CONTRIBUTION TO THE APPLICATION OF ARCHI METHOD FOR HOLM OAK IN THE CHETTABA FOREST (ALGERIA)

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ABSTRACT

The concepts of plant architecture are powerful tools for understanding plant development over time and the growth strategies of species in their environment. The architecture of plants depends on the nature and arrangement of each element and is, at a given time, the expression of a balance between endogenous processes of growth and the constraints exerted by the environment. Our work is a contribution to the health monitoring of our forest Chettaba (Algeria) which is currently done at the scale of the tree, within plots of small area (4 plots), by an original method of visual diagnosis of oaks is used (ARCHI method). To assign an Archi type to a tree, a diagnosis of the development and physiological state is made. The diagnostic results show that the holm oak in the studied plots is currently in a healthy state despite the presence of trees with degraded crowns with impoverished branching, abnormal mortality and without any viable restoration process such as substitutes, which cannot be chosen as a future tree. The holm oak of Chettaba forest is classified as a viable ecosystem, with a good probability of remaining alive.

Keywords: *holm oak, ARCHI, health monitoring, viability*

INTRODUCTION

The genus (*Quercus spp.*) is one of the most species-rich forest genera. It includes several hundred woody species of temperate and Mediterranean zones, America, Europe and also Asia, among which are some species of high economic importance [1]. In Algeria, the oaks represent a forest capital where they cover nearly 40% of the Algerian forest [2]. These oaks play an undeniable role on the ecological, economic and social. The holm oak is one of the main forest species of the Mediterranean basin. It is also one of the basic species in the National Reforestation Plan (NRP) in Algeria. The holm oak is threatened by multiple factors [3], such as the extension of agriculture, infrastructure (settlements and roads), overgrazing, fires and neglect for lack of interest [4].

Faced with these threats that risk the health and quality of forest stands of holm oak of the forest of Chettaba; the method of diagnosis ARCHI allows to appreciate the dynamics of reaction of holm oaks after a stress (leaf deficit, abnormal coloration, mortality ...), and to take traces that allow to know the state, the future of this forest by the marks and the processes of restoration (development of gourmands ...) [5]. ARCHI is the method that relies on a reading of the architecture of trees [6]. The study of the architecture of a plant organism is based on a morphological analysis of the entire aerial part [7]. Its principle consists in describing in situ all the main structural forms that the plant follows during its development, in order to deduce by comparison the dynamics of growth linking them over time. This method is widely used for trees because of their slow building process [8]. The main objective of monitoring the health status is, on the one hand, to assess the current state of health of the Chettaba forest and, on the other hand, to initiate to form a database to analyze its evolution since 2021 and to identify possible trends.

MATERIAL AND METHODS

Presentation of the study area

Forest of Chettabah is located southwest of Constantine (Algeria). The estimate terrain elevation above sea level is 865 meters. The study area is located on the map topographic Constantine Scale 1/200 000 sheet N° 17 and located between the coordinates 36°19'4" north latitude and 6°28'36" East longitude. The forest of Chettabah spreads over an area of 2398 ha and 94a, and is perfectly limited and divided into six districts. Extreme altitudes of the forest is about 1104 m (maximum altitude) and 652 m (minimum altitude), corresponding to each of them respectively following map coordinates: (x = 839, y = 344), (x '= 839.9, y' = 340.3). Its bioclimatic is semi-arid to sub-humid. The average annual rainfall is estimated between 670 and 800 mm and the mean annual temperature of the region is 18°C, with an average of the warmest month above 35°C and the coldest month varies between 1.25 and 3.05°C. A large plant grouping as the forest of Chettabah can be studied in its entirety, especially when it concerns hundreds of acres to be treated in the detail.

The ARCHI method:

A method for diagnosing tree decline and resilience, based on architectural analysis of aerial parts [6]. The principle is to carry out two series of observations: the first concerns the symptoms of crown degradation (leaf deficit, abnormal coloration, mortality...); the second concerns the processes of crown restoration (development of suckers, covering of wounds, resumption of growth...) [9]. Six architectural types can be distinguished

- Healthy tree (ARCHI H): tree whose architecture is in conformity with its development stage.
- Stressed tree (ARCHI S): tree whose architecture deviates from the reference sequence (uncertain future).
- Resilient tree (ARCHI R): tree showing a dynamic return to normal.

- Tree in crown descent (ARCHI CD): tree building a new crown under the original one.
- Tree in irreversible decline (ARCHI I): tree blocked in a situation of non-return to the reference sequence.
- Dead tree (ARCHI D): tree with dead cambium at 1.3 m above the crown [10].

RESULTS AND DISCUSSION

The results obtained from the 4 holm oak plots are shown in Table 1. In the ARCHI S type, the highest value is recorded in plot 3 with a percentage of 31.42%. The maximum value of ARCHI R type is obtained in plot 1 with a percentage of 45.83%; while the minimum is obtained for plot 3 (4.16%). For the healthy ARCHI type, the highest values are found in plots 3 and 4. The smallest values are noted for the ARCHI I and ARCHI Dead types, ranging from 0 to 4 trees per plot.

Table 1. *The different states of Aleppo pine according to the ARCHI type.*

Plot	ARCHI H	ARCHI R	ARCHI S	ARCHI I	ARCHI CD	ARCHI D
P1	6	11	10	2	0	0
P2	3	4	10	3	0	1
P3	8	1	11	3	0	0
P4	8	8	4	4	0	2

Among the 99 holm oak trees in Chettaba forest (Fig. 1), the largest number of trees is ARCHI S type (35.35%); second are the two ARCHI H and ARCHI R types with percentages of 25.25 and 24.24%. The ARCHI I and ARCHI D types have only 12.12 and 3.03% respectively. The ARCHI CD type is totally absent.

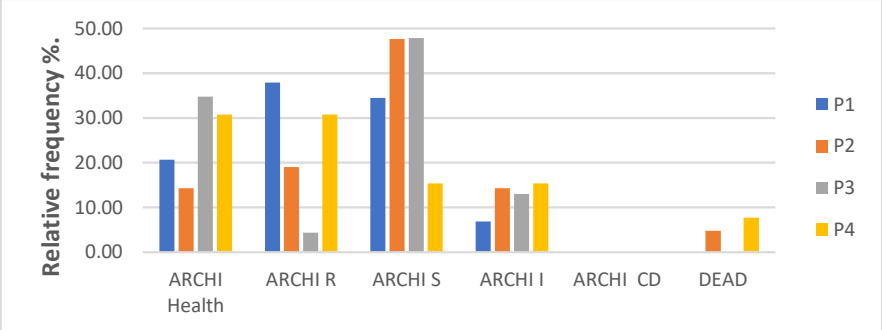

Fig. 1. *Distribution of holm oak trees by different ARCHI types.*

Our results indicate that the majority of holm oak trees in Chettaba forest are ARCHI H and ARCHI R type (50%). The healthy ARCHI type characterized by trees showing no significant symptoms of crown degradation and whose architecture is consistent with its stage of development [11]. Stressed trees show 35%; when a healthy tree undergoes stress, it expresses symptoms at the level of different organs (leaves, roots, bark...), but also at the level of its overall

architecture. One should not confuse the symptoms linked to decline (branching impoverishment, mortality...) and those resulting from the tree's defense mechanisms (covering of wounds, appearance of suckers). The first ones reflect physiological degradations; the second ones reveal repair mechanisms. Depending on the nature of the stress and the initial health status of the tree, the tree may move towards different pathways [12; 13]. The pathways of resilience, i.e. the return to a healthy state after a phase of physiological and morphological recovery. This resilience can lead to the restoration of the crown or to the establishment of a second crown and the gradual disappearance of the crown branches (top-down phenomenon), but the trees are not immune to a second stress. The dead-end paths, either because the tree is blocked in a situation of slowed and irreversible growth, or because the general weakening precipitates the organism towards an ineluctable death [8]. Thus, a resilient, or even healthy, tree may become stressed, if the climatic conditions of the next few years are unfavourable. An irreversible tree will remain alive if, on the other hand, climatic conditions remain very favourable and no biotic problems occur [14].

The ARCHI I type presents by a low value 12% and the absence of the ARCHI CD. The plots are in good health and viable despite their exposure to pressures and threats. The prediction of health is impossible without knowing the evolution of many other factors of the forest environment, mainly climate and the presence of pathogens.

The Archi method offers the forester the possibility of placing his stand, already identified as dying, in the dynamics of dieback: is it an irreversible dieback (leading to death within a variable time interval), under stress, or in the process of resilience [15].

CONCLUSION

The forester is interested in the individual "tree" for the diagnosis. During this decisive operation, the questions he asks are no longer quantitative, but qualitative. The hammerer wants to know if the tree he is observing is in good health or if it has a good probability of remaining alive at least until the next cut or thinning. This is the focus of the Archi method. The diagnostic results show that the holm oak of the Chettaba forest is in a good state of health despite the negligible presence of dead trees, the absence of descending trees and the presence with a low value of irreversible dieback trees. It is not of course the Archi method that will decide the future of the tree, but the forester will have additional information, which he will integrate in his analysis of the economic and silvicultural aspects.

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