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The study of qualitative, quantitative characteristics of lombardy & common (shirazi) poplars species in manually planted stands in Western Isfahan province

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ABSTRACT

In order to study the qualitative, quantitative characteristics of a pure common (Shirazi) poplar stand in Polkalleh & a mixed stand of Lombardy & Shirazi poplars in Karchegan, two 30-year-old stands were selected with a plantation interval (spacing) of 2.5 × 1.5 m. in each stand, 30 2-are sample pcs (20×10m) were randomly selected. In each sample piece, the diameter of all the trees was measured using a diameter gage tape & the height of all the trees was measured using a Sonto gradiometer. From the center of each sample pc up to the depth of 30 cm, the soil was sampled in order to identify soil conditions. In each sample pc, quality studies such as species freshness, crown & trunk qualitative conditions & quantitative parameters (diameter at breast height total height, diameter at breast height & volume) were then conducted. The relation of height in terms of diameter at breast height elongation coefficient in terms of diameter at breast height & the number in the diametrical & height layers were also studied. SPSS and Excel Statistical software's was used for analysis. Regarding the results and production: Soil texture was analyzed for both clay stands. The pure Shirazi poplars stand is in a better situation than the Lombardy & Shirazi poplars mixed stand. Compared with the Lombardies, the Shirazis have a better situation in the Lombardy-Shirazi poplar stand.

Keywords: Shirazi (common) poplar, Lombardy poplar. Pol Kalleh, Karchegan, Soil texture

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INTRODUCTION

Poplars are a large group of deciduous trees with rapid growth & high height. A height of 18 m within 15 years has been observed in most species. They botanically belong to the Populus genus & the Salicaceau family. They have 5 subgenera: Turanga bunge, Aigeiros duby, Tacamahaca spach & Leucoides spach. Due to an easy hybridization, the number of natural (wild) species of poplars is not known. Poplars wood is used in match, neopan (wood chips panels), fibre & box making & with the wood of the acetate leaf plants, in paper making industries, rural housing & green houses structure. Our per capita consumption of wood and relevant non replenishment through forests and the characteristics of poplars due to species diversification, quick growth and wood different applications are factors which justify poplars cultivation. Poplars wood production is 10-15 times that of forest trees. Poplars species diversification allows for the selection of the best values for each climate. Regarding our population of 70,000,000 and per capita consumption of 0.4 m^3 of wood & wood products, we annually need 28 million m^3 of wood the least of which is domestically supplied & the most of which should be provided from abroad. Another solution is of-course forest cultivation. Since poplars are amongst the quickest growing frees with a high ecological adaptation, they can substitute for forest wood [7]. Poplars have some significant characteristics: In all species, they are easily reproduced using stem cuts. They quickly grow with a uniformly white wood. They can be cultivated in single, row

& dense forest arrangements, and can be used as wind shields & green walls. All these characteristics have attracted Iranian authorities to consider the vast cultivation of different types of poplars in most locations in Iran depending on climatic conditions. In the recent century, different countries of the world have tried to supply their own demands through poplars cultivation regarding forest areas decrease & consumption increase. Nowadays, countries such as Italy the Balcans, Spain, France, Canada and even Turkey have embarked on poplars large cultivations. They thus supply a considerable portion of their needs [3]. It is notable that the average annual production/hectare of in-the-process-of-utilization north forests is 2.5 m^3 whereas by cultivating poplars species an annual production/hectare of over 15-20 m^3 of wood can be achieved [2]. On the other hand, the implementation of agroforestry plans (combining forestry with fodder & crops cultivation) is a good strategy for supplying the required wood. Since poplars quickly grow, and are, due to open branching, late vernal blooming and early autumnal leaf shedding, known better than other forest species such as alder & oak in the public mind, they are a good species for agroforestry plans implementation [18]. Evidently, if the current poplar cultivation reform & poplar cultivation areas protection & extension are considered for wood production power increase, a comprehensive study should be conducted in this regard to apply relevant findings which results in compiling & implementing poplar cultivation plans. On the bank of the Zayandehroud River, common (Shirazi) poplar, a quality poplar in Esfahan, and Lombardy poplar, has been cultivated by farmers. This research aims at a comparison done between these two types of and finally reaches the conclusion that: 1- Between two species of poplar and aspen, which is a native of Shiraz, who is a native of the state of which one is a better product? 2- Pure stands of aspen Shirazi, state or mass produced compounded better. the researcher analyzing poplar different colonies wood quality in Azerbaijan , from among 67 native colonies of P. nigra & P. alba existing in Barandooz mother base collection whose saplings were cultivated in 1969 under similar conditions selected 10 colonies which were identified to be more successful than other colonies at 10 years of age. All of them were of the P. nigra species with the mean diameter of 17 cm and average diametrical growth of 1.7 cm [16]. The researcher comparative analysis of the average annual growth of Shirazi poplar & white P. caspica in Khoshamian, Chalous concluded that the diametrical growth level of white P. caspica is very significantly different with that of Shirazi poplar. The white P. caspica sp. has more regular growth and less fluctuations than the Shirazi sp. so that no significant difference was observed between different years in different heights whereas in the 1st 5 years of poplar growth there was a significant difference with the 2nd 5 years, and local forestry works better with the white P. caspica sp. than with the Shirazi sp. and is applicable in rehabilitating the regional plain ruined forests [13]. In the qualitative, quantitative poplar plantations of Zanjanroud region concluded that, though, out of 90% of the regional stand poplars, 60% are the Shalak sp. & 30% are the Shirazi sp. yet, the Shirazi poplars enjoy better height growth & better diameter so that out of a total height of 25m, 22m of the trunk is more trunky (with a dia. of more) than 8cm whereas in the Shalak sp. out of a total height of 22.4m, 18m of the trunk is more trunky than 8cm. Accordingly, poplars in the same size were more cylindrical with more bulk. Regarding quality, due to having a thinner bark, they also receive more attention by purchasers & though they are slow growing poplars in the sapling period, this species displays its growth priorities at older ages [19]. The researcher studying the native, non native poplar species in northern khorasan, Bojnourd, including P.X. euramericana (11 colonies), P. nigra (2 Iranian [native] & 13 non native colonies), P. deltoides (5 colonies). P. alba (5 native, 3 non native colonies), P. simonii (1 colony), P. ciliata (1 colony) & P. trichocarpa (1 colony) concluded that in relation with the one (1.1) year old saplings growth, the P. deltoides, P. nigra & P. X euramericana groups had the greatest growth , respectively. At the end of the 1st year growth season, the 1 year old saplings were cut at the base, & as a result, the 1.2 year old saplings were assessed in the 2nd year; in all the groups, P. Alba enjoyed the greatest growth after being cut at the base. In the 3rd year, the 2.3 year old saplings were measured. In the end, the P.X [6]. euramericana, non native P. nigra & non native P. alba groups had the greatest growth, respectively. The researcher studying poplar different colonies of 1 year old saplings in Markazi province selection of treasury concluded that the % of viability in the P. alba sp. saplings is lower than that of the others, & the diametrical growth of P. deltoides & P. euramericana, & the longitudinal growth level of the P. deltoids& P. nigra spp. are higher than that of the others. Also, a significant different at the level of 5% is observed in different spp [9]. The researcher studied the 1.1 year old poplar colonies characteristics in Zanjan selection treasury & concluded that non native P. nigra colonies had the greatest height. Also, the diametrical growth of the non native colonies of P. nigra. P. X. euramericana, & P. deltoides enjoyed the greatest diametrical growth. The most % of viability respectively belongs to the non native groups of P. nigra, P.X. euramericana & P. deltoides, & the least % of viability belongs to the P. alba sp. Colonies [14]. In studies conducted on different numbers of colonies of the 5 poplars including Turanga bunge, Aigeiros duby, Ceuce duby, Tacamahaca spach & Leucoides spach, concluded that diametrical, height growth difference is significant in P. alba, P. nigra & P. deltoides. In this connection, in the Leucoides sp., the P. ciliate colony & some colonies of the P. nigra group have diametrical, height average growth lower than other groups. Compared with other species however, the P. alba group & P. deltoides group colonies have a very good growth [20]. studying a comparative analysis of pure & mixed

poplar forest plantation, regarding wood qualitative, quantitative production concluded that the pure poplar stands diametrical, height growth is the greatest and in terms of quality, the poplar pure stands are healthier & fresher than the poplar-cypress mixed stands & the % of bifurcated (2-branch) trees was the least in these stands [12]. The researcher study experimenting poplar colonies height growth behavior (analysis) in Kurdistan concluded that there was a statistically significant difference between the colonies in terms of height growth. At the end of growth period (November), colony P. deltoides 63.3 with a mean value of 234.4 cm had the highest height, & colony P. euphratica with a mean value of 78.8 cm had the lowest height, in the colonies under study; Groups P. nigra & P. alba were amongst these 2 colonies in term of height growth with, P. nigra being higher than P. alba. The colonies genetic potential power in terms of height growth is thus different [24].

MATERIALS AND METHODS

Cultivation area characteristics

The region under study was Pol Kalleh, 65Km west of Esfahan province, area: 4 hectares, 51º, 15' eastern geographical longitude, 32º, 23' northern geographical latitude & 1700 m above sea level for the Shirazi (common) Poplar pure stand , and Karchegan region , 87 Km west of Esfahan Province, area: 8 hectares 51º, 7' eastern geographical longitude, 32º, 25' northern geographical latitude & 1775 m above sea level for the common & Lombardy poplars mixed stand. Esfahan Province general aerology department information report with a statistical period of 10 years (1995-2004) shows that that the above mentioned region has an annual mean temp. of 4.07º - 22.72ºC with minimum/ maximum of 22º / 40.5ºC & average precipitation 174.4 – 180.8 mm. The mean number of freezing days is 117.3, precipitation seasonal distribution % is: 23.2 % in spring, 1.7% in summer; 24.8% in autumn & 50.9% in winter and relative mean humidity is 51.17% on average. The area climatically belongs to the cold-dry region in the Amberge' method. to the arid region in the DeMartin method, to the arid region with cold winter & hot summer in the Coupon method and to the moderately arid region in the Torrent White method, with no excess water & weak middle desert state. The Zayandehroud (river) is permanent in the region under study with an average flow rate of 42 million m^3 & an annual flow rate of 1328 million m^3. The Zayandehroud irrigation region soil texture is mostly heavy with sand and gravel.

Study Method

After stands selection, in each stand, 30 2-are sample pcs (20×10m) were randomly selected. The sample pcs were so selected not to lie in the stand margin and tend to be inside the stand. The length of sample pieces was measured in parallel with the (Zayandehroud) river course and the width of sample pcs was measured normal to the river course. In each sample piece, the diameter of all the trees was measured using a diameter gage tape & the height of all the trees was measured using a Sonto gradiometer.

Both stands are submersible irrigated once a week. The distance of both stands from the river bed is 10m. Both sands were nearly flush with a very low slope. From the center of each sample pc up to the depth of 30 cm, the soil was sampled in order to identify soil conditions. In each sample pc, quality studies such as species freshness, crown & trunk qualitative conditions & quantitative parameters (diameter at breast height total height, diameter at breast height & volume) were then conducted. elongation coefficient in terms of diameter at breast height & the number in the diametrical & height layers were also studied. SPSS (Analysis of variance tests & Analysis of *LSD*) and Excel Statistical software's was used for analysis

RESULTS

Relation between elongation coefficient (stability) & diameter at breast height of the trees:

The stand coefficient of stability (elongation) was obtained by dividing the stand average height by relevant average diameter at breast height using the following Eq.:

$$Fn = \frac{h \times 100}{d}$$

In this Eq., Fn= coefficient of stability (elongation) of the stand, h = average height in m & d = average diameter at breast height in cm. In the Shirazi poplar stand sizes estimated from the model show that this sp becomes very instable up to the diameter of 14 cm (h/d>100), from 14 to 30 cm., it becomes instable (80<h/d<100) and from the

dia of 30 cm onwards , it becomes stable (h/d<80). In the mixed stand of common & Lombardy poplars, the sp. becomes very instable up to dia 18 cm (h/d>100) , from 18 to 30 cm diameter, it becomes instable (80<h/d<100) & from diameter 30 cm onwards, it becomes stable (h/d<80). Elongation coefficient for the Shirazi poplars pure stand turned out to be 87.58% & for the Shirazi- Lombardy poplars mixed stand, elongation coefficient turned out to be 95.59%.

Number curve in the diametrical/ height classes:

The curve of the diametrical & height classes' number was calculated for the 2 stands the results of which will follow: Number curve in the Shirazi poplar pure stand diametrical class's shows that it has an isoage (isochrone) structure. Yet, with time elapse, competition and interference in the stand, the curve has deviated to the right. This shows that some of the trees have exited the stand in the previous years and the curve has undergone skewness the coefficient of which is +0.99 that illustrates a high level of skewness. Accordingly the number curve in the common poplar pure stand height classes shows that the curve has an isoage (isochrone) structure with a skewness level of + 0.58 which is low and the curve is nearly normal. The number curve in the Shirazi- Lombardy poplar mixed stand shows that it has an isochoric (isoage) structure. Yet, with time elapse, competition & interference in the stand, the diagram has deviated to the right and has undergone skewness the coefficient of which is +1.22 This illustrates a high level of skewness. Accordingly, the number curve of height classes for the mixed stand shows that the curve has an isoage structure with a coefficient of skewness of 0.1 which is less.

Figure 1: Number curve in the Shirazi poplar pure stand height classes

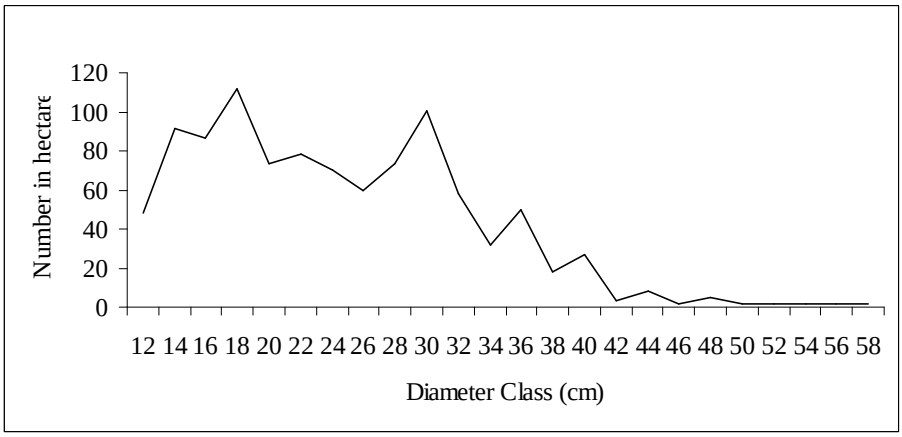

Fig.2: Number curve in the Shirazi poplar pure stand diametrical classes

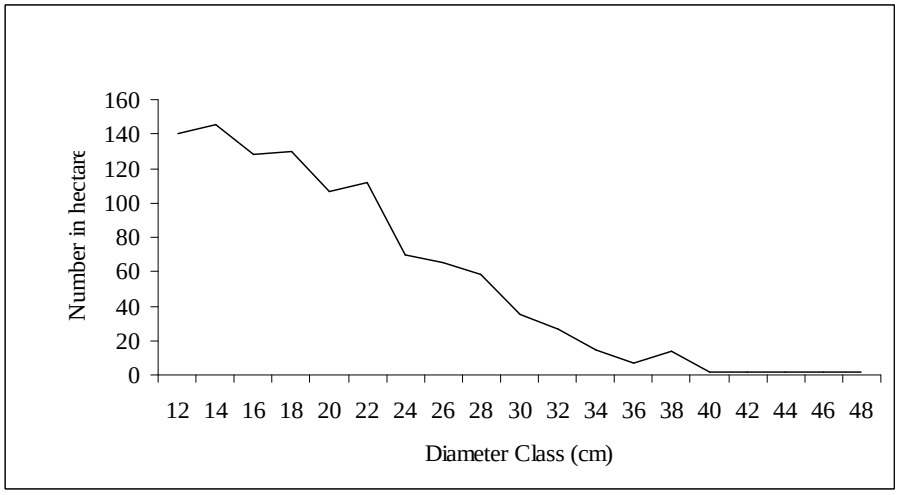

Figure.3: Number curve in the Shiazi-Lombardy poplar mixed stand diametrical classes

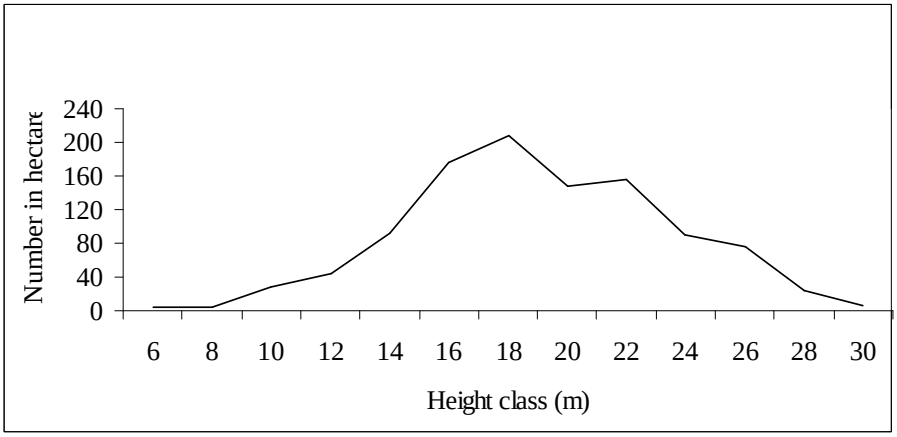

Figure.4: Number curve in the Shirazi-Lombardy poplar mixed stand height classes

Comparison of quantitative parameters of the Shirazi-Lombardy poplar spp. in the stands under study

Mean diameter

Mean diametrical growth for the pure Shirazi poplar stand: 26.36 cm
Mean diametrical growth for the mixed Lombardy & Shirazi poplars: 22.02 cm
Mean diametrical growth for the Shirazi poplars in the mixed stand: 22.44 cm
Mean diametrical growth for the Lombardy poplars in the mixed stand: 20.98 cm

Mean height

Mean height growth for the pure Shirazi poplar stand: 23.09 cm
Mean height growth for the mixed Lombardy & Shirazi poplars: 21.05 m
Mean height growth for the poplars in the mixed stand: 21.31 m
Mean height growth for the Lombardy poplars in the mixed stand: 20.42 m

Mean cross section

Mean cross section growth for the pure Shirazi poplar stand: 55.44 m^2/hectare
Mean cross section growth for the Lombardy & Shirazi mixed poplar stand: 39.42 m^2/hectare
Shirazi poplars: 29.32 m^2/hectare
Lombardy poplars: 10.11 m^2/hectare

Mean bulk (volume)
Mean bulk (volume) growth for the pure Shirzai poplars stand: 679.06 m^3
Mean bulk growth for the mixed Lombardy & Shirazi poplar stand: 430.06 m^3/hectare
Shirazi poplars: 323.81 m^3/hectare
Lombardy poplars: 106.24 m^3/hectare

Details of elongation coefficient (stability) of the Shirazi-Lombardy poplar spp. in the stands under study
Pure Shirazi (common) Poplar**:** Instable (87.58%**)**
Shirazi-Lombardy Poplar mix: Instable (95.59%)
Shirazi poplar in the mixed stand**:** Instable (94.95%**)**
Lombardy poplar in the mixed stand**:** Instable (97.30%**)**

Details of quantity /hectare & viability% of the Shirazi-Lombardy poplar spp. in the stands under study
QNT/hectare
(pcs of trees)
Pure Shirazi (common) Poplar: 1003.33
Shirazi-Lombardy Poplar mix: 1060
Shirazi poplar in the mixed stand: 753.3
Lombardy poplar in the mixed stand: 306.65

Validity %
Pure Shirazi (common) Poplar: 37.6
Shirazi-Lombardy Poplar mix: 39.75
Shirazi poplar in the mixed stand: 39.73
Lombardy poplar in the mixed stand: 39.75

Soil analysis in the Shirazi poplar pure stand & Shirazi- Lombardy poplar mixed stand

Table 1: Pol Kaleh region Shirazi poplar pure stand soil characteristics

Sample depth	Elec. conductivity	Acidity	%	%	%	P	K	Gypsum%	%	%	texture
Cm	mmohs/cm	Soil	Lime	Organic matters	N	ml.×kg	ml.×kg	Gravel	Silt	Clay	Soil
0-30	0.96	7.65	26	0.94	0.09	15.8	303	32	40	28	Clay

Table 2: Karchegan region Shirazi- Lombardy poplar mixed stand soil characteristics

Sample depth	Elec. conductivity	Acidity	%	%	%	P	K	Gypsum%	%	%	texture
Cm	mmohs/cm	Soil	Lime	Organic matters	N	ml.×kg	ml.×kg	Gravel	Silt	Clay	Soil
0-30	1.1	7.94	21	0.91	0.06	14.5	298	29	40	31	Clay

Gravel

Table 6: Variance analysis for the Shirazi Poplar pure stand & the Shirazi-Lombardy mixed stand

		Sum of Squares	Degrees of Freedom	Mean squares	Level of Significance
Diameter	Between groups	8103.705	3	2701.235	52.941**
	Inside groups	85362.305	1869		
	Total	103466	1872	51.023	
Height	Between groups	1781.339	3	593.780	27.751**
	Inside groups	39991.103	1869		
	Total	41772.443	1872	21.397	
Elongation Coefficient	Between groups	29975.864	3	9991.995	27.633**
	Inside groups	675826.032	1869		
	Total	705801.895	1872	361.598	
Cross section	Between groups	0.139	3	0.046	46.12**
	Inside groups	1.611	1869		
	Total	1.750	1872	0.001	
Volume	Between groups	31.154	3	10.385	56.135**
	Inside groups	345.903	1869		
	Total	377.058	1872	0.185	

*** Shows that the factor under consideration is significant at 2 levels of 1% & 5% (Variance analysis tables were similar at 2 levels of 1% & 5% and are significant at both levels).*

"Between groups" means the Shirazi poplars pure stand, the Shirazi-Lombardy poplars mixed stand, Shirazi poplar in the mixed stand & Lombardy poplar in the mixed stand. "Inside groups" means error. In the LSD test, it was known that regarding parameters of dia., height, cross section, volume & coefficient of elongation, the following groups are different with each other at 2 levels of 1% & 5%:

1-The Shirazi poplars pure stand with the Shirazi Lombardy poplars mixed stand
2-The Shirazi poplars pure stand with Shirazi poplars in the mixed stand.
3-The Shirazi poplars pure stand with the Lombardy sp. in the mixed stand. In the other groups, no significant difference was seen.

Shirazi –Lombardy poplars qualitative conditions:
The Shirazi poplars in the pure stand do not have cavities, extra branches & trunk node, with no significant numbers of trunky branches & bifurcation on the trunk. Regarding pest attack & degeneration, the pure stand Shirazi poplars were badly infected with willow weevil. Regarding outer appearance, they were relatively fresh with the general form of the tree being an open crown. The branches make an angle of 45º and above with the main trunk with a completely full crown. In the mixed stand, the Lombardy poplars have a shorter trunk than the Shirazi ones. The Shirazi poplars in the mixed stand do not have cavities, extra branches & trunk nodes. Yet, bifurcation on the trunk was relatively significant. About 5% of the common poplars were infected with pests which had caused their breakage & degeneration, the pests being willow weevils & wood boring worm. The other tress were however relatively fresh with a symmetric, full crown. The Lombardy poplars did not have cavities. Yet, they had extra branches and trunk nodes, with no cylindrical trunks, unlike the Shirazi poplars. Regarding pest infection & degeneration, they did not have any problem, with the general form of the trees being a closed crown. The barks of the 2 spp. are fully different with each other: Lombardy poplar has a coarse, gray bark when young, and at older ages, it gains a dark bark with large grooves, mainly vertical, whereas common poplars have bright milky white, thin & smooth barks with small eyelets. At older ages, their barks become light brown to green with big eyelets with a relatively smooth surface. Thickness difference in bark between the 2 spp. is significant at higher ages, the difference being up to 90 mm which causes tangible variations in the cut-down trees pure wood bulk.

DISCUSSION AND CONCLUSION

The number of hectare
The net muster of black poplar comprises 1003.33 trees in one hectare which, regarding the primary distance of cultivation (m 2.5×1.5) and the primary number of saplings cultivated in one hectare which was 2666.66, the percentage of their survival is 37.6%. The mixed muster of black poplars and poplars comprises 1060 trees in one hectare which, regarding the primary distance of cultivation (m 2.5×1.5) and the primary number of saplings cultivated in one hectare which was 2666.66, the percentage of their survival is 39.73%. The number of poplars in the mixed muster of black poplars and poplars is 309.7 trees in one hectare which the percentage of their survival is 39.75%. (Bagheri et al. 2001) through a quantitative and qualitative inspection of the poplar-cultivated region of Zanjanrood which comprised the two species of white poplar and black poplar , concluded the graph of the numbers of regional trees didn't enjoy a natural status. The reason is the transition of the trees from the low diametrical class to the high ones and non-cultivating and substituting the young trees.

The white poplar trees don't exist having the diametrical class of more than cm 45; meanwhile the black poplars are seen having diameters more than cm 50. The reason is the long-living of the black poplars and their more appropriate diametrical growth in their higher ages in comparison with the white poplars which the results are approximately in concordance with this research. Regarding the above mentioned results and ecological nature of black poplars and poplars' species and their ecological needs, we may conclude the primary distance of cultivation was low resulting in species' server competition which resulted in the gradually overcome and omitted. Also some factors such as wind, storm, and snow were the other impressive factors on reducing the percentage of the their survival. The number reduction in net muster of black poplars in comparison with the mixed one of black poplars and poplars was also higher.

Mean diameter
Tree diameter is one of the most important factors in determining the bulk & stature in forest stands and is easily measurable. A forest trees diametrical growth depends on edaphic (such as soil texture, structure & chemical compounds), climatic (precipitation, temp.), growth period length, nature, species, plantation interval and sp.

original conditions. For heliophyte trees, at the beginning of plantation, trees distance is set lower. As their age increases & growing operations develop, plantation interval is gradually increased. Upon removing deformed & attacked trees, conditions become optimized for the better growth of the remaining trees [10]. In the Shirazi poplar pure stand, mean diameter was calculated to be 26.36 cm with confidence limits ± 0.51 (confidence %95). In the Shirazi-Lombardy poplars mixed stand, mean diameter was calculated to be 22.02 cm with confidence limits ± 0.392. In this mixed stand, the Shirazi poplars mean diameter was calculated to be 22.44 cm with confidence limits ± 0.49 cm. Accordingly; the Lombardy poplars in the mixed stand had a mean dia. of 20.98 cm with confidence limits ± 0.61 cm.

[12]. concluded In a comparative analysis of pure and mixed poplar- cypress forest plantation at 16 years of age in Amol forests forested region in Haraz western forestry project, the mean dia. of 15 cm was obtained for pure poplar trees. Also, mean dia, in the mixed stand was calculated to be 11.55 cm. In the mixed stand, a mean dia. of 11.2 cm was obtained for the poplar trees, and a mean dia. of 11.9 cm was obtained for the cypress trees in the mixed stand. Regarding the results obtained, the Shirazi poplars pure stand can be said to be better in terms of mean dia. than the Shirazi-Lombardy poplars mixed stand. Regarding the results of similar researches, Shirazi poplars can be said to have a slower growth at earlier stages with a lower growth than Lombardy poplars and display their growth priorities at higher ages especially under natural conditions.

Mean height

In the Shirazi poplar pure stand, the mean height of 23.09 m was obtained with confidence limits ± 0.31m (confidence 95%). In the Shirazi- Lombardy poplar mixed stand, the mean height of 2.05 m was obtained with confidence limits ± 0.25 m (confidence 95%). In this mixed stand, the mean height of 21.31 m was obtained for Shirazi poplars with confidence limits ± 0.31 m (confidence 95%). Also, the Lombardy poplar in the mixed stand had a mean height of 20.22 m with confidence limits ± 0.47 (confidence 95%).

In a comparative analysis of pure & mixed poplar- cypress forest plantation at 16 years of age in Amol forests forested region and plantation interval 2×2m, (Jalali et al., 2003) obtained the following results: A mean height of 15.9 m for pure poplars, mean height of 10.3m in the mixed stand, a mean height of 11.9 m, and a mean height of 8.7 m for the mixed stand poplar & cypress tress in the mixed stand, respectively. In a quantitative, qualitative analysis of Zanjanroud region poplar plantations, [4] concluded that though, out of 90% of the region poplar stands, 60% were the Shalak sp. & 30% were the Shirazi sp., the poplars enjoy more optimal height & diametrical growth so that the total height of the region Shirazi poplar is max 25m, whereas the total height of Shalak poplars is 22.4 m. Regarding the results obtained, the Shirazi poplar pure stand can be said to be prior to the Shirazi – Lombardy poplar mixed stand in terms of mean height and to have a considerable height. Also, Shirazi poplars have an acceptable mean height relative to Lombardy poplars. This fact is confirmed by comparing the results of conducted researches.

Mean cross section

Like diameter, cross section is precisely & easily measured and is also a good index for stands density [1]. Cross section variation can, in the course of time be a good predictor for stand growth & intercuts. The combination of trunk quantity / hectare and cross section can be the best and the simplest criterion for stand density measurement. Cross section growth is the result of cross section increase in each stem & the number of stems in area unit, influenced by the habitat fertility & age of the stand. In the Shirazi pure poplar stand, a mean cross section of 55.44 m2 /hectare was obtained with confidence limits ± 0.4 (confidence 95%). In the Shirazi- Lombardy mixed stand, a mean cross section of 39.43 m^2/ hectare was obtained with confidence limits ± 0.0024 (confidence 95%). In the mixed stand, Lombardy poplars had a mean cross section of 10.11 m^2/hectare with confidence limits ± 0.0026 (confidence 95%). The results obtained show that the Shirazi poplars pure stand has a good mean cross section, and compared with the results of other researches in this regard, the Shirazi poplar pure stand is reckoned a good habitat.

Stature bulk

As dia. and height increase, trees bulk develops too. The knowledge of stature bulk & stand volume growth are one of the most important & the most basic measurable factors in forest plantation projects whose objective is to successfully administer the forest. The Shirazi poplar pure stand stature bulk in the region under study at 30 years of age was calculated to be 679.06 m3/hectare with confidence limits ± 2.0041m^3 (confidence level 95%). The Shirazi-Lombardy poplars mixed stand stature bulk was calculated to be 430.06 m^3/hectare with confidence limits ± 1.636 m^3 (confidence level 95%). The Shirazi poplar, mixed stand stature bulk for Shirazi poplars was calculated to be

323.81 m^3/hectare with confidence limits ± 0.033 m^3 (confidence level 95%). The Lombardy poplars stature bulk in the Shirazi- Lombardy poplars mixed stand was calculated to be 106.24 m^3/hectare with confidence limits ± 0.037 m3 (confidence level 95%).

[15] studied the wood production level of 20 colonies of P. nigra poplars in Oroumieh with plantation interval 4×4m within 1984-1994 & concluded that colonies P.nigra 62.54 & P. nigra 75.56 had the highest production level with 27.56 m3/ hectare & 25.70 m^3/hectare, respectively & advised the same figures to farmers for poplar planting in the region. [11] studied 9 colonies of P. nigra poplars within 7 years (1993-1999) on Kermanshah Gamasyab River Lands & concluded that at plantation interval 3×3 m, only 2 colonies P. nigra 62.71 & P. nigra 63.135 had the highest wood production level with production 27 m3/hectare & 25.79 m^3/ hectare, respectively. Results analyzation shows that the Shirazi poplars pure stand in the region under study has an acceptable production regarding the age of the stand. Also, having a lower production level relative to Shirazi poplars, Lombardy poplars have an acceptable production compared with relevant stand age regarding researcher's results.

Study of elongation coefficient (stability) of the stands under study

The rate of stability coefficient in the Shirazi poplars pure stand in the region under study was calculated to be 87.58% at 30 years of age. This coefficient was calculated to be 95.59% for the Shirazi- Lombardy poplars mixed stand, 94.95% for the Shirazi-Lobardy poplars mixed stand Shirazi poplars & 97.30% for the Lombardy poplars in the mixed stand. Regarding the values obtained, the Shirazi poplars pure stand, the Shirazi-Lombardy poplars mixed stand & the Shirazi- Lombardy poplars in the Shirazi-Lombardy poplars mixed stand are instable (80<h/d<100) according to [5] classification. The relation of dia. at breast height & coefficient of stability showed that stability coefficient has a descending course relative to dia. at breast height. The major causes of these high coefficients are low plantation intervals & competition for gaining enough light. These factors lead the heliophyte spp. to obtain a diametrical growth in proportional to the height growth & trees with a high height & low diameter are vulnerable to environmental conditions such as snow & wind. Accordingly, the high level of stability coefficient portrays that these stands have not been thinned at a proper age. In a comparative analysis of poplar- cypress mixed & pure forestry plantation at 16 years of age in Amol forests forested region with plantation interval 2×2m, [12] obtained a stability coefficient of 106% for the pure poplar stack, a stability coefficient of 106.25% for the poplar trees in the mixed stand & 73% for the cypress trees in the mixed stand. Also, in experimenting adaptation & studying poplar different colonies wood production level in Karaj with plantation interval 2×2 m at 14 years of age, [8] obtained an elongation coefficient of 90.72% for the native P. alba 88.75% for the non native P. nigra & 83.83% for the native P. alba poplars. Regarding the result obtained, any reform interference in the stands under study at the above mentioned age will cause more instability in the stands & being collapsed by wind in the trees in the stands under study.

Study of diameter at breast height-height relation

Measurement of the stand trees height is a must of forest census in order to estimate wood volume, determine habitats index & dynamism of forest stand, etc. The assessment of the above mentioned indices involves proper diameter-height models. Model $h=-0.013\ d^2 + 1.203\ d + 0.561$ with correlation r=0.82 is more able to characterize the diameter-height relation in the Shirazi poplar pure stand in the region under study at 30 years of age. Also, in the Shirazi-Lombardy poplar mixed stand, model $h= 0.015d^2 +1.220d+1.750$ with correlation r=0.76 for the Shirazi poplars in the Shirazi-Lombardy poplars mixed stand model $h=0.0152d^2+1.195d+2.3312$ with correlation r=0.758, and for the Lombardy poplars in the Shirazi-Lombardy poplars mixed stand, model h=12.74Ln(d)-18.38 with correlation r=0.779 are better able to characterize the dia. – height relation in the region under study at 30 years of age. Since in isoage stands, height curve is displaced at different ages, or in another word, it changes in the course of time [20], the above mentioned relations are thus valid at 30 years of age.

Study of the region soil

Soil texture is moderate to heavy in both stands. Yusefi et al. concluded in 2002 that the best soil for poplar plantation should have a proper compound of gravel, silt & clay the clay of which should not exceed 20%-30%. Accordingly, poplars are vulnerable to acidic sour soils. Results of the region soil tests show that the Shirazi poplars pure stand soil has 28% clay & the Shirazi-Lombardy poplars mixed stand soil has 31% clay. In terms of clay, the pure stand soil thus has a lower value with conditions being better than in the mixed stand. Both stands soil is in the alkaline range. What is nowadays clear from the poplar plantation conditions of the region under study is that the Shirazi poplar sp. has been the original choice of the region poplar planters & that after the elapse of many years, that sp. still constitutes 80% of the region trees. Since Lombardy poplars are not so fit for plantation in vast stands

nor are they native to Esfahan, the Shirazi poplars plantation has received the most attention by poplar planters. Due to low viability & slow growth at the sapling stage, the plantation of Shirazi poplars in the region was not later so welcomed. Yet, such trees significant diametrical, height growth, especially after saplings stages & apparent optimal situation of the remaining stems, caused the poplar planters to appreciate the values of this species, so that nowadays, the existing poplar plantations tend to be of this sp. Precise, Scientific opinion on Shirazi poplars growth priorities depends on the study of age- dia. relation. In this research, efforts have been made to deal with the 2 species characteristics by selecting similar age & plantation interval in the 2 Shirazi poplars pure & Shirazi-Lombardy poplars mixed stands. These characteristics display undeniable priorities of Shirazi poplars compared with Lombardy poplars. Trunky Lombardies often suffer from defects which decrease the value of their wood, whereas common poplars less suffer from such defects the reason of which an be attributed to common poplars more toleration of negative factors especially in irrigation conditions. Accordingly, due to having a thinner bark, poplars receive more attention by poplar wood traditional purchasers in the region. In spite of poplars low growth rate at sapling ages, this sp. shows its growth priorities especially under normal conditions at higher ages. This situation is observed in collection base research colony selection populetum, mother base collection & poplar different spp. adaptation projects which have also been conducted in Iran's poplar research centers, so that under optimal conditions, the growth of spp. P. deltiodes March & P.X. euramericana (Dode) Guiner & even P. nigra L. is more optimal and quicker than that of sp. P. alba L. However, with the happening of problems & failures in growth conditions especially in the rate & frequency of irrigation, the above mentioned spp. are severely hurt. This applies while poplars display more toleration to these negative conditions. Of course it is mentionable that poplar different spp. are much different with each other [4]. Since poplar plantation has faced crisis in the region & parts of relevant lands are annually allocated to agriculture & other applications, and on the other hand, waters flowing in the river are preferentially transferred to agriculture cultivations, considerations such as the spp. water demands, certain quantity of available water, man forces required for care operations, plantation proper conditions, regional conditional, existing facilities & long-term programming should be regarded. From what preceded, it is found that Shirazi poplars development in the region can enhance production yield & bring about more income to poplar planters. Regarding poplar planter's problems & bottlenecks in regularly irrigating poplar plantation stands Shirazi poplar development seems to be a proper choice. Presentation, propagation and instruction of proper spp., plantation scientific novel methods & harvest of poplar, importance of poplar plantations on the river bank & application of reasonable, continuous scientific management can protect & expand rivers margins poplar plantation stands and play an important role in enhancing Iran's wood production with no pressure on forests domains. Regarding the precious environmental values & support of agricultural lands, urban installations, roads & industrial units by poplar plantations stands against the risks of seasonal floods and in order to qualitatively, quantitatively increase production in area unit that causes more fascination to poplar plantations & protection of these stands by the residents , through comprehensive researches, species appropriate to plantation in the region should be identified and advised to provide more quality wood production and fulfill the required environmental value.

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