Open Journal of Ecology, 2019, 9, 134-144
http://www.scirp.org/journal/oje
ISSN Online: 2162-1993
ISSN Print: 2162-1985

Physico-Chemical Complex of Matorral Soils of the North Western Region of Algeria

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How to cite this paper: Meftah, F.Z., Benabadji, N. and Merzouk, A. (2019) Physico-Chemical Complex of Matorral Soils of the North Western Region of Algeria. *Open Journal of Ecology*, **9**, 134-144.
https://doi.org/10.4236/oje.2019.95011

Received: January 10, 2019
Accepted: May 19, 2019
Published: May 22, 2019

Abstract

The objective of this study is to determine the influence of soil physico-chemical factors on the spatial distribution of matorrals in the plain from Remchi to Béni-Saf located in the western region of Algeria. This study informs us of the relationships that soil can have on the diversity of matorrals. On the bioclimatic level, the region is characterized by semi-aridity accentuating the phenomena of thérophysation. Soil analyzes carried out using known methods (Stokes Particle Size Method, Electrometric Method for pH, 1/5 Extract Method for Electrical Conductivity, Bernard Calcium Method for $CaCO_3$, Anne Method for Organic Carbon). The results show a textural diversity; sandy-muddy "Remchi", sandy "Rachgoun 1 and Rechgoun 2", not far from Béni-Saf. The low clay content (Remchi: Profile 1: Horizon 1: Clays 10%, Profile 2: Horizon 1: Clays 16%, Profile 3: Horizon 1: Clays 5%, Rechgoun: Profile 1: Horizon 1: Clays 3%, Profile 3: Horizon 1: 2% Clays and Horizon 2: 3% Clays) leads to poor structural stability leading to degradation of the soil surface through erosion. The latter is revealed by the presence of small erosion claws visible on these rough slopes or almost.

Keywords

Soil, Physico-Chemical Factors, Matorral Vegetation, Anthropization, Oran (Algeria)

1. Introduction

The Mediterranean region of Matorral has a very diversified range of soils because of the great variability of the natural factors (climate, vegetation, physiography, geology and lithology) which condition their formation and distribution. Soil is the natural formation of surface loose structure of varying thickness resulting from the transformation of the parent rock, underlying under the influence of various chemical and biological physical process; it is a living environment, whose quality can be irreversibly altered by inappropriate human interventions. Several works have been devoted to him [1] [2] [3] [4] [5]. The vulnerability of a soil depends very much on its vegetation cover, and its exposure to the sun with drying winds and showers according to Roose [6]. The latter is currently considered as an interface in the environment and a resource for development, but the application for centuries and probably millennia of fire has resulted in an almost general salination of certain regions of the globe, such as the Mediterranean rim. Indeed, the degraded vegetation has ceased to protect and retain humus and soil, especially on slopes that have become thin and skeletal inability to replenish productive vegetation [7] [8]. Ozenda [9] defines soil as a major element of the environment that regulates the distribution of vegetation. It develops according to the nature of the bedrock, the topography and the characteristics of the climate. The soil is a loose and relatively stable surface formation of the soil; it contains a mineral fraction and an organic fraction [10]. In any ecological study, the soil remains the determining key of the various phenomena (growth, maintenance, adaptation) by its nutritive and mineral elements, as well as its content of water and organic matter [11]. Duchaufour [12] emphasizes that the soil is a reserve of nutritive substances and a stable medium for the biological activity. He also made it clear that all the so-called steppe soils belong to the class of isohumid soils (brown steppe soils). While Benabadji *et al.* [13], for their part, specify that the soil plays a role of compensation factor in the precipitation. It is possible in our case to see how a certain number of soils are structured. This overview will provide us with indispensable elements related to understanding the formation and structure of the soil. For this reason we have found it useful to present soils in conjunction with ours located at the littoral level [14]. Other factors, such as the nature of the material and the topographic situation, contribute to great morphological diversity. The definition of a typical profile proves difficult, especially since the terminology used to describe the horizons of calcareous accumulation is often confusing. Certainly, since the remarkable work of [15] in Morocco, it is now possible to reach some agreement concerning the nomenclature of limestone accumulations in soils. The term "calcareous soil" as used here includes "laminated soils" and "compact slab soils" (slab and crust). In any case, the distinction between the two types of soils is easily observed, despite a large number of transition profiles; it is also justified in development studies. Can this study of soils show us a differentiation between the edaphic parameters and between the profiles of the different horizons bearing a matorral vegetation taken on a rather steep topography? In order to be able or to try to answer this preoccupation it is however necessary to address in this chapter:

- Methodology;
- Soil analyzes;
- Interpretations of the results;
- Conclusion.

2. Methodology

2.1. Geographical Site

2.1.1. "Remchi" Station (Figure 1, Figure 2)

The Remchi station is close to the national road No. 22 Remchi-Beni-Saf. It rises to an altitude of 60 m and presents the following Lambert coordinates:

- 1˚42' West longitude;
- 35˚19' North latitude.

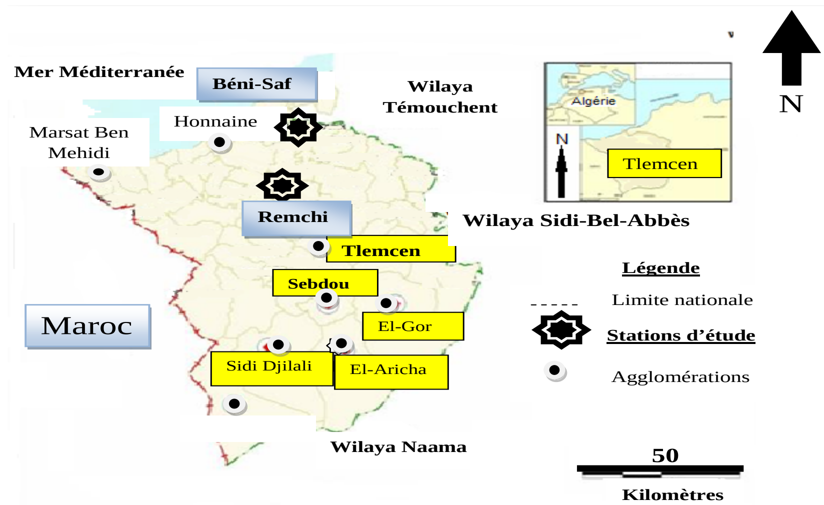

Figure 1. Géographic location.

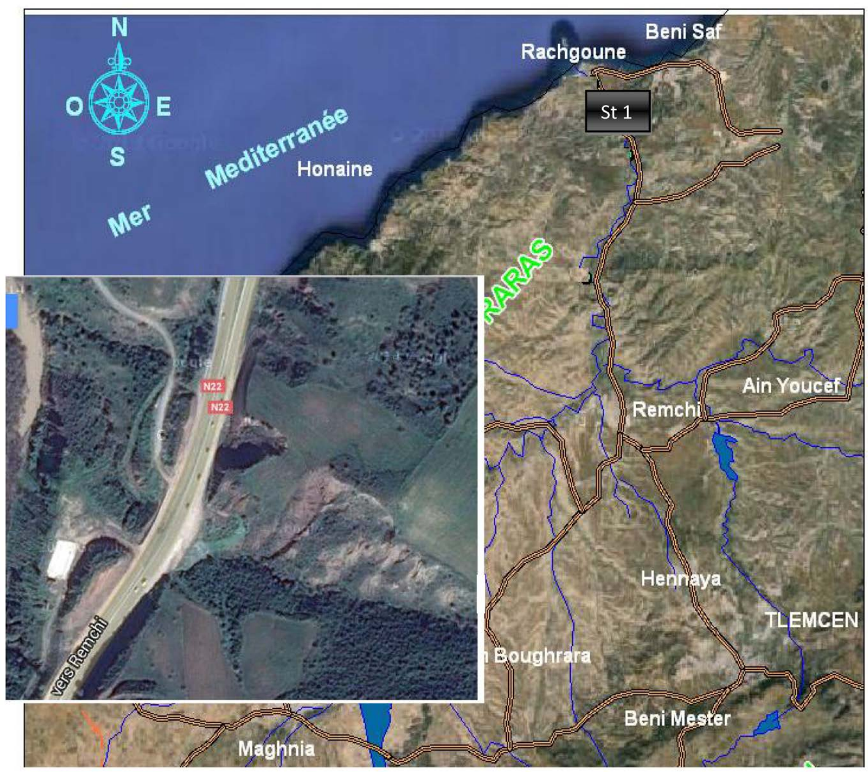

Figure 2. Satellite view of the Remchi.

The station is on a slope of 30% and is limited by plots of cereal crops. The vegetation cover rate is 60% to 70% represented by some Chamephytes Urginea maritima, Chamaerops humilis (doum) and some annual species.

2.1.2. "Rachgoun 1" Station (Figure 3)

The Rachgoun 1 station is approximately 1.2 km from the crossroads of the national road 22, on the path leading to Béni-Saf, it rises to an altitude of 35 m and has the following Lambert coordinates:

- 1˚41' West longitude;
- 35˚22' North latitude.

The rate of vegetation cover varies from 60% to 70% on a slope of 30% to 40% represented by a vegetation composed largely of: Olea europea, Chamaerops humilis, Urginea maritima and Calycotome spinosa.

2.1.3. Station "Rachgoun 2" (Figure 4)

The Rachgoun 2 station is about 6.8 km from the Rechgoun 1, it rises to an altitude of 16 m and has the following Lambert coordinates:

- 1˚43' West longitude;
- 35˚26' North latitude.

The rate of recovery of vegetation is 60% to 70% on a slope of 30% to 40% represented by a vegetation dominated by chamephytes: Chamaerops humilis, lavandula dentata, Urginea maritima and some annuals: Hordeum murinum, Bellis sylvestris, Avena sterilis.

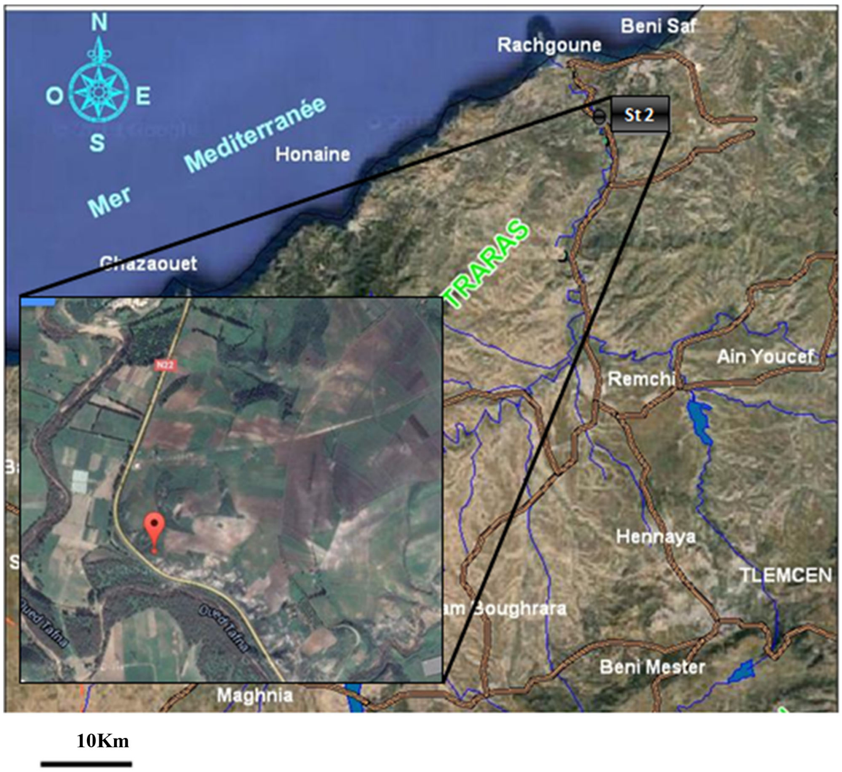

Figure 3. Satellite view of the Rechgoun 1 station.

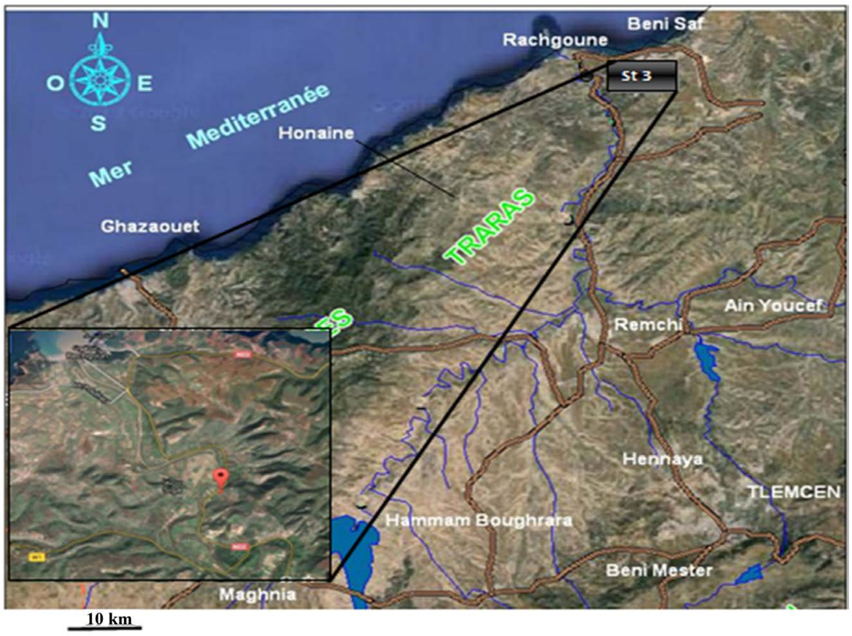

Figure 4. Satellite view of the Rechgoun 2 station.

2.2. Methodology in the Field

In the first place, it was a question of finding an area where the Matorrals formations are considered as coming, for that we headed towards the slopes of orientation (North-South, North-East, etc. ...), where l micro topographical exposure (incline slope, butte, etc. ...) was taken into account in our approach.

In order to know the edaphic factors governing the distribution of the studied matorrals, we followed a methodology comprising two stages, the first in the field and the second in the laboratory where physical and chemical analysis were carried out.

We took our samples at the level of the profiles in relation to the inclination of the slope. For each station, we have determined 3 fairly wide profiles along the slope, from each profile we took two samples: one in surface (surface horizon) and the other in depth (depth horizon), that is to say 6 samples taken at each station; The methods used are those outlined in [16] [17] in his soil manual analyzes.

2.3. Methodology in the Laboratory

The soil samples were sent to the soil testing laboratory for different treatments.

Physical Analyzes

Granulometry;

Stokes particle size method.

2.4. Chemical Analyzes

2.4.1. pH

Electrometric method.

2.4.2. $CaCO_3$ (Total Limestone)

Bernard calcimeter method.

2.4.3. Organic Matter

Anne method [18].

Knowing the amount of dichromate needed for this oxidation, we can calculate the percentage of organic carbon and humus in the soil (the ratio% humus/% Cox = 1.724) [16].

2.4.4. Electrical Conductivity

Method of diluted extract or extract a fifth (1/5). The measurements are expressed in mS/cm.

2.4.5. Munsell Coloring [19]

The color of the soil, expression of the presence of organic matter, various elements (trace elements, macro elements) can vary from one profile to another and from one sample to another.

2.4.6. Bioclimatic Aspect of the Study Area

Our study stations are located in the upper semi-arid bioclimatic stage in warm winter and in the lower semi-arid in temperate winter.

According to the thermal classification of Debrach [20], we have two types of climate namely, semi-continental for the station of Remchi and coastline for the station of Béni-Saf. According to Sari-Ali [21], this difference is due to the combined influence of the sea, terrain and altitude.

The bioclimatic classification according to the annual average temperature and "m" shows that the Béni-Saf and Remchi stations belong to the thermo-Mediterranean level.

3. Results and Interpretations

1) Remchi station (**Table 1**, **Figure 5**);

2) Rachgoun 1 (**Table 2**; **Figure 6**);

2) Rachgoun 2 (**Table 3**; **Figure 7**).

4. Conclusion

To know the soil characteristics on which the matorrals rest, it was essential to carry out a set of analyzes that highlight its physical and chemical nature. It is noted that the soils of the Matorrals studied occupy remarkably varied zones as much by the topographical location as by the texture and properties of the soil. The low clay content (Remchi: Profile 1: Horizon 1 clays 10%, Profile 2: Horizon 1: Clays 16%, Profile 3: Horizon 1: Clays 5%, Rechgoun Profile 1: Horizon 1: Clays 3%, Profile 3: Horizon 1: 2% Clays and Horizon 2: 3% Clays) leads to poor structural stability leading to degradation of the soil surface through erosion. This is revealed by the presence of small erosion claws visible on these rugged slopes. We note, among other things, a decrease in the percentages of sands towards depth horizons (**Tables 1-3** and **Figures 5-7**). How can we explain this

Table 1. Results of physico-chemical analyzes of Remchi soil.

	Profile 1		Profile 2		Profile 3	
	Horizon 1	Horizon 2	Horizon 1	Horizon 2	Horizon 1	Horizon 2
Depth (cm)	0 - 15	15 - 80	0 - 8	8 - 60	0 - 20	20 - 80
Granulométry (%)						
1) Sand	73	65	44	54	79	62
2) Silts	17	17	40	31	16	27
3) Clay	10	18	16	15	5	11
Type of texture	Sandy-Silty	Sandy-Silty	Sandy-Silty	Sandy-Silty	Sandy-Silty	Sandy-Silty
Organic matter						
4) OM (%)	5.16	4.64	4.90	4.40	4.60	4.30
5) Estimation	Very strong	Strong	Strong	Strong	Strong	Strong
Minéral réserve						
6) $CaCO_3$ (%)	11.28	8.71	26.15	22.00	21.53	16.92
7) Interprétation	Average	Average	Strong	Average	Average	Average
Soil solution						
8) pH	7.02	7.08	7.02	7.02	7.34	7.34
9) Estimation	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
10) Electric conductivity	0.65	0.44	0.76	0.67	0.87	0.67
11) Estimation	Little dirty	Unsalted	Little dirty	Little dirty	Little dirty	Little dirty
Munsell coloring	10 YR 5/4	5 YR 5/4	5 YR 4/4	10 YR 4/3	7.3 YR 4/3	5 YR 4/6

Table 2. Results of physico-chemical analyzes of Rechgoun 1 soil.

	Profile 1		Profile 2		Profile 3	
	Horizon 1	Horizon 2	Horizon 1	Horizon 2	Horizon 1	Horizon 2
Depth (cm)	0 - 15	15 - 80	0 - 15	15 - 100	0 - 15	15 - 80
Granulométry (%)						
1) Sand	83	90	89	79	92	79
2) Silts	14	8	9	19	6	18
3) Clay	3	2	2	2	2	3
Type of texture	Sandblaster	Sandblaster	Sandblaster	Sandblaster	Sandblaster	Sandblaster
Organic matter						
4) OM (%)	5.18	2.86	4.95	2.90	4.50	2.80
5) Estimation	Very strong	Average	Very strong	Average	Very strong	Average
Minéral réserve						
6) $CaCO_3$ (%)	22.05	17.94	10.76	20.00	14.35	18.46
7) Interprétation	Average	Average	Average	Average	Average	Average
Soil solution						
8) pH	7.06	7.12	7.06	7.07	7.04	7.05
9) Estimation	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
10) Electric conductivity	0.59	0.62	0.46	0.46	0.50	0.49
11) Estimation	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted
Munsell coloring	2.5 YR 3/4	5 YR 3/4	7.5 YR 4/4	7.5 YR 4/6	7.5 YR 3/4	5 YR 3/3

Table 3. Results of physico-chemical analyzes of Rechgoun 2 soil.

	Profile 1		Profile 2		Profile 3	
	Horizon 1	Horizon 2	Horizon 1	Horizon 2	Horizon 1	Horizon 2
Depth (cm)	0 - 15	15 - 80	0 - 15	15 - 80	0 - 20	20 - 100
Granulométry (%)						
1) Sand	84	84	81	82	85	68
2) Silts	12	14	14	14	12	23
3) Clay	4	2	5	4	3	9
Type of texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy - Silty
Organic matter						
4) OM (%)	5.17	3.25	4.90	3.10	4.55	2.90
5) Estimation	Very strong	Strong	Strong	Strong	Strong	Average
Minéral réserve						
6) $CaCO_3$ (%)	17.43	24.10	22.56	22.05	26.66	28.20
7) Interprétation	Average	Average	Average	Average	Strong	Strong
Soil solution						
8) pH	7.00	7.11	7.12	7.12	7.08	7.13
9) Estimation	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
10) Electric conductivity	0.49	0.49	0.05	0.53	0.62	0.55
11) Estimation	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted
Munsell coloring	7.5 YR 5/4	2.5 YR 5/8	5 YR 5/8	5 YR 5/4	5 YR 4/6	5 YR 6/4

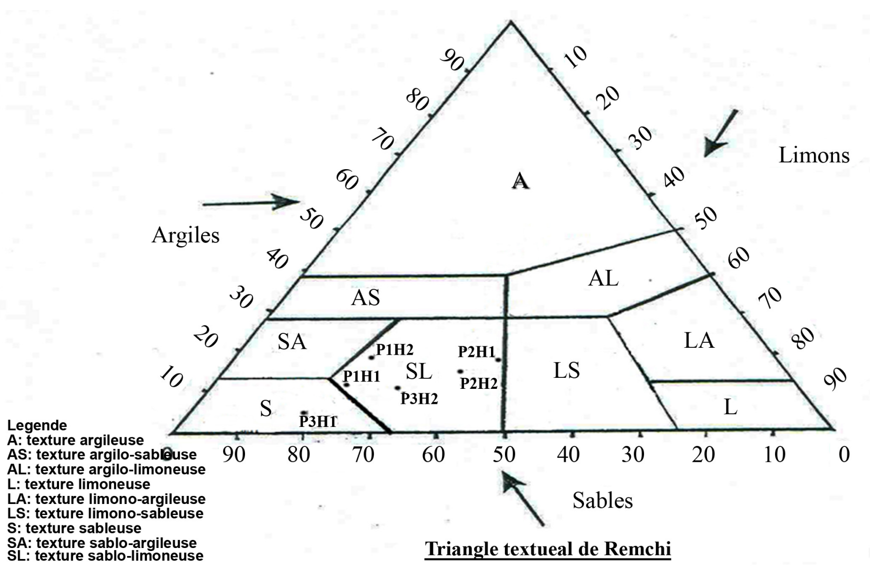

Figure 5. Remchi textural triangle.

phenomenon, which tends to generalize across all profiles? In our opinion, this sequential differentiation is due to colluvial and alluvial phenomena in these steep slopes. Soils affected by this sensitivity are often rich soils (Remchi: Profile 2: Horizon 1: silt 40% and Horizon 2: silt 31%, Profile 3: Horizon 1: silt 16%) in silt and/or fine sand (Profile 1: Horizon 1 sands 73% and Horizon 2: sands: 64%, Profile 2: Horizon 1: Horizon 2: sands 54%, Profile 3: Horizon 1: sands 79% and

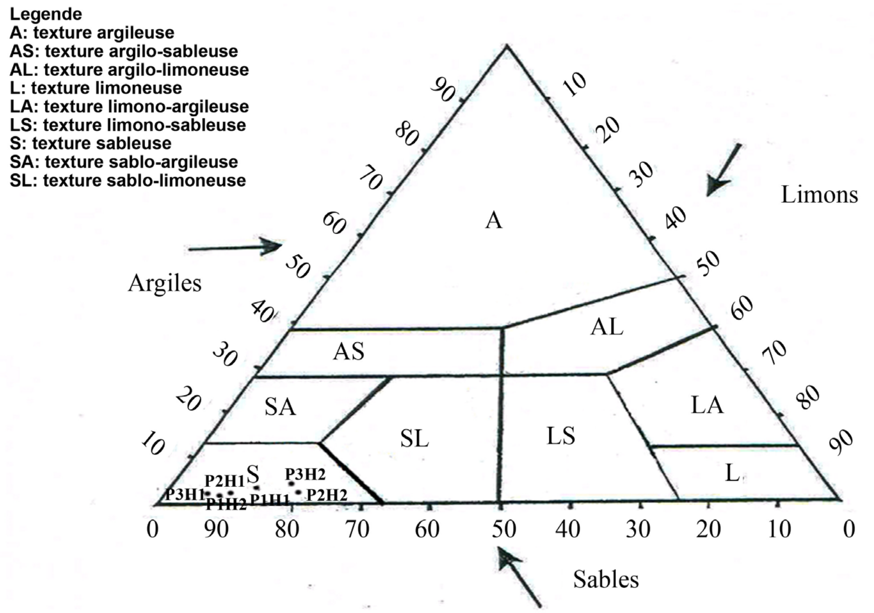

Figure 6. Textural triangle Rechgoun 1.

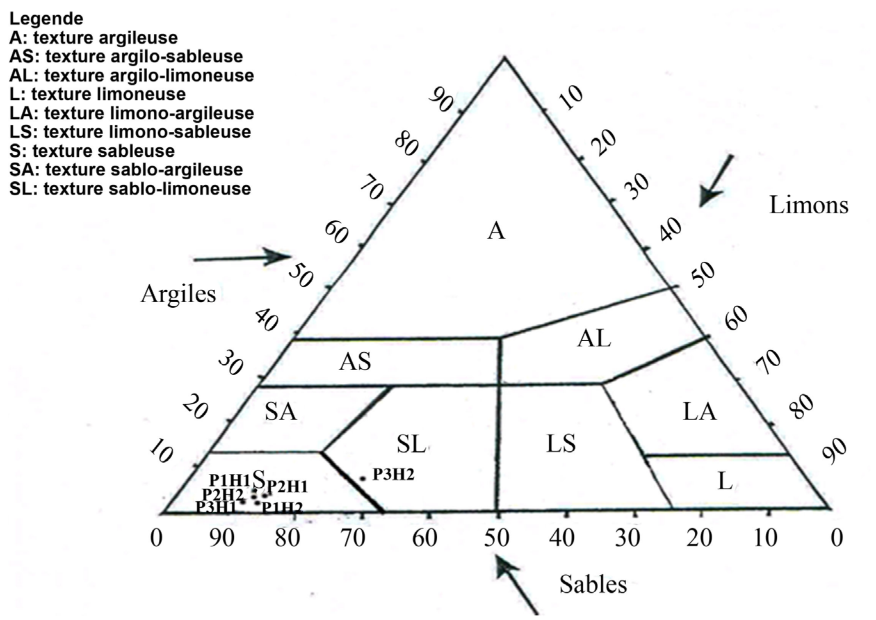

Figure 7. Triangle textural Rechgoun 2.

Horizon 2: Sands 62%). The silts have a weak cohesion and are very fine particles. They are therefore easily detached from the soil matrix and easily transported by runoff since they are small. Fine sands have an even weaker cohesion. Coarse sands have a very weak cohesion, because they are also larger sediments than fine silts and sands. Easily transported by the water these run down the slopes. A very approximate range for an ideal clay content would be between 15% and 30% - 40%. Below 15%, the structural stability becomes relatively low and the soil easily eroded; beyond about 40%, the soil tends to be heavy, with high water retention and a structure tending to be massive [22]. This very modest description of this edaphic part remains somewhat incomplete; it would probably be useful to start more detailed (quantitative) analysis on other edaphic elements such as CEC, chlorine, and other cations (iron) in particular in this region of study. These elements depend very much on the local micro-topography and the climatic factors as well as the human action (neighboring agriculture especially).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Merzouk, A., Benabadji, N., Benmansour, D. and Thinon, M. (2009) Quelques aspect édapho-floristique des peuplements halophiles de l'Algérie occidentale. Première partie: Aspect édaphiques. *Bulletin de la Société Linnéenne de Provence*, **60**, 1-15.

[2] Laperche, V. and Moussman, J.R. (2004) Protocol of Sampling of the Urbain. Ground Polluted by Lead, RP-52928-FR.

[3] Collier, D., Gachon, L. and Robelin, M. (1957) Cinquieme année d'expérience en cases d'essai de végétation de la station d'agronomie du massif centrale. Essai sur l'orge de printemps, C.R. Acad. Séance du 26 juin.

[4] Laperche, V. and Mossman, J.R. (2004) Protocol of Sampling of the Urban Grounds Polluted by Lead. RP 52928.

[5] Lahouel, N., Benabadji, N. and Benmansour, D. (2014) Characterization of the Organic Matter in the Formations with *Juniperus phoenicea*, and *Pinus halepensis* in the Matorral of the Mostaganemois Littoral. *OJE Journal*, **4**, 253-261. https://doi.org/10.4236/oje.2014.45024

[6] Roose, E. (1991) Conservation des sols en zone méditteranéens. Synthèse et proposition d'une nouvelle stratégie et lutte antiérosive: FCES-c Cahier OSTOM, série pédologie, Vol. XVI, No. 2145-181.

[7] Robert, M. (1992) Le sol, ressource naturelle à préserver pour la protection de l'environnement. Cahiers agricultures, 20-34.

[8] Benabdelmoumene, F. (2018) Contribution à une étude phytoécologique des peuplements situés dans la région de Hammam Boughrara (Oranie). 36-37.

[9] Ozenda, P. (1977) Flore du Sahara. 2ème éd. revue et complétée, C.N.R.S. Paris, 622 p.

[10] Guinochet, M. (1973) Phytosociologie. Ed. Masson et Cie, Paris, 227 p.

[11] Meziane, H. (2010) Contribution à l'étude des Groupements Psammophytes de la région de Tlemcen (Algérie occidentale). Thèse Doc. Univ. Tlemcen, 230 p.

[12] Duchauffour, Ph. (1977) Pédologie, Pédogénèse et classification. Tome I, Ed. Mass. Cie, 477 p.

[13] Benabadji, N., Bouazza, M., Metge, M. and Loisel, R. (1996) Description et aspects des sols en région semi aride et aride au Sud de Sebdou (Oranie, Algérie). *Bulletin de l'Institut Scientifique* (*Rabat*), No. 20, 77-86.

[14] Aubert, G. and Chalabi, N. (1981) Contribution l'étude édaphique des groupements Quercus cerris su. P. Pseudocerris cedruslibani et Abies cilica dans le Nord-Ouest de la Syrie. *Revue Ecol. Médit. Limnique*, **7**, 23-35.

[15] Ruellan, A. (1970) Les sols à profil calcaire différenciés des plaines de Basse-Moulouya (Maroc oriental). Contribution à la connaissance des sols méditerranéens. Mém. ORSTOM No. 54, 302 p.

[16] Aubert, G. (1978) Méthodes d'analyses du sol. 2ème Edition, C.N.D.P. Marseille, 199 p.

[17] Baize, D. (1988) Guide des analyses courantes en pédologie. INRA, Paris, 172 p.

[18] Anne (1945) Dosage rapide du carbone organique des sols agronomique.

[19] Munsell (1971) Munsell Soil Color Charts. Munsell Color Company Inc., Baltinore.

[20] Debrach, J. (1959) Notes sur les climats du Maroc occidental. *Maroc méridional*, **32**, 1122-1134.

[21] Sari-Ali, A. (2012) Contribution à l'étude des peuplements à Arthrocnemum glaucum (Del.) Ung. de l'Oranie (Algérie occidentale) taxonomie et bio-écologie. Thèse Doct. Univ. Tlemcen, 245 p.

[22] Mezouar, K. (2016) Relations Sol-Végétation dans la région sud de Tlemcen. Master thesis, 197 p.