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Could edaphic factors be at origin of *Cedrus atlantica* (Manetti, 1844) decay in the National Park of Theniet El Had (Northern Algeria)?

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ABSTRACT

The authors have explored the relations existing between rate decay of three Atlas Cedar Cedrus atlantica districts at level of National Park of Theniet El had in north of Algeria, during sylvan campaign 2009/2010. District which represents the most important decay's rate among the three ones, is "Guerouaou" district with 11.23% followed by "Tourssout" with a rate equal to 10.08% and "Pépinière" district with a rate equal to 0.73%. Decay presents a strong correlation with pH Kcl.

Key words: Decay, edaphic factors, *Cedrus atlantica*, National Park of Theniet El Had, Algeria.

INTRODUCTION

Atlas cedar covers a surface of 161.800 ha in North of Africa with 131.000 ha in Morocco and 30.800 ha in Algeria [11]. According to Nedjahi [14], Algerian Cedar forests are split up in scattered islands representing more of 1.2% of total forest area evaluated to 4.1 million hectares. Atlas Cedars populations are localized essentially in the Center and at East of Algeria, through different bioclimatic stages where they constitute beautiful forests when ecological conditions are favorable, [1, 2,13,20]. Nevertheless, Cedar's area is in net decline because of decay phenomenon which has been picked out in the majority of cedar's Algerian forests [8, 22].

According to Helis [9], origin of this phenomenon remains still unknown. Several hypotheses have been done to explain it. Forest of Theniet El Had, has turned out to be a complex case where decay reaches until 20% of trees [12]. Facing to this painful situation which affects a natural interesting heritage, scientific considerations have been taken, although at small level, to elucidate these phenomenon true causes.

Researches on Algerian forests Cedar's decay are very fragmentary. Majority studies focused on effect of hydric stress, climatic changes or causes of forestry adjustments [21, 19]. From this prospective, our goal is to steer towards an approach of decay's investigations by trying to understand the possible role of different edaphic factors to be at origin of this decay's phenomenon, in order to better visualize sanitary state and lasting management of the cedar forests.

MATERIALS AND METHODS

1. Presentation of the region and studies sites

National Park of Theniet El Had is situated in the Algerian northern east, at 35°51'56'', 35°5304'' of latitude and 01°55'30" , 02° 01' 30" of longitude, and the highest point of 1786m of altitude (Ras EL Braret), at level of Ouarsenis massif represented geologically by a chalky substratum constituted from tanned rendzines lithosols type. Massif of Ouarsenis is formed of two dissymmetrical slops; a southern sloping relatively soft and a very abrupt northern one where has been realize our study. North-west part of the northern slop is constituted of hard and compact chalk and is surmounted by an abrupt and rocky face [10].

Our sampling of patches decay was based in the Northern West part of the massif slop at the level of three districts chosen among the most attacked by decay and named “pepiniere” “Guerouaou”, and “Tourssout” (figure, 1). In the latest ones, two sites of one hectare were chosen except the district “pepiniere” which was considered as control, according to Rondeux [18].

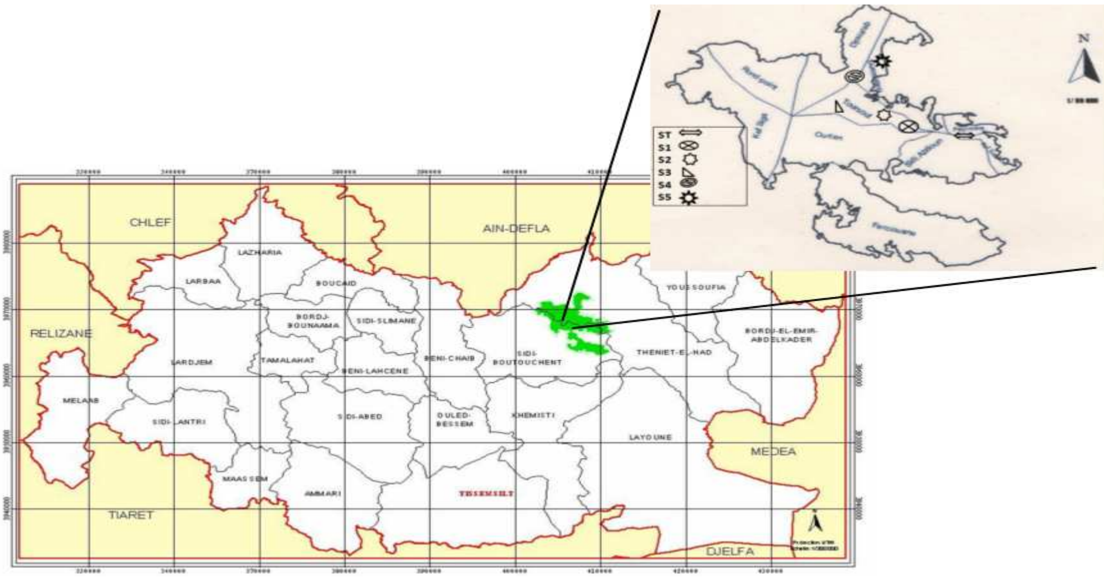

Fig.1. Localisation of the study sites in the National Parc of Theniet El Had in North of Algeria

2. Evaluation of decay rate

At level of each place, we have quantified individuals number of forest species, decayed individuals and healthy ones. We estimated the decay rate of one square in a site (DRS (%): Number of decayed individuals in a square /Total number of individuals in the place x 100) and total decay rate (TDR %: Total number of decayed individuals/ Total districtnumber of individuals)

3. Edaphic analysis

Ground analysis is limited to two periods corresponding to dry season (october-november) and to period of the first rains (December). At these periods; ground is subject to its high stability in term of biological activity [17]. In each study site, 5 samples are removed: one from center and four others from the edge corners [4] in order to have representative samples and to better characterize edaphic properties of the experimental station in consideration of its limited area. Removed samples are dried at open air during one week, then ground and sieved with a sieve of 2 mm of mesh [6].

Content in ground water has been measured according quantity of earth by loss of weight after drying at 105°C. Measure of Ph has been made with the help of digital pH meter, total chalk by chalkymetry with help of chalk meter of Bernard, by volumetrically method. Organic matter through organic carbon was determined according to Anne’s described method.

4. Microbiological analysis

Evaluation of microorganism mass is necessary to study fluxes in the ground of some items as carbon and nitrogen [16]. Indirect method, by inoculation in environment of suitable growing of ground suspension at different dilutions described by Dommergue [7] has been used. Reading of results was done after seven days of incubation and both bacteria and fungi microorganisms were studied.

4.1. Fungi Microscopic Analysis

Actinomycetes were developed in a solid medium and sown with ground suspensions with agar support for sowing. Tow drops of 0.1ml of suspension dilution at 10° C were put down and spread out with care on the whole surface of each 3 boxes. The nutritive solution first prepared, was homogenized and hatched at 28°C.

4.2. Microscopic analysis of aerobes bacteria
Aerobes bacteria were also developed in a solid medium and sown with ground dilutions suspensions with agar support. Two drops of 0.1mm of suspension dilutions at 10° C were put down on each 3 boxes and as soon as spread out, homogenized and hatched at 28°C.

The number of Aerobes bacteria (N) was calculated according to the formula: N= Mean of the developed colonies in the three boxes x inverse of the dilution x dryness coefficient x 10.Dryness coefficient = 1/ (1-wet rate).

Ammoniated nutritious and denutritious microorganisms have been sown in salted liquid medium added with a characteristic medium for each microorganism type. Number of germs by one ground gram has been determined with the help of Mac-Cray table.

RESULTS

1.Sanitary state of the Atlas Cedar Studied sites
On the whole of the three districts walked round during this study, at level of northern side, we have taken in consideration various decay phases. This let to show decay's rate equal to 19.39% for the whole six stations. District which represents the most important decay's rate among the three ones, is Guerouaou district with 11.23% followed by Tourssout with a rate equal to 10.08% and Pépinière district with a rate equal to 0.73% (Table 1). In the following, by convenience, and unless otherwise specified, term **"**decay**"** is applied for all types of died cedar or in decline.

Table 1: Evaluation of decay rate in the studied districts

District	Study site	square number/ site	Decay rate (%)
Pépinière	1	4	0.73
Guerouaou	2	8	11.23
Tourssout	3	12	10.08

Decay rate is variable starting from 4.17% to 44.44% with rate increase from of place 19 which remains lightly upper at 35%, except for places 17 and 22 presenting very weak rate decay respectively 4.17% and 5.26%. Decay' rate is very variable from place to another with a tendency to increase. In general way, two zones of decay in earth surface can be underlined; a zone with high decay and a zone having a weaker decay.

2. Effect of edaphic factors on decay
Effect of edaphic factors on the estimated decay rate was analyzed by a principal component analysis. The two first axis explain information at more than 71.82%. Proper values of the first three axis (Figure 2) are relatively high and discerned according others proper values which are very close. The first proper value is in order of 27.3% with inertia rate corresponding to 38.98% for the first axis, which proves a more or less strong structure of cloud along this axis. Axis 1 is represented by pH Kcl in so far as where this one presents stronger contributions (+ 0.700). At the opposite of this axis, weaker contributions are represented by total chalk (-0.430). Axis 2 is represented by carbon and organic matter which successively represent higher contributions (+0.814) and (0.813) respectively. On negative side of this axis, water pH is characterized by weaker contributions (-0.50), opposing to carbon and organic matter. Axe 1 Decay presents a correlation of (-0.641), distribution of the most physico-chemical factors of the ground (pH, MO, Co) are found on the positive side of this axis. Axis 2 Decay presents a strong correlation with pH Kcl (+0.392), (+0.430) this is may be liable to very weak quantities of total chalk of these grounds. Euclidian distance calculation based on homogeneity of (-3), it results three groups: Group 1 essentially gathers p11, p12 p13 p17 p14 p15 p16 p21 p22 p23 p24 p4 p3 p2 represented by water pH, Kcl pH. Group 2 (G2) is formed by (organic matter, organic carbon, content in water, total chalk) in following plots P5 p6 p7 p8 p18 p20 p19. Presence p9 p10 Group 3 (G3)**,** showed no information on properties that being enfeoffed.

1. Microbiological characteristics effect on decay
Proper values of the first three axes are relatively high and discerned according to others proper values which are very closer. The first proper value is in the order of 27.19% with inertia rate corresponding to 38.84% for the first axis which is proving a more or less strong structure of cloud along this axis.

In analysis in main component performed on microbiological identified and quantified characteristics (Figure 3), plans 1 and 2 are kept for they account for a maximum information on existing correlations between distribution of these microbiological factors and plots. This PCA let's appear: axe 1 that is represented by actinomycetes as far as where this one shows strongest contributions (+0.854). At the opposite of this axe, weaker contributions are represented by denitrifying (0.690). As for axis 2, it would seem that the last one shelters aerobes bacteria which present higher contributions (+0.460). In the other hand the negative side of the same axe is characterized by nitrifying bacteria with weaker contributions (- 0.873), opposing the slope.

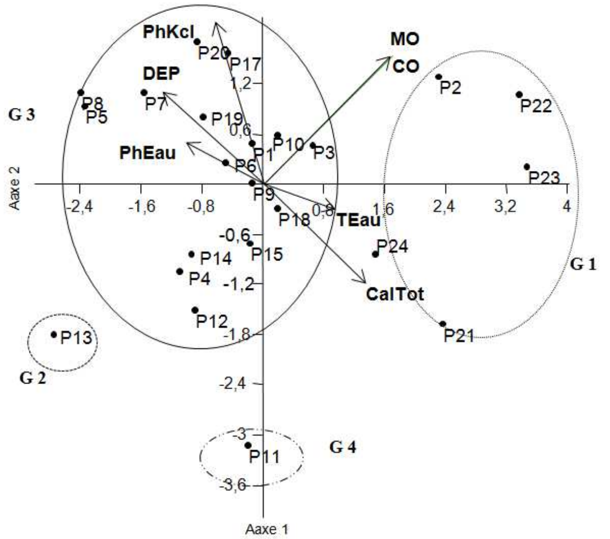

Fig.2. **Principal components analysis (PCA) of edaphic factors of the Cedar Atlas and decay factors (DEP : Decline, TE au : Water content, Cal TOT : Total limestone, MO :Matter .Organic, CO : Carbon organic)**

We notice that the two first axes of PCA explain information more than of 71.82% as it has been explained by axe 1 where decay presents correlation of (- 0.541), of major distribution of germs in solid environment (actinomycetes, mushrooms, aerobes bacteria) are found on positive side of the axe. In other respects at axis level 2, decay presents a strong correlation with aerobes bacteria (+0.456) to (0.460). On negative side of this axis nitrifying germs present a Cr = (- 0.873), which explain that limit dilution containing very weak nitrates quantity. Analysis of dendrograms and on a similarity base of (- 2.5) allows identifying three groups: group 1 (G1) gathers essentially p21. P23, p.22, p24, represented by actinomycetes germs and aerobes bacteria. As for group 2 (G2), this last one is formed by P19, p5, p6, p7, p4, p8, p20, p1, p17, p18, p2, p3. It is noted absence of information on properties which are enfeoffed. As for the last group 3 (G3), we note presence of mushrooms, Nitrifying, Ammonizing, Denitrifying for the following plots: p9, p10, p11, p13, p14, p15, p16.

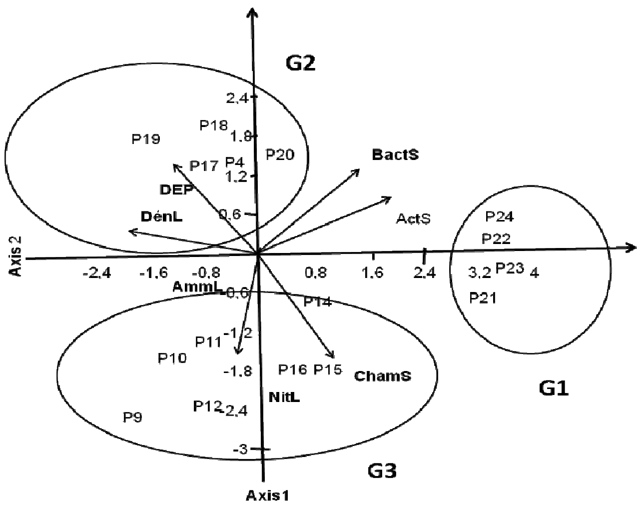

Fig.3. **Principal components analysis (PCA) of Microbiological factors of the Cedar Atlas and decay factors (DEP : dépérissement, ChamS : Champignon, BactS : Bactérie aérobie, ActS : Actinomycète,DénL : Dénitrifiant, NitL : Nitrifiant, Amm : Ammonifiant)**

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DISCUSSION

1. Possible relation decay-edaphic factors

Organic carbon quantity stored in forest grounds is equal about 2.5 times of that found in tree aerial biomass [5]. It makes up so, an important information to know forest contribution to carbon planetary result. Furthermore, organic carbon quantity allows translating some ground characteristics like its fertility, its richness in organic matters and its possibility of water retention.

The closest variable in relation with organic carbon ground content is its color: more dark is the ground, more it is rich in organic carbon. PH values vary by opposite direction to organic carbon content of mineral horizon. However, we would be expecting to a positive regression coefficient, since litter decomposition is generally faster when ground's pH is weakly acid till neuter which translates a good biological activity. That can be explained owing to the fact that litter nature also influences the ground pH.

Furthermore, climate is also a variable which affects decomposition rate of the litter, but which has not been included in the model. This variable has been able to influence with indirect manner the content pH relation in ground organic carbon. Richer grounds in chalk or those presenting rich surface horizons in organic matters and in earthy alkalino items slow down germination mechanism and survival will be highly reduced [15].

Qualitative results of the studied sites show that organic matter rate is high in surface. In effect, an enriched ground in organic matter is in favor of best vegetal growing. pH and Kcl results show that whole Atlas Cedar sites are characterized by a light acidity that would have caused an accentuated decay in these stations (because a pH and Kcl upper to7, as in our case, makes negative influence on others factors). This pH tendency is explained as a matter of fact, that Atlas Cedar litter naturally acid is balanced by a good floristic broad leaved trees. Acidifying effect due to mother rock nature is not accentuated because Cedar forests litter enriches grounds without acidifying [3]. Active chalk gives to the ground alkaline pH and turns so insoluble several indispensable items to plants (phosphore and some items-traces) [5].

2. Possible relation Decay-microbiological ground characteristics

Among all ground microorganisms, those are more numerous and smaller, their size generally does not exceed 0.5 to 0.1mm diameter to 0.2mm long. Grounds bacteria present anyway a net tendency to dwarfism [7]. They proliferate in richer and not much acid environments: They are particularly numerous around some plants roots (Poaceae, Fabaceae) within rhizosphere. Most of them are heterotrophic and saprophytes, they decompose celluloses, sugars which make up energy sources, and are mineralized in the major part under shape of CO_2. Actinomycetes seem to play a large role in transformation of some organic and mineral compounds of the ground, but this role is still bad known. They would be liable to decompose aromatic compounds (lignin, some tannin) and elaborate some humic acids by favoring peptide chains link with aromatic nucleus, particularly in quinonic. Howerver, Fungic organism's role in the ground is considerable and very varied. That role plays particularly in decomposition phase of the fresh organic matter which precedes damping. Most of them are capable to decompose celluloses; some are susceptible to hydrolyze more resistant phenolic compounds, lignin and tannins. Some fungi organisms are associated to roots trees by forming mycorrhizae which facilitates growing and nutrition of contaminated species. According to principal component analysis (PCA) and obtained results, it seems that absence of fungi organisms would provoke germs disturbance as aerobes bacteria considerably grow while nitrifying diminish (-0.873).

CONCLUSION

In this work, we have underlined an estimation of Atlas cedar decay rate at level of 3 districts in National Park of Theniet El Had. We hypothesize that edaphic factors which have been explored by the physico-chemical characteristics, have a narrow relation with this phenomena. Microbiological side has also been approached in making highlight microorganisms role sampled at level of decayed rhizosphere plants (bacteria, fungi and actinomycetes). This contribution led to acquire new knowledge not still explored at the level of Cedar forests in National Park of Theniet El Had, to take in consideration in a best integrated management of Algerian Cedar forestry within the frame work of sustainable development.

REFERENCES

[1] Abdessemed, K., *Doctorat thesies*, Univ Marseille, **1981**,199 p.
[2] Aussenac, G. Essai d'interprétation bioclimatique et écophisiologique BUU. *Soc. Sci. Nat. Vaucluse*, **1984**, 72676p.
[3] Andre, V.. Initiation à l'entomologie, Anatomie, biologie et classification.Place saint –Michel ,Paris, Tome1, 1979, 299p.
[4] Bastide, A.,. *Méthodologie d'échantillonnage sur terrain sur terrain*. Masson, **1989**, 280p.
[5] Becker, M. and Levy, G.,. *Ann.Sci.For*, **1987**, Vol 4 : 379-402.
[6] Denis, B. Guide des Analyses pédologique, INRA. France, **2000**, 254p.
[7] Dommergues, Y. La biologie des sols. Ed. Que sais-je ? Presse Universitaire de France, **1977**, 125p.

[8] El Yousfi M., *Revue sécherrèsse*, **1994**, Vol.14, N°4 209p.
[9] Helis, L. doctorat thesies, Univ Aix Marseille, **2006**, 200p.
[10] Kacha, S. ingeniorat memory . Univerdity Tiaret, **2008**, 87p.
[11] Khanfouci, M. Doctort thesies, Univ. El Hadj- Lakhdar. Batna, **2005**, 248 p.
[12] Lieutier, F., Vouland, G. et Pettinetti, M. *Rev. For. Fr*. XLIX, **1997** (3) : 215-224.
[13] M'hirit, A. Cèdre, bilan et perspectives.Foret méditerranéene, **1999**, Tome XX. (3) 91-100.
[14] Nedjahi, A., Kolai, L., Khemici, M., Yassad, S. & Arabi, M., 3. Annales de la recherche Forestière .INRF.Alger, 199, 83p.
[15] Nezar,. Mémoire d'Ingéniorat INA. El Harrach, Alger, **1980**, 58p.
[16] Oulbachir, K. Master thesies, Univ de Tiaret, **1997**,104 p.
[17] Oulbachir, K., Dellal, A., Bekki, A.,. *Européen Journal os Scientific Researchs*. **2009** Vol. 36 (3) : 407-417.
[18] Rondeux, J,. Les cahiers forestiers de Gembloux,**2002** , N°28, Belgique,17p.
[19] Sarmoum, M. Master thesies USTHB ,Alger,**2008**., 175p.
[20] Yahi, N.,. : Revue sécherrèsse AUF. **2007**, Volume14, N°4pp209.
[21] Zedek, M., **1993**. Thèse Magister.INA.EL Harrach, Algérie, 87p.
[22] Zine El Abidine, A.,. Revue sécheresse. AUF, **2003**, Volume14,N°4pp209.