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Research Paper

Comparison of soil physicochemical and mechanical properties in stabilized landslides with alder in Hyrcanain Forest

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Abstract
One of the suitable stabilization methods to reduce the instability and landslide of the margin forest roads are the use of tree cover. The aim of this study is compare two landslide area established with alder regeneration and afforestation on the basis of parameters physical, mechanical and chemical soil. First, study areas with GPS area and the map of the study area were prepared. In each region, it is random-systematic in six sample pieces Profiles were dug to a depth of impermeable layer, Soil samples from a depth of 20-30 cm, 10 cm above the impermeable layer and Horizons A and B were removed. In horizon A and B parameters of pH, potassium, sodium adsorption ratio, organic carbon and nitrogen phosphorus and lime soil, in depth 20-30 cm Classifieds and soil texture, Atterberg limits were determined. The dry density was determined at a depth of 20-30 and 10 cm above the impermeable layer. Results of soil physical-mechanical experiments Soil of two studied areas of clay and fine grained, the average dry density was 1.12 - 1. 30 g / cm3, the soil liquid limit in two floors, LL = 50-70 and LL> 70, the PI in two floors of 15-35 and PI>35 and the class of clay and mud with a high level. The plasticity limit of the stabilized area with forested areas is lower than regenerated area. The amount of sodium concentration in the two regions is very low due to high soil leaching. Therefore, the sodium absorption ratio (SAR) is low in the two regions and the soil two regions is cluster (folk). The impact of alder regeneration and afforestation on the rest of the soil parameters was almost the same. There was no significant difference between them. Alder regeneration and afforestation both improves soil stability and landslide areas are, however, the effects of afforestation can be due to the regular distribution of alder trees and more of their density than regenerative alder.

Keywords: forest roads, slip stabilization, alder, sodium adsorption ratio, mechanical physical properties

Introduction:
One of the factors that greatly affects track tracing in the forest is the landslide phenomenon. This phenomenon is usually more abundant in forest lands due to the environmental characteristics of the land such as soil and lithology, high rainfall and soil permeability (Gorji and Sarikhani, 2003). Construction of the road as an influential linear effect increases the occurrence of this phenomenon, as studies have shown that the frequency of landslides in the forest, in the range of 85 meters around the roads, is five times the incidence of landslides occurring in other parts of the forest (Larson and Parks,1997). In fact, when constructing the road, removing the claw slope and increasing the slope weight creates a disturbance in nature, which reduces the stability of the upward and downward slope of the road and consequently the mass movements (Moghimi, 2008). Also, the flow of water upstream is in the canal behind the forest road and the local influence of this water on the lower corners, which can sometimes be a stimulus to trigger or intensify the mass movement alone. Avoiding critical points at the design stage of the road network is the best way to get rid of this problem, which requires specialized diagnosis (Gorji and Sarykhani, 2003). Ganji (2011) studied some of the vegetative and vegetative characteristics of pure and mixed forests of alder and maple pods in Gozo-Babolrood Series 3. Results of physical and chemical characteristics of soil in the studied populations showed that there was no significant difference between the masses at depths of 0-20 and 10-20 cm. Salehi et al. (2012) studied the effect of forest plantation with alder and pike-perch species on activity and microbial biomass of soil in Gisum district of west of Guilan province so the results of this study showed that the grasshopper mass in comparison with pigeon is more appropriate to produce organic matter, microbial mass and soil microorganisms activity. Mohammadi Savadkouhi and Hosseini (2012) studied the effect of physical and mechanical properties of soil on landslides on the edge of forest roads. The results of this study showed that the amount of clay in the study area is relatively high and this increases the occurrence of landslide. Hoa et al. (2012) by studying the spatial distribution of soil thickness to predict the occurrence of landslides in the United States concluded that the spatial distribution of soil thickness in relation to the moisture index could provide a reasonable estimate, which avoids more prediction Helps in landslide in prone areas and less than realistic predictions in sustainable areas. One of the suitable stabilization methods for decreasing unstability and erosion on slopes is vegetation cover; vegetation is effective in increasing the stability of the slopes and improving the hydrological conditions of the soil (Fazeli et al., 2012; Beschti et al., 2005). In biological fixation, the choice of plant species is important (Gray and Sotir, 1996). *Alnus subcordata* (Alder) is a suitable species for use in landslide stabilization. This species is usually the pioneer species that initiates the secondary sequence

around the forest paths and, through N fixation, gradually provides conditions for the presence of other species, due to its high moisture content and high water absorption capacity to reduce water volume in wetlands, Soil drainage soils, irrigated soils and sloping slopes are planted abundantly (Rasane et al., 2002; Joker, 2000). The purpose of this study was to compare the stabilized area with regenerative alder (Piche senobar-Kheyrud Mazandaran Prov.) and the stabilized area fixed with forested area (Parcel 112) based on physical, mechanical and chemical parameters of the soil.

Material and methods

Description of the study area

The study site is located in Kheyrood forest in watershed number of 45 (from 27°36′ to 36°40′ N and from 51°32′ to 51°43′ E). The study was carried out in Patom district (compartments 111 and 112). A landslide was occurred in 1973 in the eastern part of Senobar switchback curve (compartment 111). The length of movement area was 65 m and the width at the top, middle and down was 10 m, 20 m and 30 m, respectively. The area of landslide was 6577 m^2. The elevation difference between up and down part of landslide was about 14 m with mean slope gradient of 20%. Alder species as well as Hazel, hornbeam, elm, Diospyrus lotus and wild fig were naturally established on landslide.

The total density of the trees in this region is 228 trees per hectare and the density of alder trees is 104 trees per hectare. Part of the road of Parcel 112 was unusable due to sliding in 1993. The length of the moving area at this point of the movement reaches about 30 meters and its width varies so that it is about 10 meters above the middle and lower parts of 15 Up to 20 meters and its area is 3544 square meters (0.344 hectares). After slipping the downstream slope, two-year-old seedlings were planted on alder, and the upstream slope of the road was a ditch for directing the slopes to the canals of the forest paths and eventually leaving them through the culvert. Total density of 389 trees per hectare and Alder trees density is 268 hectares per hectare. In the two sliding areas, the slope is approximately 20%, for the northwest and clay soils (Fig. 1).

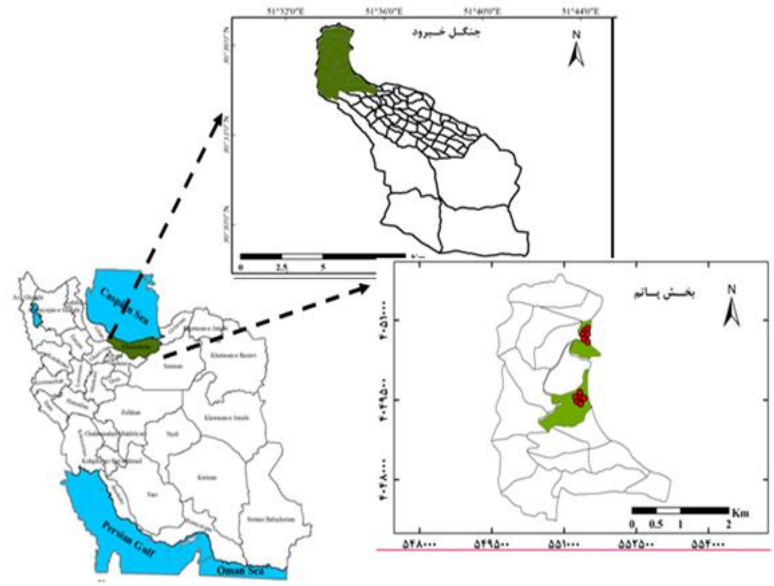

Fig.1- Study Area Location

Method of Data Collection

At first, the data and maps of the study area were collected including physiography (slope, direction and altitude), soil, geology and tree cover. Then, with circular forest and using GPS, the area of the studied areas was determined and the map of the stabilized landslide range was prepared. In order to measure the physical-mechanical and chemical parameters of soil in each region, randomized-systematic samples were taken in six sections of the profiles to the depth of the impermeable layer, in which the depth of the profiles in the parcel 111 from the bottom of the slope toward the road was 70, 60 , 99, 70, 50 and 80 cm and in the parcel 112 the depth of the profiles is from the bottom of the slope to the road 110, 98, 95, 130, 50 and 60 cm respectively.

Soil Bulk Density Measurement

The cylinder method was used to determine the soil dry density (Parsley, 2003). In this method, intact sampling was performed using metal cylinders with dimensions of 5 × 5 cm at depths of 20-30 and 10 cm above the depth of the impermeable layer. The wet soil weight of the samples was immediately weighed and then placed in an oven at 105 ° C for 24 hours to determine the moisture content and dry weight of the samples and the bulk density (dry density) was calculated. By obtaining the cylinder volume (Vt) from equation (1), where h is the cylinder height, r is the radius of the cylindrical cross section and π is 14.3, using equation (2), in which MS the dry weight of the soil and Vt soil volume, dry density (γd) of soil samples were calculated.

$$V_t=\pi r^2 h \quad (1)$$

$$\gamma_d = \frac{MS}{Vt} \tag{2}$$

Atterberg limits: In Atterberg limits analysis, LL was determined using the Equation (3) (Jafari Haghigi, 2003):

$$LL = W_N * \left[\frac{N}{25}\right]^{0.121} \tag{3}$$

Where N is number of drops of the cup required to close the groove, W is the soil moisture content (%) that the groove is closed. Moisture content was determined using the Equation (4).

$$W = \frac{W_1 - W_2}{W_2 - W_3} \times 100 \tag{4}$$

Where W_1 is the weight of the can (g) + wet soil (g), W_2 is the weight of the can (g) + dry soil (g) and W_3 is the weight of the empty can (g). The tested samples of the soils were oven-dried at 105 °C for 24 hours.

The moisture content, as determined in Equation (4), when the soil sample is cracking, is the PL. The PI of a soil is the numerical difference between its LL and its PL (Equation 3, Atterberg 1911):

$$PI = LL - PL \tag{5}$$

Standard Proctor test: To assess the amount of compaction or MDD and the water content required in the field, compaction test (Standard Proctor test) was done on the soil in accordance with ASTM. The water content, at which the MDD is attained, was obtained from the relationships provided by the test (Equation 6).

$$P_d = \frac{P_W}{\left(\frac{W}{100} + \frac{1}{G_s}\right)} \tag{6}$$

Where P_d is dry density of soil g cm^{-3}, G_s is specific gravity of the soil being tested (assume 2.70 if not given), P_W is density of water in g cm^{-3} (approximately 1 g cm^{-3}) and W is the moisture content (%).

In the Proctor test, the soil was first air dried and then separated into samples. The water content of each sample was adjusted by adding water. The soil was then placed and compacted in the 4-inch-diameter Proctor compaction mould using 25 blows by a 5.5 lb standard hammer falling 12 inches. At the end, the sample was removed from mould and the dry density and the water content of the sample were determined for each Proctor compaction test. Then, a curve is plotted for the dry density as a function of the water content. From this curve, the OMC to reach the MDD can be obtained (Mousavi and Abdi, 2014).

Soil chemistry tests

Soil samples were collected from soil layers A and B after soil drying, including acidity, lime, nitrogen, phosphorus, potassium, organic matter, sodium, calcium, magnesium and sodium adsorption (SAR). The laboratory was transmitted from sunlight, mills and 2 mm alcohols (sieve 10). The pH of the soil was measured using a pH meter (potentiometer), total nitrogen by Kajddal method, phosphorus, sodium and potassium of soil with flame photometry, carbonate Calcium (limestone) was measured by calciferry method, soil organic matter was measured by method of valky, block calcium and soil magnesium by complex metric method. To measure SAR, sodium, calcium and magnesium concentrations were determined in PPM. Then, by placing in (7), the SAR value was determined in ppm.

$$SAR = \frac{[Na^+]}{\sqrt{[Ca^{2+}] + [Mg^{2+}]}} \tag{7}$$

Statistical analysis

Collected data from physical, chemical and mechanical analysis were saved in excel software and then homogeneity of variance test (Leven test) and normality test of data (kolmogorov smirnov test). Independent sample T test in SPSS 16.0 software was used to compare data.

Results

Soil Physical and Mechanical Properties

Soil granulation results by hydrometric method showed that the soil of two studied regions is fine-grained. Test results Determining the Atterberg range using the Casagrande method showed that the psychological limit of soil samples in the studied regions is LL = 70 and LL> 70-50, according to the soil classification table according to the psychological limitations, these soils are in high psychological limits and They are very high and in terms of dough, they are in two groups of plasticity (15-35 PI) and high plasticity

(35 PI). Soil classifications in parcel 111 samples were obtained based on the CH and MH unified classification method and parcel 112 is CH (Table 1).

Table 1. Atterberg Limit and Soil texture (Hydrometric method)

soil texture	Mechanical decomposition		The Atterberg Circle			Profile
	Fine grain percentage	Percent Coarse grain	IP	LP	LL	
MH	92.54	7.46	37	35	72	111-1
CH	86.44	13.56	32.67	32	64.68	111-2
CH	92.28	7.73	44.10	29	73.1	111-3
MH	80.53	19.47	31.29	32.31	63.3	111-4
CH	82.33	17.67	45.28	30.12	75.4	111-5
CH	96.97	3.03	38.65	29.58	68.23	111-6
CH	82.72	17.28	41	30	71	112-1
CH	94.57	5.43	38.82	27.18	66	112-2
CH	99.16	0.84	36.31	29.43	65.74	112-3
CH	93.92	6.76	32.07	25.18	57	112-4
CH	88.19	11.81	39	27	66	112-5
GC	13.52	86.48	-	-	-	112-6

Changes in Soil Physical Properties in Study area

The density of the soil in the parcel of 111 soil samples is one, two, and five profiles, and in the parcel of 112 soil samples of the profiles of one, three, four and five, at a depth of 10 cm above the impermeable layer is greater than the depth of 20-30 cm, but the rest of the samples are the situation Is the opposite (Table 2).

Table 2. Soil Bulk Density variation trend

A depth of 10 cm above the impermeable layer of Parcel 112	Depth of 30 cm Parcel 112	A depth of 10 cm above the impermeable layer of Parcel 111	Depth 30 cm Parcel 111	Profile
1.19	1.11	1.06	0.96	1
1.11	1.17	1.27	1.22	2
1.30	1.24	1.24	1.31	3
1.43	1.24	0.98	1.07	4
1.62	1.42	1.32	1.03	5
1.21	1.06	1	1.18	6

Sodium Absorption Ratio: In order to obtain the sodium absorption ratio (SAR), it was necessary to calculate the amount of sodium, calcium and magnesium. Initially, these parameters were measured, then they were embedded in the formula, and the amount of sodium absorption ratio was obtained. In the two studied parches, the amount of sodium in All of the profiles were lower than calcium and magnesium, so the sodium absorption ratio is low in two regions, which indicates that the soil is not dispersed because the stability of aggregates depends on the balance between the concentration of sodium and calcium and magnesium. The more sodium in soil, the greater the dispersion of the aggregates and vice versa (Table 3).

Table 3. Changes in the Sodium Absorption Ratio (SAR) parcel 111

SAR(ppm)		Magnesium(ppm)		Calcium(ppm)		Sodium (ppm)		Profile
Layer B	Layer A	Layer B	Layer A	Layer B	Layer A	Layer B	Layer A	
0.96	0.83	2.19	24	72	120	17.9	10.01	111-1
0.72	0.68	8.28	6.9	56	64	6.67	5.83	111-2
0.67	0.51	6.33	6.81	64	88	1.7	6.9	111-3
0.70	0.50	6.9	6.57	104	120	7.50	6.1	111-4
0.64	0.58	2.19	24	64	104	5.83	6.67	111-5
0.57	0.72	24	8.28	80	104	5.83	8.34	111-6
0.13	0.90	0	4.62	64	80	6.67	7.50	112-1
0.10	0.2	8.28	24	96.5	96	9.17	5.83	112-2
0.076	0.11	4.38	6.33	96	120	10.84	7.04	112-3
0.09	0.04	8.52	48	95	88	4.17	7.52	112-4
0.077	0.048	0	8.28	120	112	6	8.34	112-5
0.65	0.99	6.9	6.9	80	160	6.6	9.7	112-6

Nitrogen and soil organic matter: In both studied regions, the nitrogen and organic matter of the layer A is higher than that of layer B, as well as the A layer and layer B of the parcel 112 is higher than that of the A layer and B layer parcel 111 (Table 4).

Table 4. Changes in nitrogen and soil organic matter

N(%) of Parcel 112		N(%)of Parcel 111		Organic(%) Parcel 112		Organic(%) Parcel 111		Profile
Layer B	Layer A	Layer B	Layer A	Layer B	Layer A	Layer B	Layer A	
0.32	0.61	0.23	0.47	0.10	0.23	0.18	0.38	1
0.34	0.49	0.22	0.25	0.17	0.21	0.03	0.21	2
0.26	0.58	0.16	0.55	0.11	0.28	0.06	0.24	3
0.21	0.67	0.14	0.49	0.07	0.40	0.03	0.12	4
0.32	0.24	0.19	0.39	0.10	0.22	0.05	0.24	5
0.11	0.13	0.24	0.61	0.08	0.22	0.08	0.24	6

Mean mechanical parameters of soil

After determining the normality of the data using Kolmogrov-Smirnov test, the homogeneity of the variances was investigated by the Lovan test. For the specimens of the Liquid and plasticity Limits and plasticity index, the level of this test was more than 0.05 so they had the same variance and the second line of the t-test was used. In the second row, the t-test was more than 0.05 so plasticity and liquid limits were not significant. The statistical analysis was not significant (p>0.0 5) in the two parcels. Statistically, there was a significant difference (p <0.05) between the particle size of the particle and 95% probability. The particle size of the particle is higher (Table 5).

Table 5. Comparison of the mechanical properties of soil

Independent t test with 95% confidence		Lovan Test	Sliding Area Parcel 112		Sliding Area Parcel 111		Measured factor
Sig	t	Sig	Standard deviation	Average	Standard deviation	Average	
0.198 ^{ns}	1.405	0.464	4.96	65.19	5.58	69.75	liquid limit
0.020*	2.906	0.853	1.96	27.75	2.29	31.68	plasticity limit
0.851^{ns}	0.194	0.85	3.43	37.44	6.41	38.07	IP

^{ns} No significant difference

Comparison of the soil physical properties

After data normalization, the homogeneity of variances was investigated by the Lovan test. The results indicated that the level of significance, the moisture content and the bulk density (dry density) of the two parcels were more than 0.05, so they had the same variance and the results of t-test were used. Regarding the results of independent t-test, there was no significant difference in the mean of moisture content and dry density at 20-30 cm depths of two parcels and 10 cm depth of the intrinsic layer of the two parcels in the 5% level (P> 5%) (Table 6).

Table 6: Comparison of Physical Parameters of Soil 20-30 cm in Two Particles

Independent t test with 95% confidence		Lovan Test	Parcel 112		Parcel 111		Measured factor
The significance level	t	sig	Standard deviation	Average	Standard deviation	Average	
0.094^{ns}	-1.86	0.05	0.180	1.29	0.133	1.12	Density of 20-30 cm deep
0.078^{ns}	1.96	0.775	9.80	32.06	27.8	37.42	The moisture content is 20-30 cm deep
0.129^{ns}	-1.66	0.815	0.18	1.30	0.14	1.14	Density of 10 cm deep
0.129^{ns}	1.65	0.221	47.9	49.30	27.14	42.40	The moisture content is 10 cm in depth

^{ns} No significant difference

Comparison of the mean chemical parameters of the soil

According to the results of t-test, the mean of acidity, organic matter, nitrogen, potassium, sodium, calcium, magnesium, phosphorus and sodium absorption ratio (SAR) of soil in A layer of two parsons and B layer of two parcels were statistically significant There is no 5% level (P> 5%) (Table 7).

Table 7- Comparison of the mean chemical parameters of soil

Independent t test with 95% confidence		Stabilized Landslide parcel 111		Stabilized Landslide parcel 112		Measured factor
Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	
0.186ns	0.239	1.29	4.297	72.58	81.303	Potassium Layer A(ppm)
0.533ns	0.646	38.114	93.257	35.78	59.261	Potassium Layer B(ppm)
1^{ns}	0	1.53	7.36	0.820	7.369	Sodium Layer A (ppm)
0.823^{ns}	0.229	0.754	9.05	1.139	8.930	Sodium Layer B (ppm)
0.539^{ns}	0.636	23.031	100	91.28	109.33	Calcium layer A(ppm)
0.013^{ns}	3.027	26.8	66.66	76.18	92	Calcium Layer B (ppm)
0.469^{ns}	0.706	6.67	25.83	73.6	28.56	Magnesium layer A (ppm)
1.29^{ns}	0.224	2.732	66.31	46.5	34.67	Magnesium layer B (ppm)
0.68^{ns}	0.43	0.58	0.64	0.13	0.61	SAR Layer A (ppm)
0.96^{ns}	0.051	0.21	0.71	0.13	0.70	SAR Layer B (ppm)
0.329^{ns}	-1.25	0.420	6.341	0.473	6.067	Acidity Layer A (ppm)
0.995^{ns}	0.02	0.547	6.591	0.263	6.593	Acidity Layer B (ppm)
0.436^{ns}	-0.812	0.707	1.87	0.606	1.57	Phosphorus Layer A (ppm)
0.534^{ns}	0.661	0.56	13.2	1.29	2.51	Phosphorous layer B (ppm)
0.051^{ns}	2.212	0.0625	0.226	0.287	0.204	Organic matter layer A(%)
0.225^{ns}	1.293	0.435	0.138	0.348	0.108	Organic matter layer B(%)
0.060^{ns}	-2.124	0.085	0.528	0.837	0.632	Nitrogen layer A(%)
0.084^{ns}	-1.196	0.067	0.217	0.049	0.282	Nitrogen layer B(%)

Discussion

Atterberg Limit

According to the results of the Atterberg test, the soil Plasticity limit and Liquid limit of the studied areas are in the LL-70 and LL-70 classes, according to the soil classification table, these soils are high and very high in the limit of plasticity. In terms of paste content, they are in two groups of plasticity (15-35 PI) and high plasticity (35 PI), due to which can be attributed to finely ground and clay soils because the soil containing fine-grained materials has high water content and this It causes longer to remain in the plasticity and to change over time and to become liquid (Majnounian et al., 2008). Therefore, because of the high liquid limit, the ability of expansion and contraction of the soil of the two study areas is very high due to the increase or decrease of moisture, therefore, in areas that are not well drained, they should be subject to stabilization; otherwise, the risk of landslide in these soils is very high. Due to the high plasticity index, the soil has a high adhesion and high absorption capacity, which indicates that in areas with inadequate soil and drainage, soil operations will be problematic and corresponded with Majnonian et al. (2008) and , Mohammadi Savadkouhi et al. (2013) results. The relationship between the Liquid limit of the two study areas in parcel 111 and 112 also did not show a significant correlation between the plasticity indexes of the two studied regions, which is consistent with the Kolaya (2011) results. Parcel 111soil has a higher inflammability and adhesion than parcel 112. It seems that the less intrusive layer depth in parcel 111 than parcel 112, the greater the density and regular distribution of alder trees in parcel 112 (planted algae with regular distribution and The type of clay and poor drainage The slopes of the upstream slopes of the Parcel 111 can be affected by the higher particle size of the Parcel 111 than the Parcel 112, because the less the depth of the impermeable layer is, the greater the penetration water is stored in the upper layers and causes more moisture becomes more plasticity.

Physical parameters of soil

It has been proved that the amount of moisture in the soil is one of the important factors in the occurrence of landslide, which is directly related to the fine-grained soil and also the direction and slope of the area. By reducing the texture and increasing clay and plasticity, the maximum density decreases and moisture increases. The increase in water has a positive effect, and after that, the water around the particles becomes completely free and absorbs the cavities and absorbs the compressive energy and reduces the density (soil dry density) and soil resistance. On the other hand, the soil density and organic carbon are two-sided, so that increasing organic matter will decrease soil density and increase porosity and improve permeability, which in turn reduces runoff and decreases erosion and increases the percentage Moisture (Carter, 2002).

The average moisture content of soil samples of parcel 111 in the depth of 20-30 cm and 10 cm above the impermeable layer was 42.37 and 46.40, respectively, and in the parcel 112, respectively, was 32.06 and 30.49, respectively. Also, the mean dry density the soil samples of Parcel 111 at a depth of 20-30 cm and a depth of 10 cm above the impermeable layer were 1.12 and 1.14, respectively, and the parcel 112 was 1.29 and 1.03 g / cm^3, respectively, the study of the average dry density from the surface layer to the depth increases.

Soil chemical parameters

In both regions, sodium concentration was lower than that of calcium and magnesium due to leaching, so the sodium absorption ratio is low and the soil of the two studied regions is not dispersed. The average absorption rate of sodium parcel 111 in the two layers A and B is 0.64 and 0.71, respectively, and in the parcel 112, respectively, is 0.61 and 0.70 respectively. In this study, low sodium concentration, low sodium adsorption ratio and flocculent soil were observed. The low amount of Na and SAR in the area can be attributed to the high rainfall in the area and consequently to heavy soil leaching in the soil. Soil is not a salt soil. In the two slippery regions studied, the results of the study on the trend of soil organic matter changes in the two layers A and B showed that in all profiles the percentage of organic matter of the layer A is higher than that of the B layer, as well as the percentage of organic matter of the A layer in all parcel profiles of 111 To layer A of Parcel 112, the reason for this can be attributed to the higher density and natural regeneration of alder trees in this parcel. On the other hand, the reduction of organic matter in the soil of alder forests can be attributed to increased bioavailability as a result of the increase in nitrogen of this mass. Results this study is consistent with the findings of Rostamabadi et al. (2014). In this study, the average percentage of organic matter in the slippery area of 111 in A and B layers was 0.266 and 0.138 and in parcel 112, respectively, was 0.204 and 0.108, respectively, which indicates that the soil of the studied areas has a moderate amount Organic matter and the organic matter in each parcel decreases from layer A to B. This, according to studies done on the organic matter of soil, seems to indicate that soil organic matter has a significant effect on most soil parameters. In both studied regions, the nitrogen content of the layer A is much higher than that of layer B. Also, the thickness of layer A and layer B in all of the parcel profiles of 112 are higher than that of layer A and layer B of parcel 111, which can be attributed to the density of most alder trees and It also attributes its forestry to this parcel, because the alder litter has more nitrogen and also its low nitrogen reabsorption, which increases the nitrogen content of the soil, Also, due to the lower thickness of litter and planted algae than the regenerated alder, its decomposition rate is higher, as well as the ratio of nitrogen appropriation in less forested plots and the amount of nitrogen in the compacted areas with alder. The results of this study are consistent with the findings of Rostamabadi et al. (2014) and Hansen and Dawson (1982).

The results obtained from the analysis of the experiments and the study of the soil of the area show that under conditions of acidic, fine-grained and clay soils, a high and very high level of liquidity soils, plasticity and high plasticity, as well as low sodium concentration. The existence of alder trees (regeneration and afforestation) as well as the presence of openings and sideways to guide the water of the slopes, both biological and mechanical, led to the stabilization of the soil in two stabilized landslide regions. According to the experiments conducted and their analysis, there is no significant difference between the two stabilized slopes with alder (afforestation and regenerated) in comparison to the physicochemical characteristics of the soil in the two regions, but between the mechanical properties of the two soil stabilization zones there is a significant difference between alder afforestation and regenerated alder, and the plasticity limit of the stabilized slip area is higher with regeneration (parcel 111). Therefore, it can be concluded that alder regeneration and afforestation both through the canopy and the exponential root system as well as the high water absorption capacity, improve the stability and stability of the susceptible soils, but the effects of planted alder can be due to the regular distribution of trees and their greater density on soil stabilization. The results of experiments on sodium adsorption in two regions showed that sodium concentration in two regions was very low due to high soil leaching relative to the concentration of calcium and magnesium. Therefore, the sodium absorption ratio (SAR) is low in both regions and the soil of the two studied regions is folliculate.

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