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Evaluation diameter at breast height (D.B.H.) and height growth of *Populus deltoides* in alluvial and forest brown soils in Guilan province

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ABSTRACT: Study the effect of soil properties on diameter at breast height (D.B.H.) and height growth of *Populus deltoides* in two region in east of Guilan province (Gamble and Safrabasteh). Therefore, for the detection and measurement of soil physical and chemical properties in each region, three excavated soil profile, description and samples were transported to the laboratory. To measure the D.B.H. and height growth per unit area in each of these areas, the quantitative characteristics of *Populus deltoides* one hundred percent in the three transects were measured 33 x 20 meters. The results showed that all parameters measured quantitatively by fir trees on alluvial soils, brown forest soils was higher than the 95 percent confidence level are significantly different. The results showed that all parameters measured quantitatively by popular trees on alluvial soils, brown forest soils were higher than the 95 percent confidence level are significantly different. A total of alluvial soils, being rich in organic matter, water supply conditions are favorable, lighter texture and permeability with better ventilation can be used well for popular stands. And lack of proper growth Populus stands can be considered a heavy texture and a high percentage of clay.

Keywords: *Populus deltoids,* Soil, Alluvial, Forest brown, diameter at breast height (D.B.H.) and height 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 fast-growing trees such as poplar and many researchers 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, forest brown, 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 forest brown 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, 2001).

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 diameter at breast height (D.B.H.) and height growth of *Populus deltoids* in two flat region of East Guilan province.

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.

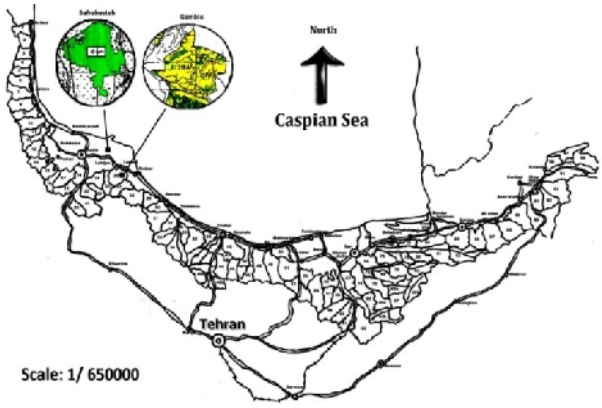

Fig. 1. Regions of study.

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°C. For this research, the two poplar plantation areas were selected by a distance of 4 x 4 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 33 x 20 cm (total height, D.B.H.) was performed, that a total of 209 poplar trees in the above area were measured. The annual D.B.H. and height 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 of the study showed that the series 2 popular stands in soil Gamble has four distinct layers with depth (0-20 (A), 20-40 (B_t), 40-80 (B_{ct}) and 80-120 cm (C)) with Forest Brown soil and in Safrabasteh has two layers with an approximate depth of the 0-30 (A) and 30-120 cm (B_c) with Alluvial soil respectively. Soil texture type of Gamble area were Loam, Clay Loam Silty, Clay Loam and Clay with depth increase and soil Texture type of Safrabasteh area were Sandy Clay Loam and sandy clay with depth increase. Apparent specific density (g/cm^3) was 1.44 in Gamble area and 1.33 in Safrabasteh area. Particle specific density (g/cm^3) was 2.27 in Gamble area and 2.21 in Safrabasteh area. The results showed that the percentage of clay and silt, saturated moisture content and bulk density of the region is significantly different than the 99% confidence level rate of clay, silt, soil Safrabasteh the first layer, respectively, 17.20, 53.5 and 26.33 percent, respectively Gamble in 33.2, 39.5 and 27.5 percent. Based on the results of the silt and clay content in more Gamble was greater than in Safrabasteh. 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 1.

Table 1: Soil chemical properties in study areas

	Areas of study		Standard error	t	Sig.
	Gamble	Safrabasteh			
pH	6.42	8.07	0.310	-5.335	0/000**
EC (µS/cm)	0.436	0.329	0.084	1.285	0.21 ns
CEC	24.58	20.44	5.046	0.82	0.42 n.s
K (mg/kg)	190.64	101.79	54.72	1.624	0.12 n.s
P (mg/kg)	7.26	0.2	3.811	1.852	0.08 n.s
N (%)	0.063	0.148	0.043	-1.979	0.05 *
C (%)	1.086	0.908	0.503	0.353	0.72 n.s
C/N	41.158	7.409	12.887	1.843	0.05 *

**: significantly different in 99%,
*: significantly different in 95%,
n.s: Non significant

The results showed that D.B.H. 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 D.B.H. growth and Average annual height growth in Safrabasteh with alluvial soils (2.41 $_{cm/ha/year}$ and 192 $_{cm/ha/year}$ respectively) was more than Gamble with forest brown soils (1.68 $_{cm/ha/year}$ and 185 $_{cm/ha/year}$ respectively) (Table 2).

Table 2: Non-paired t-test results of the quantitative parameters between the two stands studied of *Populus deltoids.*

Sig.	t	Standard error	df	Unit	Areas of study (Safrabasteh- Gamble)
0.038 *	0.351	0.492	159	(Cm/ha/year)	Average annual DBH growth
0.20 ns	1.105	51.52	159	(Cm/ha/year)	Average annual height growth

*: significantly different in 95%, ns: non-significant

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 diameter at breast height (D.B.H.) and height 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 forest brown, 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 1992 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. The results of this study showed that soil type and Gamble Safrabasteh respectively are alluvial and brown forest. Habibi in 1992 stated that the alluvial soils are rich in minerals and are suitable for the water supply and can be used as well to popular plantation. Plantations of poplar for high efficiency should be at least one meter deep alluvial soils with silt or Silty clay texture in the dry season can be used to provide water to the plant. Be more careful in choosing the right location for planting and proper performance of popular in relation to soil properties in the plains of northern Iran.

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