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The effect of soil type on basal area and volume growth of *Populus* deltoides in east of Guilan province

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ABSTRACT: This study deals the effect of soil properties on basal area and volume growth of Populus deltoids in two region of East Guilan province in IRAN. Therefore, to identify of soil type and measure the physical and chemical properties of soil in each region, three soil profiles were drilled and described and samples were transported to the laboratory. To measure the basal area and volume growth per unit area in each of these regions, the quantitative characteristics of Populus deltoids was fully measured in three transects 33x20 meters. The results showed that all quantitative parameters measured of poplars was higher in alluvial soils than forestbrown soils and were significantly different at the 95% confidence level. Due to the low rate of apparent and particle specific gravity, clay and C/N percent in the alluvial soil of the forestbrown soils and the higher porosity, silt and active nitrogen percent of the soil in the alluvial soils of the forest brown soils, basal area and volume growth of *Populus deltoids* were higher in the alluvial soils. In total, alluvial soils, being rich in organic matter, favorable water supply conditions, lighter texture and higher permeability with better aeration can well be used for poplar plantation and lack of proper growth poplar stands can be considered a heavy texture and a high percentage of clay.

Keywords: Populus deltoids, alluvial soils, forestbrown soils, basal area and volume growth

INTRODUCTION

Generally, Populus trees has a fast growing, deciduous and high economic value, they are 30 different species and provenance, as well as some cultivars. Throughout the temperate regions of the Northern Hemisphere, some species of the genus to large forest provenances and others can be found in restricted provenances near rivers and valleys wet (Ghasemi, 1996). Poplars are very dependent on water content and soil nutrient, and the importance of soil and its characteristics in poplar plantation as in most studies, is called as one of the main factors for the success or failure of poplar plantation (Hedaiati, 2000). In order to maximize the rate of growth of poplar, understanding the relationship between the growth rate of the trees and the soil's ability to supply needed nutrients and water are very important (Kelly and Ericsson, 2003). Due to the lower level and the exploitation of forests and increase in timber imports in recent decades, in order to meet the needs of wood, Forests organization has moved widespread culture of poplar especially in the Northern Province. Researchers have tried to raise the production of fastgrowing trees such as poplar and many researches have been done on the effect of soil on the growth poplar plantation. Tufekoghlu et al., (2003) in a study on poplar afforestation stated that some soil properties such as texture, pH, nitrogen, phosphorus, etc. affect the growth of poplar stands. Kia daliri et al (2004), in a study on the effect of soil type (grey-brown Podzolic

with organic matter, forestbrown, grey-brown Podzolic and Pseudogley) on qualitative and quantitative characteristics of Populus X. euramericana (Dode) guinier concluded that grey-brown Podzolic with organic matter and forestbrown are the most suitable soil types for cultivation and development of poplar in the region. Krinard and Johnson (1984), in a study near the Mississippi River on Silty-loamy soil concluded that the planting of Populus deltoids after 20 years, the highest growth rate of average volume obtained with 57.21 meters per hectare per year. Salehi et al (1391), in a study examined the effects of soil and groundwater physical property on the quantity and quality of poplar plantation in Gisum region of Guilan and concluded that poplar stands on soils with lighter textured, lower groundwater, and better aeration and infiltration there are in better condition and have better growth. Currently, P.euramerican and P.deltoides species are cultivated in large areas of Guilan and Mazandaran provinces (Asadi, 1380). Although Guilan with more than 6000 hectares area poplar plantation, it is the eighth province country (Bahri, 1371). But, due to a serious need wood-related industries in the province and government policies emphasis to reduce the exploitation of forests, more than ever felt the importance of planting trees with early return species such as poplar. Basic knowledge of the quantitative and qualitative results of poplar plantation the last three decades in different contexts of Soil in Guilan and north of the country is inevitable.

However, this study deals the effect of soil type on basal area and volume growth of *Populus deltoids* in two flat region of East Guilan.

MATERIALS AND METHODS

Regions of study located in Series 2 Gamble between 49°59' to 50°7' east longitude, 37°5' to 37°12' north latitude and poplar Research Station Safrabasteh with 49°57' north longitude, 37°19' north latitude. The regions are minimum and maximum height of 50 to 250 meters above sea level, the average rainfall is 1186 mm and the mean annual temperature is $17.5^{\circ C}$. For this research, the two poplar plantation areas were selected by a distance of 4x4 meters and due to the appearance

similarity of physiographic conditions of transects (Slope, aspect, elevation) a total of six soil profiles was drilled. After digging profiles, some soil physical and chemical properties such as soil texture, apparent and particle specific gravity, porosity percent, pH, EC, CEC, O.C, N, P and K of soil were measured. In each of these pieces, a complete inventory of poplar trees in three transects 33x20 cm was performed, that a total of 209 poplar trees in the above area were measured. The annual basal area and volume growth of trees with given the masses poplar plantation age was calculated. The calculations and statistical analysis of the characteristics of soil types using the software SPSS17 was done.



RESULT

The soil profiles results in poplar plantation regions show that in Series 2 Gamble soil consists of four distinct layer of soil to a depth of (20-0 first layer, the second layer 40-20, third layer 80-40 and fourth layer 120 to 80 cm) and in Safrabasteh two distinct layer at a depth of approximately 30-0 first layer and the second layer is 120-30 cm. Characteristics of the soil in the study area can be seen in Table 1.

Safrahastah	Series 2	Characteristics			
Sanabasten	Gamble				
alluvial	forestbrown	Soil type			
	Α				
А	Bt	Harizon			
B _c	B _{ct}	HOHZOH			
	С				
	Loamy				
Sandy Clay	Clay Loamy				
Loamy	Silty	Soil texture			
Sandy Clay	Clay Loamy				
Clay					
1.00	1 4 4	apparent specific density			
1.33 1.44		(g/cm ³)			
		particle specific density			
2.21	2.27	(g/cm^3)			

Table 1: Characteristics soils in the studied regions.



Fig. 2. Compare and significant level of 0 to 30 cm layer of soil physical properties in the area

The results showed that clay and silt percent, saturated moisture content and particle density of the two regions together are significantly different at 99% confidence level (Fig. 2) that amount of clay, silt and sand layers of soil in the Safrabasteh area were 17/20, 5/53 and 33/26 percent and Gamble area equal to 2/33, 5/39 and 5/27 percent, respectively.

According to results, the amount of clay in Gamble is greater and amount of silt in Safrabasteh is greater than Gamble regions. The results of the soil chemical properties in the study region show that pH, soil nitrogen content and the ratio of carbon to nitrogen are significantly different which can be seen in Table 2.

	Table 2: Soil chemical	properties between	two stands of <i>Populus</i>	<i>deltoids</i> at two study area
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	OC/N	OC (%)	N (%)	P (mg/ kg)	K (mg/ kg)	CEC	EC (µSiemens/cm)	рН
Gamble	41.158	1.086	0.063	7.26	190.64	24.58	0.436	6.42
Safrabasteh	7.409	0.908	0.148	0.2	101.79	20.44	0.329	8.07
Standard error	12.887	0.503	0.043	3.811	54.72	5.046	0.084	.310
t	1.843	0.353	-1.979	1.852	1.624	0.82	1.285	- 5.335
Significant level	0.05 *	0.72 ns	0.05 *	0.08 ns	0.12 ns	0.42 ns	0.21 ns	/000 ^{**} 0

**: significantly different in 99%, *: significantly different in 95%, ns: No significant

The results showed that basal area and volume growth rates between the two stands of poplar have a significantly different at the 95% confidence level and the annual height growth is no significant difference.

Average annual basal area growth and Average annual volume growth in Safrabasteh with alluvial soils (1.258 $_{m2/ha/year}$ and 18.7 $_{m3/ha/year}$ respectively) was more than Gamble with forest brown soils (0.074 $_{m2/ha/year}$ and 16.7 $_{m3/ha/year}$ respectively) (Table 3).

Table 3: Non-paired t-test results of the quantitative parameters be	etween the two stands studied of <i>Populus</i>
deltoides	

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Sig.	t	Standar d error	df	Unit	Areas of study (Safrabasteh- Gamble)
.027*	1.682	0.048	159	(m ² / ha)	Average annual basal area growth
.039 *	0.352	0.492	159	(m ³ / ha)	Average annual volume growth

*: significantly different in 95%,

DISCUSSION AND CONCLUSIONS

Given the favorable conditions of soil permeability and aeration in Safrabasteh than Gamble because of the lower apparent and particle density of soil, clay content of soil and the higher porosity percent and silt content of soil that there is a significant difference, annual growth of basal area and volume in Safrabasteh were more than to Gamble. Habibi Kaseb in 1371 stated that soil texture and structure is able to play an important role in the nutrition and growth of plants, because well-balanced structure and texture makes suitable pores that on the one hand, provides air required for root respiration and activity of soil microorganisms and on the other hand, provides water supply adequate moisture for plant growth. Salehi et al., (2012) also founded that poplar stands on lighter textured soils; better soil permeability and aeration are in better condition and have better growth. Tufekcioglu et al in 2005 lack of proper growth poplar stands of their study, due to heavy texture and a high percentage of clay and as a result of poor soil aeration and drainage. As was observed in the results, chemical factors such as the percentage of soil active nitrogen in Safrabasteh is more than Gamble region which will have a significant impact on the growth of poplar trees. The C/N amount in Safrabasteh region is much less than the Gamble, this reflects the high content of nitrogen in the soil in Safrabasteh region .Habibi (1992) acknowledged the role of soil active nitrogen in leaves that low soil nitrogen causes yellow leaves before time and developed rooting trees to search nitrogen in soils which reduces the growth of the plant. Tufekcioglu (2003) in a study on poplar forestation stated that some soil properties such as texture, pH, nitrogen, phosphorus, etc.

Affect the growth of poplar stands. Soil texture is one of the most important factors of growth and root development, which plays an important role in the absorption of minerals. The results of this study indicate that texture type of soils in Safrabasteh & Gamble are alluvial and forestbrown, respectively. For this reason, growth in the Safrabasteh region was better than the Gamble due to alluvial and deep (120 cm) of soil. Habibi kaseb in 1371 stated that alluvial soils because they are rich in minerals and in the water supply are favorable and can be used as well for poplar plantation. For poplar plantation with high efficiency should be used to alluvial soils with a thick layer of Silt or Silty Clay to a depth of at least one meter which could raise water by capillarity put the plant, in the dry season. Finally, you can spend not so much time but look closely at some of the work, at the appropriate location in relation to soil properties, act to good yields poplar in the northern plains. That based on these results it is important.

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