Table 4). Result of analysis showed significant

Table 1: Analysis of variance for measured parameters

	Variables	Total square	df	F-value	Pr>f
Model	DBH	4769.29	2	400.910	0.00
	Height	208.06	2	149.790	0.00
	Basal area	0.01481	2	279.540	0.00
	Volume ha ⁻¹	31.11	2	3136.390	0.00
	Diameter increment	0.418	2	8.291	0.001
Error	DBH	34932.71	5873	-	-
	Height	808.06	1164	-	-
	Basal area	0.13	4898	-	-
	Volume ha ⁻¹	0.869	4898	-	-
	Diameter increment	0.914	39	-	-
Total	DBH	39702.11	5875	-	-
	Height	1016.47	1166	-	-
	Basal area	0.145	4900	-	-
	Volume ha ⁻¹	1.983	4900	-	-
	Diameter increment	1.333	41	-	-

Table 2: Duncan test for diameter at breast height, height, basal area, volume per hectare and diameter increment parameters

	Classes		
Parameters	200-400 m	400-600 m	600-800 m
Diameter at breast height	12.40 ^a	12.96 ^b	14.46 ^a
Height	7.06 ^a	7.22 ^b	8.02 ^a
Basal area	0.01 ^a	0.01 ^b	0.01 ^a
Volume ha ⁻¹	0.02 ^a	0.03 ^b	0.06 ^a
Diameter increment	0.91 ^a	0.98 ^b	1.15 ^a

Table 3: Number distribution in diameter classes (in hectare) at the first, second and third classes

	Classes		
DBH (cm)	200-400 m	400-600 m	600-800 m
6	59	17.50	-
7	46	20.00	-
8	83	29.00	6
9	121	52.50	10
10	146	78.30	58
11	197	158.00	133
12	306	258.00	185
13	396	375.30	283
14	248	288.30	371
15	183	180.00	324
16	109	100.00	240
17	23	48.30	162
18	16	13.00	90
19	13	5.80	39
20	5	5.00	31
21	5	2.50	13
22	2	2.50	6
23	-	-	2

differences in level of 5 and 1% among means (Table 2). Also, the third class was in better conditions than the first and second classes.

Dominant height: In order to measurement of dominant height were selected number of 77 trees at the first and second classes and number of 79 trees at the third class. Result showed that dominant height were 8.02, 8.38 and 8.99 m for the first, second and third classes, respectively.

Table 4: Number distribution in height classes at the first, second and third classes

Height (m)	Classes		
	200-400 m	400-600 m	600-800 m
5	-	2	-
5.5	7	12	2
6	63	39	7
6.5	84	69	20
7	71	90	30
7.5	80	73	58
8	46	49	120
8.5	14	34	104
9	13	14	38
9.5	4	6	13
10	-	-	6

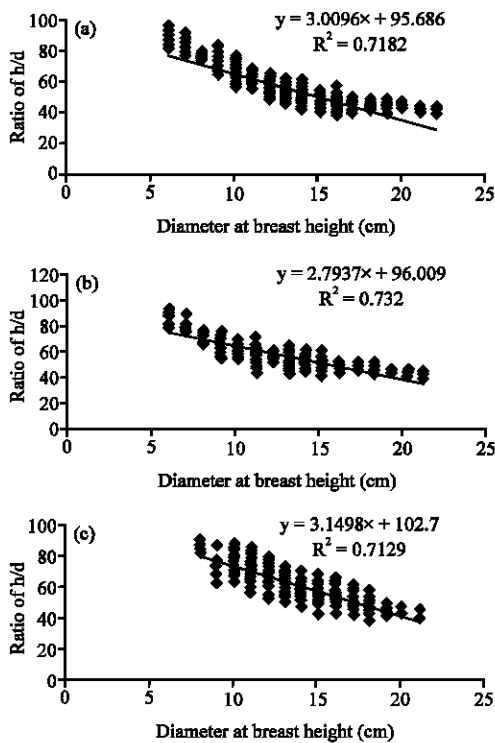


Fig. 2: Diagram ratio of h/d on basis of diameter distribution at the first (a), second (b) and third (c) classes

Artificial form factor: Form factors were calculated in order to constitute local volume tables and drawing of diagram. Form factors were calculated for three classes of height as follows: $Y = -0.0132 X + 0.4748$ ($R^2 = 0.936$) at the first class, $Y = -2.4294 X + 91.45$ ($R^2 = 0.9479$) at the second class and $Y = -0.0155 X + 0.6641$ ($R^2 = 0.9997$) at the third class. Where Y, artificial form factor and X, diameter at breast height.

Basal area: Result of analysis showed significant differences in level of 5 and 1% among means (Table 2),

the most and least of basal area were at the third and first classes, respectively.

Ratio of h/d: Result of analysis showed that ratio of h/d was less than 80 in every three classes of height (Fig. 2).

Growing stock (Volume per hectare): Pay attention to diameter, height and form factor parameters, volume table were calculated for each of classes. Volume per hectare was estimated with using of collected data in local volume and diameter frequency distribution tables. Result of analysis showed that volume per hectare was variable in relation to altitude as the third class had more volume per hectare than the first and second classes. By reason analysis of variances was performed for this parameter (Table 1, 2) Result showed that the third class had the most volume than two other classes.

Diameter increment: Result of analysis showed that increment-mean annual of diameter in the first, second and third classes were 0.91, 0.98 and 1.15 cm, respectively.

DISCUSSION

Studying of diameter and high distribution showed that theirs distribution were inclined to normal distribution. Mean of diameter at breast height at the first, second and third classes were 12.40, 12.96 and 14.42. Mean height of stand were 7.06, 7.22 and 8.02 in the first, second and third classes and also, mean of diameter increment in the first, second and third classes were 0.91, 0.98 and 1.15 cm, respectively, that has suitable conditions compare to its origin site (Turkish) with diameter mean of 12.80 cm and height mean of 7.94 m (Isik, 1999; Arbez, 2000; Burdon *et al.*, 2000; Isik *et al.*, 2000; Kara *et al.*, 2000; Atalay *et al.*, 2001; Isik and Isik, 2001; Isik *et al.*, 2001; Eren *et al.*, 2005; Aktas *et al.*, 2006).

Ratio h/d of stand trees were 56.7, 58.2 and 60.8 in the first, second and third classes that it is showing stability of studied stands on basis classification of Namiranian (2000). Significant correlation between diameter at breast height and ratio of h/d showed that h/d is reduced with increase of diameter at breast height. Investigation of calculated basal area showed that this parameter were 20.64, 22.08 and 27.88 m² in the first, second and third classes. Thus, this parameter has better conditions than the other classes. Also, in compare to its origin site with basal area 22 m² ha⁻¹, mentioned afforestation has good conditions. Isik and Isik (2001) in their research had showed that basal area parameter is more in higher altitudes and this result is similar to results of Arbez (2000), Burdon *et al.* (2000), Fisher *et al.* (2001), Isik *et al.* (2001), Kandemir (2003) and Eren *et al.* (2005) researches.

Measuring of volume per hectare showed that volume ha⁻¹ in third class is more (95.8 Silve) than the other classes and has the better conditions. Also, in compare to its origin site with volume per hectare 95 m³ ha⁻¹, mentioned afforestation has good conditions. This result confirms the results of Arbez (2000), Kandemir (2003) and Eren *et al.* (2005) researches. Totally, plantation distance of 2×3 m is suitable and afforestation of stand trees and also, thinning operation should be performed in different ages of growth in future. Performing of these operations will supply the good conditions for trees with good quality and under these conditions; we will hope to plantation this species in appropriate lands and by means of poor and low-efficiency lands (that have covered extensive areas of Ghapan region) will can secure some primary necessities of cellulose industries.

It is conducted that viewpoint quantity characteristics, the best and the most appropriate conditions was founded in the third class (higher altitudes). This result confirms the results of Atalay *et al.* (2001), Fisher *et al.* (2001), Kaya and Raynal (2002), Kandemir (2003) and Eren *et al.* (2005) researches. Also, to consideration result of volume table, studied stand has more suitable conditions compare to the origin site.

Therefore, mentioned afforestation was with success. In this research was showed that diameter at breast height, height, basal area and volume parameters showed regular changes in relation to altitude and with increase of altitude, mentioned parameters were increased. Thus, it is suggested pay attention to condense of mentioned stand and its success to this age; therefore, it is necessary to perform of more researches in different field on this species in future, certainly.

Performing of thinning operations in stand and omitting of trees with bad quality are necessary in order to support growth of trees with good quality and also, increase of quality and more efficiency of economy. Plantation of this species is recommending attention to forbearance to temperature changes in regions that forests were degraded.

REFERENCES

- Aktas, M., K. Altay and N. Dumanli, 2006. A molecular serving of bovine *Theileria* parasites among apparently healthy cattle with a note on the distribution of thick in Eastern Turkey. *Vet. Parasitol.*, 138 (3): 179-185.
- Anonymous, 2003. Ghapan region forest management. Organization of forest and range and watershed management. Islamic Republic of Iran, pp: 350 (In Persian).
- Arbez, M., 2000. Distribution, ecology and variation in *Pinus brutia* Ten. *FAO-For. Genet. Resour. Inform.*, 3 (1): 21-23.
- Atalay, I., I. Sezer and H. Cukur, 2001. The ecological properties of Red Pine (*Pinus brutia* Ten.) forests and their rejoining in terms of seed transfer. *Orman Bakaligi, Orman Agaclari*, Yayin No. 6: 108.
- Burdon, R.D., M.H. Banister, H.A.I. Madgwick and C.B. Low, 2000. Genetic survey of *Pinus brutia* Ten. *N.Z. J. For. Sci.*, 22 (3): 119-137.
- Dastmalchi, M., 1998. Investigation compatibility experimental of tree species in Ardabil province. *Jangal and Senoubar J. Inst. For. Rangelands Res.*, No. 203: 168 (In Persian).
- Eren, G., I. Kandemir and Z. Kaya, 2005. Genetic variation in Turkish Red Pine (*Pinus brutia* Ten.) seed stands as determined by RAPD markers. *Silva Genetica*, 53 (2): 169-175.
- Fattahi, M., 1994. Investigation Agreeable of Exotic Needle Leaves in Kurdistan. Publication of Institute Forests and Rangelands Researches, pp: 212 (In Persian).
- Fisher, J.T., R.W. Neumann and J.G. Maxel, 2001. Performance of *Pinus brutia* Ten./*Halepensis* group pinus in Southern New Mexico. *For. Ecol. Man. J.*, 16 (3): 403-410.
- Hemmati, A., 1997. Results compatibility of trees and shrub species in Lorestan province. *Jangal and Senoubar J. Inst. For. Rangelands Res.*, No. 173: 88 (In Persian).
- Isik, K., 1999. Altitudinal variation in *Pinus brutia* Ten: Seed and seedling characteristics. *Silva Genetica*, 35 (1): 58-66.
- Isik, F., 2000. Genetic variation, heritability and genetic gain from a *Pinus brutia* Ten. Open-pollinated progeny trial. Unpublished Ph.D Thesis, Akdeniz University, Antalya, Turkey.
- Isik, K. and N. Kara, 2000. Altitudinal variation in *Pinus brutia* Ten. and its implication in genetic conservation and seed transfers in Southern Turkey. *Silva Genetica*, 46 (1): 113-120.
- Isik, F., K. Isik and S.J. Lee, 2000. Genetic variation in *Pinus brutia* Ten. in Turkey: Growth, biomass and stem quality traits. *For. Genet.*, 6 (1): 89-99.
- Isik, K. and F. Isik, 2001. Genetic variation in *Pinus brutia* Ten. in Turkey. *Silva Genet.*, 48 (2): 293-302.
- Isik, K., M. Topak and A.C. Keskin, 2001. Genetic Variation among and Within Six *Pinus brutia* Ten. Stands in Southern Turkey: Six Year Results at Five Common Garden Plantations. *Forest Trees and Seeds Improvement Institute Publication No. 3*. Ankara, pp: 139.

- Kandemir, G., 2003. The mechanism and genetic control of cold and drought resistance in *Pinus brutia* Ten. Populations from Southern Turkey. Ph.D Thesis, University, Ankara, Turkey.
- Kara, N., Korol, L.K. Isik and G. Schiller, 2000. Genetic diversity in *Pinus brutia* Ten.: Altitudinal variation. *Silva Genet.*, 48 (1): 155-161.
- Kaya, Z. and D.J. Raynal, 2002. Biodiversity and conservation of Turkish forests. *Biol. Conserv.*, 97 (2): 131-144.
- Namiranian, M., 2000. Study of the important indices inventory of Beech species in Gorazbon district (Kheiropd Kenar Forest). *Natl. Resour. J.*, 53 (3): 87-95 (In Persian).
- Namiranian, M., 2007. Measurement of Tree and Forest Biometry. Tehran University Publications, pp: 574 (In Persian).
- Tonbak, S., M. Aktas, K. Altay and K. Azkur, 2006. Crimean-Congo hemorrhagic fever virus: Genetic analysis and tick survey in Turkey. *J. Clin. Microbiol.*, 44 (2): 4120-4124.
- Zobeiry, M., 2000. Forest Inventory (Measurement of Tree and Stand). Tehran University Publications, pp: 402 (In Persian).
- Zobeiry, M., 2006. Forest Biometry. Tehran University Publications, pp: 411 (In Persian).