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Scientific Research

Characterization of the Organic Matter in the Formations with *Juniperus phoenicea*, and *Pinus halepensis* in the Matorrals of the Mostaganémois Littoral

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Abstract

In the present work, we were able to verify the utility of splitting the organic matter that seems to be indispensable, especially when it comes to the soil humus which is very little polymerized and containing a large proportion of non-decomposed organic matter. This study even if it remains unfinished, it provides some useful information. Moreover, this work reflects the fundamental influence exerted by the organic matter as a soil and as a driving force of its dynamics. Humus factor in the vocation of a soil can promote or remove some plant species. The statistic analysis shows that the humification of the organic matter is faster on calcareous sandstone substrate (Calabrien) as on Tithonique Substrate with advanced cretaceous which can be explained by the very high rate of humic acids as the calcareous sandstone substrate. At the level of plant development, the organic matter provided by the mixed stands (*Eucalyptus, Pinus halepensis, Juniperus phoenicea*) with an undergrowth which is formed by (*Retama monosperma*, *calycotome spinosa*, *Pistachia lentiscus, Phylaria latifolia, Lavandula stoecka*) has a very god humification with a predominance of humic acids that indicate the acceleration of the development of clay-humic complexes and a permanent wealth of energy reserves.

Keywords

Organic Matter, Humus, Soil, Humic Acids, Plant Development, Clay-Humic Complexes, Bourahma Forest, Mostaganem, Algeria

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1. Introduction

The forest environment is a net sample of ecosystem organized by superimposed layers; this allows the maximum use of solar energy as well as a greater diversification of the ecological niches [1].

Among the essential components in this environment, there is the organic matter which plays a key role here. It constitutes the essential substrate of the development of the biological life because it is a major source of carbon and energy for the microorganisms. It determines the chemical properties (carbon, nitrogen and phosphorus stocks) and the physical properties (permeability, structural stability, retention and water circulation and capacities) of soil [2]-[4].

The soils are specific environment which allow the plan life but each living species has its requirements for mineral organic substances and for water, and it takes up a limited part of soil specific nature [5].

Thus, we focus our work especially on the soil and the organic element. These latters are responsible for the decay of *Juniperus phoenicea* stands. The organic matter both in quantity and inquality cannot be proactive by the root system of this forest gasoline. Sometimes, these nutritional difficulties (absorption) can lead to damaging results in terms of features (stunting, limited growth…). The results are noted for decay of stands that this work intends to investigate. We were interested in characterization of the organic matter of the Mostaganem coastline. It is the question of Bourahma forest.

As interested in the forest subjects faced with the scale of this evident degradation, we thought it useful to do this study. In this context, we suggest that we can provide a contribution on the question of relationships between soil and vegetation in the forest area. It will be very informative.

In another chapter, we will make the analysis of edaphic data received by the statistical processing. It is the Principal Component Analysis (PCA). This desired approach in this kind of study will allow us to identify the correlations which can exist between these multi-specific, monospecific groupings and the dominant ecological factors related to the soil (texture, pH, organic matter…).

2. Approach Methodology

2.1. Field Methodology Figure 1

2.1.1. Soil Sampling

The different methods of study and characterization of soils that have been proposed all lead to the sampling of topsoil [6]. However, the soil sampling does not only consist in taking off a certain quantity of the soil and in analyzing at the laboratory. It must respond to a need related to the context of the site and its occupation [7].

2.1.2. Sampling Strategies in Pedology

There are many methods and standards of soil sampling and analysis that can be adapted for soil study:

- The random method.
- The stratified random method.
- The systematic method.
- The systematic random method.
- The systematic semi-random method.
- The incomplete systematic stratified method.

In our case, the stratified random method of the area is better, because it requires to make a large number of samples where the choice of their locations is based on determining factor. Our choice is based on the geological substrate and the plant development which identify the type of the organic matter and the state of its development.

Many factors can be taken into consideration for the realization of this process such as the geological substrate, the lithosoils, the geomorphology, the soil and plants occupation [8].

The sampling strategy to set up in order to proceed on the investigation of the soil is much more led by the nature of required information [7].

2.2. Laboratory Methodology

2.2.1. Extraction and Fractionation of Humic Matters of the Soil

Description of the technique In order to ensure truly reproducible results, it is essential to standardize as far as

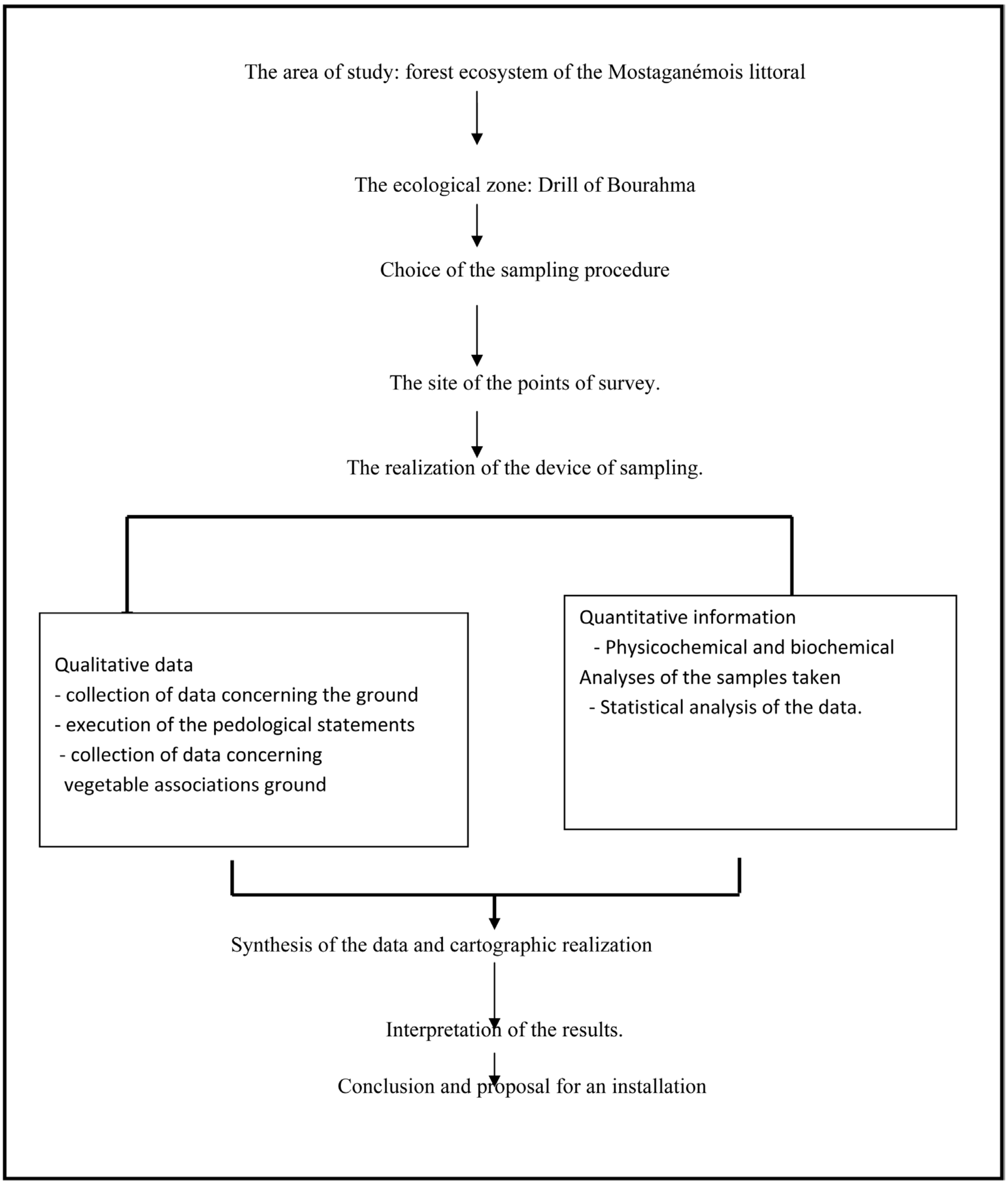

Figure 1. Experimental methodological approach.

possible the extraction method. The soil is crushed and sieved through the riddle 0.2 mm. the relationship soil/ reagent is 5/100 for each sample, but in the case of the poor soil, it is often necessary to take 20/100.

- Shake for half ½ an hour 10 gr of soil in 200 ml of PO_4H_3 (136 ml per liter of water). Repeat the process two times.
- The light plant matters are collected on filter and dried. Carbon analysis is done by combustion.
- The phosphoric solution containing free fulvic acids is preserved.
- The soil base is washed with water to a pH of 4.5 to 5. After washing, the soil is shaken for 4 hours with 200 ml of $Na_4P_2O_7$. 0,1 M.
- The extraction liquid is centrifuged and settled on filter.
- The soil residue is shaken for 4 hours with 200 ml de NaOH 0.1 M, centrifuged and settled on filter. The process is repeated two times. The filtrates corresponding to the pyrophosphate extraction and soda are pre-

served separately.

- The aliquot of each solution is dried in oven and the carbon is determined either by the potassium dichromate, or combustion and determining of released CO_2. This determines the whole humic matters (fulvic acids + humic acids) [9].
- On an another aliquot, the humic acids are precipitated by H_2SO_4 with pH 1, the precipitate is washed and the carbon is determined as before (humic acids).
- The fulvic acids are obtained by difference: % C fulvic acids = % C whole humic matters − % C humic acids.
- The free fulvic acids are directly determined by the sulphochromic oxidation of the phosphoric extract.
- The soil residue after the second soda extraction is dried, and the whole residual carbon is determined. Thus, we get the insoluble or humin fraction.
- In the end, there are seven different fractions of organic matters:

+C % of the light plant matters.
+C % of the fulvic acids extracted from sodium pyrophosphate.
+C % of the humic acids extracted from sodium pyrophosphate.
+C % of the fulvic acids extracted from soda.
+C % of the humic acids extracted from soda.
+C % Humin.
=C % total [10].

Geographical location of the study area is mentioned in the **Figure 2**.

3. Results and Discussion

3.1. Variability of the Analyzed Parameters According to Plant Association and Geological Substrate

3.1.1. Variability of the Rate of (OM) According to the Undergrowth

Figure 3 represents the rate variation of the organic matter in order of horizon groups and plant association (undergrowth), it is noticeable that the association (C) (*Phylleria latifolia*, *Pistachia lentiscus* and *Lavandula stoecka*) gathers a large number of horizon groups together with a very high rate of organic matter, and next we have the association (B) (*Retama monosperma*, *calycotom spinosa* and *Pistachia lentiscus*) and (E) (*Pistachia lentiscus* and *Disse*), and then come the other associations represented by a smaller number of horizon groups and the average rates of the oraganic matter.

3.1.2. Variability of the Rate (OM) According to Forest Groups

Figure 4 represents the rate variation of the organic matter in order of horizon groups and plant groupings (forest group), it is noticeable that the group (D) (*Pinus halepensis*) gathers a large number of horizon groups together with a very high rate of organic matter, and next we have the grouping (E) (*Pinus halepensis* and *Juniperus phoenicea*) and then come the other groupings (A) (*Eucalyptus*, *Juniperus phoenicea* and *Pinus halepensis*) and (C) (*Pinus canariensis* and *Pinus halepensis*) by a smaller number of horizon groups and the average rates of the oraganic matter.

3.1.3. Variability of the Fulvic Acids Rate According to the Forest Groups

Figure 5 represents the rate variation of the fulvic acids in order of horizon groups and plant groupings (forest group), it is noticeable that this rate is very high in the grouping (E) (*Pinus halepensis* and *Juniperus phoenicea*) with a small variation going from the horizon (1) to the horizon (2) and (3), and it has average values in the groupings (A) (*Eucalyptus Juniperus phoenicea* and *Pinus halepensis*) and (B) (*Eucalyptus*, *Juniperus phoenicea* and *Pinus halepensis*) with a remarkable difference between the surface horizon (1) and the two other horizons (2) and (3) whereas these values are very small variation between the three horizons.

3.1.4. Variability of the Humic Acids Rate According to the Forest Groups

Figure 6 represents the rate variation of the humic acids in order of horizon groups and plant groupings (forest group), it is noticeable that this rate is very high in the grouping (B) (*Eucalyptus*, *Pinus halepensis* and *Juniperus phoenicea*) with a notable decay from the horizon (1) to the horizon (3), whereas this rate is on average in the other groupings with a verya small variation between the three horizons.

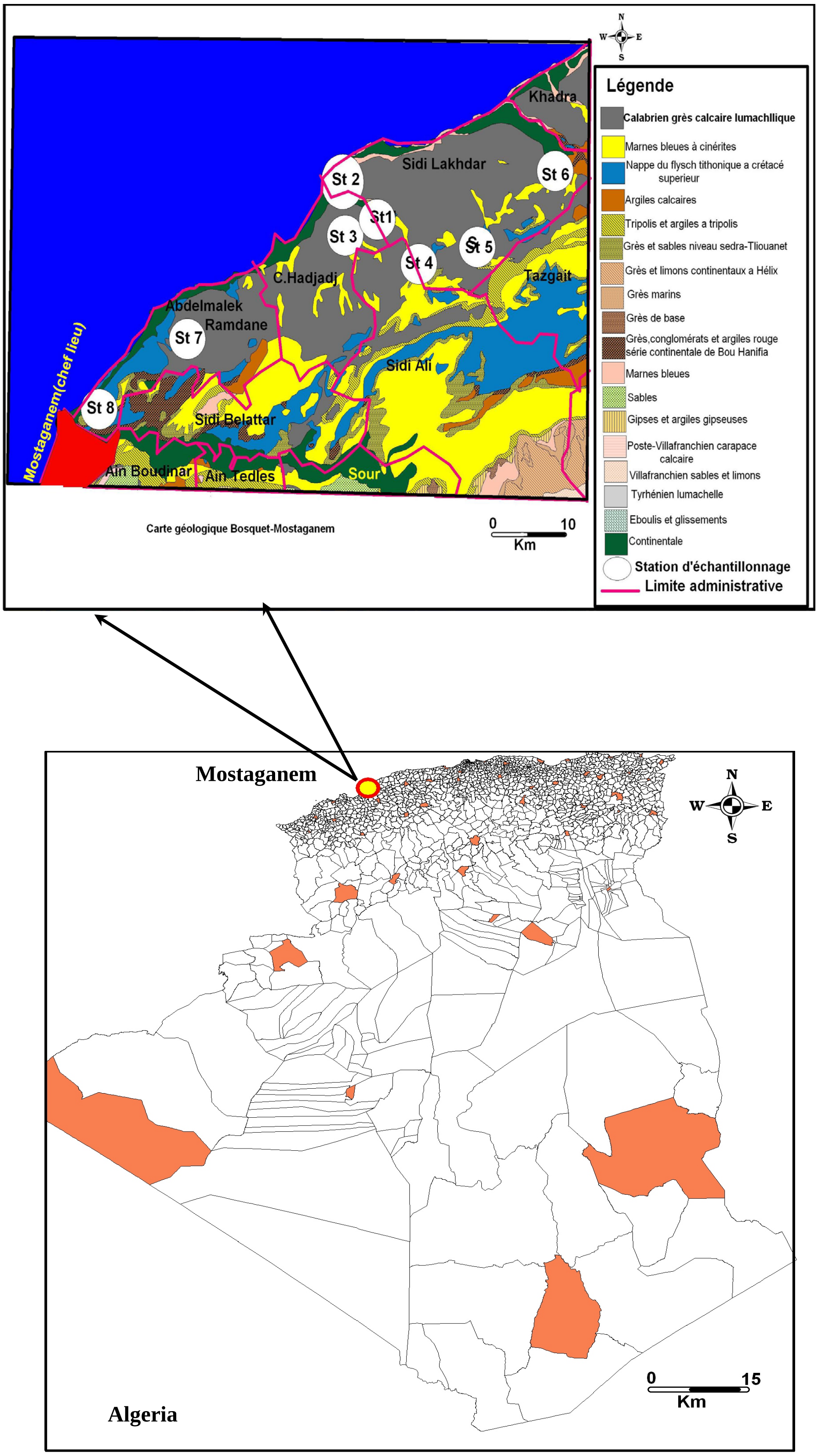

Figure 2. Geographical location of the study area.

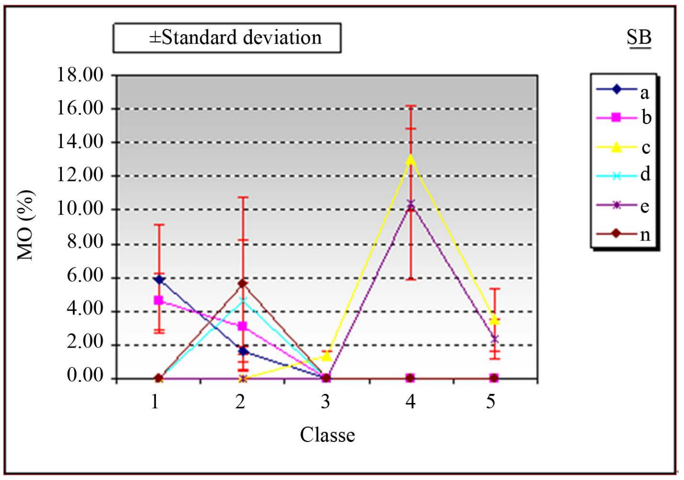

Figure 3. Chart of the variability of the rate of the organic matter by association plant (under wood).

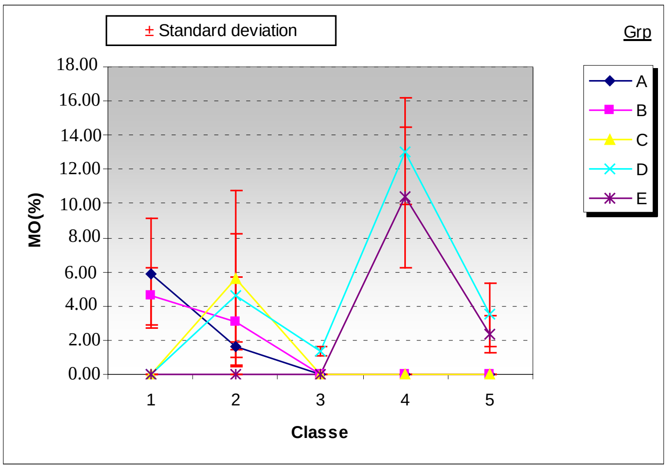

Figure 4. Chart of the variability of the rate of the organic matter by forestry groups.

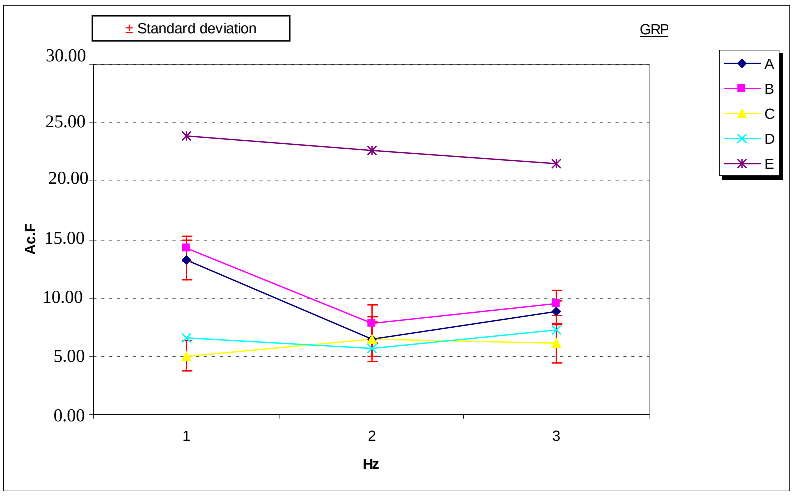

Figure 5. Chart of the variability of the rate of the fulvic acids by forestry groups.

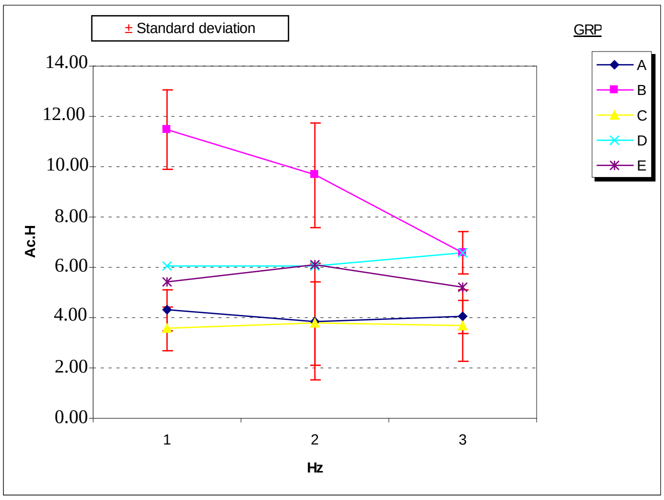

Figure 6. Chart of the variability of the rate of the humic acids by forestry groups.

3.1.5. Variability of the Fulvic Acids Rate According to the Undergrowth

Figure 7 represents the rate variation of the fulvic acids in order of horizon groups and plant association (undergrowth), it is noticeable that this rate is very high in the association (E) (*Pistachia lentiscus* and *Disse*) with a small variation going from the horizon (1) to the horizon (2) and (3), and it is on average in the association (A) (*Lavandula stoecka*, *Pistachia lentiscus* and *Retama monosperma*) (B) (*Retama monosperma*, *Calycotom spinosa* and *Pistachia lentiscus*) and (D) (*Pistachia lentiscus*) with a remarkable difference between the surface horizon (1) and the two other horizons (2) and (3) in the association (A) and (B) and it is non-existent in the association (D) whereas these values are very small in the associations (C) (*Phylleria latifolia*, *Pistachia lentiscus* and *Lavandula stoecka*) with a very small variation between the three horizons.

3.1.6. Variability of the Humic Acids Rate According to the Forest Groups

Figure 8 represents the rate variation of the humic acids in order of horizon groups and plant association (undergrowth), it is noticeable that this rate is very high in the association (B) (*Retama monosperma*, *Calycotom spinosa* and *Pistachia lentiscus*) with a remarkable decline from the horizon (1) to the horizon (3) and it is on average in the other associations with a small difference between the three horizons.

4. Conclusions

In the ecosystems both climatic and altered by humans, the humification is a controller process: the energy content is maintained, the complexity level is high, the homeostasis of the system is assured, its organization is increased but its entropy reduced. The crop rotation, the mixed stands, the plants development climax balanced with the natural environment are examples where the humus, by way of feedback or directly, take part in the system regulation by a biological and chemical diversification.

However, each simplification tends to lead to change, an accelerated evolution in the direction of instability, of mineralization of the energy reserves that increases the system entropy by decreasing the quantity and by altering the humus quality. The monocultures illustrate this orientation.

We have completed this work which consists in characterize the organic matter in a forest ecosystem of the coastal region of Mostaganem. This work is informative and useful especially in the timber production.

The specific knowledge of the principal plant development, the lithological substrate and the physicochemical aspects of soil as well as the bioclimatic characterization constitute the fundamental bases to better understand the evolution of the humic compounds in the ecosystem.

According to some authors [11], the fulvic acids being the first humic fractions which are formed in the soil during the decomposition of the fresh organic matter, are either quickly transformed into humic acids (by polymerization and neosynthesis) or quickly decomposed and mineralized. These two phenomena can leave a small proportion of humic acids highly polymerized.

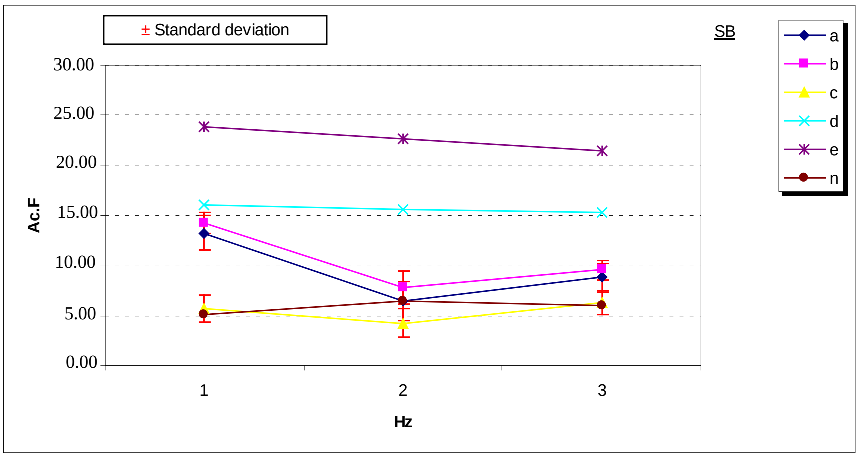

Figure 7. Chart of the variability of the rate of the fulvic acids by association plant (under wood).

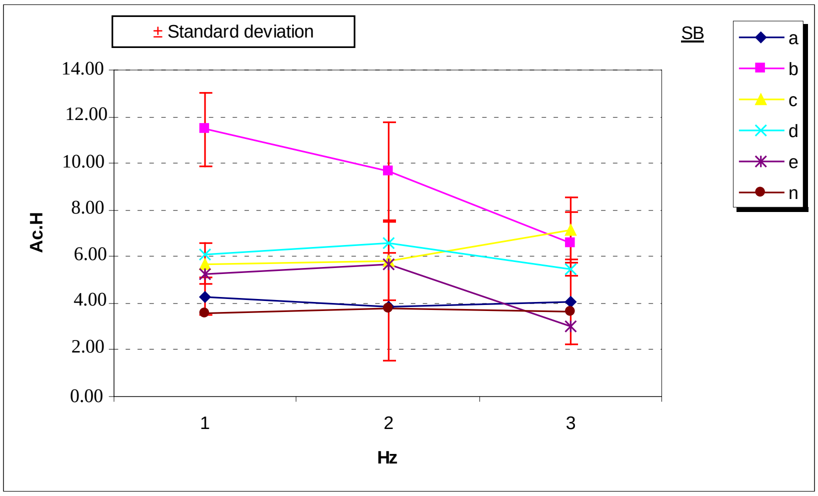

Figure 8. Chart of the variability of the rate of the humic acids by association plant (under wood).

The fractionation of the fresh organic matter and the dosage of these different humic compounds (fulvic acids and humic acids) allow us to better know the development state of the organic matter.

Through a statistical analysis in order to study the variability of these humic compounds according to different plant development, it has been noted that the organic matter provided by the mixed stands (*Eucalyptus* + *Juniperus phoenicea* + *Pinus halepensis*) with an undergrowth made of: (*Retama monosperma* + *Calycotome spinosa* + *Pistachia lentiscus* + *Phyllereo latifolia* + *Lavandula stoecka*), represents a very good humification with a predominance of the humic acids which indicates the acceleration of the development of clay-humic compounds and a permanent wealth of the energy reserves.

The responsible decision-makers for the forestry promotion and the environmental protection must take account of the speed of the degradation of these forest ecosystems and of the soil quality in the long term in the region. To achieve this, they are obliged to intervene by:

- The preservation of forest groups which constitute the plant structures relatively stable with plant association of characteristic and significant species.
- The restoration of pre-forest groups, by far, the most frequent, represents structures, usually in the form of tree-filled matorrals, blocked under the current ecological conditions and the anthropogenic activities which are still present.

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