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Original Article

The Favorable Climatic Regime in Triggering the Decline of Oak Stands

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Abstract

The decline of stands can be assimilated to structural or functional disorders, where several categories of disruptive or harmful factors compete and interact in different directions and meanings, but whose outcome is weakening the trees vigor, culminating with their death. Agents may be abiotic or biotic. The latter include bacteria, fungi and insects that are not able to invade in normal circumstances, and cause significant harm to healthy trees, but can be very destructive when attack devitalized trees. The present paper aims to highlight the role of echometer indices on growth regime in declining stands. A significant positive correlation was identified between the amount of precipitation surpluses and Lang Rain Index in the run-up phase in starting in vegetation growth, with positive influence on oak stands from subzone. A negative correlation is reported between the growth regime and the average temperature of bioactive season. From physiologically point of view, the explanation is the reducing (or termination) of the cambial division process under conditions of temperatures above 35°C. For the oak-wood area from the middle hydrographical basin of Someş instead, it appears that none of the analyzed climatic factors has a direct influence on the growth regime.

Keywords: climate regime, decline, oaks, echometer indices.

1. Introduction

The climate changes in the environment, and therefore the impact that they have on the state of vegetation and forest health, constitute a current issue of high complexity.

They frame in a global context, however, with particularizations of geographic region in which our country is located [1, 5, 6, 7, 8, 9, 10, 11, 12, 13]. Forests are, by definition, a product of the geographical environment and depend critically of climate factor.

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The geographical spread of the species and forest formations is determined, with some exceptions of this complex factor, mainly of thermic and water components of its.

Thus, this spread has as the climatic factors, an obvious regional character, and in this area there are usually considerable regional differences in temperature and precipitations [2, 3, 5, 8, 10, 14, 17, 18]. Local changes of climatic conditions, frequently accompanied by the assembly made up of substrate and vegetation, can cause the appearance of some serious health problems, over time, for various forest formations, or limit their spread as against the previous or current limits within some opoclimates, with changes in thermal, soil, moisture and air circulation regimes, etc. [1, 16]. Long term observations conducted worldwide, have concluded that in the manifestation of the Quercinae stands drying phenomena can be identified three phases [6, 7, 8, 9]:

1. - the first phase of stand weakening is either due to unfavorable weather conditions (droughts, water stagnation, late frosts) or *Microsphaera abbreviata* pathogen attack followed by repeated defoliation;

2. - the second phase, of the actual drying, has various manifestation intensities; during this phase, the installation of pathogens is facilitated;

3. - the third phase, of the dead trees, may be on short-term or fast.

The slow and partial drying from top to the base through coronary entails a gradual reduction in the rate of drying and possibility of stand fructification.

But, in the same time, due to the soil stripping and sodding, neither the acorn arrived on the soil surface does not meet favorable conditions for germination. In time, because of small quantities of leaves the soil suffers profound changes [4, 8, 15, 16, 17].

The fast drying (during a single vegetation season) appears in conditions of soil bogging, and it is accompanied by defoliation and strong attacks of *Ophiostoma* species [9].

2. Material and Method

The trial was developed in Forestry District Cluj, Forestry District Gherla (U.P.I Ţaga), Forestry District Livada (U.P. I Livada), and Forestry District Satu Mare (Nisipeni stand), during the year 2015. The trees specific for the studied area represent the biological material.

The frequency and intensity of the phenomenon of drying is determined by the percentage of trees from classes I-III Kraft from the dry sample markets or having more than 25% of the crown dry.

The highlighting the role of climatic factors was done by establishing correlations between climatic echometer indices and the temperature and precipitations increasing regimes.

3. Results and Discussions

The short-term drying phenomena were found in durmast stands located traces from hilly area, namely Forestry District Cluj, Forestry District Gherla, U.P.I Ţaga, while sudden drying stands were identified and monitored in the forest plain area of oak forests from Forestry District Livada (U.P.I Livada) and Forestry District Satu Mare (Nisipeni stand).

The frequency and intensity of the drying phenomenon is determined by the percentage of dried trees from classes I-III Kraft, from the dry sample markets, or those having more than 25% of the crown dry.

Therefore, the annual rate of drying in Nisipeni body forest (Forestry District Satu Mare), during the research, was 12% and in the experimental area installed in U.A. 80A, (Forestry District Gherla) was 3%.

From the data it can be observed that in the Great Forest, between the processes of bioaccumulation of wood mass and climatic factors, there is a distinct significant negative relation with average temperature of the biologically active period.

This is explicable in terms of physiological (at high temperature the rate of increases diminishes or ceases).

Significant positive correlations are recorded between the rate of increases and the rainfall sum during bioactive phase, deficits uncompensated by the rainfall, Lang rain index of the bioactive period and the vernal index (Table 1).

This shows that increases regimen within an oak stand in the Western Plain, in good health and vegetation conditions, is influenced by certain features of the thermal (temperatures in the growing season) and rainfall distribution, not by their quantity.

In the Nisipeni Forest, the presence of oak grove manifesting drying phenomena and a poor vegetation and health statuses is reported. We notice that a negative influence on annual increases is brought by the excesses of precipitation (water stagnant in the spring) - correlation being distinctly significant, but also by the precipitation deficits (especially those between August and September).

It can be stated that they are the primary factors of drying phenomenon in this stands alongside repeated attacks of defoliators (Table 2).

The data from Table 3 show that for the oak stands from the area of medium hills, the limiting factors in the process of bioaccumulation of wood mass is represented by the annual amount of precipitation, especially the rainfall quantity during the summer months (calculated 3.81 t> t 0.01 3.14) and the way of its distribution.

Table 1. The correlations between increases of the climatic regime - Great Forest, Forestry Department Satu Mare

Climatic index	t_{mean}	PP med	t_{mean} >10°C	Period with t_{mean}>10°C	t_{mean} V-VIII	Σt°≥ 10°C	Σ t_{mean} ≤0°C
Correlation coefficient of radial growth index/climatic factor	-0.293	0.408	-0.880	0.489	-0.480	-0.181	0.010
t	1.046	0.786	4.532^{oo}	1.376	1.341	0.451	0.025
Climatic index	Σ Pp t>10°C	Σ Pp XI-III	Σ Pp VII-VIII	ΣΔP+	ΣΔP-	I c h anual	I Gams
Correlation coefficient of radial growth index/climatic factor	0.711	0.254	0.220	0.264	-0.654	0.522	0.402
t	2.477*	0.643	0.553	0.671	2.117*	1.587	1.075
Climatic index	I p Lang t>10°C	I p Lang vern	I p estival	ETP	I. DE Martonne		
Correlation coefficient of radial growth index/climatic factor	0.672	0.709	0.505	-0.277	0.431	$t_{0.05}$= 1.94 $t_{0.01}$= 3.14 $t_{0.001}$= 5.21	
t	2.222*	2.464*	1.433	0.706	1.170		

Table 2. The correlations between the increases of climatic regime - Nisipeni Forest, Forestry Department Satu Mare

Climatic index	t_{mean}	PP med	t_{mean} 10°C	Period with t_{mean} >10°C	t_{mean} V-VIII	Σt° ≥10°C	Σ t_{mean} ≤0°C
Correlation coefficient of radial growth index/climatic factor	-0.541	-0.288	0.244	-0.320	0.282	-0.369	0.133
t	1.573	0.737	0.616	0.827	0.720	0.973	0.329
Climatic index	Σ Pp t>10°C	Σ Pp XI-III	Σ Pp VII-VIII	ΣΔP+	ΣΔP-	I c h annual	I Gams
Correlation coefficient of radial growth index/climatic factor	-0.295	-0.271	0.263	-0.872	-0.613	-0.133	-0.403
t	0.756	0.690	0.668	4.364^{oo}	2.041^{o}	0.329	1.079
Climatic index	I p Lang t>10°C	I p Lang vern	I p estival	ETP	DE Martonne		
Correlation coefficient of radial growth index/climatic factor	-0.205	-0.566	0.004	-0.385	-0.015	$t_{0.05}$= 1.94 $t_{0.01}$= 3.14 $t_{0.001}$= 5.21	
t	0.513	1.682	0.012	1.022	0.037		

Table 3. The correlations between the increases of climatic regime - Forestry Nicula u.a. 80A, Forest Department Gherla

Climatic index	t_{mean}	PP_{mean}	t_{mean} >10°C	Period with t_{mean} >10°C	t_{mean} V-VIII	Σt° ≥10°C	Σ t_{mean} ≤0°C
Correlation coefficient of radial growth index/climatic factor	-0.009	-0.740	-0.341	0.440	-0.465	-0.011	-0,005
t	0.022	2.697º	0.889	1.200	1.287	0.027	0,012
Climatic index	Σ Pp t>10°C	Σ Pp XI-III	Σ Pp VII-VIII	ΣΔP+	ΣΔP-	I c h anual	I Gams
Correlation coefficient of radial growth index/climatic factor	0.711	0.243	-0.841	-0.382	0.553	-0.635	-0,800
t	2.477*	0.614	3.809ºº	1.013	1.627	2.014º	3,267ºº
Climatic index	I p Lang t>10°C	I p Lang vern	I p Lang estival	ETP	DE Martonne		
Correlation coefficient of radial growth index/climatic factor	-0.255	0.218	-0.687	-0.231	-0.722	$t_{0.05}$= 1.94 $t_{0.01}$= 3.14 $t_{0.001}$= 5.21	
t	0.646	0.547	2.318º	0.582	2.555º		

From the data presented in the Table 4 is observed that the growth regime is directly influenced by the length of bioactive period and the precipitation during this period.

Unlike the previous case, the intensity of the correlation between the growth regime and rainfall in July and August is lower and the Water Compensation Index and Gams Index do not influence the growth regime in this case.

The results confirm the hypothesis that the phenomenon of decline of many stands from the oak subzone, in particular stands close to urban areas as the analyzed stand is less influenced by the climate regime. The causes of trees injury, thinning of crowns, growth reduction in height and diameter is mainly due to management practices, grazing or pollution in this case.

There are some drawbacks in the case of using only the correlation analysis. The variables analyzed present some overlap, which can hinder the full understanding of the phenomenon of decline in some stands, or correlations obtained represent only some particular situations, valid only for the applied situation.

To highlight only those factors that influence the stands in a certain area considered as a whole, it has been analyzed the significance of difference between the correlation coefficients.

After applying this process it can be seen that there are three factors that directly influence the growth of stands from oak subarea, namely a significant positive correlation was identified between the sum of excess rainfall and Lang Rain index in the period previous with vegetation starting (both expressing basically the same), while a negative correlation is found between the growth regime and the average temperature of the bioactive season. The physiological explanation is offered by the reduction of cambial division process in conditions of temperatures above 35 °C (Table 5).

For the oak-wood from the middle hydrographical basin of Someş, it appears that none of the analyzed climatic factors has a direct influence on the growth regime.

Table 4. The correlations between the increases of climatic regime - Bungăr Forest, Forestry Department Dej

Climatic index	t_{mean}	PP_{mean}	t_{mean} >10°C	Period with t_{mean} >10°C	t_{mean} V-VIII	Σt° ≥10°C	Σ t_{mean} ≤0°C
Correlation coefficient of radial growth index/climatic factor	0.188	-0.138	-0.142	0.664	0.017	0.186	0.282
t	0.469	0.341	0.351	2.177*	0.042	0.464	0.736
Climatic index	Σ Pp t>10°C	Σ Pp XI-III	Σ Pp VII -VIII	ΣΔP+	ΣΔP-	I c h anual	I Gams
Correlation coefficient of radial growth index/climatic factor	0.711	0.590	-0.694	-0.098	0.114	0.052	-0.220
t	2.477*	1.791	2.361°	0.241	0.281	0.123	0.553
Climatic index	I p Lang t>10°C	I p Lang vern	I p estival	ETP	DE Martonne		
Correlation coefficient of radial growth index/climatic factor	-0.179	0.528	-0.145	0.034	-0.182	$t_{0.05}$= 1.94 $t_{0.01}$= 3.14 $t_{0.001}$= 5.21	
t	0.448	1.523	0.366	0.078	0.453		

Table 5. The analysis of correlation coefficients significance difference between increases in range and climatic conditions studied using t test stands

Climatic Index	t	
	Padurea Mare vs Nisipeni	Nicula vs Bungăr
t_{mean}	0.479	-0.315
PP_{mean}	1.154	-1.286
$\bar{t}$>10°C	-2.568°	-0.335
Period with t_{mean} >10°C	1.371	-0.520
t_{mean} V-VIII	-1.286	-0.825
Σt°≥10°C	0.323	-0.316
Σ t_{mean} ≤0°C	-0.196	-0.467
Σ Pp t>10°C	1.888	0.948
Σ Pp XI-III	0.851	-0.681
Σ Pp VII- VIII	-0.073	-0.584
ΣΔP+	2.550 *	-0.482
ΣΔP-	-1.212	0.805
I c h anual	1.129	-1.269
I Gams	1.350	-1.385
I p Lang t>10°C	1.617	-0.126
I p Lang vernal	2.417*	-0.579
I p Lang estival	0.873	-1.104
ETP	0.193	-0.426
DE Martonne	0.753	-1.151
s_d= 0.632 ; GL = N1+N2-6 = 10 $t_{0.05}$= 2.228 ; $t_{0.01}$= 3.169 $t_{0.001}$= 4.578		

4. Conclusions

Studies, analyzes and experiments conducted during 2015, show that the analyzed stands present a good vertical closure, oak and ash represent the dominant floor, and hornbeam represent, in all analyzed cases, the lower limit.

A special case is noted in the experimental area of U.A. 34, Forestry District Livada, where hornbeam competes with oak, most of the trees of this species being situated in class II Kraft.

In terms of symptoms, which indicate or are generators of a stress state or of decline, it is noticed the defoliation produced by insects on oak species, which varies between 7 and 27% for oak-wood in plain forest area and between 6 and 48% for hornbeam. The most common symptom, found in all analyzed stands, is the drying phenomenon at the crown level, in leaves or spindle.

This intensities of the recorded phenomenon vary between 6 and 18% in oak species, 5-26% on hornbeam, and in U.A. 69 from the Forestry District Livada, where, in ash, it had a value of 38% of the analyzed samples.

Another general phenomenon is drying of thin branches with a diameter less than 5 cm, with the ratio of below 20% of the crown, a phenomenon which it is considered to be a warning signal for decline trigger. This symptom is met with greater frequency in all analyzed species.

Values between 15 and 62% in oak, 3-37% to hornbeam and 35% of ash were reported in analyzed trees. The abundant presence of the moss on the trees trunk, generally up to heights of 2-3 meter is found in stands of the Forestry District Livada, being more frequently on oak than accompanying species (about 40% of the total number of trees). Frost-crack is a symptom frequently encountered on turkey oak trees analyzed in experimental areas. This defect of injury itself is not a symptom of slender stands, but it can be a favorable factor because it is easy to install ligninolytic fungus.

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