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# CHARACTERIZATION OF SOILS OCCUPIED BY THE SPECIES *MARRUBIUM VULGARE* L. IN HAMMAM BOUHADJAR (NORTH WEST ALGERIA)

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**ABSTRACT**

The current study concerns the characterization of the physico-chemical parameters of the soil habitats of *Marrubium Vulgare* L. in Hammam Bouhadjar (North West Algeria),Six soil samples were taken,the edaphic results show that this species grows on soils with loamy and sandy loam textures, may humid and alkaline pH, moderately rich in organic matter with moderately to heavily calcareous soil. Statistical processing carried out by principal component analysis indicate the presence of correlations between the soil stations sampled and the edaphic parameters.

**Keywords:** *Marrubium vulgare* L., Hammam Bouhadjar, Soil, statistical processing.

## Introduction

The Mediterranean region is home to a very important biological diversity, this is why in North Africa, the species of the spontaneous flora constitute a non-negligible part of the local genetic resources with pastoral, fodder, food, aromatic and/or medicinal value (Abdelguerfi and Laouar, 1999; Ohba and Amirouche, 2003). *Marrubium vulgare* L. also called white horehound belongs to the Lamiaceae family which has a worldwide distribution with more than 7200 species in about 240 genera (Bräuchler *et al*., 2010), it is a species widespread in the Mediterranean region and widely used for its therapeutic virtues, also found in western Algeria and grows in forests, high plateaus, mountains; and also grows on rocks, crops and various pastures. This study aims to characterize the natural soil habitats of *Marrubium vulgare* L growing in Hammam Bouhadjar (North West Algeria).

## Materials and Methods

### Study area

Hammam bouhadjar and a town in the wilaya of Aïn Témouchent (Western Algeria), is home to a very famous spa in Algeria, it is located between Mount Tassala to the south, and Hassi El Ghalla and El Amria to the north, El Malah to the west, and the immense salt lake of Daoo, DjerfOugran and Side El Halfaoui in the east, which is more commonly called Grande Sebkhad'Oran (D.S.A, 2021), It is located in the narrow depression drawing the M'léta plain (Figure 1), it is characterized by the fact that its southern part is limited by limestone rock deposits in the shape of a "horseshoe" with a depth of about 800 meters (Stéphane *et al*., 1951).


**Fig. 1:** Location map of Hammam Bouhadjar (C.D.F, 2020)

### Choice of sampling stations

In the field, six sampling stations were chosen, (Table 1) the choice of these stations is based on the presence of species of *Marrubium vulgare* L. (Figure 2) which was present in the south-western part (Figure 3).

**Fig. 2 :** *Marrubium vulgare* L. (Cliche Chihab, 2021)

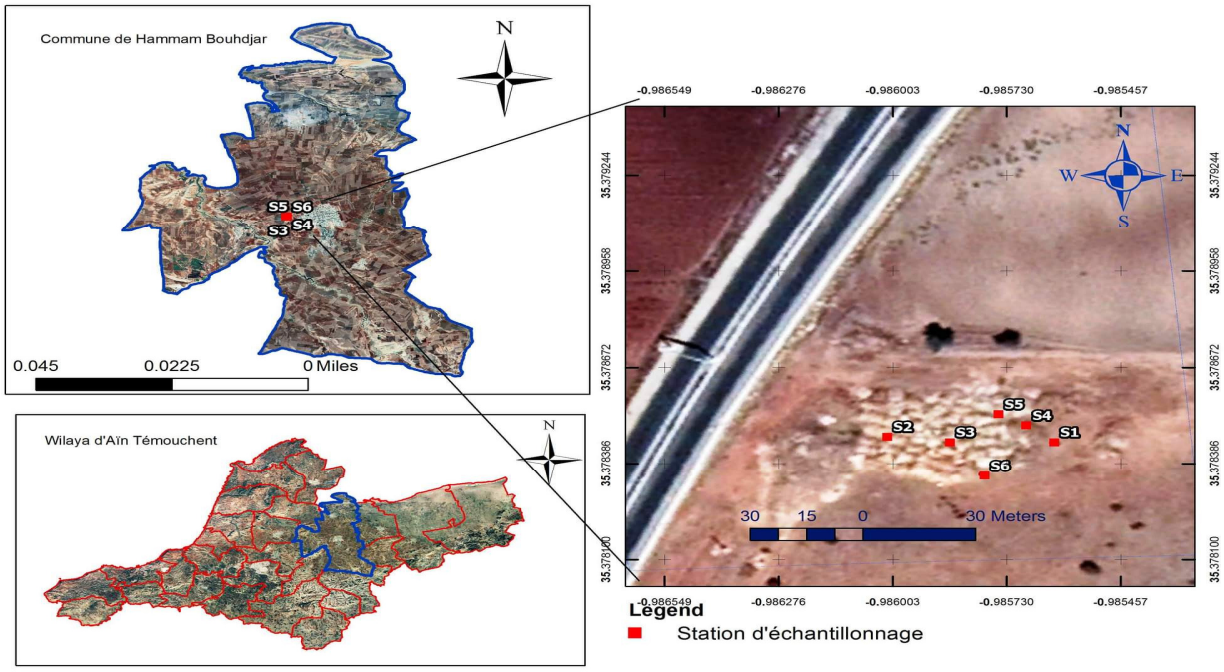


**Fig. 3**: Location of sampling stations

**Table 1:** Geographical coordinates, elevations and exposures of sampling stations

| Stations | Latitude | Longitude | Altitude (metre) | exposure |
|---|---|---|---|---|
| Station1 | 35°22.7070'N | 0°59.1370'W | 141 | South |
| Station 2 | 35°22.708'N | 0°59.161'W | 146 | North West |
| Station 3 | 35°22.707'N | 0°59.152'W | 144 | North West |
| Station 4 | 35°22.7100'N | 0°59.1410'W | 144 | Northeast |
| Station 5 | 35°22.7120'N | 0°59.1450'W | 138 | Northeast |
| Station 6 | 35°22.7010'N | 0°59.1470'W | 139 | South |

**Soil study**

The study of the soil is very essential, because the latter constitutes the main support for the development of the vegetation (Chamley, 2002).

On the ground we took a soil sample for each station (six stations) with depths varying between 10 to 20 cm, the physico-chemical analyzes of the soil consist in evaluating the humidity (H), the hydrogen potential (pH), electrical conductivity (EC),total limestone (CT),active limestone (AC) and organic matter (OM) (Aubert, 1978).

The physico-chemical parameters determined are:

- The texture of a soil is revealed by grain size analysis, its principle is based on the sedimentation rate of particles separated and dispersed by destruction of their cement (limestone and organic matter).
- Coarse silts are extrapolated by calculation from the results obtained (Baize, 1988). These results are reported according to the percentages of clays, silts and sands in the triangle of textures (Duchaufour, 1997).
- for the color, it is estimated by eye. Also, it is recommended to observe especially the color of the sample in the dry state, this last condition is necessary to distinguish more easily the different colors, for that we use the international code of Munsel.
- Dosage of total limestone $CaCO_3$, based on the characterized reaction of calcium carbonate ($CaCO_3$) with hydrochloric acid (HCl), which is carried out using Bernard's calcimeter (Baize, 1988).
- Dosage of active limestone: this is carried out using a specific reagent (ammonium oxalate), which attacks a fraction of the total limestone only. The extracted calcium is then measured.
- The carbon of organic matter, it is oxidized by potassium dichromate in the presence of sulfuric acid. By knowing the amount of dichromate needed for this oxidation, we can calculate the percentage of organic carbon and humus in the soil (Baize, 1988).
- For pH, include measuring the electromotive force of an aqueous soil solution (water/soil ratio) using a pH meter.
- The electrical conductivity is measured using a conductivity meter as a function of the electrolyte concentration in an aqueous extraction solution at 1/5(Richard, 1954). The cationic and anionic compositions of the soil extract were carried out according to the method described by (Jackson, 1962).
- For humidity a sample of fine soil, saturated with water, is submitted. It is measured by weighing before and after drying at 105°C.

**Statistic study**

Factorial correspondence analysis (FCA) is commonly used in ecology. Its principle offers many possibilities which have been continuously developed with the progress of computing (Bonin etTatoni, 1990)**.**she deals with tables of numbers; it replaces a difficult to read table with another simpler one, while having a good approximation of this one (Cibois, 1983), According to Cordier (1965), this method applies to the case where two or more sets are in relation, whatever their nature. for our study it is the relationship between the sampled stations and their soil profile, the XLSTAT 2016 software and used.

## Results and Discussion

The average values consistent with the different physico-chemical parameters characteristic of the surface horizon of the soil corresponding to the six stations are mentioned in Table 2.

**Table 2**: Results of pedological analyzes of soil samples for the study stations carried out

| | Station 1 | Station 2 | Station 3 | Station 4 | Station 5 | Station 6 |
|---|---|---|---|---|---|---|
| **Altitude (m)** | 141 | 146 | 144 | 144 | 138 | 139 |
| **Depth(cm)** | 11 | 14 | 16 | 19 | 18 | 20 |
| **Color** | Marron claire | Marron foncé | Marron | Marron foncé | Marron claire | Jaune |
| **Soil texture** | LS | L | L | L | L | LS |
| **Humidity (%)** | 4,1 | 5,2 | 5,4 | 5,4 | 5,2 | 4,4 |
| **Silt (%)** | 26,80 | 33 | 39,40 | 42,60 | 43 | 27,20 |
| **Clay (%)** | 15,60 | 17,60 | 11,40 | 13,40 | 15,40 | 9,80 |
| **Sand (%)** | 32,40 | 39,80 | 32,40 | 44,40 | 44 | 53,40 |
| **pH** | 8,3 | 8,5 | 8,6 | 8,4 | 8,1 | 8,7 |
| **E.C (ms/cm)** | 0,12 | 0,19 | 0,18 | 0,37 | 0,17 | 0,14 |
| **O.M (%)** | 1,5 | 1,9 | 1,2 | 3,1 | 2,1 | 3,3 |
| **T.L (%)** | 24 | 11,5 | 27,25 | 22,50 | 46,75 | 66 |
| **A.L (%)** | 1,06 | 2,45 | 2,11 | 3,12 | 3,31 | 4,75 |

**cm:** centimeters, **m:** metre, **pH**: potential hydrogen**, E.C**: electrical conductivity, **O.M**: organic material, **T.L**: total limestone, **A.L:** active limestone

- We note a variability in the depth of the soil and this highlights the differential characters of the stations studied (Chihab *et al*., 2018), the depth varies from 11 cm in station 1 to 20 cm in station 6, thus determining surface soils. The composition of the surface horizon, especially in the Mediterranean region, plays an important role in the behavior of vegetation (Aubert, 1989), due to actions of human, agricultural and pastoral disturbances, most soil descriptors mainly concern the surface horizon (Devineau, 2001).
- The granular property of the different samples taken at the stations in the study area was determined by the triangle of Jamagne (1967),The results relating to the granulometric analyzes in the region of Hammam Bouhadjar indicate the presence of an average quantity of sands with the percentages of the order of 32.4%, 39.8%, 32.4%, 44.4%, 44%, and 53.4% respectively in stations 1, 2, 3, 4, 5, and 6,followed by silts with average and variable rates of the order of 26.8%, 33%, 39.4%, 42.6%, 43%, and 27.2% respectively in station 1, 2, 3, 4, 5, and 6. Finally clay with a maximum of about 17% in station 2.
- For soil texture, two stations are sandy loam (St 1, St 6), four stations are loam (St 2, St 3, St 4 and St 5).Silts correspond to soils whose excess of silt and insufficient clay can cause the formation of a massive structure, which can become compact (Duchaufour *et al*., 2018).
- The colors of the soils studied are heterogeneous, we find yellow soils (station 6), brown (station 3) and light

brown (station 1 and 5), dark brown (station 2 and 4),this parameter is considered as a physical character which can reveal certain conditions of pedogenesis and sometimes the possible vocations of the soil considered (Aubert, 1978).

- The humidity rate varies from one station to another, the low value characterizes the two stations 1 and 6 with a rate of 4.1% to 4.4% and the highest values are recorded in stations 2, 3.4 and 5 With a rate of 5.2% to 5.4%, the moisture content depends on the period and place of sampling and the type of soil (Aubert, 2003).
- The PH value is moderately alkaline, it varies from 8.7 in station 6 to 8.1 in station 5, the pH is not a stable characteristic of the soil, but depends on the different cations absorbed, the nature of the plant cover and the climatic conditions (Dajoz, 1982)
- Indeed the levels of organic matter are very variable, we find soils moderately rich in organic matter for stations 4, 5 and 6 and low in organic matter for stations 1, 2 and 3. Depending on the position of the stations, the amount of organic matter recorded in a station depends on the age and type of vegetation, but also on the abundance of coarse elements (Bouzidi *et al*., 2009)
- Electrical conductivity for the study area indicates unsaline soils in all samples (C. E 0.6ms/cm).
- The percentage of total limestone in our study area is moderately calcareous for stations 1, 2 and 4 with respective values of around 24%, 11.5% and 22.50% (Table 2). While stations 3, 5 and 6 present respective values of 27.25%, 46.75% and 66%, ranging from strongly to very strongly calcareous soils, the active limestone content shows maximum values of 4.75% for station 6 and a minimum of 1.06 for station 1,the levels of total and active limestone present in the soil samples remain very heterogeneous (moderate to high). This high content is linked to the nature of the source rock, which is often limestone, thus explaining the installation of scrubland resulting from the degradation of forest formations (Benabdelli 1983).

**Statistical processing**

The factorial correspondence analysis (FCA) carried out for the six stations of our study region allows the identification of the variables (physical-chemical parameters of the soil) on the factorial plan (Dim1 x Dim2).This axis represents 42.34% of the information by axis 1 (Dim1), against 27.60% of inertia explained by axis 2 (Dim2) (figure 4).

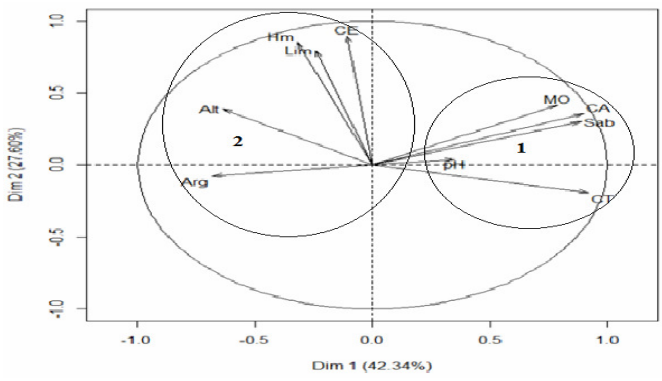


**Fig. 4:** Correlation circle of edaphic variables

Two groups are distributed on both sides of Dim 1: one group on the positive side (Gr 1) and one on the negative side (Gr 2).

The correlation matrix between the variables where the information is represented show the existence of a correlation between clays and sands (-0. 390) which are closely related indicating the role that the origin of the source rock plays in the increase in the proportions of these elements in the soil (Chamley, 2002).Another correlation observed between altitude and humidity (0.648), between pH and humidity (0.742), thus characterizing a group indicating the role played by altitude and humidity favoring the increase or decrease of the pH of which moisture plays a major role in the soil (Limaux *et al*., 1998).

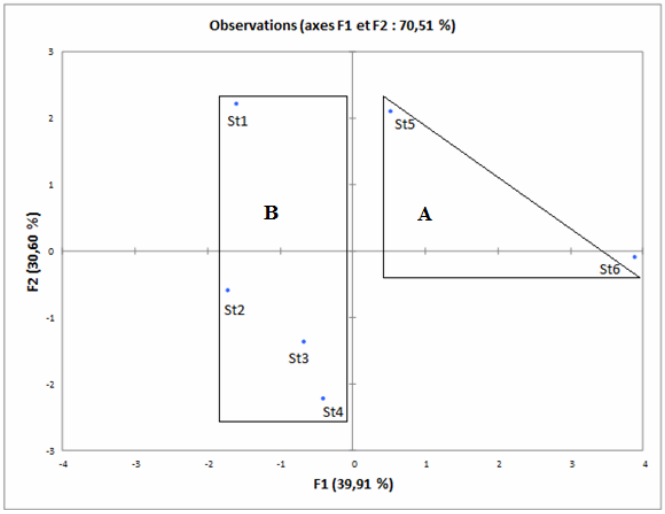


**Fig. 5**: Principal component analysis of the stations on the factorial plane (F1 x F2)

From the point of view of the factorial classification of the soils observed, the PCA places in the positive side of axis 1 the soils of the northeast and south exposure (stations 5 and 6) and in the negative side the soils of the south and north-west and north-east exposure (station 1, 2, 3 and 4) (Fig. 5)

The overlapping of the correlation circle on the factorial plane (F1 x F2) made it possible to note the existence of two groupings:

- Group composed of correlation circle 1 on the triangle A of factorial plan (F1 x F2) of the soils which corresponds to the 5 -th and the 6 -th station this group is positively correlated with total limestone and active with sands, pH, and to organic matter, these elements are very important for the development of *Marrubium vulgare* L.
- The second group composed of correlation circle 2 on the triangle B of factorial plane (F1 x F2) of the soils which corresponds to station 1,2,3 and 4, this group is correlated with the altitude, the slope and the l moisture, clay and silt.

## Conclusion

The soil habitats of *Marrubium vulgare* L. in the region of Hammam Bouhadjar, is characterized by a species that develops at altitudes between 138 and 146 m, with predominantly silty and silty-sandy textures, with soils moderately rich in organic matter, with a low humidity rate, at alkaline pH, with moderately to strongly calcareous soils. Finally, our study can be associated with another prospection

for the identification of the floristic procession that accompanies our species to better understand how it is preserved as well as the need for judicious use.

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