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Research Article

Some Edaphic Aspects of the Matorrals of Sidi-Djilali (South-West of Tlemcen)

Mezouar Khadidja[1], Benabadji Noury[1] , Aouadj Sid Ahmed[2,3] , Merzouk Abdessamad[1] , Benabdelmoumene Fatna[1] and Zouidi Mohamed[4]

[1] Laboratory of Ecology and Management of Natural Ecosystems, Abou Bakr Belkaid University, Tlemcen- Algeria.
[2] Hassiba Benbouali University of Chlef, Algeria.
[3] Laboratory of Ecology and Management of Natural Ecosystems (LEGEN13), Tlemcen- Algeria.
[4] Centre de Recherche en Aménagement du Territoire (CRAT), Campus Zouaghi Slimane, Route de Ain el Bey, 25000 Constantine- Algeria.

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Abstract
The region considered is the South of Tlemcen (Sidi Djilali), in order to high the analysis of the main soil edaphic factors. This study takes into account on one hand the analysis of the different physicochemical characters and on the other hand, the statistical analysis of these factors.
The soils in our study area show some homogeneity. They have a silty-clay texture. With a presence of clay known for its high retention capacity, this texture also includes a significant percentage of sand in front of the other granulometric elements (Sande: 37.5%, Silt: 30.75%, Clays: 31.75%); The pH of the soil is not very alkaline for this region, it varies between 6.69 to 6.89; The rate of organic matter is very low (0.3 and 0.8%), it justifies the low rate of vegetation cover (20 to 30%) and the rather limited restitution to the soil; The limestone rate is average for this region and does not exceed 24.4%; The analyzed soils are unsalted (0.1 and 0.3 mS / cm). Regarding the color of the soil, it differs from one station to another with a tendency to brownish color expressed according to the international color of Munsell (YR). Furthermore, the biostatistical treatment of data collected through the A.C.P. realized with the help of the software "MINITAB 16" concretized with the help of graphs, the correlations which can exist between the different edaphic parameters studied. These biostatistical results allowed us to analyze in a rather precise way the edaphic factors of the southern slope of the Tlemcen region.

Keywords: Matorral; Edaphic parameters; Physico-chemical analyses; ACP of soil; Sidi Djilali.

Introduction

In any ecological study, the soil remains the determining key to the various phenomena (growth, maintenance, adaptation) by its mineral nutrients, as well as by its water and organic matter content. Ozenda [1] defines the soil as a main element of the environment that regulates the distribution of vegetation.

It develops depending on the nature of the bedrock, topography and climate characteristics. The soil of Mediterranean regions is often exposed to degradation phenomena, which are the frequent result of very ancient practices. The main factors responsible for these interactions are man, climate, etc. [2].
The soil is a loose and relatively stable superficial formation of the ground, it can include, generally a mineral fraction and an organic Guinochet fraction [3]. Edaphology is only one part of pedology, in fact it deals with the genesis and distribution of Killian soils [4].

* Corresponding author: **M. Khadidja, Email:** khadidja.mezouar@univ-tlemcen.dz
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Algeria is part of the group of Mediterranean countries where the drought, observed for a long time, clearly led to the process of salinization of the Ozanda soils [1]; Gaucher and Burdin [5] with 3.2 million Ha [6, 7-13].
These two natural constraints, drought and salinity, have modified the stability of ecosystems. According to Tricart et al. [14] soil is the natural formation of a surface with a loose structure and variable thickness resulting from the transformation of the underlying bedrock, under the influence of various physical, chemical and biological processes.
Valentin [15]; Lieth et al. [16] show that this situation is gradually evolving towards the phenomenon of desertification of Hamdy soils [17]. Orania is characterized by a particularly important extension of salty environments, the halophilic zones extend especially in the semi-arid bioclimatic stage with hot winter as well as in the arid enclaves [18-21].
The soils of the sub-littoral depressions in Oranie are of the Solontchak type with a sodium complex mainly loaded with sodium chloride [22-24]. This situation is due to the arid and semi-arid conditions where the possibilities of evaporation are considerable, and the rainfall limited [25].
Few works have yielded significant results on the soil characteristics of the Tlemcen region. However, we can cite a few of them such as: Durand [26]; Duchaufour [27]; Amrani [28]; Bouazza [29]; Bouazza [30].
Through this study it was a question of carrying out a certain number of quantitative and qualitative physicochemical analyzes of the soil in order to be able to bring a complementarity to the edaphic studies carried out in these pre-forest areas of these mountain slopes for this, we have in our case, the following parameters are taken into consideration: particle size composition (texture), color, pH, electrical conductivity, carbonate ($CaC0_3$), organic matter. The data finally collected were the subject of biostatistical analyzes (factorial correspondence analyzes) [31-34].

Material and Methods

Study area

The study area is located in western Algeria (Table 1, Figure 1), it is a vast environment reported as being a vast eco-complex located on the foothills of the southern slopes. Administratively belonging to the Daira of Sidi-Djilali, the region is crossed by the wilaya road connecting Sebdou to Sidi Djilali and is limited to the west by the state of Morocco.

Table 1.

Geographical coordinates of the 04 Stations

Stations	Latitude	Longitude	Altitude (m)
Station 1 (Sidi Djilali)	34°59’	1°24’	1014
Station 2 (Ain Sfa)	34°52’	1°49’	1294
Station 3 (Barrage vert)	34°43’	1°57’	1252
Station 4 (Sidi El-Mokhfi)	34°49’	1°48’	1326

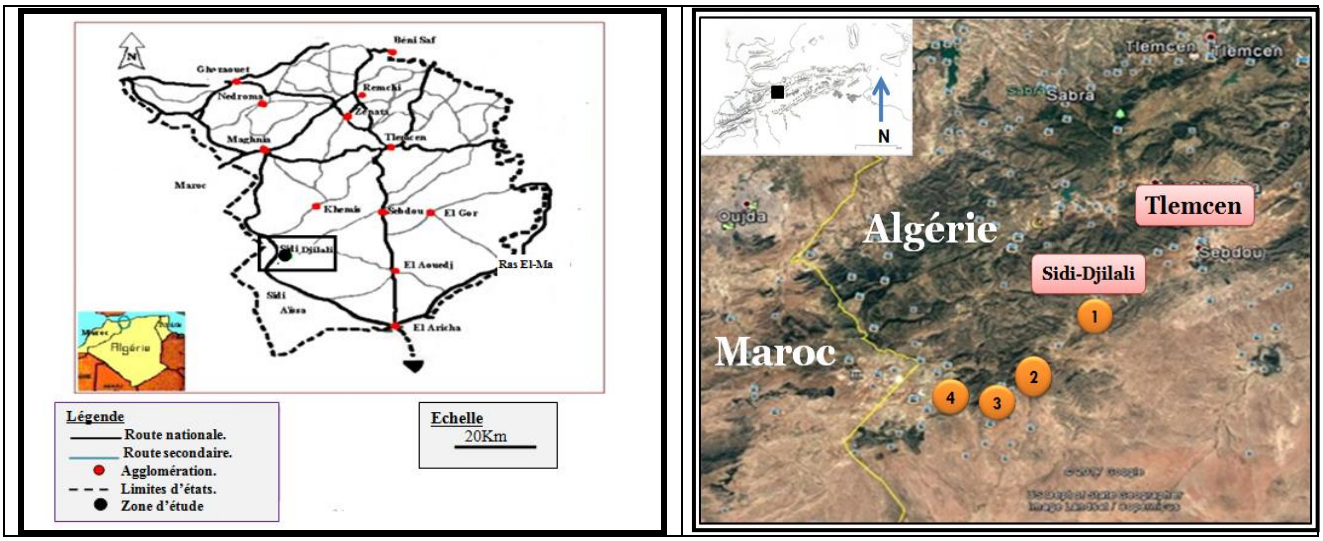


Figure 1. The region Area (Saida-Western of Algeria)

Methods

a. Soil analyzes:

a.1. At the field

The 5 samples considered representative per station were taken from the rhizosphere, that is to say between 0 and 30 cm at the level of the first 2 horizons. Account was taken of the substrate on which the soil was formed (especially bedrock). The soil samples are spread out on paper and then left to dry and sieved (2 mm diameter mesh sieve). This operation then consists in separating the fine earth (ø <2 mm) from the coarse elements (ø> 2 mm). They were collected in sachets in the number of 05 samples per station (one to two samples per profile depending on the case, ie 20 in total). The choice of the number of samples was dictated by the nature of the terrain (facies and local microtopography).

a.2. In the laboratory

Returned to the laboratory, the soil samples were numbered, then dried and sieved (2 mm diameter sieve). The analyzes were carried out on fine earth (diameter of 02 mm).

- Granulometry, Casagrande densimetric method,
- Total limestone, Calcimeter Bernard method,
- Organic carbon, Anne's method [35].
- Organic matter, MO/C =1.724,
- pH, distilled water, electrometric method
- Coloring, international Munsell method (Munsell Soil Color Chart).

b. ACP sol

The principle of the method was developed from work already carried out on the lawns of the southern Apennines in Italy [36].

Statistical processing For the computer processing of edaphic data, we used the principal component analysis (PCA) method, assisted by the “Minitab 16” software.

This type of treatment, the mathematical foundations of which are exposed in Cordier's thesis [37] and the works of Benzekri [38], Roux [39], Lacoste and Roux [40] have been used for many years.

The P.C.A makes it possible, thanks to graphic representations, to construct point clouds representing in a dimensional space and vice versa.

The software calculates the statistical distance between the readings according to the frequencies of the edaphic data recorded. Benzekri [38] specifies that there is no reason to question the validity of a first axis having more than 50% of inertia rate. The coordinates of the points are given for each of the factorial axes, after projection.

Results and discussion

Soil analyzes

a-Station 1. (Sidi Djilali) (Table 2, Figure 2).

Table 2.

Results of soil analyzes at the Station 1 (Sidi Djilali)

Stationary characteristics	**Station 1**					
Geographical location	Sidi Djilali					
Altitude (m)	1014					
Samples N°	1	2	3	4	5	
Depth of horizons (cm)	0-5	0-5	0-15	0-15	0-30	
Coulor Munsell.	7.5 YR 5/6	7.5 YR 4/4	7.5 YR 5/6	7.5 YR 5/4	7.5 YR 4/4	
Granulometry (%)						**Mean**
Sand	39	37	42	35	41	38.8
Silt	30	33	29	33	30	31
Glays	31	30	29	32	29	30.2
Gravel	16	15	19	20	18	17.6
Texture type	Silt-Clays					
organic material (%)	0.8	0.8	0.5	0.8	0.8	0.74
Estimate	very weak	very weak	very weak	very weak	very weak	very weak
Soil solution						
pH	6.79	6.75	6.85	6.80	6.86	6.81
Appreciation	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Mineral reserves (%)						
total Calcaire	15	17	15.7	19.3	20	17.4
Estimate	Mean	Mean	Mean	Mean	Mean	Mean
Electrical conductivity (mS/cm)	0.3	0.2	0.1	0.1	0.1	0.16
Estimate	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted	Unsalted

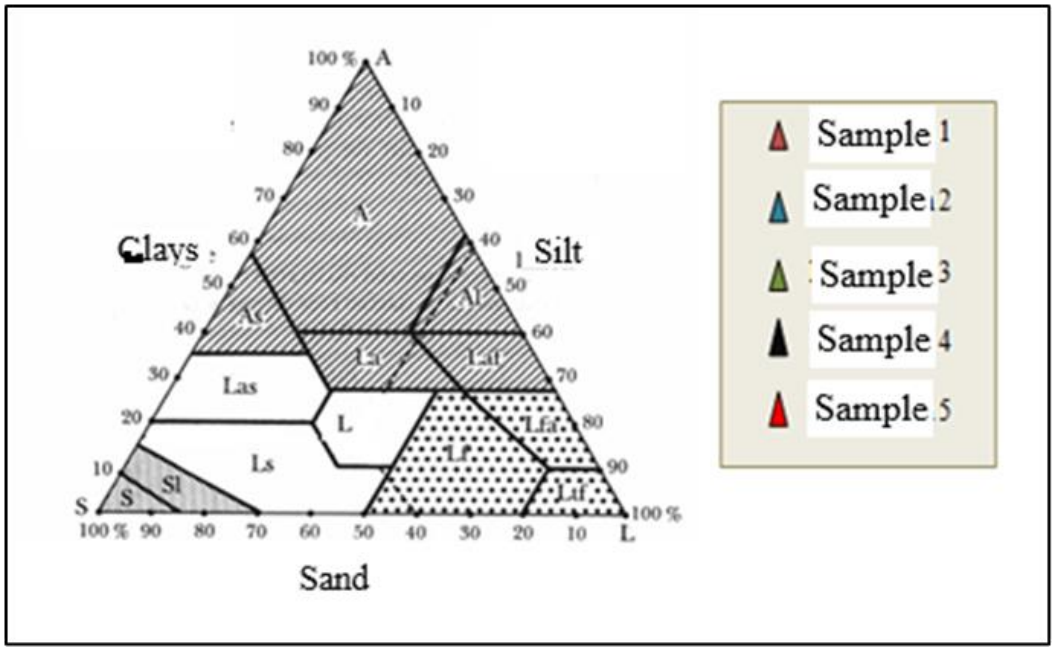


Figure 2. Textural triangle of the Station 1 (Sidi Djilali)

• Color to Munsell

The coloring of the soil is directly related to the composition of chemical elements. This edaphic variable varies from one sample to another which shows a difference between the different colors of the soil: samples 1 and 3 of type (7.5 YR, 5/6), sample 2 (7.5 YR, 4/4), sample 4 (7.5 YR, 5/4), and sample 5 (5 YR, 5/6).

•Granulometry

Particle size analysis of the samples at this station shows that the texture is mostly silty clay.

• pH

Regarding the pH, it is variable: sample 1 (pH = 6.79); sample 2 (pH = 6.75); sample 3 (pH = 6.85); sample 4 (pH = 6.80) and for sample 5 (pH = 6.86). The pH is almost neutral for all the samples at the station.

• Organic material

The quantity of organic matter in the samples from this station is very low; it is 0.5% for sample 3, and 0.8% for samples 1, 2, 4, 5. This situation may seem surprising, in fact, the samples in pre-forest environments must show some richness in organic elements coming from the vegetation returned to the ground by the forest subjects or by the formations of lawns covering the ground.

•Total limestone

The samples from this station show an average amount of total limestone for sample 1 ($CaCO_3$ = 15%), sample 2 ($CaCO_3$ = 17%), sample 3 ($CaCO_3$ = 15.7%), sample 4 ($CaCO_3$ = 19.3%), sample 5 ($CaCO_3$ = 20%). In this range of values, the lime content in samples 1 and 3 (15 and 15.7%) are low. These values obtained seem to be in conformity with those analyzed in ecosystems of the same kind (scrub, pre-forest).

•Electrical conductivity

The soil samples are unsalted and therefore have a very low electrical conductivity 0.3mS / cm for sample 1, 0.2 mS / cm for sample 2 and 0.1 mS / cm for samples 3, 4, 5, which in our humble opinion makes sense. The salinity in plant formations of matorral should not show relatively high values.

Table 3.

Results of soil analyzes at the Station 2 (Ain Sfa)

Stationary characteristics	**Station 2**					
Geographical location	Ain Sfa					
Altitude (m)	1294					
Samples N°	1	2	3	4	5	
Depth of horizons (cm)	0-5	0-5	0-15	0-15	0-30	
Coulor Munsell.	7.5 YR 4/4	7.5 YR 6/6	5 YR 5/6	7.5 YR 5/4	7.5 YR 4/4	
Granulometry (%)						Mean
Sand	39	40	37	35	40	38.2
Silt	31	29	30	32	29	30.2
Glays	30	31	33	33	31	31.6
Gravel	13	19	16	19	15	16.4
Texture type	Silt-Clays					
organic material (%)	0.6	0.5	0.8	0.6	0.5	0.6
Estimate	very weak	very weak	very weak	very weak	very weak	very weak
Soil solution						
pH	6.69	6.80	6.89	6.84	6.81	6.80
Appreciation	neutral	neutral	neutral	neutral	neutral	neutral
Mineral reserves (%)						
total Calcaire	16	20	19.6	15	18	17.72
Estimate	mean	mean	mean	mean	mean	mean
Electrical conductivity (mS/cm)	0.1	0.2	0.3	0.1	0.2	0.18
Estimate	unsalted	unsalted	unsalted	unsalted	unsalted	unsalted

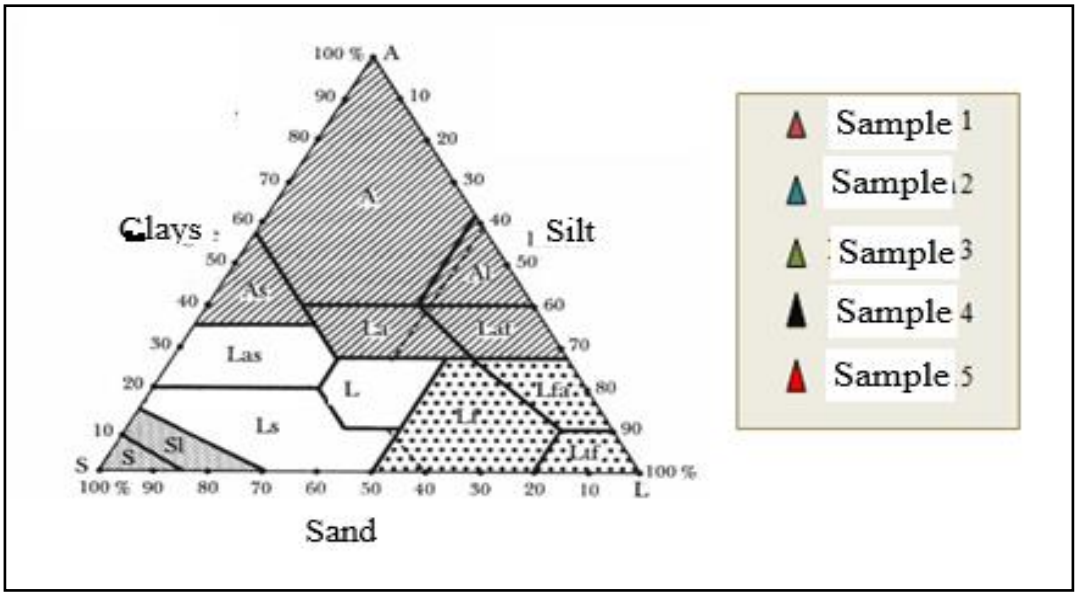


Figure 3. Textural triangle of the Station 2 (Ain Sfa)

• Color to Munsell

There is a difference between the colors of the different soil samples of this station which displays the following types: type samples 1 and 5 (7.5 YR, 4/4), sample 2 (7.5 YR, 6 / 6), sample 3 (7.5 YR, 5/6), and sample 4 (5 YR, 5/4). Red is the dominant color with a brown tendency.

• Granulometry

The particle size analysis of the samples at this station shows that the texture is of the same type,

silty clay despite some variations between the samples. The percentage of sand reaches its maximum threshold in samples 2 and 5 (40%). The other percentages of silts and clays show very little variation.

• pH

For sample 1 it has a value of 6.69; sample 2 (pH = 6.80); sample 3 (pH = 6.89); sample 4 (pH = 6.84) and for sample 5 (pH = 6.81). The pH is generally neutral with very little significant variation between samples. • Organic material This organic matter variable of the soil samples is very low, it is 0.5% for samples 2 and 5, 0.6% for samples 1 and 4, and 0.8 for sample 3. Here too this situation is in contradiction with the pre-forest environments which should in principle display a certain richness in organic elements.

• Total limestone

The samples from this station show an average amount of total limestone which for sample 1 ($CaCO_3$ = 16%), sample 2 ($CaCO_3$ = 20%), sample 3 ($CaCO_3$ = 19.6%), l sample 4 ($CaCO_3$ = 15%), sample 5 ($CaCO_3$ = 18%). The lowest percentage is that of sample 4 with 15%. These stations are geographically close in part to the steppe region, which in our opinion may be favorable to the limestone inputs released by substrates of the same kind (calcareous crust).

• Electrical conductivity

The soil samples in this station are unsalted with a very low electrical conductivity reaching 0.1 mS / cm for samples 1 and 4. A tendency to rise is noticeable (0.2 mS / cm) for samples 2 and 5 and 0.3 mS / cm for sample 3.

c-Station 3. (Green Dam) (Table 4, Figure 4).

Table 4.

Results of soil analyzes at the Station 3 (Green Dam)

Stationary characteristics	**Station 3**					
Geographical location	Green Dam					
Altitude (m)	1252					
Echantillons N°	1	2	3	4	5	
Depth of horizons (cm)	0-5	0-5	0-15	0-15	0-30	
Coulor Munsell.	7.5 YR 6/6	7.5 YR 5/6	7.5 YR 6/6	7.5 YR 6/6	7.5 YR 5/6	
Granulometry (%)	Silt-Clays					Mean
Sand	33	41	36	39	35	36.8
Silt	31	29	28	30	33	30.2
Glays	36	30	36	31	32	33
Gravel	17	14	13	16	15	15
Texture type	Silt-Clays					
organic material (%)	0.60	0.60	0.30	0.60	0.60	0.66
Estimate	very weak	very weak	very weak	very weak	very weak	very weak
Soil solution						
pH	6.79	6.82	6.76	6.81	6.81	6.79
Appreciation	neutral	neutral	neutral	neutral	neutral	neutral
Mineral reserves (%)						
total Calcaire	19.50	20.00	16.60	16.00	17.00	17.82
Estimate	Mean	mean	mean	mean	mean	Mean
Electrical conductivity (mS/cm)	0.2	0.3	0.2	0.1	0.1	0.18
Estimate	unsalted	Unsalted	unsalted	unsalted	unsalted	unsalted

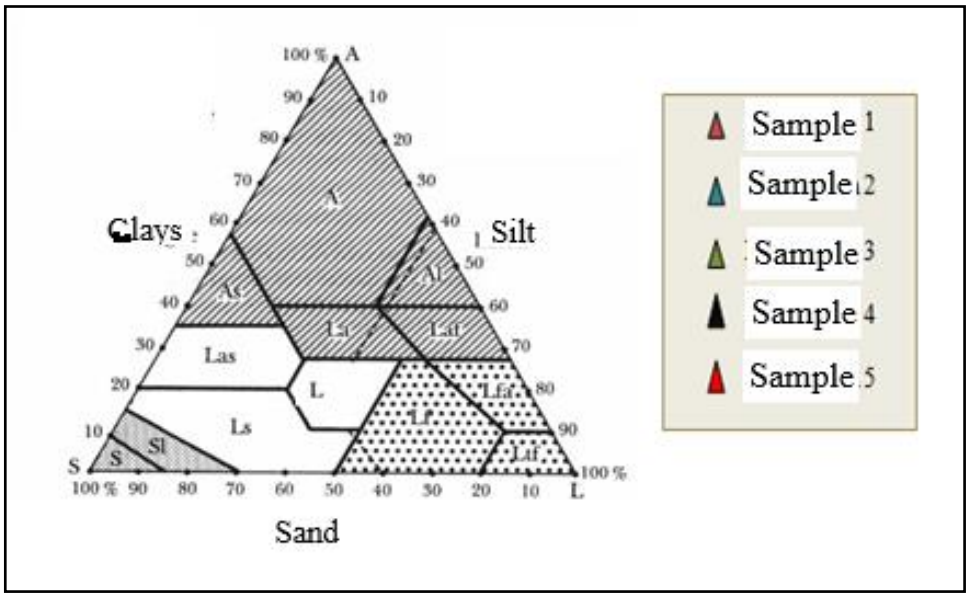


Figure 4. Textural triangle of the Station 2 (Green Dam)

• Color to Munsell

The edaphic variable shows the difference in colors of the soil samples: we have the following colorations: samples 1, 3 and 4 are of type 7.5 YR,* 6/6, samples 2 and 5 of type 7.5 YR, 5/6. The same remarks made previously (Stations 1 and 2) are also valid for the coloration recorded at this station.

• Granulometry

The granulometric analysis of the samples in this station 3 (green dam) shows that the texture is identical silt-clay, even if sometimes we note a tendency to fluctuations, in particular (sample 1: 33% and the 2: 40% of sands), despite some variations between samples. The percentage of sand reaches its maximum threshold in samples 2 and 5 (40%). The other percentages are low in silt and clay and vary from 1 to 6%.

• pH

The pH of the samples in this station is neutral or close to neutrality: sample 1 (pH = 6.79); sample 2 (pH = 6.82); sample 3 (pH = 6.76); and (pH = 6.81) for samples 4 and 5. However, we note a tiny variation between the different samples which is 0.2%.

• Organic material

The amount of organic matter in the samples is not only low but shows an identical value of 0.6%, except for sample 3 where the percentage drops to 0.3%.

• Total limestone

The samples from this station show an average amount of total limestone for sample 1 ($CaCO_3$ = 19.5%), sample 2 ($CaCO_3$ = 20%), sample 3 ($CaCO_3$ = 16.6%), sample 4 ($CaCO_3$ = 16%), sample 5 ($CaCO_3$ = 17%). A difference of around 4% is noted between the different samples analyzed.

• Electrical conductivity

The soil samples vary very little (0.1 mS / cm), they are unsalted with a very low electrical conductivity 0.2 mS / cm for samples 1 and 3, and 0.3 mS / cm for the sample 2 and finally 0.1 mS / cm for samples 4 and 5, which is in principle completely admissible. The salinity in such ecosystems should not tend to increase.

d-Station 4. (Sidi El-Mokhfi) (Table 5, Figure 5).

Table 5.

Results of soil analyzes at the Station 4 (Sidi El-Mokhfi)

Stationary characteristics	**Station 4**					
Geographical location	Sidi El-Mokhfi					
Altitude (m)	1326					
Samples N°	1	2	3	4	5	
Depth of horizons (cm)	0-5	0-5	0-15	0-15	0-30	
Coulor Munsell.	7.5 YR 5/8	7.5 YR 5/8	5 YR 4/4	7.5 YR 8/4	7.5 YR 5/4	
Granulométrie (%)						Mean
Sand	41	29	35	40	36	36.2
Silt	30	36	32	29	31	31.6
Glays	29	35	33	31	33	32.2
Gravel	14	16	12	18	13	11.2
Texture type	Silt-Clays					
organic material (%)	0.60	0.30	0.30	0.60	0.50	0.46
Estimate	very weak	very weak	very weak	very weak	very weak	very weak
Soil solution						
pH	6.73	6.89	6.78	6.84	6.82	6.81
Appreciation	neutral	neutral	neutral	neutral	neutral	neutral
Mineral reserves (%)						
total Calcaire	21.70	24.40	24.00	16.20	22.00	21.66
Estimate	mean	mean	mean	mean	mean	mean
Electrical conductivity (mS/cm)	0.20	0.10	0.10	0.20	0.10	0.14
Estimate	unsalted	unsalted	unsalted	unsalted	unsalted	unsalted

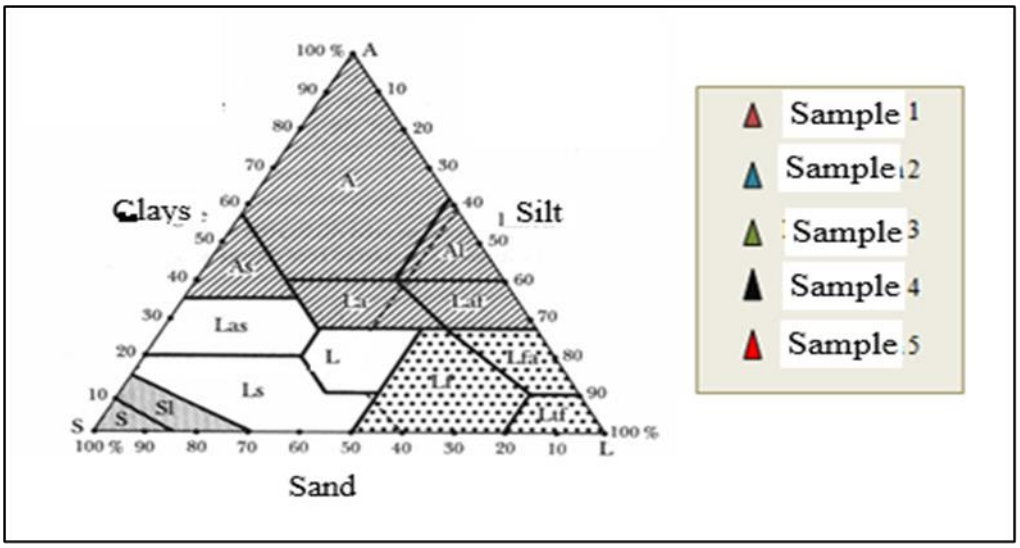


Figure 5. Textural triangle of the Station 4 (Sidi El-Mokhfi)

• Color to Munsell

In this station this edaphic variable shows a difference between the color of the soil samples: samples 1, 2 are of type (7.5 YR, 5/8), sample 3 of type (5 YR, 4/4), sample 4 is of type (7.5 YR, 8/4), and sample 5 of type (7.5 YR, 5/4).

• Granulometry

The particle size analysis of the samples at this station shows that the texture is of the silty clay type.

• pH

The pH of the soil samples varies: Sample 1 (pH = 6.73); sample 2 (pH = 6.89); sample 3 (pH = 6.78); sample 4 (pH = 6.84) and for sample 5 (pH = 6.82). The pH is neutral for all samples at the station.

• Organic material

The levels of organic matter may indeed surprise these low percentages vary between 0.3 and 0.6% depending on the stations.

• Total limestone

The samples from this station show an average quantity of total limestone for all the samples: sample 1 ($CaCO_3$ = 21.7%), sample 2 ($CaCO_3$ = 24.4%), sample 3 ($CaCO_3$ = 24%), sample 4 ($CaCO_3$ = 16.2%), sample 5 ($CaCO_3$ = 22%).

• Electrical conductivity

The soil samples are unsalted with a very low electrical conductivity 0.1 mS / cm for samples 2, 3 and 5, and 0.2 mS / cm for samples 1 and 4.

ACP Sol

Station 1 (Sidi Djilali)

Interpretation of axis 1

- Own value: 4.9545
- Inertia rate: 0.991

+	-
pH (-0.70175) $CaCO_3$ (-0.02978) Organic material (-1,08662)	Clay (+0.78265) Silt (+0.83391) Sande (+1.32506)

At the level of this axis we notice an organic matter (OM) gradient which goes from the positive side to the negative side of the axis, while on the positive side the textural gradients (fine and coarse) underlie the axis.

Interpretation of axis 2

- Own value: 0.0335
- Inertia rate: 0.007

+	-
Clay (-0.76956) Silt (-1.28986) $CaCO_3$ (-0.51064)	Sande (+1.81392) pH (+0.23782) MO (+0.22674)

On this axis 2, there is an increasing silt gradient (fine earth) which goes from the positive side to the negative side.

Interpretation of axis 3

- Own value: 0.0100
- Inertia rate: 0.002

+	-
Sande (-0.10271) $CaCO_3$ (-2.15345)	Clay (+0.96232) Silt (+0.32629) pH (+0.29241) MO (+0.28215)

It should be noted that $CaCO_3$ (total limestone) is the main gradient that manages the axis in question. The latter goes from the positive side to the negative side (Table 6, Figure 7).

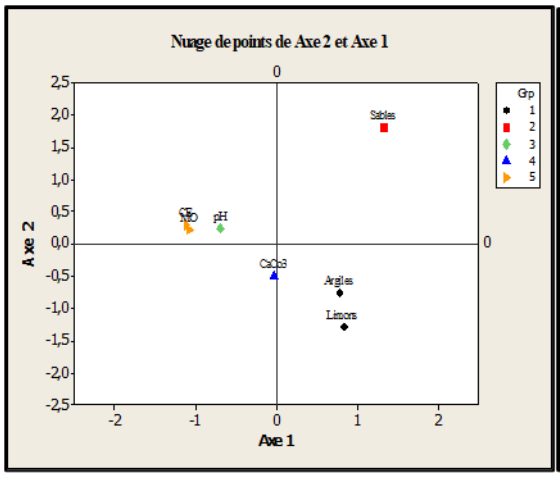


Figure 6. Factorial plane
Station 1. Sidi Djilali (Axis 1 – Axis 2)

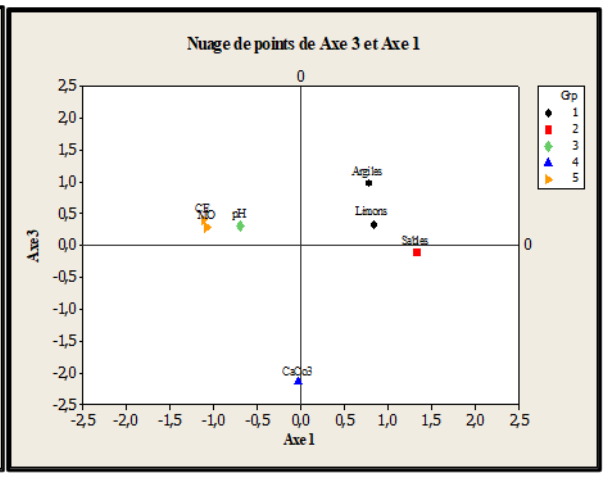


Figure 7. Factorial plane
Station 1. Sidi Djilali (Axis 1 – Axis 3)

Station 2 (Ain Sfa)

Interpretation of axis 1

- Own value**:** 4.9676
- Inertia rate**:** 0.994

+	-
pH (-0.70467) $CaCO_3$ (-0.01166) MO (-1.09882)	Clay (+0.87065) Slit (+0.78156) Sande (+1.28849)

The same phenomenon noted on the previous station exists, indeed the fine texture elements subtend this axis, their gradient goes from the positive side to the negative side. On the other side the organic matter seems to stand out well, the gradient of this parameter goes from the positive side to the negative side of the axis.

Interpretation of axis 2

- Own value**:** 0.0232
- Inertia rate**:** 0.005

+	-
Clay (-0.98476) Silt (-1.32923) pH (-0.11878) MO (-0.09247)	Sande (+1.22091) $CaCO_3$ (+1.32279)

On the positive side of the axis, the edaphic parameters (sands and $CaCO_3$) mark an increasing gradient which moves in the direction: negative side to positive side of the axis. The texture variables (clay and silt) are located on the negative part of the axis marked by a gradient from the positive side to the negative side of the axis.

Interpretation of axis 3

- Own value**:** 0.0087
- Inertia rate**:** 0.002

+	-
Clay (-1.23332) $CaCO_3$ (-1.54115)	Silt (+0.62269) Sande (+0.33348) pH (+0.29243) MO (+1.18435)

The edaphic texture parameter (sand) is characterized by an increasing gradient which goes from the negative side to the positive side of axis 3.
On the opposite side the total limestone and clay are stretched by an increasing gradient which moves from the positive side to the negative side of the axis (Table 8, Figure 9).

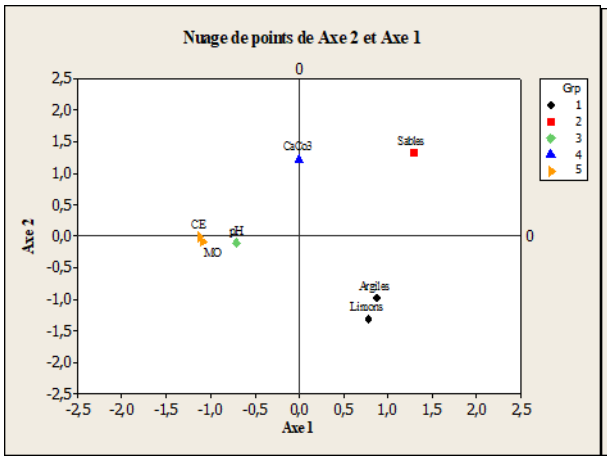


Figure 8. Factorial plane
Station 2. Ain Sfa (Axis 1 – Axis 2)

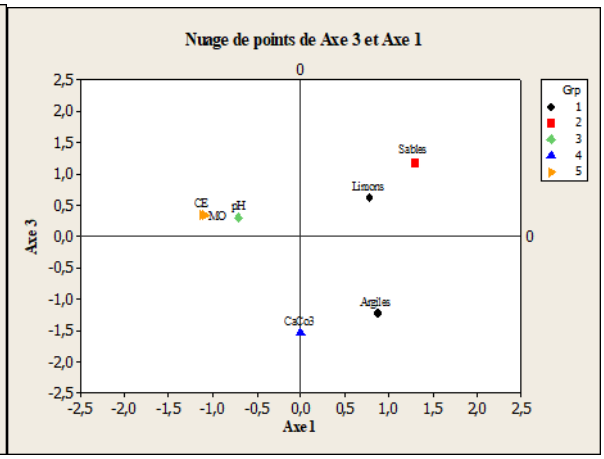


Figure 9. Factorial plane
Station 2. Ain Sfa (Axis 1 – Axis 3)

Station 3 (Green Dam)
Interpretation of axis 1

- Own value**:** 4.9346
- Inertia rate**:** 0.999

+	-
pH (-0.70935) MO (-0.00566) $CaCO_3$ (-1.10718)	Clay (+0.96364) Silt (+0.78526) Sande (+1.20348)

Axis 1 at this station of the green dam is marked by an increasing gradient of the edaphic parameter sand. On the negative part we essentially notice an increasing gradient of the organic matter element which from the positive side to the negative side of the axis.

Interpretation of axis 2

- Own value**:** 0.0441
- Inertia rate**:** 0.009

+	-
Silt (-1.63251) Clay (-0.40656)	Sande (+1.77433) pH (+0.03660) $CaCO_3$ (+0.03423) MO (+0.10201)

On this axis, the edaphic element sand seems to be consolidated at the end of the plane, it is characterized by a gradient from the positive side to the negative side of the axis. Opposite the axis is installed at the negative end a very fine element (clay), itself characterized by an increasing gradient which goes from the positive side to the negative side of the axis.

Interpretation of axis 3

- Own value**:** 0.0140
- Inertia rate**:** 0.003

+	-
Sande (-2.06524) MO (-0.00301)	Clay (+1.16220) Sande (+0.58491) pH (+0.03834) $CaCO_3$ (+0.12570)

At the negative level of the axis we have a fine edaphic parameter (silt) which opposes the variable (clay). This axis confirms the interpretations provided in the previous axes 1 and 2 (Table 10, Figure 11).

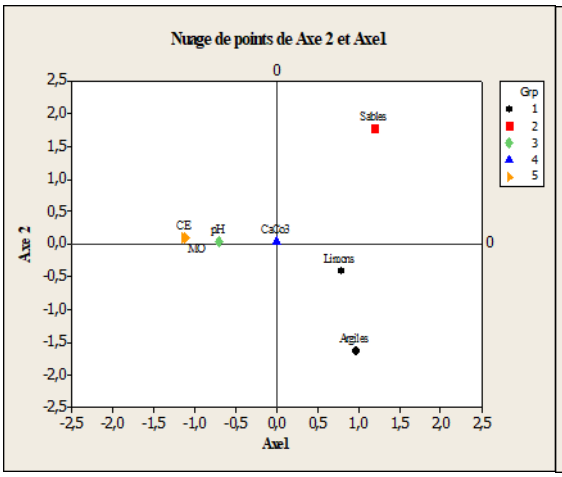


Figure 10. Factorial plane Station 3. Green dam (Axis 1 – Axis 2)

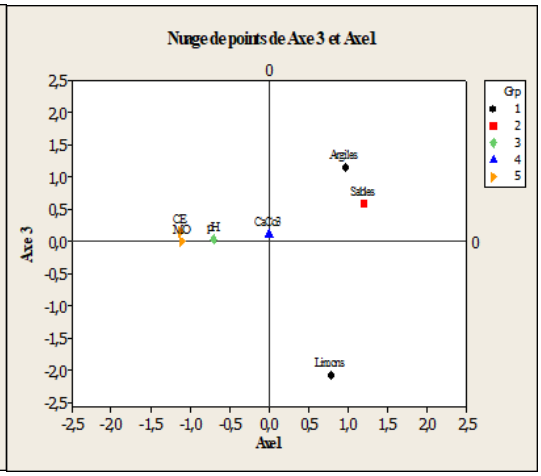


Figure 11. Factorial plane Station 3. Green dam (Axis 1 – Axis 3)

Station 4. (Sidi El-Mokhfi)

Interpretation of axis 1

- Own value**:** 4.8838
- Inertia rate**:** 0.977

+	-
pH (-0.73988) MO (-1.14407)	Clay (+0.87584) Silt (+0.83663) $CaCO_3$ (+1.13077) Sande (+0.20515)

On this axis the edaphic variable (organic matter) is marked by an increasing gradient going from the positive side to the negative side of the axis. The positive part of the axis, on the other hand, shows the presence of the variables with fine and coarse textural characters (clay, silt and sand) with increasing gradients going from the negative side to the positive side of the axis.

Interpretation of axis 2

- Own value**:** 0.1027
- Inertia rate**:** 0.021

+	-
Sande (-1.93455) pH (-0.15081) MO (-0.23389)	Clay (+0.70952) Silt (+0.92457) $CaCO_3$ (+0.88437)

This axis includes fine textural elements (clays, silts) as well as total limestone with gradients that move from the negative side to the positive side of the axis. Quite at the end of the axis (negative side) opposes a coarse textural edaphic element (sand).

Interpretation of axis 3

- Own value**:** 0.0115
- Inertia rate**:** 0.002

+	-
Sande (-0.32804) $CaCO_3$ (-1.99321)	Clay (+1.27277) Silt (+0.37992) pH (+0.28668) MO (+0.19857)

This last axis of the station can only confirm what has been said previously. The total limestone which is on the negative side is opposed to the clays marked by an increasing gradient which goes from the negative side to the positive side of the axis (Table 12, Figure 13).

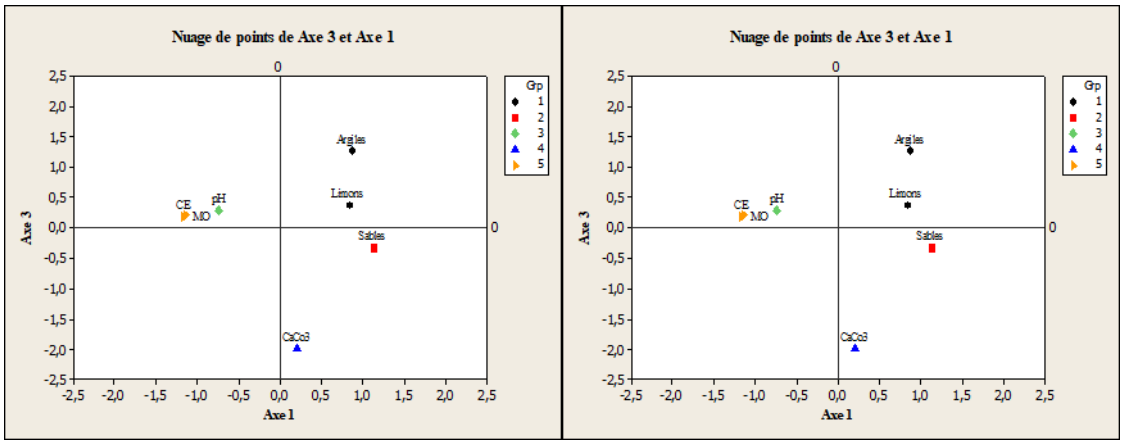


Figure 12. Factorial plane Station 4. Sidi El-Mokhfi (Axis 1 – Axis 2)

Figure 13. Factorial plane Station 4. Sidi El-Mokhfi (Axis 1 – Axis 3)

Conclusions

Soil is an element of the environment whose destruction is often irreversible and has the most serious short- and long-term consequences.

The soils in our study area display certain homogeneities. They have a silty clay texture. This is due to the presence of clay which has a high retention capacity, but this texture has a high percentage of sand; the latter makes the soil light and easily accessible to the roots but sensitive to Itab erosion. Light soils are very sensitive to degradation agents, an aspect that has been strongly noted and which has been studied and then reported by many authors. The presence of coarse elements (gravel: 12 to 20%) increases the path of the water and more or less attenuates the phenomenon of erosion.

In the Mediterranean region, the presence of these elements in high percentage does not constitute an obstacle to the growth of shrub or arborescent plants. They can even promote it by influencing the water regime of Aubert soil.

Thus, in a climate with low rainfall, the deep horizons of the soil will be more frequently soaked with water that it contains on the surface with more coarse element. The soil pH is not very alkaline for this region, it fluctuates between 6.69 and 6.89, it does not act directly.

The pH naturally depends on the nature of the bedrock. The rate of organic matter is very low (0.3 and 0.8%), it justifies the low rate of plant cover. The level of limestone is average for this region and does not exceed 24.4%. This variable (total limestone) reaches average levels for the region of the matorral. Regarding salinity, we have unsalted soils (0.1 and 0.3 mS / cm) according to the Aubert salt scale.

Regarding the color of the ground, each station differs from the other with a tendency to the color red-brown (YR).

Statistically, inertia rates fluctuate from one factor plane to another. The principal component analysis (PCA) used allowed us to highlight a certain number of gradients supporting the axes which seems to be logical, they are known to manage the axes in the distribution of edaphic parameters on the planes factorials.

However, we can point out through this approach or preliminary study on the soils of pre-forest or scrub stands which, in our opinion, requires further investigation (more stations, samples to be analyzed, etc.) to confirm or deny the results collected.

Author Contribution: this manuscript contains complementary results of my doctoral research work. I worked on data collection, interpretation, manuscript final writing, editing and approval. BA my thesis supervisor contributed to the correction the article. ZM performed the processing of my article. AT verified the analytical methods and BB carried out the histological study

Conflicts of Interest: The authors declare that they have no conflict of interests regarding the publication of this article.

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