Algerian Journal of Biosciences

Journal homepage: http://www.ajbjournal.periodikos.com.br

Original Article

Ecodendrometric parameters of some medicinal plants in Aleppo pine forests of northern Sétif (Algeria)

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ARTICLE INFOR

Article history:
Received 02 November 2020
Revised 15 December 2020
Accepted 21 December 2020

Keywords:
Ecological parameters;
Pine forest;
Medicinal plants;
Local development;
Pine

ABSTRACT

The ecodendrological study, on 35 plots were sampled in the Alep pine formation of the Ain Hamda Tizi N'bechar forest at the rate of one plot per station and in each plot a Phytoecological floristic survey was carried out. Concerning the species of the floral procession of the pine forest, there are 19 medicinal species, belonging to 13 families and 20 genera. This medicinal potential must be protected and preserved; it is in this context that this study is based on the knowledge of the factors which influence the distribution and the distribution of these species within the framework of a good rational management in support of the local and sustainable development of the local population through valuation.

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1. Introduction

Algerian forests present very significant potentialities, 2840 Sahara species included, 147 must be considered as endemic according to i.e. more than 235 belong to Mediterranean lineages, with more than 300 endemic North African species; however, the valuation and the good management of this floristic heritage is marked as a prime
The interest of medical sciences and industry is growing for medicinal and aromatic plants, from their production to their use by the public, several sciences and disciplines are concerned, forestry, agronomy, chemistry, pharmaceuticals and ecology [2]. Phytoecology, which is interested in the study of the autecology of species by associating with the synecology between groups of species and their environment, the objective of which is to ensure sustainable development for a possible proposal for a management plan on a stationary scale which will facilitate monitoring We also note the objectives of this which consists in giving a global picture on the existing relationship between eco-dendrometric parameters such as (height, density, circumference, vegetation cover) and ecological (altitude, exposure, slope, geology).
With the aim of proposing a development plan that will serve as a management tool for decision-makers [3].

2. Materials and Methods

2.1. Study area

The state forest of Ain Hamda (Fig. 1), located 40 km north of the capital of the wilaya of Sétif, covers an approximate area of 9,200 ha.
This forest receives an annual rainfall total of 395 mm, where the maximum temperature is recorded in August with 30.8 ° C while the minimum is equal to -1 ° C taken in

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Peer review under responsibility of University of El Oued
DOI : http://doi.org/10.57056/ajb.v1i2.28

January. The pluviothermal quotient of Emberger being 43.63, which makes it possible to classify the forest in the bioclimatic stage as subhumid variant with cool winter. The number of snowing days cover, is estimated at 10 days/year.The study station belongs to the Mesomediterrannean vegetation stage. The highest point is 890m at the top of Djebel Mentanou.

The tree layer is made up of *Pinus halepensis* Mill, *Quercus ilex* in a state of degradation in the form of coppices, this low density makes it possible to eliminate the dominated strata which present some species in a stunted state; *Juniperus oxycedrus*, *Ampelodesma mauritanica*. There is also some shrubs layer dominated by *Rosmarinus officinalis*, *Cistus salvifolius*, *Asparagus aculiatus*, *Phyllirea angustifolia*, *Ajuga iva*, *Fraxinus angustifolia*, *Inula viscosa* and *Origanum glandulosum*.

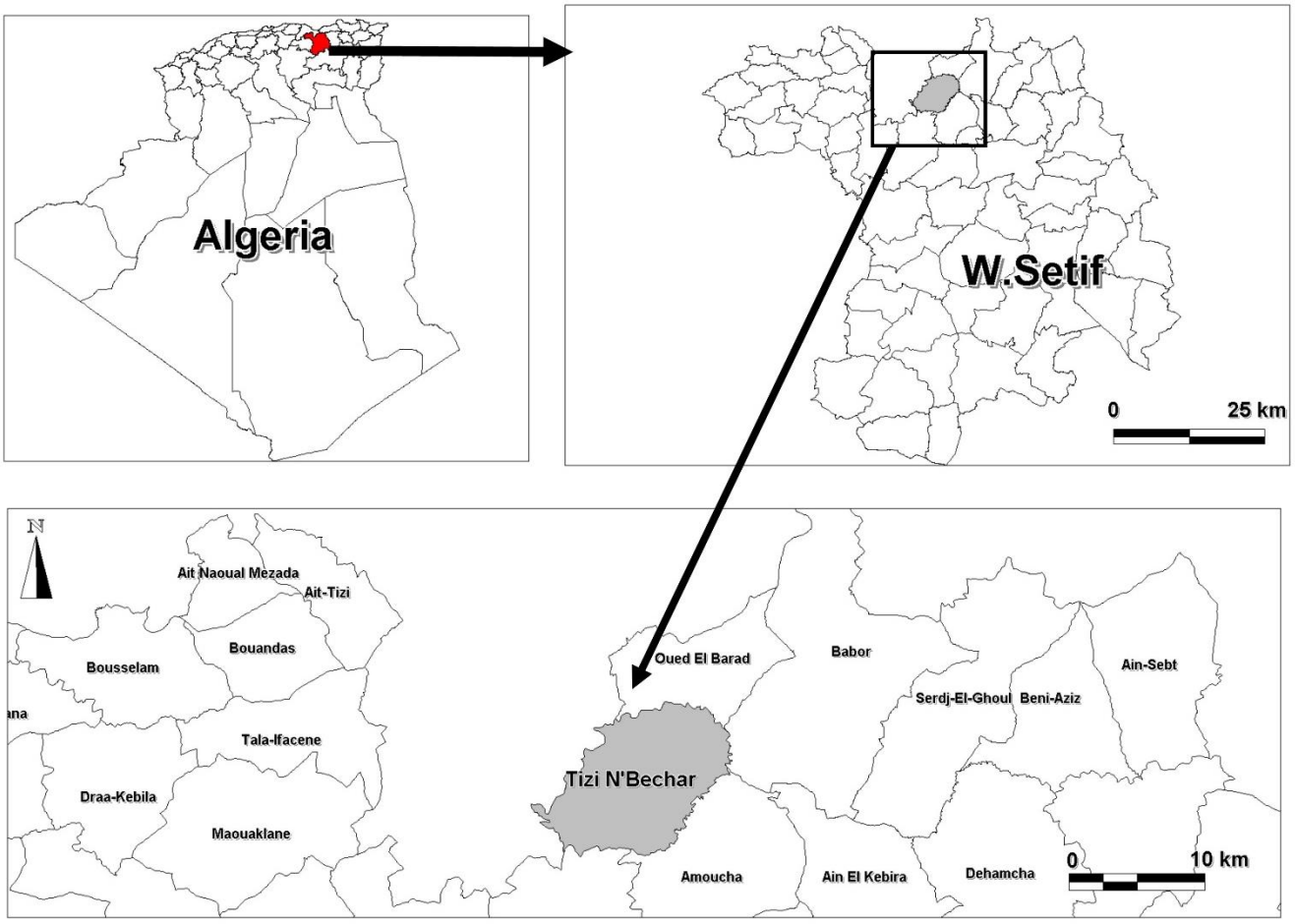

Fig 1. Geographical location of the study area Ain el Hamda, Tizi N'Bechar, Sétif (Algeria).

2.4. Methodology

The dendroecological study, phytosociological surveys were carried out according to the phytosociological method of [4]; developed by [5], the basic concept of this method is based on the vegetation survey.

The species identified in the 38 sampled plots have been identified, they are 24 in number, belonging to 15 families and 21 genera, they reveal medicinal properties

The plots sampled circles of 314 m^2 in of 314 m2 in area, which corresponds to the minimum area of our survey. Each plot meets criteria determined by the stratified sampling technique and each plot is different from the others by at least one factor. The stationary ecological factors considered are the rainfall in 2 classes (400 - 500mm) and (500 - 600mm) defined by the map of [6], the geology in 4 substrates (Marno limestone , limestone, marly and sandstone clays), The slope divided into low (0 - 12.5%) medium (12.5 - 25%) high (> 25%), then the altitude in 2 classes (800 - 1000 m) and (> 1000m), and finally the 7 aspects (the western exposure was not sampled).

3. Results and Discussion

The various analyzes were carried out to explain the existing relationship between *Pinus halepensis* and environemental factors of sampling sites, given that, it is the only forest species present in these plots, in

addition to the influence of these factors on and their relation with the procession of floristics.

The factorial correspondence analysis (CA) facilitates and recognizes the ecological factors that influence plant formation of the Aleppo pine in the forest of Ain el Hamda, by its regression, its growth and the relationship of stationary factors with the species of the floristic procession

Factorial correspondence analysis

The approach adopted for the processing of the data includes a factorial analysis of the correspondences on the entire matrix of surveys and the sampled plots (Table 1).

Table 1. Valeurs propres

Axis	Axis 1	Axis 2	Axis 3
Own values	0.71	0.63	0.54
Inertia rate %	22.86	20.18	19,02
(%)cumulative inertia	22,86	43.04	62,06

The analysis factorial of the correspondences shows that the axis explains 62.06% of the total variance represented by the 3 axes, where the eigenvalues are more important in the axes 1,2, and 3. The axes 1,2 and 3 explain respectively 22.86%, 20.18% and 19.02% of the total variance are the most discriminating, while from axis 4 the variance is low.

Axis 1 of the factorial plane (1x2), opposes the group of plots I: to the group of plots II (Fig. 2).

Group I plots are located in the section with high rainfall which varies between 700-8500 mm, while group II belongs to the 500 - 600 mm rainfall section.

Axis 1 divides the plots into two subsets: set I which is located in the 650-700mm rainfall range) which includes low fertility stations. Ensemble II covers the remainder of the low, medium and high fertility stations located in the 500 - 600 mm range.

A priori this seems paradoxical. Indeed, [7; 8]. In this study on the Aleppo pine in Algeria suggests that the optimum development for the Aleppo pine ranges from 400 to 600 mm of rain. The rainfall of 500-600 mm would therefore seem to be the most favorable for the development of the Aleppo pine in the Ain el Hamda forest

which has a subhumid bioclimate. It can be concluded that the group I plots do not benefit from the amount of rain they receive, these stands are based on limestone and clay substrates, which show poor water retention. Axis 1 then expresses the rainfall. Regarding the 2nd axis, it opposes in its positive part the plots of the 1st group whose contributions vary from 0.26 to 0.78 to the 2nd group of the negative part whose contributions range from -0.20 to 0.63. The plots of the first group belong to the first altitude class 800-1000 m while the second belongs to the second class (> 1000m. (Fig. 2).

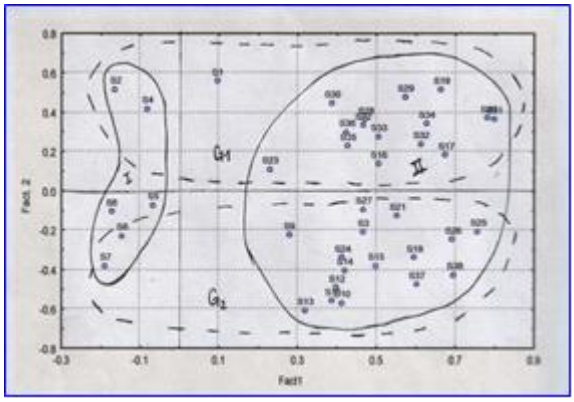

Fig. 2. Factorial map (1,2)

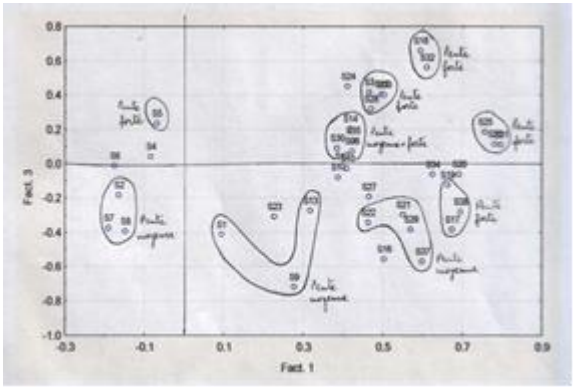

Fig. 3. Factorial map (1,3)

in which we find the most fertile stations as shown in the factorial map (1,2). The increase in the height of the trees in altitude would be explained on the one hand by the fact that the rain in Algeria is of orographic origin and the proximity of the forest to the sea which enjoys the attenuation of high temperatures by influence humid maritime.

Axis 2 would then express the altitudinal gradient. The factorial plane (1,3), the plots are grouped together in small sub-groups, the further one moves away from the origin, which corresponds to areas of medium slope and to those of strong slope (Fig. 3).

The plots of strong contributions for axis 3 are all located on medium or steep slopes, the medium slopes are ideal for the development of Aleppo pine because they have a good water reserve.The problem lies in the steep slopes, the explanation is simple, these uneven grounds are inaccessible to the anthropozoogenic action which allows the trees to develop while the cover of the herbaceous vegetation is very weak resulting from an intense runoff. Axis3 expresses a slope gradient.

Height of dominant trees

The growth of the Aleppo pine in height , this is certainly due to the variation of genetic factors and to competition between individuals of the same species, or of different other species, in particular the herbaceous layer. However, a large amplitude of this variation is the consequence of the influence of surrounding ecological factors. To find out more ,we used simple regression.

1. Importance of the dominant height according to geology

Fig. 4, represents the graph, from the right with an ascending pace from the clay and limestone sandstone substrates towards the marl-limestones and the marls. These are the most suitable for the development of the Aleppo pine, they are tender and allow exploration of the depths through the roots.

By studying the forests of the Mediterranean rim, [9] indicates that the Aleppo pine prefers marly and calcareous marl substrates.

2. Effect of Rainfall on Dominant Height.

The right has a slight inclination from the 500-600 mm rainfall range towards the 400-500 mm range, which is apparently the most beneficial for the Aleppo pine, [10], reports that in North Africa a significant mass of Aleppo pine stands is located in the annual 350-450 mm (Fig. 5).

3. Relationship Between Dominant Height and Altitude

According to the graph in (Fig. 6),the altitude is proportional to the dominant height of the trees, i.e. the more you climb in altitude the more the dominant height increases. The benevolent stands of the forest of Ain el Hamda thrive at altitudes above 1000m. [7] suggests that the optimum development of the Aleppo pine in the Tell varies from 600 to 1200m. [11]

4. Dominant Height and Exposure.

Aleppo pine stands are doing well in terms of silviculture, in the North and North East exposure classes as well as in the South (Fig. 7).

5. Dominant Height and Slope factor.

The dominant height does not seem to be influenced by the slope (Fig. 8). However, one could think of an intervention of other factors, the good growth of the pine on a steep slope is perhaps due to its distance from the anthropozoogenic action of the forest. which , in good condition ,is one which is far from access to humans and animals. .

6. Dominant Height and Vegetation Coverage.

The dominant height decreases as the cover increases, clearly reflecting the negative effect of the competition of herbaceous vegetation on the height growth of Aleppo pine, an effect reported by [12] who showed that the height growth of the Aleppo pine is rapid in clearings against its decrease in full population, in their study of the regeneration of the Aleppo pine in central Tunisia (Fig. 9) which shows the relationship between vegetation and site characteristics. Through the correlation matrices, all the stationary characteristics are related to the floral procession.

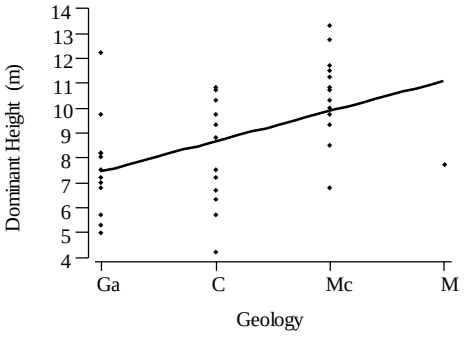

Fig. 4. Relationship between dominant height and geology

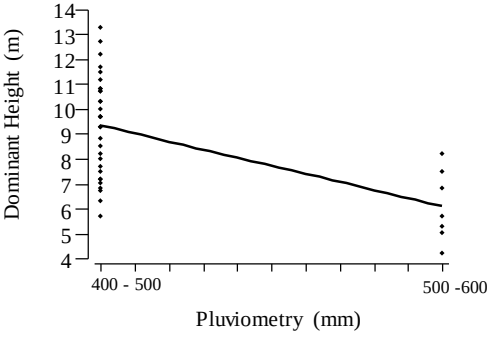

Fig. 5. Relationship between dominant height and rainfall

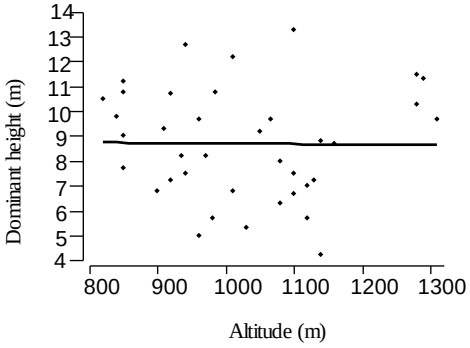

Fig. 6. Relationship between the dominant height of the tallest trees and the altitude

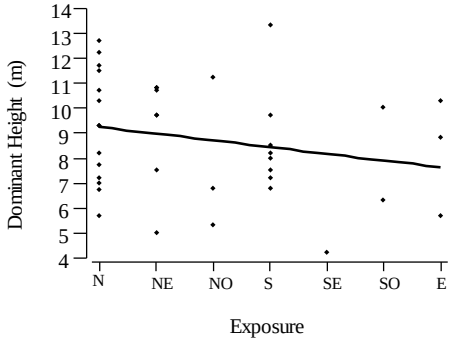

Fig. 7. Relationship between the dominant height of tallest trees and exposure

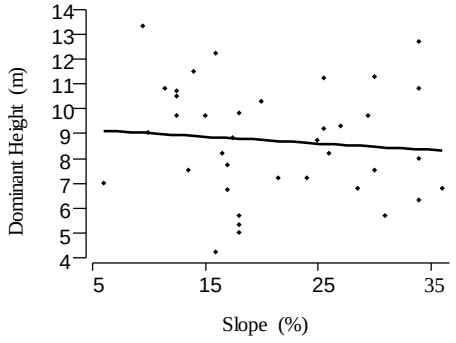

Fig. 8. Relationship between dominant height of tallest trees and slope

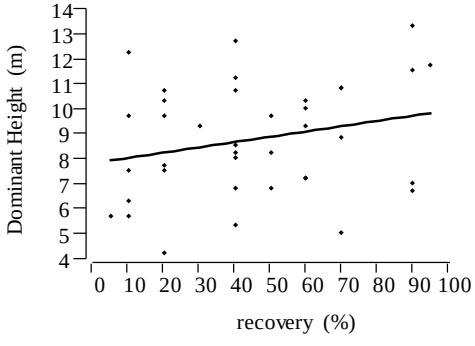

Fig. 9. Relationship between the dominant height of the tallest trees and the cover

The floristic procession of of the most abundant plant genus are *Rosmarinus*, *Cistus*, *Juniperus*, *Globularia*, *Phillyria* and *Ampelodesma*, these species have been reported by [13], [14] and [15], in the region, in Algeria and in the Maghreb.

According to the values of the coefficients of the correlation matrix, *Rosmarinus officinalis* which adapts to drought is related to the northern exposure (r = 0.34).

In his study on the vegetation of western Algeria, [16], mentions that *Juniperus oxycedrus* in cold and cool semi-arid understory is better adapted than holm oak to drought and almost as well as pine d ' Aleppo. In the same way, in this same understory, the humid cold suits it as well as the holm oak and favors it over the Aleppo pine.

The surveys carried out show that the species *Juniperus oxycedrus* seems to prefer the north and north-west exposure less exposed to the sun, as it is inversely linked to the altitude exceeding 1000m, It is also inversely linked to the steep slope (r = -0.32), the explanation lies in the fact that the plots located in this slope class are located in southern exposure and in the rainfall range (400-500mm) so they are sunny stations, in addition to the soils at the level of these stations are rocky, that is why one finds them there instead of the *Juniperus oxycedrus*, the *Juniperus phoenicea*.

The degradation of the pine forest and on rocky soils is the *Ampelodesma mauritanica, Juniperus phoenicea* which takes over from the *Pinus halepensis*. This is indeed what we have noticed in most of our stations. On the ground, *Juniperus phoenicea* is omnipresent in the driest stations and with *Globularia alypum* it grows in low altitude. Their correlation coefficients with the first altitude class (800-1000 m) are respectively (r = 0.33 and r = 0.32). According to [17]

Jasminum fruticans seems to have a preference for the northeast, this species which indicates the cool variant of the semi-arid bioclimate[7], seems to be in search of freshness.

Teucrium polium is absent in stations with a marnocalcaire substrate, in fact it is inversely correlated with it and weakly linked to the southern exposure.

Phillyrea angustifolia prefers sites with high rainfall (500-600mm) (r = 0.41) and shuns steeply on sloping land and marnocalcary substrate. Due to the fact that it belongs to the forest formations of the semi-arid and subhumid bioclimate, according to [18], it is in search of cool stations [19].

In addition, it appears quite clear that, *Cistus albidus* has a preference for low-sloping land (r = 0.31) and adapts to the marnocalcary substrate (r = 0.39), after fire or exploitation, it occupies the land for the installation of pyrophytic formations.

Quercus ilex is negatively related to the northern exposure (r = -0.42) which indicates the regression of this species in favor of thermophilic species namely Ampelodesma mauritanica, which marks its presence not only in stations with northern exposure but also at an altitude exceeding 1000 m, it can be noted that according to [7], the steppization of the pine forests is only the result of a thinning of the pine cover.

Asparagus acutifolius is well correlated with the low slope (r = 0.40), as we note the disappearance of this species next to the phillaria in favor of species linked to degradation formations such as the case of *Teucrium polium* and *Paronychia argentea*. Despite this, the latter is linked to the northeastern exposure and the 500-600mm rainfall range, indeed the stations characterized by these two factors are almost all located either halfway on a flat or on an average slope. , apparently these conditions reinforce the availability of water in these stations.

Cistus monspeliensis is strongly correlated with the northern exposure and denotes its requirement in terms of humidity and freshness, As for *Ammoides verticillata*, it is correlated with the 600-700mm rainfall range.

Allium roseum has a great affinity with the weak slope (r = 0.61) and Thymus ciliatus prefers calcareous soils and eastern exposure.

Finally, for *Sonchus oleraceus*, *Rhamnus alaternus*, *Lotus corniculatus*, *Asparagus officinalis*, *Pistacia lentiscus*, *Calycotome spinosa* and *Ampelodesma mauritanica*, no relationship with the site parameters was recorded perhaps due to their wide distribution in the study area.

4. Conclusion

This study made it possible to arrive at the results thus obtained, to bring out the ecological factors which have an influence on the installation of the Aleppo pine and its floral procession, according to the water supply that it comes from the atmosphere, either through rainfall or through air humidity (Chàabet Lakhra dam (Kherrata, Bejaia) and the maritime influence obtained at altitude (influence whether it is available in the ground. Add to this, the exposure which influences the local microclimatic conditions, the substrate, the hardness of which hampers the root exploration of the depths, the slope which conditions the soil's water retention capacitiesn, together with, the competing vegetation and the action of man and animals. We can often isolate a determining ecological factor responsible for the differentiation of plant populations, but most of the time these are effects of several simultaneous causes [20], the behavior of the species is only the combination of several ecological factors of which we have just elucidated only a part. Finally, our floristic wealth deserves more interest from scientists and managers with the aim of preserving the biological and phytogenetic potential, but also the promotion of rural areas.,This will only be done through a partnership between the university and the industrial sector in order to make university studies profitable and put them on the test.

Acknowledgements

The University of Mohamed Boudiaf, M'sila, Algeria and the Laboratory of Biodiversity and biotechnological techniques for the valuation of plant resources, Department of Natural and Life Sciences, Faculty of Sciences.

Conflict of Interest

The authors declare that they have no conflict of interest

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Recommended Citation
BOUNAR R., GHADBANE M., CHERMAT S., REBBAS K. Ecodendrometric parameters of some medicinal plants in Aleppo pine forests of northern Sétif (Algeria). *Algerian Journal of Biosciences*. 2020, 01;02:061-067.