



## **Full Length Article**

# **The investigation on the relationship between soil physical and chemical properties in different forest type in Heyrcanian forest**

**Mahmoud Radaei**

<sup>1\*</sup> Department of Forestry, Gorgan University of Agricultural Science and Natural Resource, Gorgan. Iran  
Email: mah\_radaei@yahoo.com

### **ABSTRACT**

*Soil properties are the important factors that influence plant distribution specially, the aim of this research is investigation on the relationship between soil physical and chemical properties in forest type in Heyrcanian forest. This study located in Lajim forest, Mazandaran province, north of Iran (Hyrcanian forest). To study effect of different forest type, selected four forest types by similar ecological conditions. Soils sample were taken from 0-30, 30-60 and 60-100 cm depths. The measured soil factors included, EC, organic matter, texture, organic materials, available moisture, pH, and soluble ions. Results showed that the mean of Bulk density ( $gr/cm^3$ ), real density ( $gr/cm^3$ ) and EC in the Pure Alnus Type are a maximum quantity. Results showed that the mean of Porosity%, organic materials and C/N in the Dominant broadleaves are a maximum quantity. Results showed that the mean of about EC (ds/m), Available phosphorus (p.p.m) and available Potassium (p.p.m) in the Picea with Alnus and Acer type are a maximum quantity, about CEC the Picea with Alnus and Acer type are a maximum quantity. Overall results showed that the maximum of soil physical and chemical properties observed in the Alnus and Acer type and Dominant broadleaves.*

Key words: relationship, soil, physical and chemical properties, forest type, Heyrcanian forest

Received 12.04.2014

Revised 01.05.2014

Accepted 15.06. 2014

### **INTRODUCTION**

Iran is the most attractive and versatile country among all countries in south –west Asia relating to vegetation. Hyrcanian (Caspian) forest in northern Iran has a richness of biological diversity, with endemic and endangered species, and a diverse range of economic and social conditions. About 45% of the Hyrcanian forests are located in mountainous areas, where forest lands are not readily accessible with ground-based logging equipment's, but cable yarding technologies are still undeveloped in this forest area (Jourgholami, 2012). These forests cover 1.8 million hectares of land area and are none commercial forests of Iran. Approximately 60 percent of these forests are used for commercial purposes and the rest of them are degraded. The Hyrcanian forests are extended at the altitude of a maximum of 2800 meters from sea level and have an uneven topography and very steep slopes. They are suitable habitats for a variety of hardwood species such as beech, hornbeam, oak, maple, alder, and encompass various forest types including 80 woody species. As a fact, the soil properties are affected by geology, topography, climate and biology of areas. Therefore, soil properties are the important factors that influence plant distribution specially, in saline areas. To develop an efficient management it is necessary to have precise information on soil and vegetative cover relations in all areas [2]. The several the researcher studied the role of soil physical and chemical properties in pure stands of oak (*Quercus castaneifolia*) in Galandroud forest and The Results showed that oak. Trees grow on six different soil types: Typic Haplumbrepts, Typic udorthents, Mollic Hapludalfs, Typic Rendolls, Lithic Udorthents, Typic udisamments. the mean of diameter and height in three elevation classes ( lower than 500 m , 500-1000m ; higher than 1000m ) was evaluated and It was confirmed that there is a significant difference between measured parameters in three localities with different types of soil and the highest value of parameters were occurred in Typicudorthents soils [1].

The researcher studied the Acquaintance with the Relationship between Plant Ecological Groups and the Soil Characteristics in a Kelarabad Plain Forest (Chaloos) and results showed that the 1<sup>st</sup> and 4<sup>th</sup> ecological groups had the highest correlation ship with the 1<sup>st</sup> axes whereas 2<sup>nd</sup> and 3<sup>rd</sup> ecological

groups demonstrated the highest correlation ship with the and axes. PH increased from the 1st group toward the others. Each of these four groups can be identified by the following environmental factors: earth worm biomass, OC% and Sand% for the 1st group; Sand % and Silt% in the 2nd group; P and Clay% in the 3rd group, K in the 4th group. So it is concluded that physical characteristics influence the most effects on formation of ecological groups in Kelarabad plain forest [4].

The researcher studied the Soil Physical and Chemical Properties in Relation to Tree Ecological Groups in Nam-Khaneh District of Kheirood- Kenar Forest and results indicated that among studied soil properties, percentage of organic carbon, C/N ratio, soil texture, and soil bulk density were the most significant factors that varied and determined the distinction among tree ecological groups (forest types) [5].

The researcher studied the relationship between Plant Ecological Groups and Stand Edaphical Conditions and Results illustrated that the first ecological group, namely *Ruscus hyrcanus*, and second group including *Asperula odorata*, *Viola odorata*, *Hypericum androsaemum*, *Dryopteris filix-mass*, were related to soil chemical properties. The third group with *Oplismenus undulatifolia*, *Cyclamen caucasicum*, along with the fourth group, including *Mespilus germanica*, *Rumex sanguineus*, and *Solanum kisereitzcki* were mainly in relation to physical properties. Also, it was found that soil fertility in the first and second groups is more suitable and higher than in the others [6].

The researcher studied the vegetation analysis based on plant associations and soil properties in natural forests and Results showed that two communities constitute the major part of the study area, *Rusco-Fagetum* and *Carpineto-Fagetum*. Soil variables that played the most important role for expansion of *Rusco-Fagetum* association were depth, silt, P and pH, while in *Carpineto-Fagetum* important were clay, sand, Sp, N and C [7].

The researcher studied the relationship between vegetation and physical and chemical properties of soil in *Fagetum* communities and Results showed that the distribution of plant species is mainly associated with aspect, clay, total nitrogen, and organic matter, phosphorous and exchangeable cations. *Geranium robertianum*, *Mercurialis perennis* and *Ruscushyrcanus* indicate high soil fertility, while *Festuca drymeia*, *Blechnum spicant* and *Epicedium pinnatum* show low soil fertility. *Carex remota*, *Sanicula europaea* and *Carex divulsa* indicate a moderate soil fertility conditions [8]. The researcher studied the Changes of Soil Physical and Chemical Characteristics in Three Adjacent Land Use Including Forest, Rangeland and Agricultural Land and ANOVA with Duncan test ( $p < 0.01$ ) using SPSS software was used in order to have a comparison of soil properties among different land uses. The results showed that carbon and nitrogen had relatively more and pH less alterations in the study area. Also, soil properties show significant different among various land uses [9].

The researcher studied the relationship between soil physico-chemical properties and plant community's parameters and two plant communities have been recognized in the area; *Salsola crasa* and *Salsola-Tamarix*. The study showed that, the canopy cover and plant diversity were highly affected by soil properties. The amount of clay and EC were the most effective factors on plant characteristics [2].

The researcher studied the relationship between soil physical and chemical properties and succulence of natural and planted sexual (*Haloxylon* spp) and results of the principal component analysis (PCA) indicated that there is a significant difference between succulence of Sexual shrubs and some of soil properties. For example, increasing organic matters and Carbon content improved the succulence and this reality is more sensible in soil surface horizons. On the other hand, increasing the content of Na, K and salinity in the soil, decreased the succulence of Sexual shrubs. Also, there was not any correlation between  $\text{CaCO}_3$ , pH and bulk density and succulence of Sexual shrubs. Thus, soil physical and chemical characteristics were the most important factors affecting on the succulence of Sexual shrubs [3]. Soil, as a bed of plants, is one of the important components of ecosystems, and is affected by land use change [9]. The aim of this research is investigation on the relationship between soil physical and chemical properties in forest type in Heyrcanian forest

## MATERIALS AND METHODS

### Site description

The study was carried out in the Lajim Forest plantation, located Approximately 60 km south of Sari city, Mazandaran province, northern Iran (Figure 2).

Lajim forest plantation accrued 1963 in 65 hectare area by used the bored leaf and deciduous species. The planted species include *Picea abies*, *Alnus Subcordata* and *Acer cappadocicum*. This plantation and nature forest has a four forest type (table 1).

Table 1: the area of forest types in Lajim forest

Species name	English name	stands	Area (hectare)
<i>Picea abies</i>		Pure stand	29.1
Mixed <i>Picea abies</i> (with <i>Alnus Subcordata</i> and <i>Acer cappadocicum</i> )	Maple	Mixed stand	36
<i>Alnus Subcordata</i>	Alder	Pure stand	4.9
deciduous forest		Mixed stand	2228

Altitude ranging between 900 and 1000 meters above the sea level. Average annual precipitation of about 1290 mm/year, with the heaviest precipitation in the summer and fall. Temperatures are moderate, ranging from a few below -6.4 C in December, January, and February to +40°C during the summer.

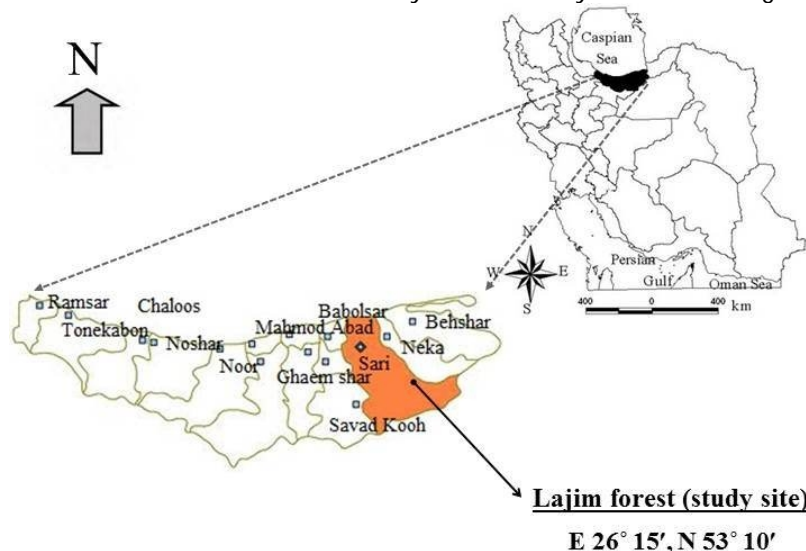


Figure 1. Study site location in the Mazandaran Province, Hyrcanian forest, and northern Iranian state of Iran

In Lajim forest identify a four forest type include: *Picea* with *Alnus* and *Acer* type, Pure *Picea* type, Pure *Alnus* Type, Dominant broadleaves (table 1)

**Methods:**

To study effect of different forest type (four forest type include *Picea* with *Alnus* and *Acer* type, Pure *Picea* type, Pure *Alnus* Type, Dominant broadleaves) on soil physical and chemical properties in forest type in Hyrcanian forest, selected four forest type by similar ecological conditions. Used the transect method for select sample. Soils sample were taken from 0-30, 30-60 and 60-100 cm depths. The measured soil factors included, EC, organic matter, texture, lime, available moisture, pH, and soluble ions.

**RESULTS**

Soil properties are affected by geology, topography, climate and biology of areas. Therefore, soil properties are the important factors that influence plant distribution specially, in saline areas.

Table 1: soil physical and chemical properties in forest type in Hyrcanian forest

C:N	Available Potassium	Available phosphorus	Nitrogen%	%Organic matter	% C	CEC	%BSP	EC ds/m	pH (KCL 9)	Porosity%	Calcium carbonate%	Real (gr/cm3) density	Bulk density (gr/cm3)	Soil texture	%Sand	Silt%	Clay%	Depth (cm)	Forest type
15	377/2	38/4	0/122	3/46	1/73	44/24	79/87	0/39	6/4	54	0/7	2/44	1/12	Clay	12	17	71	0-31	Picea with Alnus and Acer type
20	246	15/2	0/026	1/04	0/52	40/02	95/41	0/34	7/1	47	17	2/63	1/39	Clay	6	17	77	32-68	
24	229/6	12	0/028	1/36	0/68	40/32	97/9	0/23	7/2	24	20/6	2/57	1/45	Clay	4	17	79	69-81	
7	180/4	32	0/10	1/26	0/63	36/5	60/75	0/26	5/7	67	1/9	2/49	0/82	Clay	12	31	57	0-23	Pure Alnus Type
24	274/7	16	0/028	1/34	0/67	41/98	83/97	0/30	6/6	47	9/9	2/49	1/32	Clay	4	17	79	24-60	
25	188/6	12/8	0/027	1/36	0/68	37/86	94/76	0/33	7/1	46	24/8	2/59	1/38	Clay	8	19	73	61-81	

11	192/7	38/4	0/39	8/86	4/43	26/78	77/03	0/43	6/5	58	2	2/20	0/93	Clay	32	33	35	0-15	Dominant broadleaves
43	233/7	12	0/055	4/82	2/41	36/86	89/66	0/48	6/9	43	8/8	2/44	1/39	Clay	6	23	71	16-47	
44	176/3	12	0/05	4/40	2/20	34/86	91/46	0/28	7	43	15/7	2/56	1/46	Clay	12	21	67	48-85	
13	352/6	33/6	0/14	0/14	3/54	1/77	40/22	88/27	0/41	6/8	51	2/44	1/19	Clay	12	21	67	0-27	Pure Picea type
12	159/9	15/2	0/044	1/06	1/06	0/53	30/74	95/03	0/20	7/2	41	2/60	1/54	Clay	8	32	60	28-73	
13	184/5	15/2	0/038	1	1	0/50	30/53	92/56	0/25	7/1	39	2/5	1/53	Clay	12	29	59	74-96	

## CONCLUSION

To develop an efficient management it is necessary to have precise information on soil and vegetative cover relations in all areas [2]. Many of the physical properties important for assessing soils in agricultural systems are the same for forest soils. However, because of the nature of forest soils and terrain associated with forest ecosystems, the most appropriate methods for agricultural soils are not always suitable for forest soils. Coarse fragments, large roots, and steep slopes limit the suitability of some methods for forest soils [10]. Compaction is one of the key physical processes that is affected by forest management and can influence soil productivity in forest soils (Powers et al. 1998). Results showed that the mean of Bulk density ( $\text{gr}/\text{cm}^3$ ) in the Pure Alnus Type are a maximum quantity. About Real density ( $\text{gr}/\text{cm}^3$ ) in the Dominant broadleaves are a maximum quantity, about Porosity% the Dominant broadleaves are a maximum quantity, about EC ( $\text{ds}/\text{m}$ ) the Pure Alnus Type are a maximum quantity, about CEC the Picea with Alnus and Acer type are a maximum quantity. Decay processes in an ecosystem can be thought of as a continuum beginning with the input of plant litter and leading to the formation of soil organic matter. About Organic matter the Dominant broadleaves are a maximum quantity, about Available phosphorus (p.p.m) the Picea with Alnus and Acer type are a maximum quantity. About available Potassium (p.p.m) the Picea with Alnus and Acer type is a maximum quantity. About C/N the Dominant broadleaves are a maximum quantity.

Overall results showed that the maximum of soil physical and chemical properties observed in the Alnus and Acer type and Dominant broadleaves.

## REFERENCE

- Ahmadi T, Sheikhlislami A. (2004). The role of soil physical and chemical properties in pure stands of oak (*Quercus castaneifolia*) in Galandroud forest (west Mazandran state), Pajouhesh & Sazandegi No: 63 pp: 59-68
- Akbarlou M., Yar S, Mohammad Esmaeili M. (2012). Study on the relationship between soil physico-chemical properties and plant communities parameters (Case Study: Ghareh Tappeh Area, Saveh), *J. of Water and Soil Conservation*, Vol. 19(2), 2012, 192-199.
- Mahmoudi A.A., Zahedi Gh. Etemad V. (2012). The investigation on the relationship between soil physical and chemical properties and succulence of natural and planted sexual (*Haloxylon* spp) (Case study: Hosseinabad plain, Southern Khorasan province), *Iranian Journal of Forest*, Vol.4, No.4, winter 2012, 289-299.
- Mahmoodi J., Zahedi Amiri Gh. Adeli E., Rahmani R. (2005). An Acquaintance with the Relationship between Plant Ecological Groups and the Soil Characteristics in a Kelarabad Plain Forest (Chaloos). *Iranian J. Natural Res.*, Vol. 59, No. 3, 351-362.
- Salehi A., Zarinkafsh M., Zahedi Amiri Gh. Marvi Mohajer R. (2005). A Study of Soil Physical and Chemical Properties in Relation to Tree Ecological Groups in Nam-Khaneh District of Kheirood- Kenar Forest, *Iranian J. Natural Res.*, Vol. 58, No. 3, 2005, 566-578.
- Mataji A., Zahedi G. (2006). Relationship between Plant Ecological Groups and Stand Edaphical Conditions (Case study, Kheiroudkenar Forest – Noshahr), *Journal of the Iranian Natural Res.*, Vol. 59, No. 4, 2006, pp. 853-863.
- Mataji A., Zahedi Amiri Gh. Asri Y. (2009). Vegetation analysis based on plant associations and soil properties in natural forests, *Iranian Journal of Forest and Poplar Research* Vol. 17 No. 1, 84-98.
- Eshaghi Rad J., Zahedi Amiri Gh. Marvi Mohajer M.R. Mataji A. (2009). Relationship between vegetation and physical and chemical properties of soil in *Fagetum* communities (Case study: Kheiroudkenar forest), *Iranian Journal of Forest and Poplar Research* Vol. 17 No. 2, 174-188.
- Jafarian Z., Shabanzadeh S., Kaviani A. and Shokri M. (2011). Study Changes of Soil Physical and Chemical Characteristics in, Three Adjacent Land Use Including Forest, Rangeland and Agricultural Land, 59-71.
- Page-Dumroese, D.S., Jurgensen, M.F., Brown, R.E., and Mroz, G.D. 1999. Comparison of methods for determining bulk densities of rocky forest soils. *Soil Sci. Soc. Am. J.* 63: 379–383.