CONTRIBUTION TO THE SILVICULTURAL STUDY OF CUPRESSUS SEMPERVIRENS

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ABSTRACT

In order to promote the timber industry of *Cupressus sempervirens* in Algeria and to be able to give a proposal of silvicultural conduct, we undertook research on the species and a silvicultural analysis of some stands of the forest of El Hamimet (East Algeria). The results of the bibliographic research reveal that the wood of *Cupressus sempervirens* is of superior quality, having all the criteria such as aesthetic aspect, hardness, structural stability and durability that a multitude of uses requires. The results of the silvicultural analysis of the studied stands show that the forest of El Hamimet is a very favourable station for *Cupressus sempervirens.*

Keywords: *Cupressus sempervirens, timber, El Hamimet forest*

INTRODUCTION

In Algeria, forests and scrubland cover 4.1 million hectares, i.e. an afforestation rate of 16.4% for the north and only 1.7% if the arid Saharan regions are also taken into account. These afforestation rates are obviously very insufficient to ensure physical and biological balance. The *Aleppo pine* occupies an area of more than one million ha followed by the cork oak and holm oak [1]. Among the secondary endemic species, *cupressaceae*, especially the Thuja (*Tetraclinis articulata*) and junipers (*Juniperus phoenica, Juniperus thurifera, Juniperus oxycedrus*) which constitute the majority of forest and pre-forest formations in dry mountainous areas [2], [3]. These formations are of great importance on the ecological plans, through their role of protection against the processes of desertification and erosion, very dynamic in these regions [4].

In Algeria, the *Cupressus genus* is found in small formations, as isolated trees or used as windbreaks or ornamental trees or alignments. The endemic or naturalized species of this genus are: the Tassili cypress (*Cupressus dupreziana*), the Atlas cypress (*Cupressus atlantica*), the evergreen cypress (*Cupressus sempervirens*) and the Arizona cypress (*Cupressus arizonica*) which is an introduced species and not much used.

All along the Mediterranean Sea rim, green cypress (*Cupressus sempervirens*) is used mainly as a windbreak in areas at risk of high winds [5]. During the colonial period, in the plain of Mitidja and Mohammedia where it was planted vast fields of citrus, this species massively in order to border and delimit these fields serving as shelters and create a microclimate favourable to the culture of citrus. This species

with thick cover, cones consisting of overlapping scales woody or fleshy at maturity could be used in the Mediterranean area at low altitude for several purposes namely, the exploitation of the technology of its wood, the fight against erosion, for various types of reforestation and because of its lower susceptibility to fire. The main objective is to promote the timber and service wood sector of *Cupressus sempervirens* and to propose a silvicultural management.

MATERIAL AND METHODS

Presentation of the study area

The El Hamimet area is located in the wilaya of Oum El Boughi, between 35° 58' 26" N and 7° 11' 11.7" E. It extends over the territories of the communes of Ksar Sbihi, Ain Diss, Ain Babouche, Oum El Boughi, Berriche and Zorg. It covers an area estimated at 78 000 ha. The reforestation area El-Hamimet extends over an area estimated at 1460ha.

Delimitation of plots

It is not possible to cover the entire area of the forest of El Hamimet, it is therefore necessary to proceed to a sampling of existing environments and choose a representative site. We made the choice of eight plots of Aleppo pine in relation to the floristic composition and altitude.

The plots chosen for the study have rectangular shapes; each plot has an equivalent area of 900m2 (30m x 30m), within each plot all individuals are inventoried foot by foot. The geographical coordinates of each plot were taken with a GPS to facilitate their location at the time of data collection (Fig. 1).

Fig.1. *Boundaries of the study plots.*

DATA COLLECTION

Data collection takes place at two levels: Observations that provide qualitative data can be complete (considering all individuals) or partial (focusing on a few individuals); Counting and measuring quantitative data requires well-defined

physical devices. Within each plot, the traditional diameter at 1.30 m from the ground (BHD: breast height) was for all species including BHD ≥ 2cm. The total height was measured using Bloom Lies on individuals of characteristic and valuable forest species by diameter class and plot [6].

RESULTS AND DISCUSSION

Recall that the horizontal structure of a species combines the distribution of stems and the distribution of basal area by diameter class. Since density, basal area and stand development are strongly linked, the study of one cannot be done without the introduction of another [7]. This study will be done by taking into account at least two of these factors. Table 1 summarizes the main stand characteristics of regenerating Cupressus sempervirens in each plot, concerning trees with measurable basal area. With an average diameter between 9 and 11.94 cm, these stands are in the sapling stage. The total density of cypress trees with a diameter at breast height greater than 5 cm varies from 67 to 378 individuals per hectare. The youngest of all is the one in plot 7 with an average DBH of 9.03 cm. This stand contains a large number of young trees.

Table 1. *Quantitative characteristics of the stands*

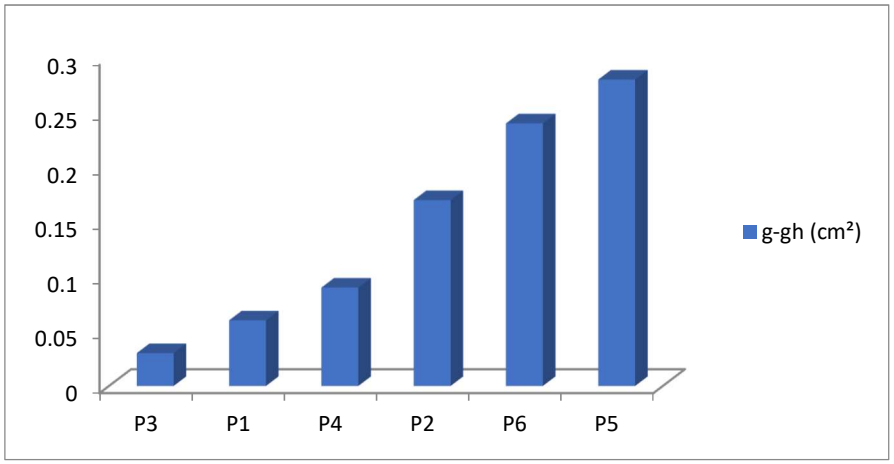
Plot	D	H	H/D	g (m²)	gh	g-gh	N/ha	G
P1	10.51	6.2	61.47	0.0079	0.01	0.06	78	0.616
P2	9.69	4.46	47.17	0.0081	0.01	0.17	233	1.887
P3	11.94	5.81	52.22	0.012	0.01	0.03	22	0.264
P4	11.25	5.95	58.11	0.014	0.01	0.09	67	0.938
P5	11.88	5.55	41.83	0.0014	0.01	0.28	222	3.108
P6	9.03	3.63	42.04	0.0071	0.01	0.24	378	2.684

The results of Figure 2 allow us to deduce that for a naturally regenerating stand without any intervention, up to 10 cm of average stand diameter, it is mainly the development state of the stand that determines its total basal area. However, from the high perch state (average diameter greater than 10 cm), the total basal area depends on both the total density and the distribution of stems across the diameter classes.

The value of (g - gh) of Cupressus sempervirens varies from 3 cm² for plot 3 to 28 cm² for plot 5. Stands with an average diameter between 9.03 cm (plot 6) and 11.94 cm (plot 3) all have a positive (g - gh). This means that in these stands the trees are on average larger than the average tree [8]. These developmental states then correspond to a stage where the trees reinforce their stability by growing in the width direction. The variation of (g - gh) is irregular between 9.03 cm and 11.94 cm. The total density and the average diameter of the stand no longer explain the parameter (g - gh). We can say that the other development factors such as spacing,

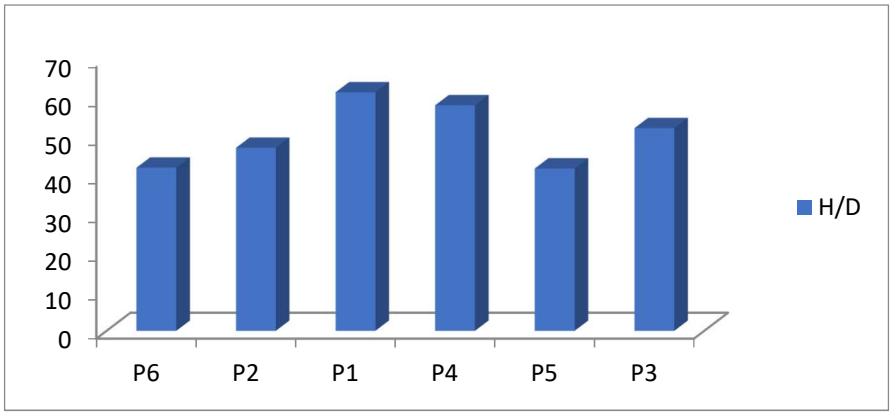
texture and canopy influence a lot the productivity of the stand towards the average diameter of 11 cm.

Fig. 2. *Difference between average basal area and average tree basal area.*



The first three plots (6, 2 and 1), with an average diameter between 9.03 cm and 10.51 cm, have average slenderness coefficients between 42.04 and 61.47%. Between plots 4, 5 and 3, which have respectively 11.25 cm, 11.88 cm and 11.94 cm of average diameter, the variation of H /D is irregular (Fig. 3). This finding allows us to assume that the slenderness coefficient is a function of the average diameter and therefore of the age of the stand [9], [10].

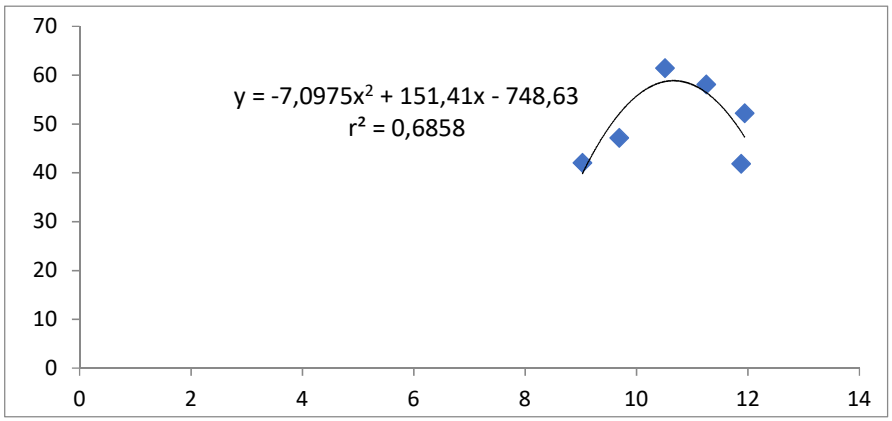
Fig. 3. *Slenderness coefficient per plot.*



According to this figure, the slenderness coefficient is a negative function of the mean diameter. The coefficient of determination $r^2 = 0.6858$ of the trend line means that only 32% of the observed values are not explained by the trend line. This 32% surely corresponds to the almost constant portion of the curve in the interval

from 10.51 cm to 11.25 cm. Thus, there is a relationship between the mean diameter and the mean height of the natural regeneration stand **(Fig. 4).**

Fig. 4. *Slenderness coefficient as a function of average stand diameter.*



CONCLUSION

Through this research, we have been able to highlight the opportunities that *Cupressus sempervirens* can bring in the timber and service wood sector of Algeria. The use of the species in reforestation for the purpose of timber production will not only be a way to valorize the various qualities of its wood, but also a way to diversify the products on the timber market and a way to protect the barren soils of some arid areas. This research has also allowed us to understand some of the behaviors of the species and therefore to recommend silvicultural care and treatments to improve the future production of *Cupressus sempervirens* stands.

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