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New data on some matorralized soils in the western Algerian region

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ABSTRACT This paper continues the work carried out 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 and on 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 analysis was carried out using known methods (Stokes Particle Size Method, Electrometric Method for pH, 1/5 Extract Method for Electrical Conductivity, Bernard Calcium Method for Ca CO3, Anne Method for Organic Carbon). The results confirm the following characteristics: sandy-muddy "Remchi", sandy "Rachgoun 1 and Rechgoun 2", not far from Béni-Saf. The low clay content (Remchi: Profile 1: Horizon 1 clays 9%, Profile 2: Horizon 1: Clays 12%, Profile 3: Horizon 1: Clays 16%, Rechgoun Profile 1: Horizon 1: Clays 5%, Profile 3: Horizon 1: 5% clays and Horizon 2: 6% clays) leads to poor structural stability and degradation of the soil surface due to visible erosion especially on steep slopes.

KEY WORDS Soil vulnerability; anthropization; Matorral; Mediterranean region; Western Algeria.

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INTRODUCTION

Soil is the natural surface formation, of varying thickness, resulting from the transformation of the rock under the influence of various chemical, biological, and physical processes.

It contains a mineral fraction and an organic fraction (Guinochet, 1973), regulates the distribution of vegetation (Ozenda, 1997) and plays a protective role in atmospheric precipitation (Benabadji et al., 1996). Its content of water (Meziane, 2010) and nutritive elements are crucial for all biological phenomena that take place in it (Duchaufour, 1977).

The soil is a resource for human development, but this environment can be damaged by human activity (Collier et al., 1957; Baize, 1988; Laperche & Moussman, 2004; Merzouk et al., 2009; Lahouel et al., 2014) failing to carry out its important ecological functions (Robert, 1992; Benabdelmoumene, 2018). The vulnerability of a soil depends very much on its vegetation cover, its exposure to the sun and other atmospheric agents such as winds and rains (Roose, 1991).

In the Mediterranean region, the Matorral has very diversified soils due to numerous natural factors (climate, vegetation, physiography, geology and lithology) which condition its formation and distribution.

Often the definition of soil is difficult because the terminology used to describe the limestone component is not clear.

Following Ruellan (1972), it is possible use the term “calcareous soil” to include the “laminated soils” and “compact slab soils” (slab and crust). Duchaufour (1977) also clarified that all the so-called steppe soils belong to the class of isohumid soils (brown steppe soils). In any case, the distinction between the two types of soils is easily observed, despite a large number of transition profiles.

It is possible, in our study, to see how a certain number of soils are structured and we will try to highlight a differentiation between edaphic parameters and between the profiles of the different horizons, at the littoral level (Aubert & Chalabi, 1981), on a matorral vegetation examined in a fairly steep territory.

We have already provided some preliminary data (Meftah et al., 2019) and, in this work, we will provide new data some matorralized soils in the western Algerian region.

MATERIAL AND METHODS

Study area

The soils of the Matorrals of the study area (western Algeria) occupy varied topographical location and have different properties.

1. “Remchi” Station. 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.

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 *Champhytes* as *Drimia maritima* (L.) Stearn, *Chamaerops humilis* L. (doum) and some annual species.

2. “Rachgoun 1” Station. 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% with a vegetation composed largely of: *Olea europea* L., *Chamaerops humilis*, *Drimia maritima* and *Calicotome spinosa* (L.) Link.

3. Station “Rachgoun 2”. 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 vegetation cover varies from 60 to 70% on a slope of 30% to 40% with a vegetation dominated by chamaephytes: *Chamaerops humilis*, *Lavandula dentata* L., *Drimia maritima* and some annuals: *Hordeum murinum* L., *Bellis sylvestris* L., and *Avena sterilis* L.

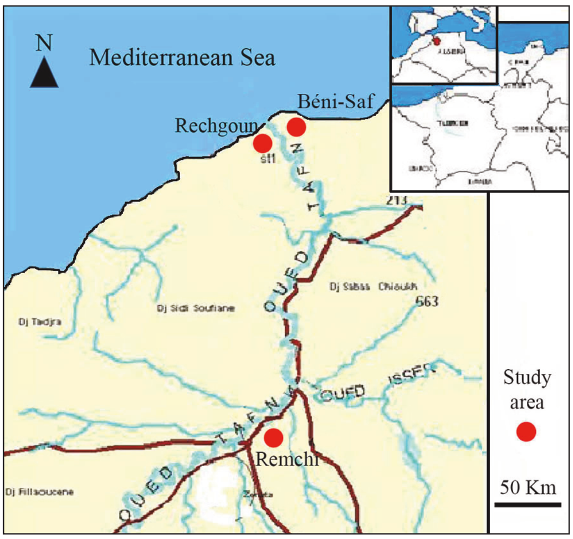

Figure 1. Study area.

Methodology in the field

As done previously (Meftah et al., 2019), 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 in the different profiles in relation to the inclination of the slope. For each station, we have determined 3 fairly wide profiles along the slope, and, from each profile, we took two samples: one on the surface (surface horizon) and the other in depth (depth horizon), for a total of 6 samples taken at each station. The methods used are those outlined by Aubert (1978) in his soil manual analyzes.

Methodology in the laboratory

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

1. Physical analyzes: Granulometry, Stokes particle size method.
2. Chemical analysis.
3. pH: Electrometric method.
4. CaCO3 (Total limestone): Bernard Calcimeter Method.
5. Organic matter: Anne Method (1945). The total organic matter content of the soil is generally obtained by measuring the carbon content. The organic matter to carbon ratio is estimated to be around 1.72 (Aubert, 1978).
6. Electrical conductivity: method of diluted extract or extract a fifth (1/5). The measurements are expressed in mS/cm.
7. Munsell coloring (1971): the color of the soil, expression of the presence of organic matter and various elements (trace elements, macro-elements) can vary from one profile to another and from one sample to another.
8. 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 (1959), 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 (2012), this difference is due to the combined influence of the sea, terrain and altitude.

RESULTS

Results of physico-chemical analysis on the soil of Remchi, Rachgoun 1, and Rachgoun 2 Stations are shown in Tables 1–3.

DISCUSSION AND CONCLUSIONS

The results obtained with these new samples confirm what already observed previously (Meftar et al., 2019). The low clay content also found in these new samplings (Remchi: Profile 1: Horizon 1 clays 9%, Profile 2: Horizon 1: Clays 12%, Profile

	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
Granulometry (%)						
1. Sand	82	60	62	63	68	78
2. Silts	9	30	16	19	16	12
3. Clay	9	10	12	18	16	10
Type of texture	Sandy - loam	Sandy - loam	Sandy - loam	Sandy - loam	Sandy - loam	Sandy - loam
Organic material						
4. MO (%)	4.18	4.50	4.70	4.75	4.35	4.29
5. Estimation	Very strong	Strong	Strong	Strong	Strong	Strong
Mineral reserve						
6. Ca Co3 (%)	12.92	9.71	16.07	21.30	25.53	18.92
7. Interprétations	Way	Way	Strong	Way	Way	Way
Soil Solution						
8. pH	7.22	7.18	7.22	7.02	7.38	7.35
9. Estimation	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
10. Electric conductivity	0.7	0.33	0.75	0.63	0.89	0.68
11. Estimation	Little dirty	Unsalted	Little dirty	Little dirty	Little dirty	Little dirty
Munsell Color	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 1. Results of physico-chemical analysis 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	0-15	15 -100	0-15	15-80
Granulometry (%)						
1. Sand 2. Silts 3. Clay	79 16 5	85 10 5	88 10 2	82 15 3	90 5 5	77 17 6
Type of texture	Sandblaster	Sandblaster	Sandblaster	Sandblaster	Sandblaster	Sandblaster
Organic material 4. MO (%) 5. Estimation	5.28 Very strong	3.86 Average	4.85 Very strong	3.90 Average	4.65 Very strong	3.80 Average
Mineral reserve 6. Ca Co3 (%) 7. Interprétations	22.05 Average	17.94 Average	10.76 Average	20.00 Average	14.35 Average	18.46 Average
Soil Solution						
8. pH 9. Estimation	7.07 Neutral	7.15 Neutral	7.05 Neutral	7.08 Neutral	7.06 Neutral	7.04 Neutral
Electric conductivity						
10. Valor 11. Estimation	0.58 Unsalted	0.65 Unsalted	0.49 Unsalted	0.43 Unsalted	0.52 Unsalted	0.47 Unsalted
Munsell Color	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

	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
Granulometry (%)						
1. Sand 2. Silts 3. Clay	80 12 8	85 11 4	82 10 8	75 15 10	80 9 11	68 23 9
Type of texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy - loam
Organic material 4. MO (%) 5. Estimation	6.17 Very strong	4.25 Strong	4.80 Strong	3.50 Strong	4.25 Strong	2.95 Average
Mineral reserve 6. Ca Co3 (%) 7. Interprétations	18.43 Average	23.10 Average	21.56 Average	20.05 Average	25.66 Strong	27.20 Strong
Soil Solution						
8. pH 9. Estimation	7.20 Neutral	7.15 Neutral	7.15 Neutral	7.18 Neutral	7.18 Neutral	7.16 Neutral
10. Electric conductivity 11. Estimation	0.50 Unsalted	0.45 Unsalted	0.08 Unsalted	0.55 Unsalted	0.60 Unsalted	0.51 Unsalted
Munsell Color	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

Table 2 (above). Results of physico-chemical analyzes of Rechgoun soil 1.
Table 3 (bottom). Results of physico-chemical analyzes of Rechgoun soil 2.

3: Horizon 1: Clays 16%, Rechgoun Profile 1: Horizon 1: Clays 3, Profile 3: Horizon 1: 5% clays and Horizon 2: 6% clays) leads to poor structural stability of the soil and therefore to degradation of the surface through erosion visible on these slopes with also a decrease in the percentages of sands towards depth horizons (Tables 1–3).

Soils affected by these phenomena are often richer than other components (Remchi: Profile 2: Horizon 1: silt 16% and Horizon 2: silt 19%, Profile 3: Horizon 1: silt 16%,) in silt and/or fine sand (Profile 1: Horizon 1 sands 82% and Horizon 2: sands: 60%, Profile 2: Horizon 1: sands 62% and Horizon 2: sands 63%, Profile 3: Horizon 1: sands 68% and Horizon 2: sands 78%). The silts are very fine particles and have a weak cohesion. They are therefore easily detached from the soil matrix and easily transported by runoffs. Fine sands have an even weaker cohesion and coarse sands have a very weak cohesion.

An 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 show with high water retention and a massive structure (Merzouk et al., 2009; Mezouar, 2016).

It is necessary to study this phenomenon even better, even with further environmental, vegetational and mineralometric investigations, but it is evident that the most vulnerable soils should not be damaged by human activity but affected by recovery and protection projects.

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