ANALYSIS OF CALCAREOUS SOILS FOR TWO VARIOUS FACIES WITHIN THE NATURE RESERVE OF EL-MERGUEB (M'SILA, ALGERIA)

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Abstract

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This research was conducted on the protected area of El-Mergueb at M'sila province. The zone of El-Mergueb is located about 180 km south of the capital Algiers, at an altitude from 550 to 800 m, and is characterised by arid climate. The zone of El-Mergueb has a landscape from the steppe to Alfa that lies just as well in the flat ridges hills that in their slopes and in the top part of the ravines. *Alfa tenacissima* dominates the most geographical space of El-Mergueb. This study is based on the analysis of the homogenous and heterogeneous facies by the determination of the content of calcium carbonate (CaCO_3), active calcium carbonate (ACCE) and gypsum through monitoring these chemical parameters during 3 years: 2017, 2018, 2019. Six soil profiles of 15 soil samples collected in the site of study were studied and several chemical soil properties were considered. These factors included: soil pH, calcium carbonate (CaCO_3), active total carbonate (CA), gypsum (CaSO_4) and electrical conductivity (EC). Principal component analysis (PCA) was used to identify the variations in soil properties. Results showed that there are significant relationships between some soil factors and two PCA axes. The results thus obtained showed that the content of CaCO_3 and CA analysed ranged from average to high. The average of gypsum and salinity was low. Floristic diversity defined 284 species. The data on the chemical characteristics of the soil studied have been the subject of a detailed statistical analysis (PCA). Our database consisted of quantitative variables. The implementation of the PCA to the soils studied showed a major dominance of the limestone in the two stations, which explains the alkaline pH and the low concentration of gypsum. Finally, these types of high total limestone are the most observed in the majority of steppe and arid soils.

Key words: calcareous soils, Mediterranean soil, vegetation steppe, arid ecosystem, natural reserve of El-Mergueb.

Introduction

Changes in climate and land use induced by human activities affect productivity, water regime and biodiversity, and result in changes in the structure and functioning of terrestrial ecosystems. These alterations would probably intensify in the near future (Miranda et al., 2011). There is an extensive literature analysing the potential effects of increased greenhouse gas concentrations in the atmosphere on ecosystem function and services. However, an almost unexplored, but important characteristic of global change is the alteration of rainfall patterns, with probable increases in rainfall variability (IPCC, 2007). The United Nations Convention to Combat Desertification (UNCCD) defines arid, semi-arid and dry sub-humid zones as 'areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65'. Hyper-arid zones are characterised by a ratio typically less than 0.05. Together, these arid environments account for

over 47% of the landmass of the earth and are spread geographically across all continents. The African continent contains the largest area of arid environments, while Australia has the highest proportion (about 75%) of its area (Gratzfeld, 2003). Mediterranean ecosystems are especially sensitive to climate change because they have large topographic complexity with disparate land uses as well as marked water availability gradients (Lavorel et al., 1998). Mediterranean shrub land ecosystems are quite vulnerable to rising temperatures and reduced water availability (Uso-Domenech et al., 1995), and the expected increase in aridity and temperatures in regions already dry, such as the Mediterranean basin, will likely have serious consequences (IPCC, 2007).

Mediterranean climates are characterised by winter rains with some months of excess rainfall over evapotranspiration, warm and dry summer months with moisture deficits drying out soils and their annual vegetation (xeric moisture regime). They are found on the western parts of all continents, between the cooler temperature zone and the hot dry desert zone. The largest

Mediterranean region, surrounding the Mediterranean Sea, extends over 4,300,000 km² and exhibits a wide variety of soils and geo-ecosystems. Mediterranean soils are no longer used as a separate classification group in modern, well defined, soil property-controlled taxonomies (Soil Taxonomy; FAO system), but have been partially replaced by Duchaufour's term Fersiallitic soils in some classification systems. Terra rossa continues to be used in some classification for hard limestone-derived red soils, mostly shallow (Yaalon, 1999).

The Mediterranean region is one of the 34 hot spots of biodiversity identified at a global level. This richness is explained by the diversity of geological and edaphic contexts, by strong heterogeneity of the climatological conditions at meso- and micro-scale and by the seniority and importance of agro-pastoral practices. This region is subject to strong environmental pressures of different nature: climatic stresses (intense and prolonged droughts), poor soil conditions (thin, sandy, poor and xeric soils) and anthropogenic perturbations more and more intensely linked to the development of human populations. All the typical pressures of the Mediterranean regions are exacerbated in the semi-arid and arid North African environments. In Algeria, the degradation of natural resources remains a topical problem associated with climate change, deforestation and intensive pastoralism, soil erosion and the recurrence of fires (FAO, 2013). Arid soils possess unique characteristics that distinguish them from soils from more humid regions. Arid systems are generally limited in biological activity, and thus contain low levels of organic carbon. This lack of organic carbon is a large driver in the structuring and function of arid soils. Extended periods of water deficiencies also slow the elimination or leaching of soluble salts, which are further accumulated due to high rates of evaporation. Thus, arid soils tend to accumulate calcium carbonate, gypsum or silica. Despite similarities in soil genesis, the different climates, geology and vegetation of arid lands create unique soil characteristics, so that the morphology and soil characteristics vary between different dry lands. A characteristic of arid regions is reduced biological diversity (Steven, 2017). In fact, a global survey of dry lands worldwide found that the diversity of soil bacteria and fungi was linearly correlated to the aridity of the ecosystem (Maestre et al., 2016). In this regard, aridity is a large predictor of the diversity of soil communities. However, dry lands are not homogenous regions experiencing low precipitation. The vegetation is sparse, soil edaphic factors vary, the terrain is uneven, and precipitation and temperature vary erratically (Maestre, Cortina, 2002). The Algerian steppes constitute a geographical unit whose limits are defined by a bioclimatic criterion. With an estimated area of about 20 million ha, the Algerian steppes are located between the 400-mm rainfall isohyet to the north and the 100 mm-rainfall isohyet to the south, forming a 1000-km-long ribbon over a width of 300 km in the west and in the centre, reduced to less than 150 km in the east (Miara et al., 2018). According to Nedjraoui and Bédrani (2008), the steppe regions constitute a buffer between coastal Algeria and Saharian Algeria, of which they limit the negative climatic influences on the former.

Calcareous soils cover a large percentage of land from the north coastal region of Africa (Taalab et al., 2019). Calcareous soils are defined as soils containing large amounts of calcium carbonate, which affect distinctly the soil properties related to plant growth, whether they are physical, such as water rela-

tions and soil crusting, or chemical, such as the availability of plant nutrients (Rasha, 2005). Carbonates, which are common constituents of many soils of arid and semi-arid areas, have a marked influence on soil chemical properties, for example, pH, cation and anion sorption and physical properties, such as soil structure (Del Campillo et al., 1992).

Gypsum is widespread in both arid and semi-arid regions. Gypsum (CaSO₄·2H₂O) is found over a wide range of temperatures, but most gypsic soils occur in xeric, ustic and aridic soil moisture regimes (FAO, 1990). Understanding the relationship between plant diversity and land use history can have important implications in management decisions, especially when these ecosystems were widely used by humans (Tålamo et al., 2012). The effects of environmental variables on plant species have been the subject of many ecological studies in recent years (Ramirez et al., 2007).

The first aim of this study was to identify the floristic composition of the two stations (homogenous and heterogeneous) of the experimental site. The second aim was to analyse the chemical typology of calcareous soils. Moreover, the study also aimed to obtain information about how can the calcareous soils impact the development of vegetation under an arid climate with low precipitation. The results can be used like an argument to explain how this category of ecosystem with homogenous and heterogeneous facies inside natural reserves in semi-arid and arid regions resists climatic changes and human impact; also, the results show the potential of the ecosystem's vulnerability to degradation. Finally, it was aimed to propose a new strategy to protect and preserve the biodiversity indicators of this ecosystem and similar type of ecosystem.

Material and methods

Study site location and description

The zone of El-Mergueb is a natural area of steppe that is to the western limit of the pan of the Hodna. It occupies an area of 16.481 ha 42 are and 67 that, and straddles three district steppes of the northern side of the Atlas of the Sahara belonging to the province of M'Sila (Hadjab et al., 2016). According to the law on 'protected areas in the framework of sustainable development' proposed in July 2005 to the General Secretariat of the Government by the Ministry of Spatial Planning and Environment (MATE), the natural site of El-Mergueb can only be classified in the category 'Habitat and Species Management Area' established by the IUCN (Plan de gestion..., 2005). The two experimental stations are between latitudes (35°36'03.4"N, 35°32'42.1"N) and longitudes (03°56'33.4"E, 04°00'17.5"E) with an altitude of 568 and 633 m and are located in the region of Ain El-Hadjel (Fig. 1).

The El-Mergueb reserve belongs to the structure of the high steppe plains formed by thick, more or less horizontal alluvial deposits accumulated on the primary base. The soils deposited in horizontal layers belong, from a geological point of view, to the more or less gypsum Miocene. They are covered locally by limestone banks of the lacustrine Pliocene. The relief of the reserve is little accentuated. The relative altitude does not exceed some metres. It is a plain of medium altitude that oscillates between 550 and 800 m, whose average slope varies between 3 and 20%. It is also a desert enclave in the highlands presenting a hilly relief (Ioualen, 2012).

Fig. 1. The geographical position of the nature reserve of El-Mergueb with the location of the study area (Ain El-Hadjel) (Ghaouaci et al., 2018, Google Earth, d-maps.com).

Vegetation study and identification

This research was performed from April 2017 to May 2019. A survey was carried out by observation and sampling plants using the phytosociology method, the 'Braun-Blanquet approach'. Its principal goals are delimitation and characterisation of vegetation types based on the complete floristic (species) composition. Plots are placed to minimise within-plot heterogeneity and maximise between-plot variability; typical sizes are 4–25 m² in herbaceous and 50–400 m² in woody vegetation. Plot records consist of header data (locality, environment, structure) and a complete species list with cover values. Floristically similar concrete stands (phytocoenoses), places vegetation units into a hierarchical system based on varying degrees of floristic similarity (Dengler, 2017). The floristic data have been identified by an updated nomenclature of species according to the flora of Ozenda (1958, 1991a,b) and the New flora of Algeria by Quezel and Santa (1962–1963). Also, we calculated the frequencies of the dominant botanical group in each station.

Description of facies

The stations were selected based on the homogenous and heterogeneous floristic composition of each one with the dominant species and representative. This phase corresponds to an inventory of the flora, based on the execution of the floristic surveys. In general, realisation of the floristic surveys focused on ecological parameters, physiognomy and floristic homogeneity. Many authors have discussed how to carry out phytosociological surveys (Braun Blanquet et al., 1952; Kaabache, 1990). For each survey, the following are noted: geographical location and stationary characters (altitude, geological substrate, covers, etc.). The first station (Station T) is a homogenous steppe formation dominated by *Stipa tenacissima* L. It is located between the geographical coordinates 03°56'33.4"E and 35°36'03.4"N. The altitude is 633 m with a recovery rate of 20% (Fig. 2). The second station (Station M) is a heterogeneous steppe represented by the groups of species of *Artemisia campestris* L. and *Medicago arborea* L. It occupies the geographical coordinates 04°00'17.5"E and

Fig. 2. The experimental area (Station T - top and Station M - bottom).

Fig. 3. The most represented families (number of taxa) of Station T.

Fig. 4. The most represented families (number of taxa) of Station M.

35°32'42.1"N. The highest point of this station is 568 m with a medium recovery (Fig. 2).

Soil sampling and analysis method

After characterisation of each horizon in situ to precise the apparent characters of profile was carried out (colour, length, depth, effervescence and the recovery rate) (Delaunoy, 2006) at the level of the two stations also, using the chart of Munsell of colour (Munsell Soil Color Book, 2009). The 15 samples used in this study were collected from the surface horizons (0–45 cm). In this contribution, the analyses were conducted in the laboratory of research in Ecology and Environment, University Abderrahman Mira of Bejaia, Algeria. The soil analyses were carried out according to volume 1 of soil analyses (Petard, 1993). Each soil sample was air dried, thoroughly mixed and passed through a 2-mm sieve. Then, all the analyses were performed in the sample. Chemical properties of the soil samples were quantified in laboratory. The pH was measured using a pH me-

ter with a soil/water ratio of 1/2.5. Electrical conductivity (EC) of saturation extracts was determined by a conductivity meter with a land/water ratio of 1/5. Total limestone was determined by the calcimeter method of Bernard. ACCE was determined by the NH_4 -oxalate method (Drouineau, 1942). Gypsum (calcium sulphate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) content was found by acetone precipitation method. This method is a wet chemical method. It includes extraction of soil sample with an amount of water sufficient to dissolve all the gypsum present and then gypsum is precipitated with acetone. The precipitate is completely dissolved in distilled water and gypsum is obtained by measuring the EC of the solution (US Salinity Laboratory Staff, 1954).

Statistical analysis

Principal Component Analysis (PCA) is a multivariate statistical technique that uses orthogonal transformation to convert a set of correlated variables into a set of orthogonal, uncorrelated axes called principal components. Ecologists most frequently deal

Table 1. Biological types of the study area

Biological type	No. of taxa (ST)	No. of taxa (SM)	Proportion % (ST)	Proportion % (SM)
Therophytes	50	65	38	42
Hemicryptophytes	35	40	27	26
Chamaephytes	32	38	24	25
Phanerophytes	8	6	6	4
Geophytes	6	4	5	3
Total	131	153	100	100

Table 2. Averages of chemical analyses.

Station	pH H ₂ O	pH KCl	CaCO ₃ (%)	CA%	GYPSUM%	EC (mS/cm)
STH1 TC	8.21	7.67	25	16	3	0.2
STH2 TC	8.29	7.73	24	11	5	0.15
SMH1C	8.35	7.46	18	12	1	0.098
SMH2C	8.38	7.52	17	10	2	0.24
SMH3C	8.44	7.72	26	17	4	0.21

Fig. 5. Frequency of various type Station T.

Fig. 6. Frequency of various type Station M.

Fig. 7. Representation of the different percentages of the axes to CPA.

with multivariate datasets. This is especially true in field ecology, and this is why PCA is an attractive and frequently used method of data ordination in ecology. PCA enables condensation of data on a multivariate phenomenon into its main, representative features by projection of the data into a two-dimensional presentation. PCA has been widely used in various fields of investigation and for different tasks. Many authors have used PCA for its main purpose, that is, to reduce strongly correlated data groups or layers. These studies concern either environmental variation (Grenouillet et al., 2011).

Results and discussion

Floristic diversity

In total, we recorded 284 taxa at the two sites. This number seems very interesting compared to that obtained by some authors who worked in the same region, including Kaabeche (2005) with 211 species and Adjabi et al. (2019) with 277 species. Our taxa belonged to 45 botanical families. The most represented families in the two stations were: Asteraceae (101 taxa), Poaceae (47 taxa), Brassicaceae (21 taxa) and Liliaceae with a total of 19 taxa. Other families like Ranunculaceae, Boraginaceae, Geraniaceae, Apiaceae and Lamiaceae were moderately represented with seven, six and five taxa, respectively. The rest of the families were poorly represented and accounted for less than four taxa (Figs 3, 4). According to Le-Houérou (2005), Compositae (=Asteraceae), Leguminosae (=Fabaceae), Labiaceae (=Lamiaceae), Cruciferae (=Brassicaceae), Liliaceae and Umbelliferae (=Apiaceae) are the families well represented in Mediterranean regions. Endemic species are represented by 13 species; this number is more approximate to the list of endemic taxa having only a Mediterranean affinity prepared by Kaabeche (2005) inside the protected area of El-Mergueb. According to Ozenda (1991a,b), Asteraceae, Poaceae and Brassicaceae characterise the arid and semi-arid areas in the Mediterranean regions. In Algeria, some studies (KaziTani et al., 2010) highlighted the dominance of Asteraceae, Poaceae and Fabaceae in the steppe regions. This was also reported in Morocco by Fennane et al. (2012).

Biological type

The bio-morphological type of each station is also demonstrated below (Table 1). Therophytes (ST, SM: 38%, 42%), Hemicryptophytes (ST, SM: 27%, 26%) and Chamaephytes (ST, SM: 24%, 25%) were the most represented in our experimental area in comparison to others (Figs 5, 6). According to Dajoz (2003) and Deghiche-Diab (2016), Therophytes are herbaceous species that typically appear just after a rain and when the moisture of the soil is superficial. These are the species that have difficulty to survive in a period of drought and remain in seeds form. Indeed, the richness in Therophytes represents a sign of aridity of the environment (Nègre, 1966) and the phenomenon of therophytia is considered by Daget (1980) as a strategy for avoiding adverse periods. Hemicryptophytes and Chamaephytes represent stages of degradation of grassland steppes. Their great presence can be explained by the fact that Chamaephytes are bushes that resist well to drought conditions by their foliage systems and have roots adapted to arid conditions (Le Houérou, 2005).

Table 3. Percentage of inertia explained by the first four CPA axes.

	F1	F2	F3	F4
Eigen value	3,985	1,248	0,724	0,043
Percentage of the variance (%)	66,409	20,807	12,063	0,722
Cumulative percentage of the variance (%)	66,409	87,216	99,278	100,000

F: component

Table 4. Correlations between the different edaphic variables.

	F1	F2	F3	F4
pH H₂O	-0.018	0.853	-0.522	-0.020
pH KCl	0.964	-0.221	-0.052	-0.137
CaCO₃ (%)	0.973	0.228	0.001	0.044
CA (%)	0.991	-0.080	-0.096	-0.047
Gypsum (%)	0.952	-0.210	-0.174	0.141
CE (mS/cm)	0.470	0.608	0.640	0.004

Table 5. Observations of coordinates.

Observation	F1	F2	F3	F4
STH1 TC	0.375	-1.101	1.227	-0.199
STH2 TC	1.901	-1.134	-0.567	0.265
SMH1C	-3.383	-0.424	-0.800	-0.065
SMH2C	-0.880	1.449	0.826	0.226
SMH3C	1.988	1.210	-0.685	-0.227

Table 6. Correlation between different variables (soils factors).

Variables	F1	F2	F3	F4
pH H₂O	-0.018	0.853	-0.522	-0.020
pH KCl	0.964	-0.221	-0.052	-0.137
CaCO₃ (%)	0.973	0.228	0.001	0.044
CA%	0.991	-0.080	-0.096	-0.047
Gypsum	0.952	-0.210	-0.174	0.141
CE (mS/cm)	0.470	0.608	0.640	0.004

Edaphic data

The average of each parameter for the soil samples collected for 3 years is given in Table 2. The mean pH H₂O values ranged between 8.21 and 8.44, and the average pH KCl was between 7.46 and 7.73. Soils that have a pH in this range are slightly alkaline soils. The mean soil salinity (EC) of soil samples used to build the models ranged from 0.098 to 0.24 mS/cm, indicating that all soils in the study area are not salt affected (Aubert, 1978). The CaCO₃ % content of the samples ranged between 17% and 26%; these means were noted for all samples, considered moderately and highest calcareous in the third horizon of SM (Lambert, 1975);

Fig. 8. Graphical presentation of the quantitative variables used for the implementation of the CAP axes 1 and 2.

Fig. 9. Correlation between different edaphic variables of the two stations T and M.

for the active limestone, the average was from 11 to 17%. The content of gypsum varied from 1 to 5% according to Barzanji (1973), who identified five classes of gypsum soils based on the aspect of 'soil-plant' the soils studied are all low gypsum (<10%). The pH of our facies was alkaline; according to Franc de Ferrière (1933), North Africa (Morocco, Algeria, Tunisia) steppe region is characterised by low rainfall in winter and long summer drought causing suction of deep water to the surface, present in contrast to pH, which is mostly alkaline, pH 7, pH 8. This high pH is, according to Mengel and Kirkby (2001), caused by an absence of ammoniacal nitrogen. A qualitatively high pH affects the solubility of some elements, thus influencing their absorption (Raven et al., 2010). According to Benchetrit (1956), 70–80% of the soil of Algeria is slightly to moderately filled with limestone horizons deep in the soil versus superficially. So, it appears that the soil in the study areas is calcareous like most Algerian soils. In the Mediterranean and desert regions and, in particular, countries of the Middle East, soils containing limestone in one or several horizons are very frequent (Ruellan, 1976). Limestone can be formed by alteration of the principal rock (Ruellan, 1976) or secondary calcium carbonate precipitation (Ruellan, 1971; Duchauffour, Souchier, 1977). According to Bonneau and Souchier (1980), soils with a pH above 7 are rich in active limestone, as in the case of the soils analysed by us. Grisso et al. (1999) indicated that the sandy fraction has low EC. The soils in the study area have low salt levels; various environmental factors that lead to the dissolution of calcareous salts in the soil, being able to interact with each other, result in variation of EC of the soil. According to the FAO (1990) and Florea and Al Joumaa (1998), the high level of limestone in soil decreases and reduces the gypsum content. Halitim (1985) showed that in the arid areas of Algeria, gypsum is always posterior to calcite.

Statistical data

The PCA biplots ordination diagram is called the equilibrium contribution circle, and the radius of this circle represents a variable that would contribute equally to all dimensions of the PCA space. Therefore, for any given pair of axes, the variables that have vectors longer than this radius make a higher contribution than average and can be interpreted with confidence (Borcard, Gillet, 2018). Soil physical and chemical properties, as an important indicator of soil quality, possess not only obvious differences, but also interactions and close associations with each other, which jointly determine the quality characteristics of the soil (García-Ruiz et al., 2009).

Choice of the number of dimensions to be studied

The inertia of the factor axes indicates that the variables are structured (presence of correlation between variables) and suggests the number of main components to be interpreted (Husson, Pagés, 2009). The first two axes present 87.22% of the total inertia. Also, 87.22% of the total cloud variability of individuals (or variables) is represented by the first plan (Table 3, Fig. 7). This percentage is, therefore, important, and the foreground well represents the variability contained in all active datasets. Axes 3 and 4 present 12.063% and 0.722% of the total inertia, respectively, of which we have no important information. We based our findings only on two principal axes.

Study of the variable cloud

Cloud representations of variables allow visualisation correlations between variables. The PCA function provides the first graph particular to the method, that is, the circle of correlations for axes 1 and 2 (Fig. 8). The latter corresponds to a projection of the initial variables on a two-dimensional plane consisting of the first two factors (axes 1 and 2) with the active variables and additional variables (active variables in black and solid line and additional variables in red dotted lines). The fundamental result concerning variables is the table of variable factor correlations (Table 4). Present the coefficients of linear correlation between the variables who explain the position of edaphic factors studying.

Figure 8 shows that all the variables are well represented on plan 1-2. This quality of representation on the graph of variables, this good representation done because the tip of the arrow and the circle of radius 1 is so proximate. The coordinates of the variables, their qualities of representation (cosine square) and their contributions to the construction of the axes are presented in Table 4.

Figure 5 demonstrates that the first factor (F1) is positively correlated and therefore very well represented on the graph with each the following variables: gypsum and pH KCl with CA% are very close to the circle of correlation in the same axis 1. EC (mS/cm) is not correlated with other variables, but $\text{CaCO}_3\%$ is highest positive and not correlated with other variables, which explains that our stations are dominated by limestone composition of soils (Fig. 5). pH H_2O is negatively correlated with other variables of F1 (first axis); when the soil samples have low values of edaphic variables in F2 (second axis), all soils of the two stations will be calcareous and with no salt in all axes from F1 to F4. According to Artieda and Herrero (1996), the pH influences the solubility of gypsum due to the attachment of H^+ ions to SO_4^- anions. Solubility is high at low pH; but this reaction can hardly occur because in all gypsum soils studied, the pH is always higher than 7 (Pouget, 2008).

The distribution of the chemical parameters is shown in Fig. 9 and the observations of coordinates in Table 5. Figure 9 shows that Station T, homogeneous facies, is very positively correlated with gypsum, pH KCl and CA%, but Station M, heterogeneous facies, especially the third horizon, is positively correlated with $\text{CaCO}_3\%$. The EC is not correlated with the two stations because all our experimental sites have a low content of salt. The second horizon of Station M is correlated with pH water, but the first horizon is in the negative position of second axis (F2). This irreversible distribution of variables inside the two stations is explained by the dominance of essential parameters an related with calcareous soils (pH H_2O alkaline) en relation with typology of vegetation composition (Table 6).

Conclusion

The climate is the main determinant of distribution of plant communities. Thus, the combination of a small number of bioclimatic variables predicts the distribution of vegetation types. The quality of soil is important for ecosystems because it is directly related to environmental quality and it has a direct impact on development of vegetation. Our study demonstrated that the calcareous soils dominate in a steppe ecosystem and show the high potential of vulnerability of these soils, especially when it is affected by different anthropic pressures and limited

rainfall. Some properties inside degradable pedagogical horizons can reduce the necessary density of vegetation. Land cover of regions of El-Mergueb with their homogenous or heterogeneous facies are characterised by a high coefficient of erodability, which has been proved by many academic researchers in where they need a typical vegetation can adapted with pedological degradation under all forms of climate negative impact. The edaphic properties are the first factor that can support and protect the different phases in development of steppe plant in all seasons. The reaction between these factors is not positive all the time inside the calcareous typology of soils (alkaline) because they are exposed easily to the two categories of erosion, that is, low gypsum and salt content. has not a really effect on the vegetation in where the carbonate of calcium are the principal edaphic properties of all soils of El-Mergueb. This conclusion can be introduced and interesting of a similar category of soils inside protected area in the arid, semi-arid and sub-humid floors.

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