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ORIGINAL ARTICLE

Change on Soil Carbon after Afforestation with different tree species, a case study: Safrabasteh, Iran

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ABSTRACT
The conservation of native broadleaf forests to exotic forest plantation is occurring in northern of Iran. Impacts of this land-cover change on soil carbon are beginning to investigate. This study examines the effects of Populus caspica, Populus deltoids 77/51, Alnus glutinosa, Alnus subcordata and Taxidium disticum on soil carbon in Safrabasteh region, Astaneh Ashrafieh, 20 years after plantation establishment. For each land cover and replication, the two soils samples (0-20 cm and 20-40cm) sampled around each tree. Some soil properties such as bulk density, pH, organic carbon and texture examined. The results showed that bulk density of soils did not significantly differ among tree stand and soil depth, but pH and content of clay and organic carbon significantly differ between treatments. We concluded that Taxidium plantation in this region can increase soil organic carbon more than other tree stand.
Keywords: *Carbon sequestrations, Land cover change, broadleaf forest*

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INTRODUCTION

Feedbacks between plants and soil are a potential driver of plant community and ecosystem dynamics [7]. It has been suggested that plant species can control soil physicochemical properties such as soil pH, moisture and C-to-N ratio [1]. To evaluate the potential importance of plant-soil feedbacks in forest ecosystems, it is fundamental to understand the spatial range within which plant species control soil physicochemical and microbial properties, as well as the strength of plant controls over soil properties [8].

Sequestering C in biomass and soils is widely believed to be an effective method to mitigate global climate change caused by the rising atmospheric carbon dioxide concentration. Carbon Sequestration resulting from incremental forest management, afforestation and reforestation are eligible for receiving C credits under the Kyoto protocol [8]. Afforestation/reforestation projects have the potential to remove a significant amount of CO2 from the atmosphere in the short and medium term, and can be deployed relatively rapidly and at a moderate cost [3]. The objective of this study was to investigate changes in soil C storage following plantation with different tree species.

MATERIALS AND METHODS

Safrabasteh region (37○ 19 N, 49○ 57E) located in Gulian province in the north of Iran. The mean annual precipitation and air temperature are 1600 mm and 20°C respectively. Composite soil samples (0-20 and 20-40 cm depth) were collected from corner and center of each replicate. The treatments was *Populus caspica, Populus deltoids 77/51, Alnus glutinosa, Alnus subcordata* and *Taxidium disticum* that had 20-years-old. Soil samples air dried and passed from two mm sieve. Particle-size distribution (using the hydrometer method), soil pH (in 1:2.5 soil suspension) and organic carbon [6] were determined. Bulk density was estimated using the core method described by Karla and Maynard [4]. Statistical analyses were conducted using SAS statistical software [9] as CRBD. The significance of differences was determined with Tukey's confidence half-interval at the significance level P = 0.01.

RESULTS AND DISCUSSION

Bulk density

By analyzing the amount of B.d of soil under different land cover, it became evident that the difference between the B.d values of soil under different tree species and soil depth was not significant (Table 1).

Clay Content

The results of the ANOVA showed that the influence of land cover change and soil depth on the amount of soil clay is significant (Table 1). Comparing the mean value of this particle revealed that the most and least amount of clay exists in soils under *Populus deltoides* and *Alnus subcordata* plantation respectively (Fig. 1). The amount of clay content was significantly higher in surface soil than other (Fig.2).

Soil pH

The type of plant cover did not have a significantly meaningful effect on the amount of soil pH (Table 1), but the depth of soil samples had significant effect on soil pH (Fig. 3).

Organic Carbon

ANOVA results revealed that the type of plant cover has significant effects on amount of O.C of soil (Table 1). A comparison of means showed that *Taxidium* plantation has had a significant and positive effect on the amount of O.C of soil compared to other treatments (Fig. 4). Also amount of soil %O.C decreased significantly with increasing soil depth (Fig.5).

Table 1. Analysis of variance of some soil properties in different land cover

S.O.V	DF	MSE			
		B.d	Clay	pH	O.C
Block	2	$0.7^{n.s}$	$1.81^{n.s}$	$0.008^{n.s}$	$0.006^{n.s}$
Land cover	4	$0.5^{n.s}$	74.89^{**}	$0.12^{n.s}$	8.24^{**}
Soil Depth	1	$0.2^{n.s}$	175.21^{**}	0.31^{**}	26.43^{**}
Land cover*Soil Depth	4	$0.3^{n.s}$	83.4^{**}	$0.53^{n.s}$	2.64^{**}
Error	18	0.21	5.44	0.5	0.86

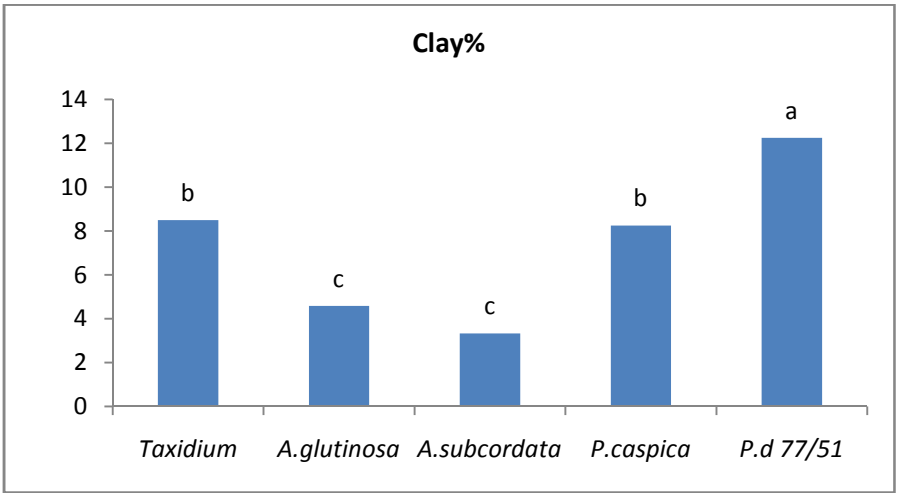

Figure 1. Effect of tree species on %clay content of soil

Although in most of the reported studies after clear cutting for creating new forest the amount of organic material in soil faced a decrease [5, 7] but in the experimented soil, no decrease was observed. Parfitt et *al* [5] observed that the amount of organic material in *Pinus radiate* planted soil has significant difference compared to rangeland. In their opinion the organic material decrease of mineral soils is compensated by the return of litters into soil. In the early years of the stand development in forest ecosystems, the amount of produced plant litter are of almost no value due to low biomass and also low decomposition rate of litters. Therefore in the early stages of stand development, the amounts of organic material leftover of mineral soils decrease intensively [2]. After the completion of canopy, an increase amount of plant leftovers and litter are gathered in the soil surface and due to soil organism activities, are partially mixed with higher soil horizons. Therefore the decrease of organic material in the surface horizon of these soils is less than the lower horizons. Considering that each species of land cover has a different influence on soil, these changes can due to different chemical compositions of plant organs and the rate at which they decompose. With regard to the greater influence of *Taxidium* on amount of soil O.C that has been

observed in regions that were studied, it can concluded that after more study and research, *Taxidium* can planted for increasing sequestration of carbon in same sites.

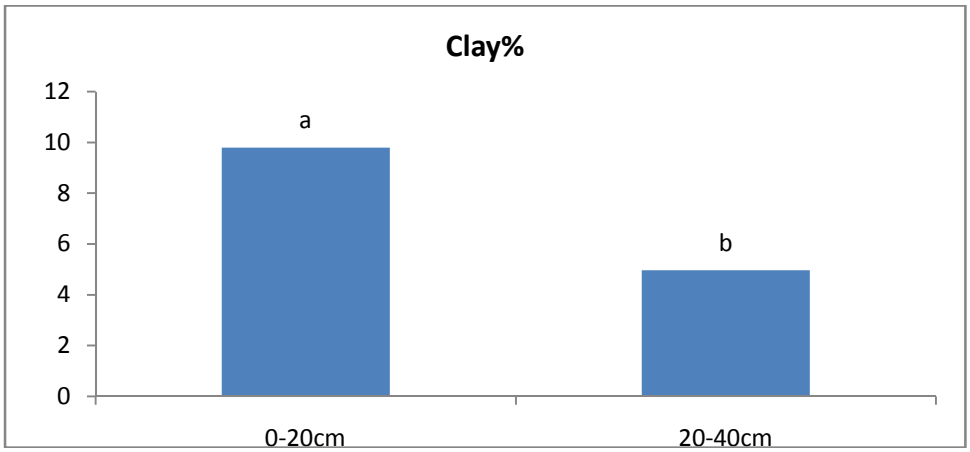

Figure 2. Effect of soil depth on %clay content

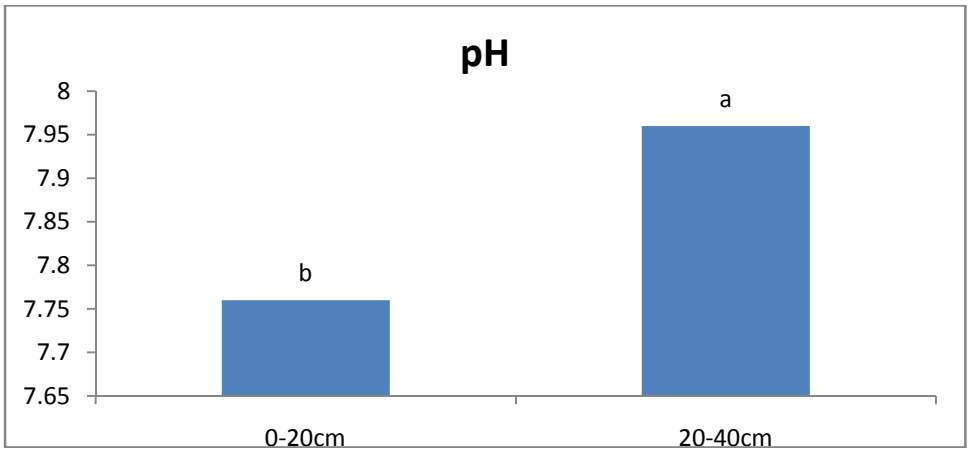

Figure 3. Effect of soil depth on soil pH

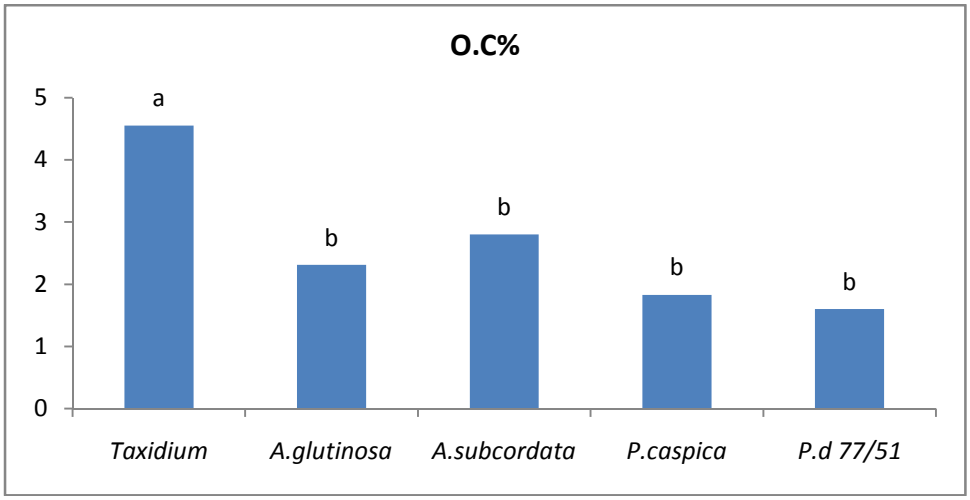

Figure 4. Effect of tree species on %O.C content of soil

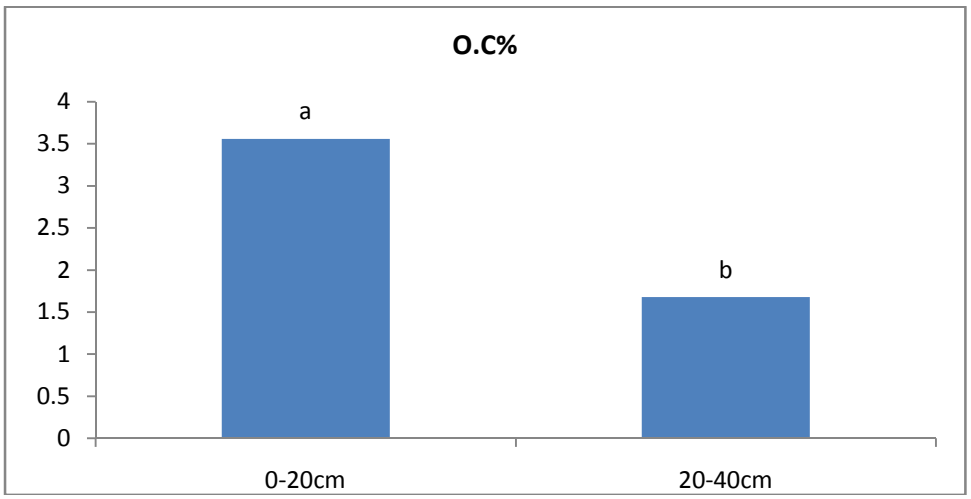

Figure 5. Effect of soil depth on amount of soil %O.C

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