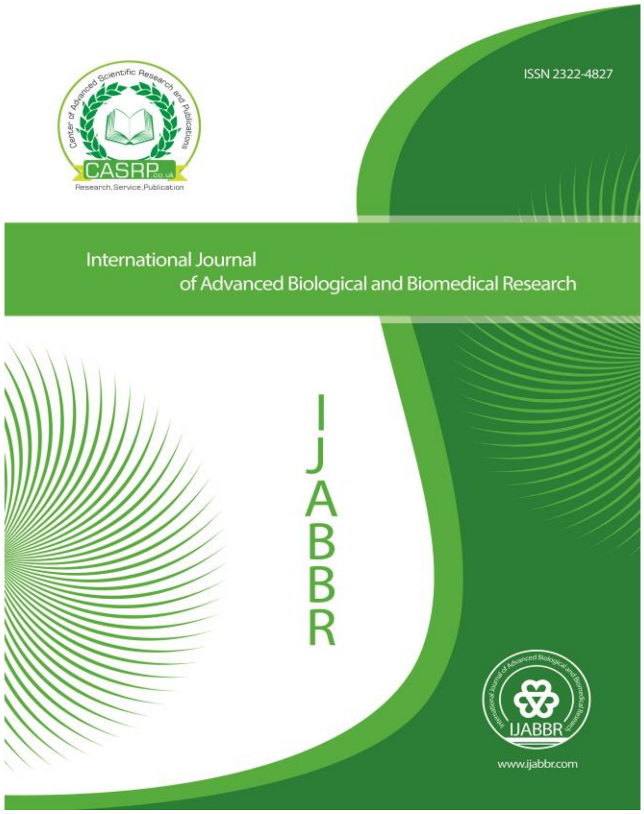
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Soil Changes Induced by Hardwood and Coniferous Tree Plantations Establishment: Comparison with Natural Forest Soil at Berenjestanak lowland Forest in North of Iran

Aboulghasem Yousefi[1]*, Leila Darvishi[2]

[1]Department of Forestry, Faculty of Natural Resources, University of Agriculture and Natural Resources of Mazandaran, Iran.

[2]Department of Rehabilitation of Arid and Mountainous Regions, Faculty of Natural Resources, University of Tehran, Iran.

Abstract

Increasing urbanisation and industrialisation have led to a dramatic reduction in forest area, and now only culturally protected remnants of natural forests and some new plantations remain in most areas of the north of Iran. To investigate the status of the chemical and physical characteristics of soil under these remnant forests and assess the possible impacts of reforestation on soil properties in the plantation forests, soils at 0-10, 10–20, and 20–30 cm depths were sampled from four tree plantations 22 years of age and it covers 42ha, composed of *Pinus brutia* L., *Populus nigra* L., *Acer velutinum* Boiss and *Fraaxinus excelsior* L. species, which is located in the South of town of Ghaemshahr in Berenjestanak lowland forest in the North of Iran, where there was remnant natural forest, and soil pH_{Kcl} and pH_{H2O}, total nitrogen, soil organic matter (SOM) and soil organic carbon (SOC) contents, exchangeable cations (Ca, Mg and K) contents and saturation moisture were determined. Results showed that the amount of SOM of the first layer of the soil profiles in all forest types was greater than the other two layers. Furthermore, Soil pH was significantly lower in *Pinus brutia* L. plantation than the other forest types at 0-10 cm of soil depth. A positive value for ΔpH demonstrate the presence of negatively charged clay colloids and the cation exchange capacity is higher than the anion exchange capacity .Soil exchangeable K and Ca contents were significantly lower under plantation forests than under natural forest in all layers, whereas exchangeable Mg contents showed little difference between types of forests. Moreover, contents of all exchangeable cations except

***Corresponding author:** Department of Forestry, Faculty of Natural Resources, University of Agriculture and Natural Resources of Mazandaran, Iran.

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Mg showed a significant decrease with depth. The value of soil moisture in the topsoil was higher than in the subsoil in all the categories of the natural forests and the tree plantation studied. The comparison indicated that the tree plantation conducted in this region must be forwarded to mixed forest under tending operations instead of monoculture to enhance and improve soil physicochemical statues.

Keywords: Berenjestanak, Soil changes, Exchangeable cations, Soil moisture, Plantation.

1. Introduction

Existing statistic and information all over the country of Iran indicate that representing about 91% of total forests consists of degraded forests (73.2% of West forests, 12.5% of South forests and 4.5% of North forests) which do not have ability of wood production (Fattahi, 1994). Among this, forest areas in the north of Iran during past 30 years had declining trend, in a way that only during ten years (from 1986 to 1996) about 140000 ha (7%) reduced (Resaneh et al. 2001). Regarding that each year natural forest areas in the north of Iran reduced due to destruction and intense logging and on the other part need to woods had increasing trend due to improvement of population, therefore plantation with native species and exotic ones for rehabilitating degraded forests and providing requirements of society is necessary for our country (Yousefi et al. 2010). On one hand, plantation and its replacement instead of degraded natural stand due to having its special characteristics, affect physico-chemical characteristics of soil and improve and restore some of the ecosystem services including the physical, biological and biogeochemical processes (Li et al. 2012; Berger et al. 2009; Malchair and Carnol, 2009; Prescott and Vesterdal, 2005). Knowledge on soil characteristics serves as one of the main principles of forest management and forestry by which many silvicultural options including species selection, habitat fertility determination, stand growing rate and required storage area in forest, survival percent prediction and seedlings growing and development are affected (Daniel et al. 1979). Different tree species growing on similar sites often differ in productivity, canopy structure and the quality and quantity of litter. Thus Different tree species are often associated with different soil properties. Tree species differ in their effects on soil properties and biogeochemical cycles. There are many papers dealing with the effects of different tree species on the chemical and physical characteristics of soil (Finzi et al. 1998; Haghen-Thoren et al. 2004; 2006, Vesterdal et al. 2008; Antunes et al. 2008; Luan et al. 2010; Vesterdal et al. 2013). According to Augusto et al. 2002, overstory composition significantly influences the physical, chemical and biological characteristics of topsoil and the impact of a tree species on soil fertility varied depending on the type of bedrock, climate and forest management. Nevertheless, the effect of the canopy species on soil fertility was rarely significant enough to promote forest decline. Studies by Smolander and Kitunen 2011 indicated that silver birch (*Betula pendula* Roth), Norway spruce (*Picea abies* (L.) Karst) or Scots pine (*Pinus sylvestris* L.) affects soil microbial activities related to C and N cycling. Arsalan et al. 2010 reported that that tree species and forest management practices play important roles in N cycling in forest ecosystems. Diaz-Pinez et al. 2011 studies revealed that Differences in SOC stocks between tree species were mainly due to the particulate organic matter (not associated to mineral particles). Therefore, it is important to consider the influence of tree species composition on the storage and stability of SOC at a given site, as it may inform forest management towards for practices that increase the quantity and long-term stability of the SOC stocks. According to results on literatures, it can be inferred that tree species impose various impacts on soils involving changes in soil biological, physical and chemical properties among others. Specially, forest plantation yield relies on soil nutrients, in turn, change by management activities and species type so that species composition and forest productivity under different stands is associated closely to different soil properties. On the other hand, there is increasing demands to evaluate soil properties mostly due to controversial management issues on forest ecosystem yield sustainability (Fisher and Binkley, 2000; Binkley and Giardina, 1998; Antunes et al. 2008; Binkley et al. 2000). Getting good knowledge and better understanding in how different species affect soil conditions and what kinds of mechanism make change on it, may promotes decision and policy makers and also managers ability to predict species impacts on ecosystems specially forest plantations and subsequently their forthcoming management. Analogical evaluation of some tree species growing on similar sites provides comprehensive understanding on interspecies differences under similar nutritional and habitat conditions (Hagen-Thorn et al. 2004, 2006). The main objective for the ingoing study is to investigate and compare various effects of endemic and exotic afforested hardwood and coniferous tree species as widely used trees on forest tree plantations in north of Iran, on the chemical and physical characteristics of soil. Results obtained in the present research can be used to planning future forest plantation planning in similar and fertile lands in north of Iran and choosing suitable tree species proportional to their negative an positive impacts on soils properties mainly through identification of hardwood and coniferous tree species long term impacts on plantations area soils.

2. Materials and methods

2.1. Site descriptions

Study areas are located in Berenjestanak lowland forest in the Southern of Ghaemshahr city (36° 23′ 30" N and 52° 54′ 30" E, respectively) (Figure 1). This study was carried out in four tree plantations, 22 years of age and cover 42 ha and in surrounding degraded mixed hardwood natural forest. The plantations composed of *Pinus brutia* L., *Populus nigra* L., *Acer velutinum* Boiss and *Fraaxinus excelsior* L. species. These plantations were planted in 1987. The altitude at the plantation site ranges from 180 to 220 m, and the slope varies between 0 and 30%. Mean annual precipitation and temperature are 1043.6 mm and 14°C, respectively. Edaphically, soil consists of semi heavy (Clay Loam) to heavy texture (Clay and Silty-Clay) with weak drainage and pH ranges from 5.9 to 7.7 in the studied compartments (Yousefi et al. 2010).

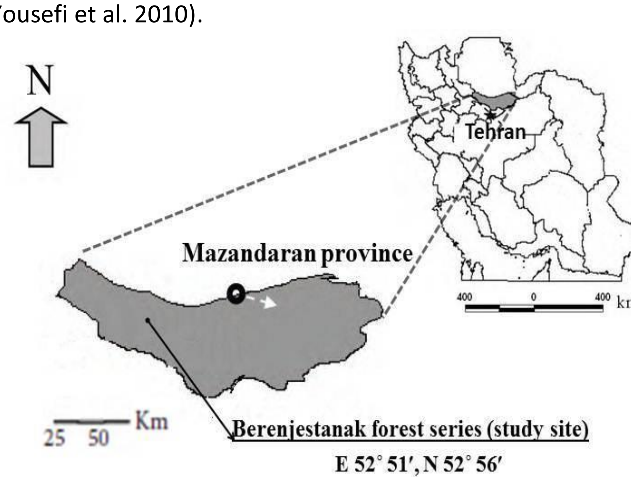

Fig. 1. Location map of studied area at Berenjestanak lowland forest in Mazandaran province, north of Iran.

2.2. Soil sampling

Soil samples were collected at the end of April 2010 in four tree plantation and natural forest. Four undisturbed samples from each forest type were taken from 0−10, 10-20 and 20-30 cm depth of four soil profiles by a hand spade. These soil profiles were placed randomly in each plot at the same level of altitude, Aspect and slope (Table 1). The trail was conducted under the design of Randomized Complete Blocks (RCB) with five replicates. Thus, we compared soils from these different vegetation types to clarify soil properties changes during the conversion from natural forest to these tree plantations.

2.3. Soil analyses

In the laboratory, large live plant material (root and shoots) and pebbles in each sample were separated by hand and discarded. Soil samples were dried and screened with a 2 mm screen (aggregates were broken to pass through a 2 mm sieve to remove roots prior to chemical analysis. The following factors were determined in the soil samples: pH potentiometrically in H_20 (1:2.5 ratio) and in 1M Kcl. Delta pH was calculated as pH_{H2O}-pH_{KCL} (Tan, 2010). Exchangeable base cations (Ex-K, Ex-Ca, and Ex-Mg) were extracted with 1M ammonium acetate buffered at pH 7, and their concentration was determined by atomic absorption spectrophotometry. The method of Walkley and Blacky that utilizes oxidation of organic carbon by potassium dichromate ($K_2Cr_2O_7$) in acid medium was used for the detection of soil organic carbon (SOC) and soil organic matter (SOM) (Burt, 2004). The total nitrogen was measured using a semi Micro Kjeldhal technique (Bremner and Mulvaney, 1982). Also saturation Moisture was determined by the weighting method.

2.4. Statistical analyses

Kolomogrov-Smirnov test showed that soil data were followed of normal distribution. The differences among the five forest types at every 10 cm from 0 to 30 cm soil profile regarding the examined soil parameters (pH_{Kcl} and pH_{H2O}, total nitrogen, organic matter and organic carbon content, exchangeable cation (Ca, Mg and K) were tested by one-way analysis of variance (ANOVA). Different groups were determined by the Tukey HSD test, and similar groups were designated with the same letters and different groups with different letters. The treatment averages for different parameters were tested at $p \leq 0.05$. SAS v. 9.1 for windows software was used for all statistical analysis.

Table 1
Site characteristic features and physiographic factors of study plots in the plantations and natural forest at Berenjestanak lowland forest in north of Iran

Forets type	Elevation (m)	Aspect	Slope (%)	Canopy (%)
Acer velutinum Boiss	210	Western	15	80
Populus nigra L.	194	South western	7	75
Fraaxinus excelsior L.	200	Southern	10	85
Pinus brutia	200	South western	15	80
Natural forest	210	Southern	10	70

3. Results and discussion

3.1. Differences in soil pH among soil depths and forest types

The pH of the soil and that of its solution tends to affect the ability of the soil to either retain or release chemical properties of soil. Unlike water, soil has two pH values; the pH of the soil matrix known as (pH_{KCl}) and that of the soil water matrix (pH_{H2O}). The (pH_{KCl}) is often regarded as the pH of the soil because it takes into account all the physical and chemical characteristics (Asuma, 2012). Consequently the pH_{KCl} is used in this study as the pH of the soil. On the other hand, a measure for the net charge status of the soil is delta pH (∆pH), referring to the difference between pH_{KCl} and pH_{H2O}. The pH_{H2O} exceeded the pH_{KCl} in all layers a positive value for ∆pH indicates the presence of negatively charged clay colloids and the cation exchange capacity is higher than the anion exchange capacity (Tan, 2010; Pansu and Gautheyrou, 2006). Investigate of pH_{KCl} values in respect of different soil layers for each forest types separately showed that in *Fraaxinus* and *acer* plantations was significant difference between 1, 2 and 3 layers ($P < 0.05$) so that the amount of soil acidity at the all forest types decreased when the soil depth increased. Other forest types did not show significant difference (Table 2, Figure 2a). Results of soil depths comparisons between tree plantations and natural forest of the present study, suggested that there were significant difference in the first layer among the forest types regarding pH_{KCl} content ($P < 0.01$) (Table 3, Figure 3a). The amount of pH_{H2O} however did not show significant difference in none studied soil depths in forest plantation and natural forest separately and between forest types as well.

3.2. Differences in total N, SOM and SOC among soil depths and vegetation types

Comparison of different soil layers in studied forest types with respect to amount of N indicated that there was significant difference between the first layer with the other two layers in *Fraaxinus* plantation and also between 0-10, 10-20 and 20-30 cm depths in *Acer, Pinus* plantations and natural forest ($P < 0.05$) (Table 2, Figure 2c). Studies on control area and tree plantations showed that the vegetation types influenced significantly on N content at 10-20 cm in depth in soils of different forest types ($P < 0.05$) (Table 3, Figure 3d). There was no significant difference with respect to the others soil depths.

Tabel 2

Source of Variation	Df	Mean Square: pH Kcl	pH H_2O	N (%)	OM (%)	OC (%)	K (ppm)	Mg (ppm)	Ca (ppm)	SP (%)	
Profile	3	0.07*	0.009^{ns}	0.002^{ns}	1.34^{ns}	0.45^{ns}	8988.87*	7787.73^{ns}	295065.36^{ns}	103.33^{ns}	*F. excelsior*
Depth	2	0.39**	0.04^{ns}	0.03*	13.58**	4.61**	33578.7**	1912.96^{ns}	1158284.21**	327.58*	
Error	6	0.01	0.11	0.002	1.18	0.39	1348.48	6941.01	66639.12	39.91	
R-Square		0.93	0.14	0.81	0.81	0.81	0.92	0.39	0.89	0.8	
Profile	3	0.65**	0.15^{ns}	0.006^{ns}	2.65^{ns}	0.90^{ns}	301495.54**	25752.65*	398467.12*	66.30^{ns}	*A. velutinum* Boiss
Depth	2	0.84**	0.01^{ns}	0.03*	13.51^{ns}	4.55^{ns}	59472.91^{ns}	37098.88*	1149103.573**	378.08*	
Error	6	0.05	0.04	0.005	2.66	0.90	23729.82	3996.65	41579.87	53.63	
R-Square		0.92	0.65	0.70	0.68	0.68	0.87	0.86	0.93	0.74	
Profile	3	0.15^{ns}	0.08**	0.007^{ns}	3.29^{ns}	1.11^{ns}	6658.09*	8285.88**	293018.75^{ns}	142.08^{ns}	*P. nigra* L.
Depth	2	0.13^{ns}	0.03^{ns}	0.006^{ns}	2.58^{ns}	0.87^{ns}	27498.89**	1211.58^{ns}	3886002.33**	213.25**	
Error	6	0.04	0.006	0.002	1.05	0.35	1021.38	646.80	468150.67	10.91	
R-Square		0.72	0.88	0.73	0.70	0.70	0.92	0.87	0.75	0.92	
Profile	3	0.61**	0.10*	0.005^{ns}	2.42^{ns}	0.81^{ns}	1987.21^{ns}	13031.08*	2667283.01**	235.66*	*P. brutia* L.
Depth	2	0.01^{ns}	0.03^{ns}	0.02*	9.48*	3.21*	3583.00^{ns}	1847.08^{ns}	233504.36^{ns}	270.75*	
Error	6	0.01	0.01	0.002	0.89	0.30	711.86	2302.84	170854.15	36.75	
R-Square		0.94	0.78	0.82	0.82	0.82	0.75	0.75	0.89	0.84	
Profile	3	1.37*	0.52**	0.01^{ns}	6.29^{ns}	2.13^{ns}	15004.28^{ns}	9716.38^{ns}	1122151.40^{ns}	92.30^{ns}	Natural forest
Depth	2	0.42^{ns}	0.05^{ns}	0.07*	31.24*	10.55*	60083.54^{ns}	11366.33^{ns}	7095594.61*	917.58*	
Error	6	0.22	0.04	0.01	4.76	1.60	14595.52	8422.22	725361.16	137.13	
R-Square		0.78	0.86	0.74	0.73	0.74	0.65	0.50	0.80	0.71	

Table3.

ANOVA for soil properties in relation to soil depth in different tree plantations and natural forest

Source of Variation	DF	Mean Square: pH Kcl	pH H_2O	N (%)	OM (%)	OC (%)	K (ppm)	Mg (ppm)	Ca (ppm)	SP (%)	
Stand	4	0.48**	0.05^{ns}	0.009^{ns}	4.39^{ns}	1.48^{ns}	41729.01**	2742.94^{ns}	6904423.40**	91.92^{ns}	0-10 cm
Profile	3	0.12^{ns}	0.05^{ns}	0.01^{ns}	8.50^{ns}	2.87^{ns}	9232.59^{ns}	1021.23^{ns}	213371.11^{ns}	199.86^{ns}	
Error	12	0.08	0.05	0.01	4.85	1.64	5961.31	4647.69	873915.47	116.49	
R-Square		0.69	0.37	0.41	0.42	0.42	0.73	0.20	0.72	0.40	
Stand	4	0.17^{ns}	0.06^{ns}	0.008**	3.87**	1.31**	14567.65^{ns}	11044.91^{ns}	1699316.55^{ns}	147.42^{ns}	10-20 cm
Profile	3	0.22^{ns}	0.03^{ns}	0.0007^{ns}	0.32^{ns}	0.11^{ns}	15261.21^{ns}	4141.94^{ns}	477190.26^{ns}	44.33^{ns}	
Error	12	0.28	0.11	0.001	0.66	0.22	9987.37	9060.75	498606.58	47.62	
R-Square		0.27	0.19	0.67	0.67	0.67	0.46	0.34	0.57	0.55	
Stand	4	0.31^{ns}	0.04^{ns}	0.001^{ns}	0.56^{ns}	0.19^{ns}	51726.06	63185.77**	2998432.98**	16.32^{ns}	20-30 cm
Profile	3	0.41^{ns}	0.05^{ns}	0.005^{ns}	2.40^{ns}	0.81^{ns}	39785.15^{ns}	7258.04^{ns}	145902.04^{ns}	116.45^{ns}	
Error	12	0.33	0.13	0.002	0.96	0.32	32667.28	10484.46	348651.00	44.82	
R-Square		0.38	0.17	0.46	0.45	0.45	0.45	0.68	0.74	0.43	

⁎⁎ Different is significant at the 0.01 level, ⁎ Different is significant at the 0.05 level , (ns): Non significant differences ($P > 0.05$),
OM: Organic matter, OC: Organic carbon, SP: Saturation moisture

SOM: individually comparison of different soil depths in forest plantation and control forest indicated significant difference between 0-10 cm with the other soil depths in *Fraaxinus* plantation ($P < 0.05$). Also significant difference was observed among soil depths of 0-10, 10-20 and 20-30 cm in *Brutia* plantation and control area ($P < 0.05$) (Table 2, Figure 2d). As for different soil layers among forest types, there was significant difference between SOM content in the second layer of forest plantation and control forest soils ($P < 0.01$) whereas *Brutia* and *Acer* plantations had the highest and lowest amount respectively (Table 3, Figure 3e). Table 2: ANOVA for soil properties of study area (forest types) in different soil depths

SOC: comparing results obtained showed that SOM content was significantly between the first layer to those 10-20 and 20-30 cm depths in *Fraxinus* plantation ($P < 0.01$) and soil depths of 0-10, 10-20 and 20-30 cm in *Brutia* plantation and control area ($P < 0.05$) (Table 2, Figure 2e). Among studied types, SOC amount significantly differed in the second layer of soils ($P < 0.01$) (Table 3, Figure 3f). This was not case for other layers.

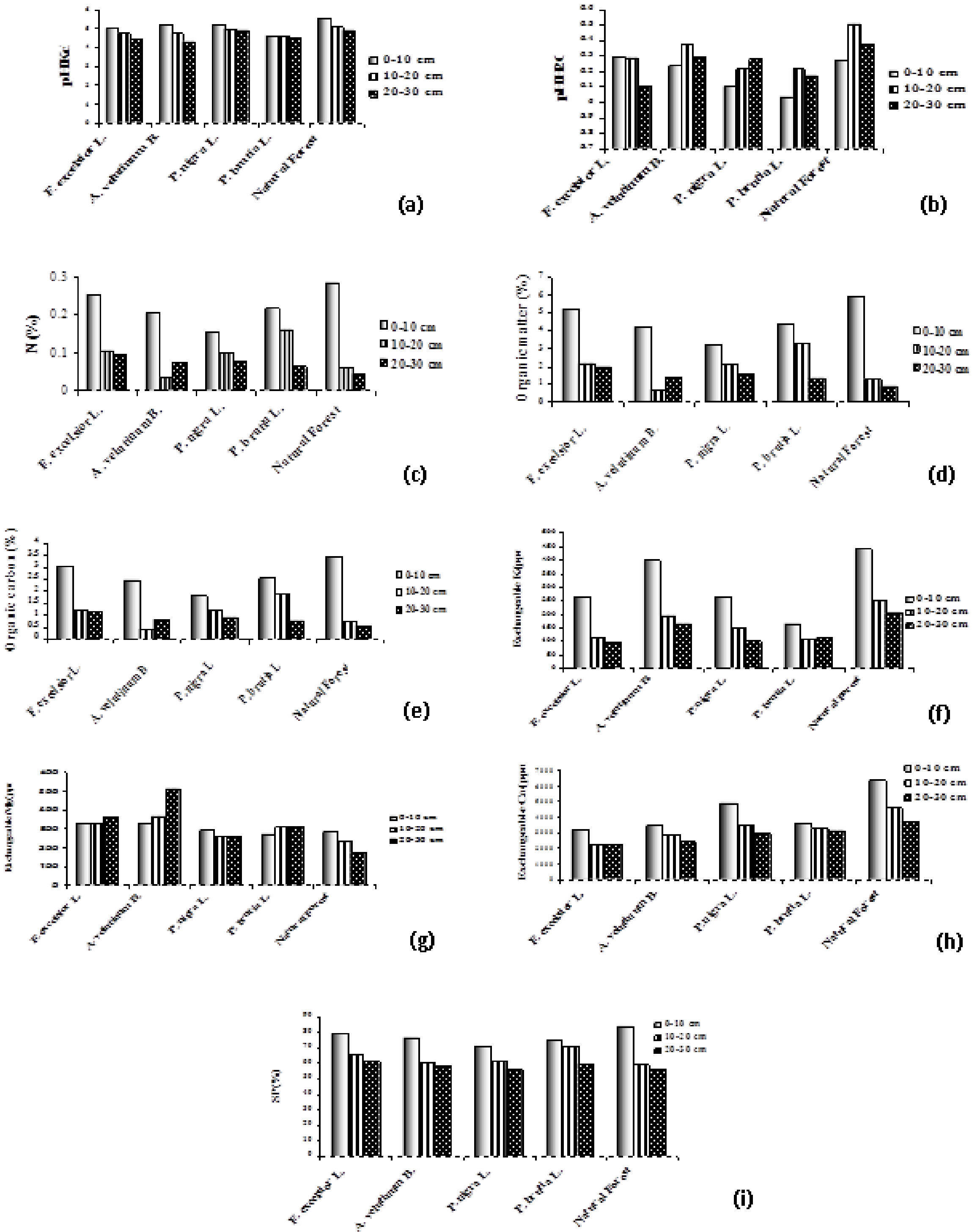

Fig. 2. mean values of physicochemical properties of soil at three soil depths in relation to different forest types.

SP: Saturation moisture

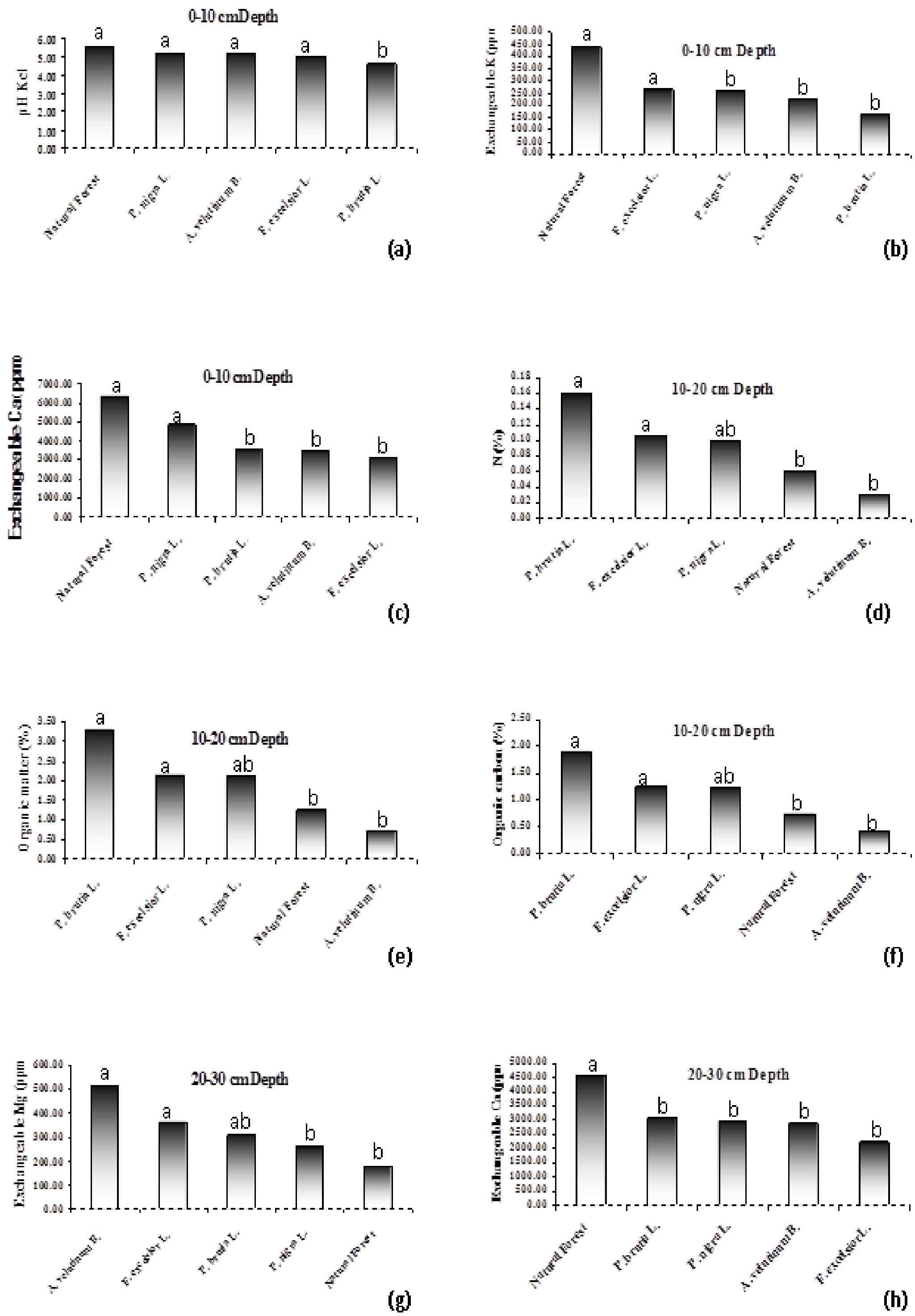

Fig. 3. Mean values of physicochemical properties of soil in different forest types in relation to soil depths. Similar groups were designated with the same letters and different groups with different letters

3.3. Differences in nutrient stocks among soil depths and vegetation types

EX-K: Comparison of different soil layers individually under each forest types, exhibited significant difference between 0-10 cm depth to those 10-20 and 20-30 cm depths in *Fraaxinus* and *Populus* plantation ($P< 0.01$) (Table 2, Figure 2f). Similarly, comparison of results for different soils depths among five types indicated that in terms of EX-K amount, there was significant difference between forest plantations and control forest at soil depth 0-10 cm ($P < 0.01$) (Table 3, Figure 3b). for other soil depths, the same was not true.

Ex-Mg: Investigation of Ex-Mg content in different soils layers individually for each given types showed that just in Acer plantation, there was significant difference between 20-30 cm to those 0-10 and 10-20 cm ($P < 0.05$) such that as soil depth increased, Ex-Mg increased too (Table 2, Figure 2g). Comparison of forest plantation and natural forest impacts on Ex-Mg content for various soils layers indicated that there was significant difference in soil depth of 20-30 cm among the forest type ($P < 0.01$). The highest amount of this element was related to *Acer* plantation in this layer compared to the other types (Table 3, Figure 3g).

Ex-Ca: Comparison among different soil depths in the vegetation types individually showed that significant difference between the first layers to those second and third in *Fraaxinus* plantation and also between soil depths of 0-10, 10-20 and 20-30 cm in *Acer* plantation ($P < 0.01$). Also, there was significant.

difference between strata 1, 2 and 3 in vegetation types ($P < 0.05$) (Table 2, Figure 2h). Ex-Ca content was significantly different in probability level of $P < 0.01$ among studied forest types (Table 3, Figure 3h).

4. Discussion

4.1. Soil pH

Varied soil pH content in different soil layers in *Fraaxinus* and *Acer* plantations were affected by plant and soil factors. Lime is one of the determinant factors causing changes in soil acidity (Jafari et al. 2006). Marl lime and limestone parent beds are prevalent in study area. However, soil erosion and leaching results from degradation activities increases limestone dissolving and eventually increases soil lime concentration and transport it to deeper horizons, lessening soil acidity. PH changes in calcareous soils are attributed to H_2O-CO_2 interactions. Carbon dioxide released by developing roots and trees organic matter degradation improves soils dissolved calcium. It can be served as the most important factor influencing pH content in different soil depths. Studies by Ponnampruma, 1972, Goertzen and Bower, 1958, Chhabra and Abrol, 1977 and Salehi et al. 2011 are in line with this subject. Results of the present study suggested that hardwood and coniferous species influenced significantly pH content in the topsoil (0-10 cm) in probability level of $P < 0.01$, wherese natural forest and *Brutia* plantation had the highest and lowest pH values respectively in mentioned depth. Augusto et al. 2002 also pointed out significant effects of various tree species on soil pH in top 10 cm. some factors such as accumulation of acidic litters of coniferous species and as a result higher soil organic matter acidic power, soil microclimate change, their high capacity of coniferous species to intercept atmospheric deposition which is potentially acidic, releasing protons having been cations absorbed by trees, are the main reasons for acidic coniferous species soils compared to that for hardwood species.(Smolander and Kitunen, 2011; Binkley and Valentine; 1991, Berthrong et al., 2009; Shabanian et al. 2010) also reported acidic properties of soils under coniferous species. Mixed hardwood forest of *Parrotio-Carpinetum* as control forest in the present study produces less humus and litter due to having less crown cover and degradation compared to plantation, in turn accelerates litter decomposition along with enough light reached to forest floor, increasing microorganisms activity. *Carpinus betulus* L. dominance and its rapid decomposition of litter, leads to much more humus and alkaline salts accumulation (Mohajer, 2006) and subsequently increases soil acidity compared with forest plantation.

4.2. Total N

Comparison of different soil layers between control and plantation area, shows significant difference among layers 1, 2 and 3 so that across all types as soil gets deeper, N concentration declines. Given that much N accumulation in soil organic horizon(top layer) accounting for 99% soil nitrogen totally(Habibi Kaseb, 1992) and also higher concentration of organic matters in the first soil layer than those second and third, so it is expected higher nitrogen concentration of nitrogen in depth 0-10 cm compared to deeper layers. Results from this study showed that largest contribution of nitrogen is concentrated in surface (0-10 cm) layers (Figure 2c). It implies to considerable N turnover through litter. Of course, nitrogen-fixing fungus and microorganism involve in turnover process. Johnson et al. 2001 reported highest trace elements concentrations like calcium, potassium and carbon in forest soil top horizons. Jafari et al. 2003 pointed out increased nitrogen level in top soil layers in *Haloxylon* plantation mainly due to much more litter decomposition. More concentrated N in the second soil layer of *Brutia* plantation area compared to other types can be attributed to higher organic matter accumulated as a nitrogen production source for nitrogen fixing microorganism and fungi. Mycorrhiza serves as the most active and important soil fauna and primary decomposer on organic matter. Mycorrhiza symbiosis to *Pinacease* families roots, mostly in acidic soils. One of the most outstanding ecological attributes of Mycorrhiza is nitrogen fixing and absorption. Ecto-Mycorrhizal fungi plays substantial role as a key organism in forest ecosystem trophic cycle as well as establishing atmospheric nitrogen fixing bacteria in soils (Yousefi and Jalilvand, 2008, Mohajer, 2006). Olsson et al. 2012 and Jones et al. 2012 also reported similar results in their studies. Also thanks to higher height, more leaf area index (LAI) and foliage longevity and evergreen trait compared to contemporary hardwood stand, coniferous species fix much atmospheric nitrogen among others (Augudto et al 2002).

4.3. SOM and SOC characterization

Results of present study suggest that these indices declines significantly across all types from soil top horizons into deep. It relates to vegetation residues on soil surfaces representing considerable their turnover through aboveground organs as a results of plants roots and litter biodegradation, improving soil physicochemical status and fertility. Jiménez et al. 2007 also reported organic matter storage decreases with soil depth in lowland plantation area of CostRica. Also these results indicated that in the second depth, *Brutia* type had highest organic matter and carbon compared to other types inhabited with hardwood species. Results of Kasel and Bennett, 2007; Schulp et al. 2008 and Augusto et al. 2002 studies also confirmed this. Soils organic carbon and matter depends on type of species in forest overstory so that species exert various impacts on these indices values. Vegetation can change soils organic carbon storage through different key factors like litter quantity and quality, developing root system and soil chemical properties. Wang et al. 2012 and Augusto et al. 2002 Accentuated positive correlation to annual litter accumulation and soil nitrogen concentration in their investigations. In the present research, in respect to higher annual litters of coniferous compared to hardwood (Zinn et al. 2002; Augusto et al. 2002) and much concentered N in *Brutia* plantation soils, may be reason for much concentration of SOM and SOC in this depth. Due to less crown cover and subsequently less humus production and much solar radiation, within *Acer* plantation and control types, SOM occurs in rapid manner than other types, decreasing them in soil. in addition Li et al. 2012and Diaz-Pinés et al. 2011 in their studies, found that difference in organic carbon concentration under different species soils results from higher litter accumulation and soil organic matter and reported considerable coniferous capacity to store organic matter compared to that of hardwood.

4.4. Ex-K, Ex-Mg and Ex-Ca characterization

Results showed that except *Brutia* plantation, those trees planted in different soil layers had significant impacts on Ex-K, Ex-Mg and Ex-Ca concentration. In most forest types, much concentration of Ex-K, Ex-Mg and Ex-Ca in the first layer relates to its higher SOM. On the other hand, rapid weathering prevents taking up potassium be trees. In case potassium released due to weathering is much more than its absorption, potassium fixing process leads to potassium storage (Mohammadi Samani et al. 2006). Results showed that all types had highest Ex-K concentration on top layers. But this was not case for Ex-Mg so that there was just significant difference in *Acer* plantation. Since soil texture in study area is clay loam and high clay is concentrated in deeper layers and on the other hand clays type quantity and size plays determinant role in potassium fixing and releases, as a result, potassium among layers connects to mineral strongly and it appears as un-exchanged potassium since it can penetrate clay layers through diffusion phenomenon and fixed within it. As a result potassium releases is reduced severely (Jalali, 2002). Yamashita et al. 2008 and Berthrong et al. 2009 found that basic cations movement from soil layers to plant biomass and higher leaching are responsible for low exchangeable cations like Ca and Mg. This mechanism may substantiate present study results. Investigation of these elements in different soil layers among types indicated a difference in Ex-K and Ex-Ca values on the first layer and Ex-Ca and Ex-Mg in the third layers in control forest and plantation soils. Highest Ex-K and Ex-Ca content was concentrated in mentioned depths among forest types. Presumably, increased level of organic matter in the first layer results from mixture in natural forest and accumulation of different species litters and consistency of trophic levels, improves cations exchangeable capacity and Ex-K and Ex-Ca concentration in the top layers. Findings for Wang et al. 2012 and Salehi et al. 2012 researches substantiate this result. Jobbagy and Jackson, 2003 reported that, the less cationic exchange capacity (CEC), declining soil capacity to accommodate exchangeable cations.

4.5. SP

Although the amount of soil water may seem insignificant when compared to the total quantity of water at the global scale, it is this thin layer of soil that played the important role on growth of vegetation (Rodriguez Iturbe, 2000), groundwater recharge and partitioning of rainfall into runoff and infiltration (Merz and Plate, 1997) are well documented. The effect of land cover on soil moisture variability has not received sufficient research attention. Although this aspect has been the subject of intense research from the agricultural/agronomic perspective, few field experiments have focused on long-term soil moisture variability under natural vegetation (Vankatesh et al., 2011). Studied forest types, imposed different impacts on SP in different soil different layers so that it decreased descending from top to deep layers. Due to heavy texture (loamy-clay) in deeper depths, water penetration is low and SP is high in topsoil layers. Another main reason for higher SP is much organic matter concentrated in top soil horizons. It is confirmed by findings Vankatesh et al. 2011, Gharavi Manjili et al. 2009.

5. Conclusion

Long term sustainability of forest ecosystems is dependent on preserving soil quality. Therefore, knowing the forest soil conditions and studying the different action effects on status of soils are very important and it can be effective in forest management. In light of the present study results, different tree species affect varyingly soils physicochemical properties. Based on these results, the least pH was related to soil on which *Brutia* plantation. So its monoculture must be avoided and it should be cultivated under vast forestry programs as mixed to northern hardwood species. ΔpH sign was positive in all types. Higher N concentrated in top horizons in studied forest types than deeper ones, is related mainly by much soil surface SOM. On the other hand, descending trend of SOM and SOC contents to deeper horizons is attributed to higher plants residues and litters accumulation on soil surface. As a whole, mixed natural forest adjacent to plantation area is rich in nutrients and organic matter generally pure and monoculture plantaions could not improve understory soils fertility compared to control area. Among them, only *Brutia* plantation improved N concentration in the first and SOM and SOC in the second depths significantly. Also *Acer* plantation enhanced Ex-K concentration in the third depth in comparison to other types. The comparison indicated that the tree plantation conducted in this area must be forwarded to mixed forest under tending operations instead of monoculture to enhance and improve soil physicochemical statues. Also some programs must be taken in to account to evacuate livestock from forest marginal lands and preventing illegal tree cutting in area, supporting tree plantation and forestry operations via fencing and watching over by enclosures guards. Preventing transportation of plants and trees residues result from tending operations may be effective to improve soil nutritional status and fertilization. Best practices of retaining logging residues and debarking harvested plantations on site could substantially reduce cation losses from afforestation. Residual parts of harvested trees with little commercial value (leaves, branches, and bark) contain the majority of Ca and Mg in forest biomass. Typically these residues are removed from the site or burned, leading to export or losses of cations through accelerated leaching (Berthrong et al. 2009). Knowledge on soil properties of site on which trees species grows, is so promising to choose appropriate species adapted to soil condition under the same area. Therefore, results of present study can be used to restoration and reclamation of degraded forest area under similar climatic, topographical and ecological condition. However, comparisons among tree species are very difficult because many factors should be taken into account.

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