THE CHARACTERISTICS OF SOME PINE STANDS FROM OUTSIDE THE HABITAT, AFFECTED BY DRYING

CARACTERISTICILE UNOR ARBORETE DE PIN DIN AFARA AREALULUI, AFECTATE DE USCARE

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Abstract. *In recent years, an alarming evolution of the drying phenomenon of pine stands from outside the habitat has been reported. Previous researches have shown that the most vulnerable are the pure, dense stands, not covered in time with care works, aged 30–40 years. The paper presents synthetic data on the structural and qualitative parameters of the affected stands as well as biometric and qualitative characteristics of the pine trees. The research was carried out in 2020, in pine stands affected by drying in order to substantiate ecological reconstruction solutions. The analyzed pine stands have an inadequate structure in relation with the number of trees, the remaining trees being affected by drying in the proportion of 58-71% of the total number. Drying also causes the depreciation of the wood in the internal structure. Analyzes carried out on trees from the species Pinus sylvestris, Pinus ponderosa and Pinus strobus revealed the proportion of depreciated wood through variations in micro-forage resistance (R). The decrease in micro-forage resistance, indicates the increase in the proportion of degraded wood. At Pinus strobus, relatively high proportions of depreciated wood were recorded (between 6-41%). The analyzed trees were included in the category of those strongly damaged (density index (I_d <0.68) and degree of defoliation (DD=26-60%), and their ecological reconstruction is necessary. The results obtained are particularly important considering the restoration need and sustainable management of those large areas with pine stands from outside the habitat, affected by drying, existing at the national level.*
Key words: ecological reconstruction, micro-forage resistance, pine, drying

Rezumat. *În ultimii ani, s-a semnalat o evoluţie alarmantă a fenomenului de uscare a arboretelor de pin în afara arealului natural. Cercetările anterioare au evidenţiat că cele mai vulnerabile sunt arboretele pure, dese, neparcurse la timp cu lucrări de îngrijire, cu vârsta de 30–40 de ani. În lucrare sunt prezentate sintetic date privind parametrii structurali si calitativi ai arboretelor afectate precum si caracteristici biometrice si calitative ale arborilor de pin. Rezultatele au fost efectuate în anul 2020, în arborete de pin afectate de uscare in vederea fundamentării soluțiilor de reconstrucție ecologică. Arboretele de pin analizate au structură necorespunzătoare în raport cu numărul de arbori, iar arborii rămaşi sunt afectaţi de uscare în proporție de 58-71% din numărul total. Uscarea cauzează și deprecierea calității lemnului în structură internă. Analizele efectuate pe arbori din speciile Pinus sylvestris, Pinus ponderosa și Pinus strobus au evidențiat proporția lemnului depreciat prin intermediul variațiilor rezistenței la micro-foraj (R). Scăderea rezistenței la micro-foraj indică creșterea proporției lemnului depreciat. La Pinus strobus s-au*

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înregistrat proporții relativ ridicate ale lemnului depreciat (între 6-41%). Arboretele analizate au fost încadrate în categoria celor puternic vătămate (indice de desime (I_d <0,68) și grad de defoliere (DD=26-60%), fiind necesară reconstrucţia ecologică a acestora. Rezultatele obtinute sunt deosebit de importante având în vedere necesitatea refacerii și gestionării durabile a unor suprafețe însemnate cu arborete de pin din afara arealului, afectate de uscare, existente la nivel national.

Cuvinte cheie: reconstrucție ecologică, rezistența la micro-foraj, pin, uscare

INTRODUCTION

One of the vector of the aridization of the southern and plain areas is the increase of the average annual temperatures by more than 1-2ºC (Constandache *et al.*, 2022). The conjugated action of some harmful factors causes an increase of degradation of the environment (Constandache *et al.,* 2017). In 2015, the area of pine stands affected by drying was of 3427 hectares (MMAP, 2015), which represents approx. 5% of the area of pine stands installed outside the habitat in Romania. In 2019, the affected area was only 595 hectares (1%) (MMAP, 2020). According to IPCC reports, temperatures are expected to increase between 2030 and 2052 by 1.5˚C (IPCC, 2018). To mitigate the drought stress of Pine stands, means to use mixture of trees species (Steckel, 2020). In this context, the aim of the present study is to analyze the structural and qualitative characteristics of pure pine stands affected by drying, which no longer correspond from an organizational and functional point of view.

MATERIAL AND METHOD

The researched pine stands are located in the silvo-steppe zone of Bărăgan Plain, in Călărași County, Perișoru commune (fig.1). These are part of the national forest fund administered by INCDS "Marin Drăcea", the Bărăgan Experimental Base, the production unit III Bărăgan, the landscaping units 4I, 4J, 4K, 4L. (44˚25'40,73'' N; 27˚35'29,14'' E).

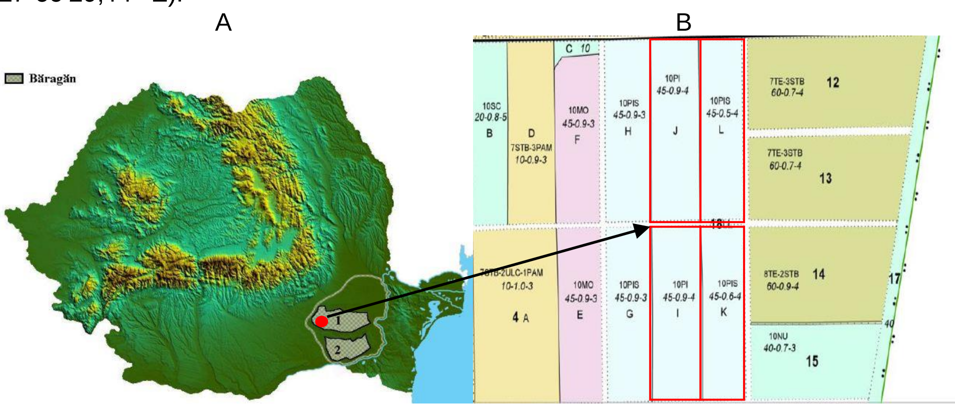

Fig. 1. The localization of the research (source: www.wikipedia.org)
A.Bărăgan Plain; B. Extract from the landscaping map

The installation of the stands was carried out during the 70's, aiming at the promotion of resinous stands and testing their resistance to extreme edapho-climatic conditions. Based on the data entered in the forestry management plan, it was possible to obtain important information regarding the composition of the stands but also the existing environmental conditions. The stands analyzed were created for experimental purposes, with different species of pine (*Pinus sylvestris, Pinus ponderosa and Pinus strobus*) in pure cultures. Circular research areas were placed, thus constituting a selective network. In the research areas, observations and measurements were made on the elements that define the structure of the stands, the state of health and the quality of the wood. The degrees of defoliation (DEF%) and the state of vitality of each tree in the analyzed populations were determined. For the analysis of the structure, the general statistical indices of the experimental distributions (mean, median, standard deviation, coefficient of variation, asymmetry, excess) were determined. The determination of the resistance of the wood to micro-drilling was done by dividing the annual rings into concentric circles of ½ mm, at a spatial resolution of 0.1 mm. The obtained data were processed in Excel, Statistica 8.0 and F-Tools Pro programs.

RESULTS AND DISCUSSIONS

1. Biometric and structural particularities of the pine stands affected by drying

From the field data processing, the following biometric and structural characteristics of the stands resulted (tab. 1).

Table 1

Biometric and structural characteristics of pine stands affected by drying

Species	Age (years)	DBH (cm)	HR (m)	NR/ha	NN /ha	Ig	Id	G_{real} /ha	G_{norm}/ ha	V (m^3) /ha
Pi	47	22.55	14.91	620	1022	0.68	0.61	24.74	36.14	164.4
Pi.p	47	25.49	15.34	525	563	0.86	0.93	26.76	31.12	189.3
Pi.s	42	24.24	15.17	600	741	1.53	0.81	43.95	28.68	319.0

Legend: Pi- *Pinus silvestris*; Pi.p- *Pinus ponderosa;* Pi.s- Pinus strobus; DBH – average diameter; HR – average height; NR – real number of trees/hectares; NN – normal number of trees/hectares; Ig; Id – density/thickness index; $G_{real/ha}$ – real basal surface/hectare; $G_{norm/ha}$- normal basal surface/hectare; V– volume

In general, the affected pine stands show reduced consistency (0.4-0.6). In the case of the Scots pine stand (fig. 2.A), a reduced frequency of the number of trees around the lower diameters (3.23-9.68) is observed. From the point of view of thickness and density, a distribution of the number of trees resulted close to the theoretical number from tables (Giurgiu *et al.,* 2004). In the situation of the yellow pine stand, the distribution of the experimental data (fig. 2.B), indicates a ranking of the trees around the lower-middle diameters, the asymmetry being negative, to the right (asymmetry index=0.32).

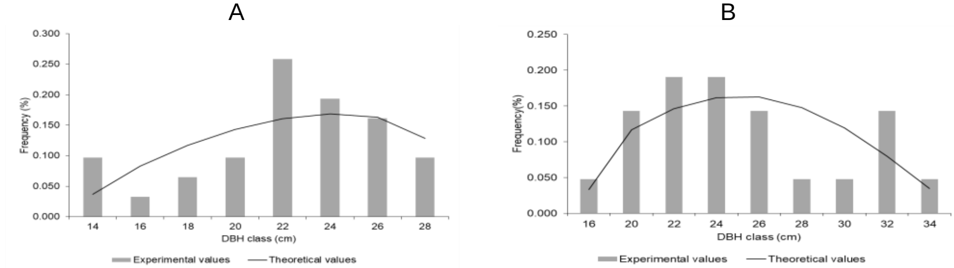

Fig. 2. Fitting the experimental distributions by the *Beta* function of the number of trees per hectare: A.*Pinus sylvestris*; B.*Pinus ponderosa*

Table 2

General statistics parameters for diameter (cm) and height (m)

Species	*Pinus sylvestris*		*Pinus ponderosa*		*Pinus strobus*	
Analyzed parameter	DBH	HR	DBH	HR	DBH	HR
Mean	22.70	14.70	25.70	14.88	24.53	15.16
Median	23.00	14.65	24.50	14.55	23.00	15.00
Standard deviation	3.715	1.473	4.459	1.807	4.886	1.70
Cv (%)	16.37	10.02	17.35	12.14	19.92	11.23
Kurtosis	0.193	-0.291	-0.573	0.565	0.294	-0.565
Skewness	-0.641	0.043	0.708	-0.208	0.922	0.422

Thickness and density indexes show high values (table 1), the competition between trees being high. In general, the variability of pine populations (table 2), in terms of diameter, is moderate (Cv%=16.37-19.92), relatively homogeneous. In terms of height, the variability is low, statistically homogeneous. Therefore, the horizontal structure is much more affected than the vertical one, which presents a continuous profile.

2. Qualitative features of pine stands affected by drying

As a result of the negative effects caused by harmful abiotic factors, most of the number of trees (58% Scots pine, 71% yellow pine, 71% weymouth pine) are moderately damaged (DEF%= 26-60%) (figures 3.A, B).

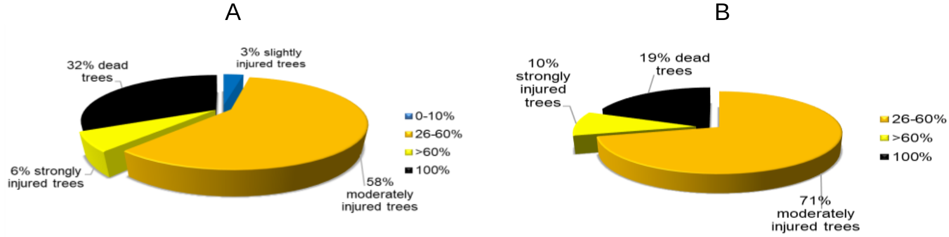

Fig. 3. The proportion of trees affected by drying per degree of defoliation: A. *Pinus sylvestris*; B.*Pinus ponderosa*

The wood quality of the trees was estimated by the variability of wood resistance to micro-drilling (R%). By means of the variation diagrams of the resistance of the wood to micro-drilling (R%), it was possible to identify the cavities with quality-depreciated wood in the cross-section of the trees on the foot (fig. 4).

The results are presented in table 3 (excerpt).

Table 3.

Variations in micro-drilling resistance for *Pinus strobus* species

Species	Plot	DBH [cm]	Min Drilling depth [mm]	Max Drilling depth [mm]	R_M [%]	Cavity [cm]	Cavity[%]
PIS	S3	36	6.0	184.1	10.7651	1.02	6
PIS	S3	20	7.3	105.3	8.5514	2.11	22
PIS	S3	28	12.5	142.6	14.0818	1.82	14
PIS	S3	22	6.1	112.9	10.3785	4.33	41
PIS	S3	36	6.1	184.1	10.7703	1.02	6

Note: R_M [%]-average resistance; Cavity- the portion of affected wood.

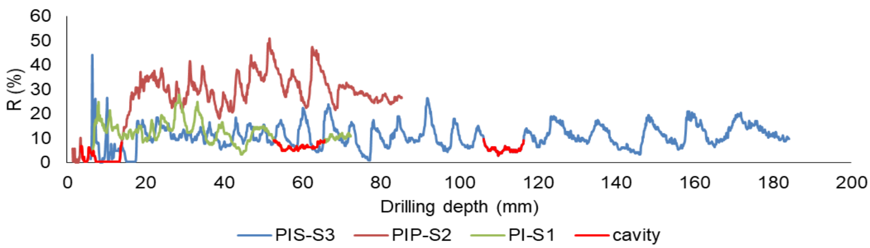

Fig. 4. Variations in wood resistance and the delimitation of portions of depreciated wood

It can be seen that in the case of weymouth pine trees, the depreciation of the wood is much more pronounced compared to the other species. The affected portions of wood from the internal structure and the resistance of the wood can be important vectors predicting drying, even from the initial phase (fig.4). For this species, the average resistance is located in the range of 8.5514-14.0818%, mainly influenced by the variability of some usual qualitative indicators (density, humidity, modulus of elasticity). The Bărăgan Plain is characterized by contrasts regarding the spatial variation of the temperature, as well as by the atypical non-periodic variations of the annual average values (Vrînceanu, 2011). This aspect is also confirmed by Angearu, 2020, Bărăgan Plain is the most vulnerable region to agricultural drought, under the influence of climatic conditions. The area of pine trees affected by drying is constantly increasing, therefore there is a need for a continuous monitoring of their state of health through specific methods and the study of the multifactorial action that generates this phenomenon.

CONCLUSIONS

1. The horizontal structure of the pine stands is destabilized, the reason being the reduction in the number of trees and the consistency. The increase in the values of the density and thickness indexes favored the decrease in the growth in diameter but also the degradation of the stands.

2. Most of the pine trees were classified in defoliation class 2, the degree of defoliation (DEF%=26-60%).

3. The variability of the populations is weak to moderate, homogeneous from a statistical point of view, especially in the vertical structure, where the stands present a continuous profile, structured.

4. The depreciation of wood quality is much more pronounced in the case of weymouth pine, the resistance of the wood being diminished due to the influence of some usual quality indicators.

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