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CHARACTERIZATION OF CORK OAK INFECTION BY *BISCOGNIAUXIA MEDITERRANEA* IN TWO CORK OAK FORESTS OF OCCIDENTAL ALGERIA: DJEBEL SAADIA (W. RELIZANE) AND HAFIR (W. TLEMCEN)

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Abstract

Description of the subject: In recent decades, cork oak forests have experienced serious health problems, including decline caused by pathogenic fungi, leading to the instability and degradation of this important forest resource. Due to the great ecological and economic importance of cork oak forests and given the lack of information on the etiology on this degradation.
Objectives: The study are aimed to: i) study the health status of the stands in each region and ii) assess the infection of the cork oak by the endophyte *Biscogniauxia mediterranea*, an agent of charcoal canker associated with cork oak decline.
Methods : Sampling was carried out in 2017 on two forests in western Algeria: Djebel Saadia (Relizane) and Hafir (Tlemcen), which was the subject of various surveys distributed according to station surveys relating to the station data, dendrometric, tree condition and management data were considered.
Results : There obtained from the point of view of circumferences and heights, showed that the trees affected by *B. mediterranea* canker in the forest of Hafir contains a threshold of 80% form the 2nd class of circumference (Ø between 70 and 109 cm) and the other classes are less attacked and belong to the two classes 2 (H: 6-7 m) and 3 (H: 7-10 m) of heights, , whereas in the forest of Djebel Saadia, the infected subjects belong to class 1 whose circumference is of the order of Ø < 70 cm and class 1 whose height is of the order of H < 6 m. For each individual forest, a statistical analysis was performed to relate the detection of *B. mediterranea* to the quantitative data of dendrometric parameters, including height and circumference, plus calculation of infection rate, which shows no difference between the two study sites.
Conclusion: This original study, reports the diagnosis health status and forest of the cork oak in two forests such as Djebel-Saadia and Hafir to characterize them, the evaluate and highlight the involvement of the pathogen *B. mediterennea* in the observed decline from the various parameters related to the state of the trunks by meticulous observations and notations reveal the presence of the fungus.
Keywords : *Quercus suber* ; charcoal canker ; Hafir ; Djebel Saadia ; decline.

CARACTERISATION DE L'INFECTION DU CHÊNE-LIÈGE PAR *BISCOGNIAUXIA MEDITERRANEA* DANS DEUX FORÊTS DE CHÊNES-LIÈGES DE L'ALGÉRIE OCCIDENTALE : DJEBEL SAADIA (W. RELIZANE) ET HAFIR (W. TLEMCEN)

Résumé

Description du sujet : Au cours des dernières décennies, les forêts de chêne-liège ont connu de sérieux problèmes sanitaires dont le dépérissement causé par les champignons pathogènes conduisant à leur instabilité et leur dégradation de cette importante ressource forestière. En raison de la grande importance écologique et économique des subéraies et vu le manque des informations sur l'étiologie de cette dégradation; les subéraies de la partie d'Algérie occidentale n'échappent pas à ce constat.
Objectifs : de l'étude vise à : i) étudier l'état sanitaire des peuplements de chaque région et ii) apprécier l'infection du chêne-liège par l'endophyte *Biscogniauxia mediterranea* agent du charbon de la mère associé aux dépérissements du chêne-liège.
Méthodes : L'échantillonnage était réalisée en 2017 sur deux forêts: Djebel Saadia (Relizane) et Hafir (Tlemcen), qui a été l'objet de divers relevés repartis selon les relevés stationnels relatifs à la station, les relevés dendrométriques, l'état d'arbre et l'état d'exploitation.
Résultats : Obtenus de point de vue circonférences et hauteurs, ont montré que les arbres atteints par le chancre à *Biscogniauxia*, dans la forêt de Hafir contient un seuil de 80% forment la 2ème classe de circonférence (Ø entre 70 et 109 cm) et les autres classes sont moins attaqués et appartiennent au deux classes 2 (H : 6-7 m) et 3 (H : 7-10 m) de hauteurs, , alors que dans la foret de Djebel Saadia, les sujets infectés appartiennent à la classe 1 dont la circonférence est de l'ordre de Ø < 70 cm et la classe 1 dont la hauteur est de l'ordre de H< 6m. Chaque forêt individuelle, une analyse statistique a été effectués pour relier la détection de *B. mediterranea* aux données quantitatives des paramètres dendrométriques, dont la hauteur et la circonférence, plus le calcul du taux d'infection, qui ne montre aucune différence entre les deux sites d'étude.
Conclusion : Cette originale étude, a permis de réaliser le diagnostic sanitaire du chêne-liège dans deux forêts telles que Djebel-Saadia et Hafir pour les caractériser, les évaluer et mettre en évidence l'implication du pathogène *B. mediterennea* dans le dépérissement observé en se basant sur les différents paramètres liés à l'état des troncs.
Mots clés: *Quercus suber* ; Charbon de la mère; Hafir ; Djebel Saadia ; M'sila ; dépérissement.

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INTRODUCTION

The cork oak (*Quercus suber* L.), an evergreen tree belonging to the Fagaceae family, is endemic to the Mediterranean basin and spreads from the western Mediterranean region to the Atlantic from where it overflows the western part of Portugal and Morocco. It has also been reported on all the major islands between the Iberian Peninsula and the Italian Peninsula, in some scattered parts of southern France and some coastal regions and mountainous regions of Morocco, Algeria and Tunisia [1, 2, 3, 4]. In Algeria, cork oak forests are one of the most important forest species due to their ecological, social and economic value. The cork they supply constitutes a significant economic contribution for the country [5, 2, 6, 3].

The stands of cork oaks have experienced over time a problem of degradation of the sanitary state leading to the gradual reduction in the range of stand density and cork production, which constitutes a decline phenomenon in several European countries such as Portugal since the end of 1980's [7, 8, 9, 10], France where became of concern in 1952 [11], in Spain found in the early 1980's [12], in Italy in the early 1990's [13], and in the south Mediterranean region (the Maghreb countries) which became more serious, it was observed in Morocco towards the years 20 [14, 15], in Tunisia it began in 1992 and was archived in 1998 [16, 17], in Algeria which prevailed until the 90's [18, 19, 3, 20], but some authors believe that this phenomenon began much earlier [21]. This decline phenomenon is a complex process that according to Sousa [22] is generally carried out in two phases: *(i)* a phase of physiological weakening, *(ii)* a phase of generalized weakening. Several unfavorable factors, of varying intensity from one region to another, have been involved in this process either sequentially or simultaneously [23]. These factors, according to Cabral & Sardinha [24], are grouped into three categories: *(i)* predisposing factors which act throughout the life of the tree and relate to poor management of the forest, inappropriate practices as well as disturbance of soil structure and fertility [25]; *(ii)* the inducing factors that lead to the onset of the decline phenomenon such as climate change (drought) [9] and excessive debarking; *(iii)* acceleration factors which are essentially fires, insect attacks (defoliators, xylophages and xylomycetophages) such as *Zeuzeyra pyrina*, *Lymantria dispar* and *Platypus cylindrus* and pathogenic microorganisms such as *Phytophthora cinnamomi* and the fungi *Botryosphaeria* spp.,*Armillaria mellea*, *Biscogniauxia mediterranea*, *Coryneum modonium* and *Endothiella gyrosa* [26, 27, 28, 29, 30]. Also, pathogens such as *Pythium spiculum* and *P. sterilum* have been identified on cork oak, in Spain and Portugal [31], and several Ophiostomatoid fungi in Portugal, Tunisia and Algeria [32, 33a & b, 34, 35, 36]. Several other pathogens and pests have been frequently associated with the decline and mortality of cork oak stands in various contexts, whose aggressiveness to trees is variable [37, 38a & b, 39, 40, 41, 42, 43]. Nevertheless, some species of opportunistic fungi have received more attention because they can colonize plant tissues as endophyte, in the latent phase, without inducing symptoms and for a long period [44, 45]. Once trees are weakened, these fungi, initially confined, can colonize adjacent tissues, leading to gradual decline and eventually death of the tree [46, 47]. *Biscogniauxia mediterranea* is one of the opportunistic and potentially invasive fungal pathogens whose frequency of attacks on cork oak trees has increased considerably over the last decades in the Mediterranean region [48]. In 1986, Lanier [49] reported the genus *Biscogniauxia* in North Africa from declining cork oak stands. He suggested that this pathogen was a contributing factor to the decline of oaks [50] particularly in the Mediterranean basin [51, 52, 53, 54, 31, 20, 17]. *Biscogniauxia mediterranea* causes the charcoal canker disease and has been associated with various decline symptoms such as leaf chlorosis, crown dieback, bark cankers, tannic exudation and reduced radial tree growth [55b, 56]. This fungus has a cosmopolitan distribution and is found on a wide range of hosts located in southern Europe and North Africa; it has been reported on *Q. suber* in Spain [57, 38, 31], Italy [58, 51], Portugal [59, 39, 54, 60 b], Morocco [51, 61], Tunisia [62, 17] and Algeria [63, 29, 20]. Several authors have demonstrated that a wide range of factors influence the incidence and severity of this pathogenic species, including recurrent seasonal droughts, water stress, air pollution and insect attack [21, 54, 6]. According to Branco et *al.* [64], *B. mediterranea* is observed on trees already attacked by either primary pathogens like *P. cinnamomi* or *D. corticola*. Although previous studies on the role of *B. mediterranea* in oak dieback has been widely demonstrated in Europe, very few studies have been done on this pathogen and the possibility of involvement in the decline of cork oak stands in North African countries in Tunisia[65, 17, 66],

in Morocco[67]. No study has been undertaken on this pathogen on cork oak in Algeria, where the majority of the stands are in a deplorable state and a large part is still doomed to disappear [68]. This health problem is visible in many stands across the Hafir-Zarieffet massif where the degradation is summarized in fine texture of clay-sandy nature which supports the loss of rainwater by runoff and the water deficit of the trees. It is in this context that the present study is inserted with the aim of confirming the presence of *B.mediterranea* in the cork oak forests of occidental Algeria (cork oak forest of Djebel Saadia -W. Relizane- and Hafir -W. Tlemcen and to relate the infection to the stationary, dendrometric , sanitary and management characterizations.

MATERIEL AND METHODS

1. Description of the study area

The selection of forests was based on two essential criteria: the bioclimatic step and the relief. The work was carried out in two forests of occidental Algeria between February and March 2017, namely the forests of Hafir and Djebel Saadia that are distinguished phytogeographically in the mountainous zone division. Hafir forest (34°77'79.4"N, 0°14'29.45"W; 34°77'70.3"N, 0°14'29.44 "O) is located in the southwest of the capital of the wilaya of Tlemcen (Figure 1.1) with an altitude ranging from 1000 to 1420 m and an area of between 9872 ha and 10157 ha with rainfall between 500 and 600 mm. This cork oak forest, which is one of the relicts stands of Orania, provides the best cork in Algeria.

This old forest is essentially made up of natural stands of cork oak and the presence of other oak species (*Quercus rotundifolia* and *Quercus fagineas*sp. *tlemcenensis*), the wild olive tree (*Olea europea* ssp. *oleaster*) and a few ash trees (Fraxinus oxyphylla*)*, but also coniferous trees such as the barberry cedar (*Tetraclinis articulata*) and the oxycedar juniper (*Juniperus oxycedrus*), Aleppo pine (*Pinus halepensis*), pine gable (*Pinus pinea*), common cypress (*Cupressus sempervirens)* and eucalyptus (*Eucalyptus* sp.) are found in certain degraded cantons.

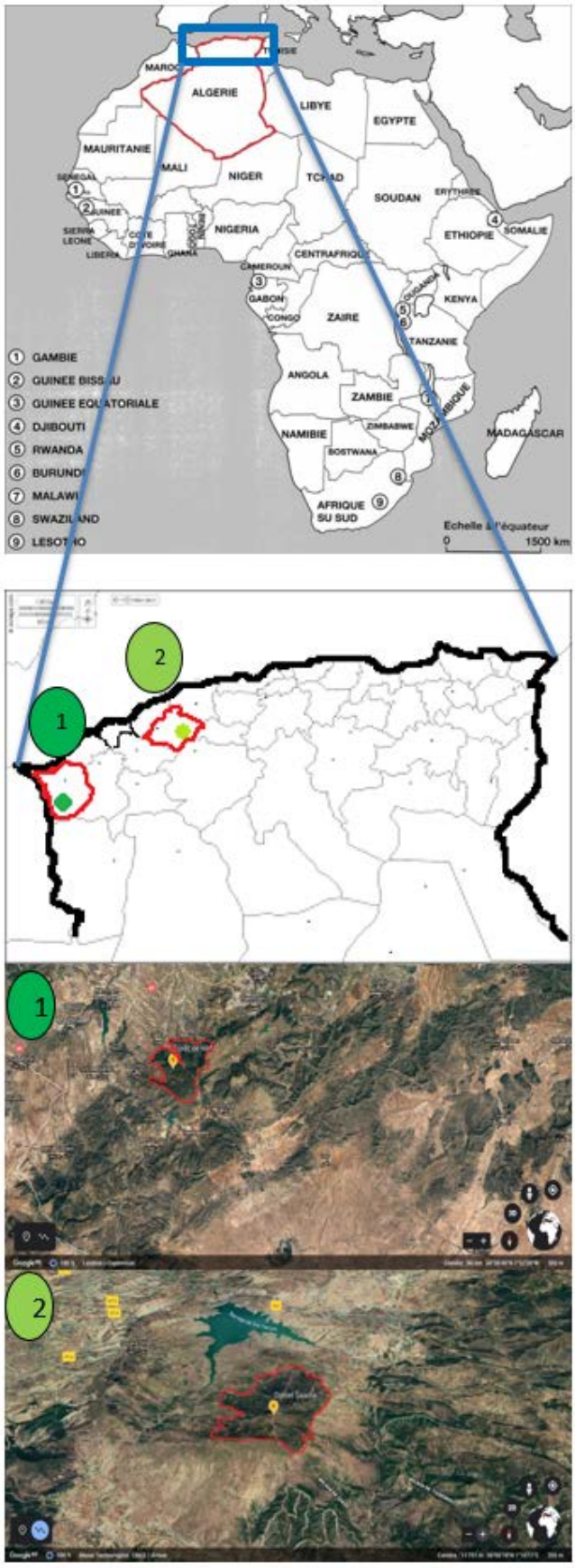


Figure 1- the two study forests with their geographical locations: 1) Hafir Forest, 2) Djebel Saadia Forest (Google earth, 2020 and Bendjebbar, 2020).

Half of the stands (2,300 ha) are pure while the others are mixed. Djebel Saadia forest (35°53'39.9" N, 01°19'24.7" E) is located northeast of the wilaya of Relizane (Figure 1. 2) with an area of 588 ha and an altitude of 956 m with a rainfall of 250 mm. It is characterized by a cork oak forest and a mixture of several plant species and forest species. The latter, besides cork oak are composed of zeen oak (*Quercus canariensis*), the carob tree (*Ceratonia siliqua*), oxycedar juniper and holm oak (*Quercus ilex*). The accompanying floristic species are rich in *Erica arborea, Cistus monspeliensis, Cistus salvifolius, Cytisus triflorus, Black stoniaperfoliata, Hordeum murinum*, etc..
Referring to the classification of Debrach [69], the forest of Hafir and the forest Djebel Saadia are linked to the semi-continental or altitude Mediterranean climate.

2. Sampling

In each plot, the monitored trees were selected according to the nearest neighbor tree method used in Europe (CEE network) and in France (blue network) [70]. Each forest plot was made up of a variable number of trees, at least 40. The monitoring covered a total of 376 trees which were the subject of various surveys divided between three categories: station, dendrometric and health surveys according to the method adopted in Bouhraoua & Villemant [71]. Station surveys relate to the station (geographical and topological surveys). Dendrometric readings are distributed by classes, which are recorded as follows: height (1: < 6 m, 2: 6-7 m, 3: 7-10 m, 4: > 10 m) and circumference-at-breast height (1: < 70 cm, 2: 70-109 cm, 3: 110-149 cm, 4: 150-189 cm 5: > 189 cm). Management data considered debarking (debarked/ undebarked). Health assessment was based on the visual observations of the state of the crown by estimating the leaf deficit of the sample trees [72, 73, 74], with disease classes ranging from 1 to 4 according to the scale set by Bouhraoua & Villemant [71], classes: 1:< 25% (low leaf deficit, Health category: healthy tree), 2: 30-60% (moderate leaf deficit, Health category: weakened tree), 3: > 60% (high leaf deficit, Health category: withering tree), 4: dead or dry tree, Health category: dead tree). The observations were made towards the end of March and the beginning of April in order to assess the response of the trees to unfavourable. The evaluation of *B. mediterranea*was made by the observation of charcoal canker characteristic symptoms: trees with longitudinal cracks in the bark and hard, black-carbonated subcortical plates [48] (Figure 2). The infection rate (IF) by fungus was calculated according to the formula adopted from [20]: IF = (n/N) × 100 (n: number of trees attacked; N: total number of trees).

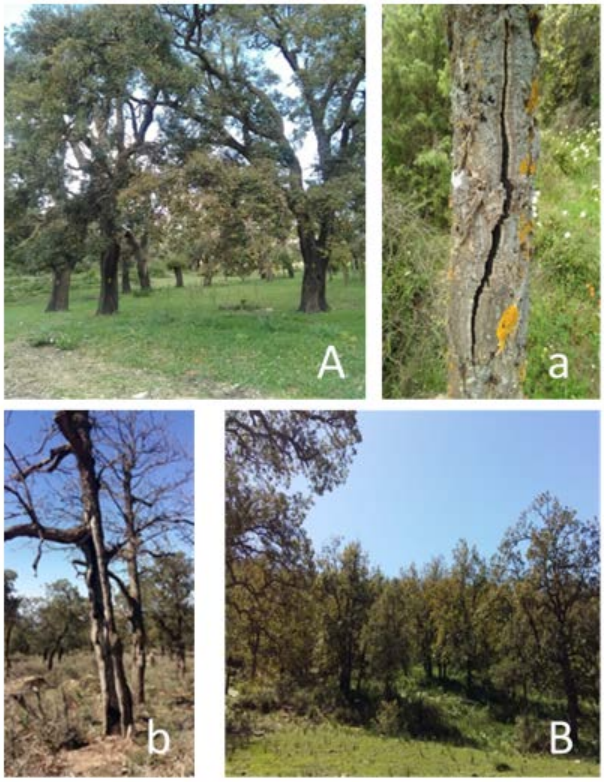


Figure 2- Cork oaks of the two forests:- A) General appearance of the forest Hafir; B) General appearance of the Djebel Saadia forest; -a and b. trees with *Biscogniauxia mediterranea* charcoal cankers (original photos).

3. Statistical analysis

The relation between the *B. mediterranea* infection of the trees ans considered variables was statistically analysed. The dendrometric variables were compared using ANOVA followed by an LSD test whenever statistically significant differences were recorded. The health variables analysis between the two forests was made using non-parametric Kruskal-Wallis ANOVA by ranks. For each forest, two ANOVA tests were carried out to relate the detection of *B. mediterranea* with the height of trees and their circumferences, followed by the Mann-Whitney U test whenever statistically significant differences were recorded. All statistical processing was carried out using the STATISTICA software package (StatsoftInc, 2003, version 6.1, Tulsa, OK, USA).

RESULTS

1. Description of the study area

from a stationary point of view, referring to the classification of Debrach [69], indicates the belonging of the two forests Hafir and Djebel Saadia to the semi-continental or Mediterranean climate of altitude and according to the climagram of Emberger , the Djebel Saadia forest is characterized by a semi-arid to sub-humid climate, it receives between 380 mm and 660 mm of rain, the average minimum temperature of the coldest month varies from 1.71 to 6.16 C° and the average maximum temperature of the hottest month varies from 30.20 to 35.12 C°, also for the Hafir forest, characterizing the brutality of the thermal contrasts, The cork oak of the Hafir forest corresponds to the meso- Mediterranean. the climate converges towards a subhumid bioclimate receiving annual rainfall of between 500 and 600 mm. The minimum temperature is always below 3°C, thus characterizing a cool winter.

2. Sampling

Biscogniauxia mediterranea isolates were obtained from different parts (branches and trunks) of the cork oak which showed longitudinal bark cracks and spots as described in the occidental region of Algeria from two populations (Hafir and Djebel Saadia) [75, 76, 59]. From each site, branches were harvested and pieces of wood tissue were cut from the trunks after removing outer bark. The sample trees, their dendrometric characteristics are illustrated in the figures 3, 4, 5 and 6. The figure 3 and 4 clearly shows a heterogeneity between measurements of height and circumference of sample trees (debarked and undebarked). The average height of a stand can be a very useful criterion for assessing forest productivity. The average total height of the trees examined <6m, with a minimum of 3m and a maximum of 10m.

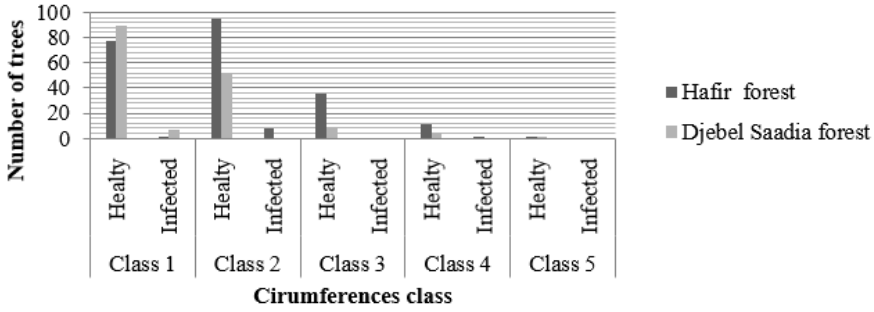


Figure 3- The different classes of sample tree circumferences from two forests
C - 1: < 70 cm, 2: 70-109 cm, 3: 110-149 cm, 4: 150-189 cm, 5: > 189 cm.

The trees affected by *Biscogniauxia* canker, at the level of the Hafir forest belong to three classes (1, 2 and 4) of circumferences of which 80% have formed the 2nd class of circumference (Ø between 70 and 109 cm), Class 1 (Ø < 70 cm) and Class 4 (Ø between 150 and 189 cm), are formed by 1/8 of the sample trees, whereas in the Djebel Saadia forest the infected subjects belong to class 1 in circumference (Ø < 70 cm) whose first forest out of a total of 99 trees contains 07 contaminated trees.

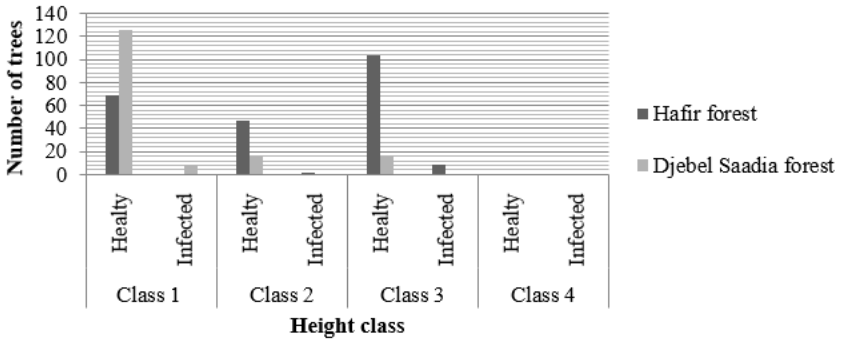


Figure 4- Graphical representation of the distribution of sample trees by total height classes (m) of two forests

H – 1: < 6m, 2: 6-7 m, 3: 7-10 m, 4: > 10 m.

The interpretation of the figure 4, allows us to see the trees infected by *Biscogniauxia* canker, from a height point of view,, at the level of the Djebel Saadia forest belong to a single class of height cl 1 (H<6m) comprising out of a total of 126 trees containing 07 infected trees. while in the Hafir forest, the infected subjects belong to the two height classes cl 3 and cl 2, whose height The trees are between 7 and 10 m are present in the batch of samples with a rate that exceeds 80% followed of those of height is between 6 and 7 m with 10%. The other trees of the 1st and 4th class are missing from the lot.

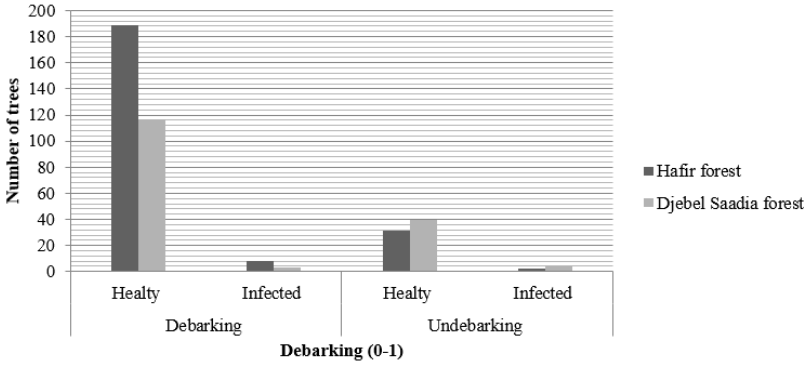


Figure 5- Graphical representation of the distribution of sample trees according to the dendrometric debarking (0-1) of two forests.

Figure n° 5 illustrates the distribution of trees according to the dendrometric debarking survey in the two forests, the trees that are affected by charcoal canker in the Hafir forest, particularly the debarked trees with an infection rate that exceeds 3% and the undebarked trees with a rate of 0.9%, in contrary, in the Djebel Saadia forest the undebarked trees are the most infected with a rate that exceeds 2% and the debarked trees carry an infection rate of 1.9%.

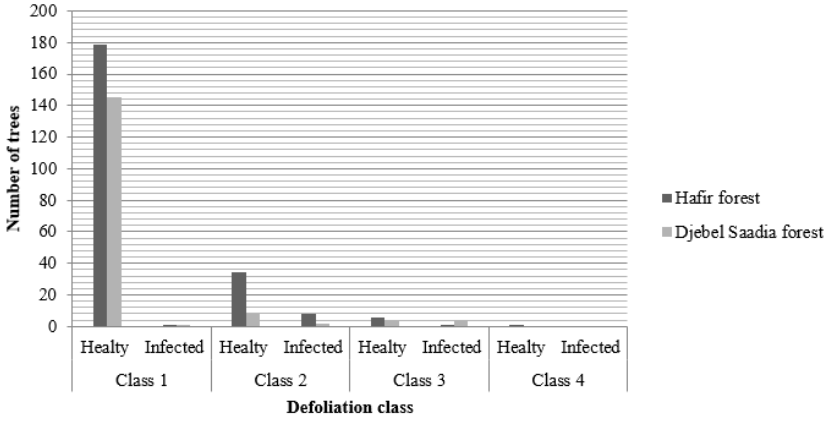


Figure 6- shows the health assessment consists essentially of observations based on the visual assessment of the state of the crown of the trees sampled from two forests.

Cl -1: < 25% (low leaf deficit), 2: 30-60% (moderate leaf deficit), 3: > 60% (high leaf deficit), 4: Dead (dead or dry tree).

The results of the health observations of the crowns of the 376 sample trees are shown in Figure 6 below. According to this figure, we find that the forest of Hafir contains a presence of the four classes of defoliation whereas at the level of the forest of DjebelSaadia only have the presence of three classes of defoliation of which, on 145 trees belonging to class 1 with low leaf deficit (<25%), i.e. a rate of 92%. The rest of the trees (5%) belong to class 2 of moderate leaf deficit varying between 30 to 60% and (2.5%) belong to class 3 of leaf deficit having lost more than 60% of their foliage and the forest of Hafir, class 1 of weak foliar deficit (<25%) contains 179 trees present by a rate of 81%, class 2 of moderate foliar deficit varies between 30 to 60% carries a percentage of 15.5%, class 3 of foliar deficit having lost more than 60% of their foliage present by a threshold of 2.7% and class 4 which results in dead trees carry a percentage of 0.4%.

3. Statistical analysis

The results obtained from the Kruskal-Wallis ANOVA statistical analysis of dendrometry and health between the two forests (Hafir and Djebel Saadia) and the link with the incidence of *B. mediterranea* have been recorded in figures 7, 8 and 9.

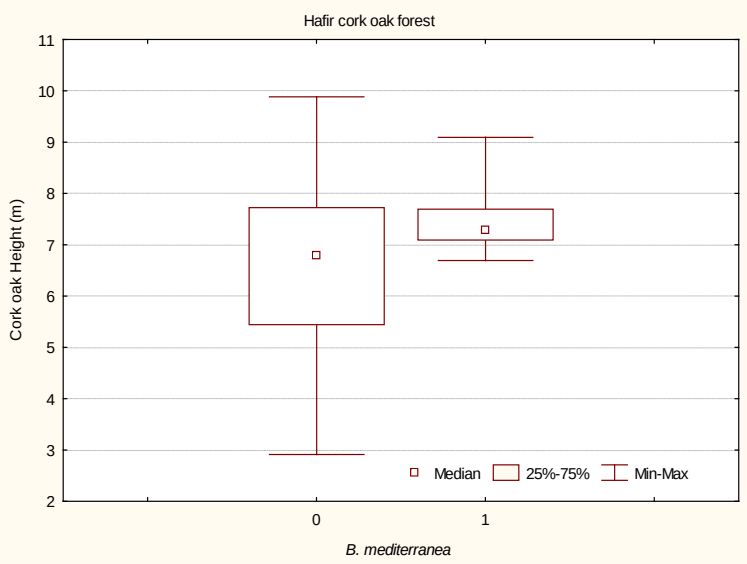
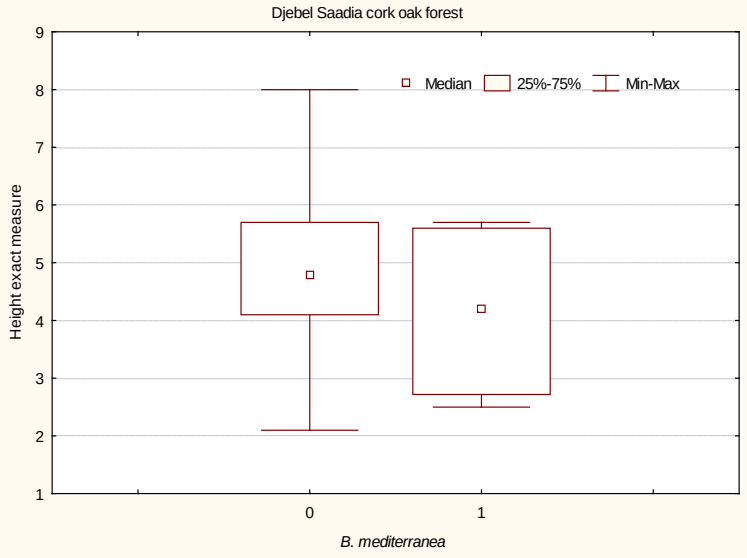


Figure 7- Statistical analysis of the height for the forest of Hafir By variable: *B. mediterranea* 0-1



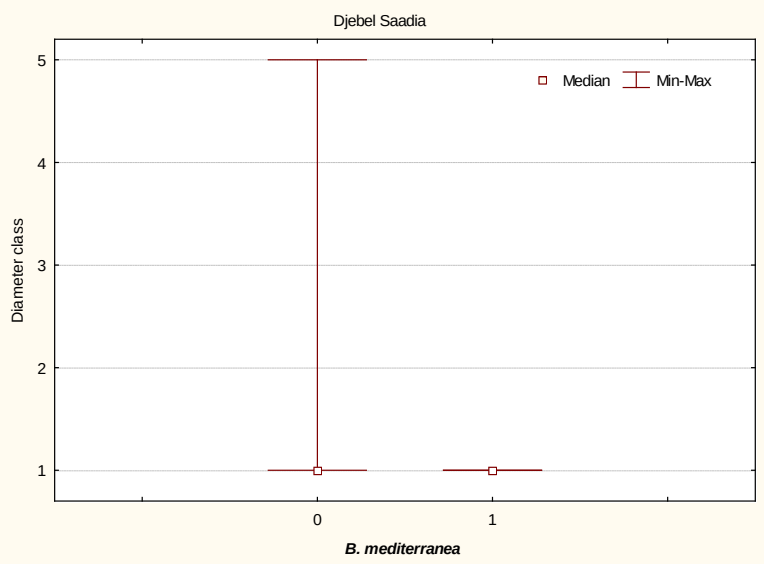


Figure 8- Statistical analysis of the height and diameter for the forest of Djebel Saadia By variable: *B. mediterranea* 0-1

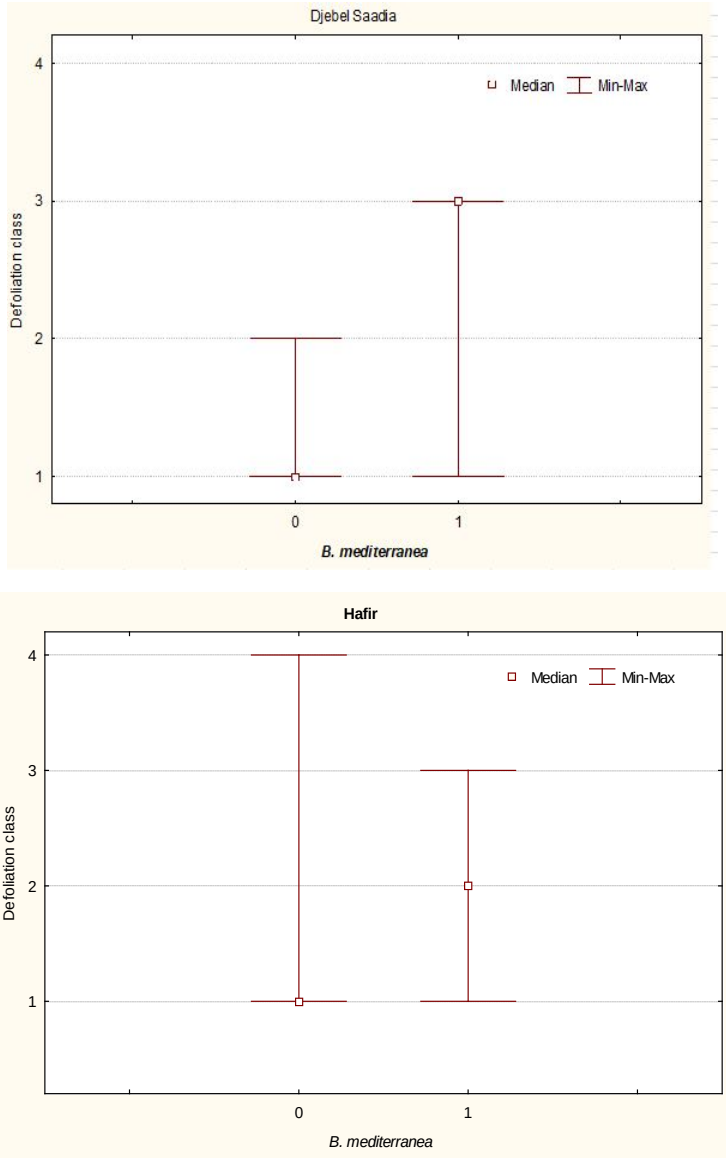


Figure 9- Statistical analysis of defoliation for the two forests Hafir and Djebel Saadia By variable: *B. mediterranea* 0-1

In the two forests, there are highly differences between the heights of the trees (F(375.1) = 115,0765; $p< 0.001$) and significant for circumference (F(375.1) = 13,967;$p = 0.002$).
Independent analysis for each forest concluded that for Hafir forest, B. mediterranea infection is related to tree height (F (1, 218) = 4.9744 p = 0.0267), being only detected in trees taller than 6.5 m (fig. 4), but this is not a specific condition for infection, there are taller trees in which the fungus was not detected visually . For circumference, there was no significant relationship with infection (F (1, 218) = 0.5417 p= 0.4625), For Djebel Saadia forest, none of the tree variables proved to be significantly relevant for B. mediterranea infection: height (F (1, 155) = 3.4255 p = 0.0661) and circumference (F (1, 155) = 2.7567 p = 0.0989) (Fig.8).
The difference in defoliation classes between the two forests is also significant (Z = 29570; P = 0.003). The Hafir forest has a level of defoliation very high (Figure 9), this means that the trees are in conditions unfavorable sanitary facilities compared to the Djebel Saadia forest. This phenomenon of dieback linked to the presence of the pathogen is probably linked to the location and different rainfall in the two localities (Hafir with higher rainfall than Djebel Saadia). The infection rate by *B. mediterraneain* the two forests (Hafir and Djebel Saadia is around 4% (Fig. 5).

DISCUSSION

Referring to our results and faced with this worrying situation, many investigations have been carried out in the field in order to explain the mechanisms and factors responsible for the incessant sanitary degradation of the cork oak stands and the reduction in their area has had harmful repercussions on the maintenance and the future of this industry. Several agents have thus been identified. Here we will discuss the main factors that are directly involved. We find *B. mediterranea*, is an opportunistic fungus of weakness on which it causes the disease of charcoal canker , known for its pathogenicity towards many forest species, in particular of the genus *Quercus* [77], of which it causes the decline in North Africa [78]. It is the agent of the sooty stroma of oak trunks and branches that has played an important role in the decline of oaks throughout the Mediterranean region [79]. Among them, the Algerian cork oak forests [63, 29, 20]. In this study, showing the characteristic symptoms of canker oak, isolates of *B. mediterranea* collected from different parts of trees in two cork oak forests (the Djebel-Saadia forest and the Hafir forest) were evaluated and characterized on the dendrometric and health levels.
This first report represents a significant progress towards the appreciation of the relationship between station surveys, dendrometric surveys and the occurrence of *B. mediterranea*. Our results showed that *B. mediterranea* in infected trees are characterized by leaf chlorosis, crown dieback, bark canker, tannic exudation, reduced radial growth and tree mortality are described as the main symptoms by Vannini [80 a]. In addition, the leaves are smaller than normal, and yellow in color. Similarly, the appearance of localized black spots on the trunk and branches. At maturity, they are exteriorized by causing the cork to burst and end up with premature mortality of the tree or of the affected part [56, 81].
These results showed that significant correlations were observed between canker disease and dieback of oak stands. In the Mediterranean, the climatic conditions, however, it is the latter that really takes on importance in the epidemiology of dieback [82, 52, 48], because it leads to maintaining a high inoculum pressure and therefore makes it possible to multiply the centers of infection on the trees for a large part of the year, thus accelerating their vegetative decline [80a]. So, in Italy, the attention of plant pathologists did not draw attention to carboniferous canker until the 1980, as a disease associated with the decline of *Quercus* [83], but also in Portugal in 1931, this fungus has been described in cork oak as a secondary disease associated with trees in advanced decline. Consequently, in our study, satisfactorily explains that the debarking considered as a way of propagation of *B. mediterranea* by these operations such as the instruments used Santos [84], the study of Montoya Oliver [85], confirms the idea and which deals with the development of fungus whose fungal spores carried by pruning or removal of cork forestry equipment can infect other trees. In addition, poor cork disposal practices used by unqualified workforce prevents natural healing of injuries and facilitates the development of the disease. In addition, defoliation by several insects also contribute to the spread of this fungus in cork oak forests, their action being important not only as vectors of inoculum, but also because the wounds they cause can serve point of infection [86, 38a & b].

Among the main insects that have been identified as vectors of *B. mediterranea* are *Agrilus sp.*, *Tropideres sp*. and *Platypus cylindrus* [32, 60b, 6].

Otherwise, studies carried out confirm the relationship between the fungus and the xylophage *Platypus cylindrus* in Portugal, including a study by Henriques [87] undertaken on phytopathogenic fungi, among them there are twelve species are commonly carried by both sexes of the platypus; the most important seem to be the Ophiostomatales and some Hypocreales and Xylariales. These two groups are represented respectively by *Acremonium crotocinigenum* and *Biscogniauxia mediterranea* (anamorphic form *Nodulisporium sp.*) already isolated from galleries and from platype mycangia. And also the study by Sousa [22], which has already been reported on the relationship of *B. mediterranea* with *P. cylindrus* and its association with the undeniable weakening of cork oak stands in the Mediterranean basin and in Portugal [88, 60 b, 54].

And in Algeria, the *B. mediterranea* fungus observed in some cork oak forests in occidental Algeria (Tlemcen and Relizane) was partly responsible for the sanitary degradation of trees and the appearance of cases of acute dieback. But a significant proportion of the mortality remains unexplained, the study by Henriques et *al*. [54], explains and supports that recently, many younger and non-degraded cork oaks have been suffering from a sudden decline presenting an atypical expansion of this disease. It can affect all age classes, but is more common in older trees [84]. According to the life cycle, the fungus contains a latent phase in which it lives asymptomatically as an endophyte within the host [89, 90]. When the tree is subjected to water stress [91], the fungus increases its virulence on cork oak [92, 93]. The transported spores land on the host tissues. On the one hand, their relationship with the leaves and buds can be a simple commensalism, on the other hand, at the level of the ligneous organs, they can have a pathogenic action if the conditions are favorable. This is what Franceschini et *al.* [90] think, because it is true that in plants in good vegetative conditions, the necrotrophic activity of the fungus, linked to the production of enzymatic and/or toxic substances may be thwarted by tissue reactivity [94]. Furthermore, it is a highly thermophilic species that can grow under very low water potential [55 b].

CONCLUSION

The study undertaken on the health and forest diagnosis of cork oak in two forests such as Djebel-Saadia and Hafir to characterize them, evaluate them and highlight the involvement of the pathogen *B. mediterennea* in the observed decline. The sanitary situation of the cork oak forest of Djebel Saadia is considered satisfactory but in the other forest Hafir the disturbance of the biotope leads to its gradual regression, even to its disappearance. Assessing the health status of stands and researching the agents directly or indirectly involved in any alteration in the vigor of trees is a complex task to carry out and requires regular monitoring of the health status of trees and stands and silvicultural work. brought to the forest over several years. The results obtained on the health status of the crowns allowed us to go out by: the Djebel saadia forest displaying a lower average defoliation (1.10), we can say that the cork oak stand has a satisfactory overall health status and good health. While the forest of Hafir (1.22) (KW: H (N = 2.442) = 10 58426 p = 0.0050). From the various parameters related to the state of the trunks by meticulous observations and notation reveal the presence of the fungus.

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