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Contribution of *Chamaerops humilis* L. (Arecaceae) in Conservation *in Situ* of Soil Resources in the Tlemcen Region (Western Algeria)

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Abstract

In recent years, the anthropic action on scrubs in the region of Tlemcen (a province in western Algeria) has represented a threat to the groups of *Chamaerops humilis* L. (Arecaceae). The main purpose of the present investigation is to highlight the relationship between *Chamaerops humilis* and its biotope. Taking advantage of the refurbishment works in the study area, clumps of *Chamaerops humilis*, freshly dug by machinery, were collected and used to conduct some measurements. A total of 34 clusters were considered. The main parameters to be studied are: 1. The height of the tangle of roots and the number of roots in each cluster; 2. The weight of soil trapped between roots; 3. Physico-chemical properties of soil in which taxa grow. The results obtained showed that the average weight of soil retained by the clumps was important (70.3 kg); the average height of the tangle was 68.4 cm and the average number of roots was 382. The tangle of roots, of various stocks of *Chamaerops humilis*, creates a root network, very tangled in its upper part, thereby trapping a significant amount of soil. The statistical analyses of pairs of parameters, considered in the present work (height of the tangle, mass of soil trapped by roots and number of roots), were found to be highly correlated. These analyses allowed identifying the relationships existing between the studied parameters. They also helped to deduce the role of the taxon in the *in situ* conservation of edaphic potential.

Keywords

***Chamaerops humilis*, Morphometric Measurements, Soil, Conservation, Tlemcen**

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1. Introduction

Today, global ecosystems are evolving in a changing environment. Those in North Africa are exposed to climate and anthropogenic stresses, unprecedented. The adverse circumstances as well as the human pressures that Africa is currently experiencing disturb the ecological balance and promote the installation of degraded formations.

The investigations which were carried out in western Algeria showed a dysfunction of the existing ecosystems (forest, meadow-forest, scrub and steppe) [1]-[9]. These authors emphasized the floristic richness of the ecosystems in the region of Tlemcen; they also focused on the anthropic impact on natural resources, and this often led to the depletion of several plant species.

Our investigation focused on scrub species (matorrals), and particularly on *Chamaerops humilis* (*C.h*). According to literature, this species is originally from Europe and North Africa [4].

The same author indicated that this species occupied a very significant area; it was a member of many plant groups. During the last decade, several research works showed a degradation of *C.h* formations, commonly called a Chamaeropaie. The significant decrease in the expansion range of *C.h* was observed onsite following the operations of clearing, construction, illegal logging and fires which prevailed in the region of Tlemcen [4] [10] [11].

Our study aimed at evaluating the importance of *C.h* in keeping up the edaphic biodiversity facing up to the environmental constraints (climatic and anthropogenic). This type of work has not been addressed to date.

2. Materials and Methods

2.1. Geographic Location: Choice of Study Site

Although the range of *C.h* plantations in the western part of Algerian is important, our investigation mainly focused on the station of Ouled Ben Sbaa, a small town in Ain Fezza (province of Tlemcen). This station is located at 34˚53'30.8" north latitude and 01˚15'23.1" west longitude and is part of the mounts of Tlemcen. Moreover, it rises 710 meters above sea level and covers an area of 27.5 km^2.

With regard to its climate, the station is characterized by:

- ✓ Average annual rainfall of 345 mm/year, ranging mostly between November and March, with a dry season from June to August. The average temperatures range from 9˚C for m (minimum temperature) recorded in January, to 32˚C for M (maximum temperature) recorded in August,
- ✓ The station is located in the lower semi-arid bioclimatic stage, with a temperate winter, according to Emberger's pluviothermic climagram [8].

2.2. Methodological Approach

In order to appreciate the importance of the ground biomass of *C.h*, and the physicochemical characteristics of the soil in which the species has its optimum development, it was decided to divide the work into three parts:

i. Carry out some morphometric measurements, on the field, on one hand, and quantify the weight of the soil retained by *C.h* roots, on the other;

ii. Conduct a statistical study;

iii. Perform some soil tests in the laboratory.

2.2.1. Morphometric Measurements

The clumps of *C.h* have roots that extend 3 m deep, according to Hasnaoui [4]. In our situation, we took advantage of the development work that took place in the spring of 2013, in the small town of Ain Fezza (Tlemcen). This allowed saving the biodiversity, on the one hand, and reducing the cost of our investigation, on the other. The equipment used in these operations dug up clumps of *C.h*, which contain large amounts of earth trapped in the tangled roots of the plant. To better assess the weight of earth trapped between the roots and to conduct our morphometric measurements, 34 samples were taken randomly (clumps). In order to know more on the role of *C.h* in soil conservation, it was decided to carry out the following measurements on each clump:

- ✓ Counting the number of stocks (Ns) per clump,
- ✓ Counting the number of clumps (Nc),
- ✓ Counting the number of roots (Nr),

- ✓ Measuring the height of the tangle (Ht),
- ✓ Quantifying the weight of soil retained by the roots (Ws).

A meter tape was used to measure the height of root tangles; a balance of type "Zenati electronics-ACS-A3" was utilized to evaluate the weight of earth retained by the clump. To avoid losing that trapped earth, each clump was placed on a plastic plane, so that the entire mass of soil can be recovered and weighed.

2.2.2. Statistical Study

To better clarify the relationships between the variables under study, a statistical analysis (correlations and Principal Component Analysis) was conducted, using the software XLSTAT 2010. The approaches under consideration made it possible to identify the relationships between the selected parameters; they also allowed raising the degrees of interaction between them on one hand, and highlighting the potential role of this species in its biotope, on the other.

2.2.3. Physicochemical Analyses

These analyses were performed according to the experimental protocol described by Aubert [12].

Ten soil samples were collected from the surface layers (0 - 30 cm) from stocks of *C.h*. The main analyses conducted are:

- ✓ Physical: grain size, color,
- ✓ Chemical: pH, $CaCO_3$,
- ✓ Electrical Conductivity (E.C).

3. Results and Discussion

3.1. Morphometric Analyses

The *C.h* groves in the western region of Algeria are generally in the form of clumps, ordinarily circular, with a variable number of stocks, depending on the substratum. It was possible to identify five clump classes (**Table 1**).

From **Table 1**, one can say that:

- ✓ The height of the tangle of roots varies between 36.98 and 68.44 cm;
- ✓ The amount of soil retained by the clumps increases with the number of roots and the height of the tangle;
- ✓ Regarding classes, class 5 has a large number of stocks, between 24 and 27, with an average number of roots equal to 382, an average height of tangle Ht equal to 68.44 cm, and an average mass of soil equal to 70, 29 kg;
- ✓ Considering the variation in the average mass of soil retained by roots, the various classes may be ranked in the following order: class 5 > class 3 > 4 class > class 2 > class 1.

C.h in our regions is usually found in the form of clumps. The number of stocks per clump depends on the parameters of each station (type of soil, substratum, climate, anthropic impact, etc.). This character allows the species to have a large root network.

Statistically, the results obtained show that the correlations are highly significant between pairs of variables. One can retain the following:

- ✓ Nr/Ht (r = 0.995),
- ✓ Nr/Ws (r = 0.994),
- ✓ Ht/Ws (r = 0.988).

Table 1. Morphological parameters of *C.h* and weight of soil retained by the roots.

Class No.	Ns	Nc	Average Nr	Average Ht (cm)	Average Ws (kg)
1	7 - 11	4	163	36.98	19.4
2	12 - 15	6	230	44.09	39
3	16 - 19	10	376	65.65	69.38
4	20 - 23	8	314	58.71	59.29
5	24 - 27	6	382	68.44	70.29

These high coefficients can be explained by the fact that *C.h* has a powerful fasciculated root system and very tangled in the upper part of soil; it can reach 80 cm. Deep roots decrease in number and get longer. This status allows them to play a leading role in keeping the soil up [4].

The above mentioned correlations can also be explained by the adaptive strategies of the plant to the conditions of the environment in which it grows (nature and depth of soil). Hasnaoui [4] showed that *C.h* can develop in different types of soils and even in rock cracks. These strategies can increase the contact and exchange surfaces between the soil and the plant and keep the soil in place.

Using the principal component analysis (P.C.A), one can note very important information on their degree of correlation. Thus, it is possible to see that the variables Nr, He, Ps are very close to the correlation circle. The rather closed angle (from the origin), formed by points Nr, He and Ps, indicates that these variables are fairly well correlated. This means that the three parameters are evolving in the same direction. Overall, the more important Nr is, the more crucial its associated parameters (He, Ps) are (**Figure 1**).

3.2. Physico-Chemical Analyses

The results of the physicochemical analyses, of different soil samples, are summarized in **Table 2**.

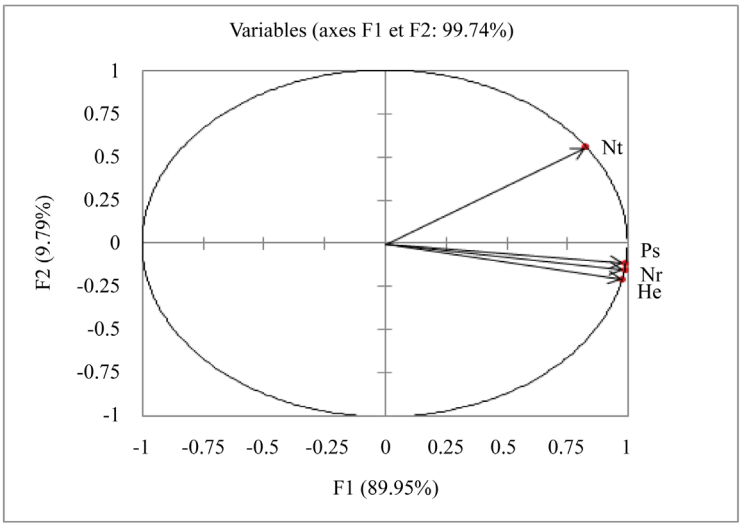

Figure 1. Correlations between morphometric parameters.

Table 2. Physico-chemical analyses of soil, at the station of Ouchba.

Station	**Ouchba**									
Samples	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
Depth (cm)	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30	0 - 30
Munsell color	5YR4/6	7.5YR4/6	7.5YR4/6	5YR4/6	7.5YR4/6	7.5YR4/6	7.5YR4/6	5YR4/6	5YR3/4	5YR4/6
Sand (%)	46	64	55	50	58	58	70	61	70	63
Silt (%)	45	25	34	43	31	32	20	34	22	30
Clay (%)	9	11	11	7	11	10	10	05	8	7
Texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Humidity (%)	41.24	33.64	39.36	30.22	23.96	34.04	40.59	33.48	40.10	28.25
$CaCO_3$	0.70	0.62	0.08	0.62	1.11	1.51	2.37	0.95	1.51	0.78
pH	7.76	7.35	7.82	7.70	7.69	7.63	7.84	7.48	7.56	7.78
E.C (mS/cm)	0.482	0.450	0.730	0.378	0.478	0.937	0.590	0.364	0.765	0.439
Estimation of salinity	unsalted	unsalted	little salted	unsalted	unsalted	little salted	unsalted	unsalted	little salted	Unsalted

- ✓ The analysis of samples shows that the texture of that soil is sandy-loam. It was found that all soils contain very little clay (less than 15%) and a significant amount of silt and/or sand. This gives them low cohesion and low structural stability. These soils are easily eroded, and loose particles are easily carried away by runoffs [13];
- ✓ Soil moisture was found between 24 and 41.2%;
- ✓ The CaCo3 content was found low for all samples. This ratio is between 0.08 and 2.37 and the pH ranges from 7.35 to 7.84. The surface horizons of soils, located on limestone rocks, are often decarbonated and have a neutral pH [14]. The long dry period promotes conservation, or sometimes enhances the capillary rise of bases in the profile. The environment is not acid (or becomes acid slowly) [15];
- ✓ The E.C shows that this plant grows on soils that are little salty or not salty at all (**Table 2**).

4. Conclusions

The results obtained are interesting, as they confirm the potential role of *C.h* in maintaining the edaphic potential *in situ*.

The various statistical combinations made between the morphometric measurements of the parameters under study show that the correlations between the pairs Nr/He, Nr/Ps and He/Ps are highly significant.

From these correlations, one can deduce that *C.h* has the capacity to trap a significant quantity of soil between its very tangled roots. This quantity depends on He and Nr. Overall, the more important He and Nr are, the higher Ps is.

Therefore, it can be stated that *Chamaerops humilis* is capable of maintaining the *in situ* edaphic potential. This plant species offers one efficient way for keeping soil in place; it therefore needs to be seriously protected.

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