

RESEARCH CONCERNING THE DEVELOPMENT OF RED HEARTWOOD AND ITS INFLUENCE ON BEECH WOOD SORTING

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Abstract: *Red heartwood represents the main anomaly with respect to colour and structure of beech wood, generally coloured in red to brown-reddish, situated at the centre of the transversal section of wood, delimited by darker coloured lines with an irregular contour which does not follow the trajectory of annual rings and, with certain properties different from those of wood. Irrespective of the causes which determine the appearance of red heartwood, its presence at beech logs considerably reduces the value of round wood. The downgrading occurring as a result of the presence of red heartwood can lead to a 40 to 50% decrease in the revenue coming from the valuing of beech round wood irrespective of the sorting system applied.*

Key words: *red heartwood, logs, European beech.*

1. Introduction

Red heartwood represents the main anomaly with respect to colour and structure of beech wood. It is an area generally coloured in red to brown-reddish situated at the centre of the transversal section of wood, delimited by darker coloured lines with an irregular contour which does not follow the trajectory of annual rings and which has properties different from wood (Figure 1).

Regarding the formation proper of red heartwood Vintilă (1946) concludes that its appearance is closely related with the balance existing between the water and air content from green wood, considering that

red heartwood only occurs in the central drier areas in which wood has more than 20% air. The causes of the appearance of red heartwood have been attributed by Ghelmeziu (1958) cited by Milescu et al. (1967) to a pathological process, to a reaction of the tree against xylophagous fungi or to a normal process of duraminisation, in which case the appearance of thylls and gummosis which fill the vessels would occur as a result of air penetrating the cells. Wernsdörfer et al. (2006) claims that red heartwood appears when oxygen penetrates the trunk of old trees by means of dead branches, forking or wounds. Drăghiciu (2005) maintains that the is based most certainly on an

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oxygenation process of woody cells which appears and develops as a normal physiological phenomenon that starts after a certain age (around 100 years), being determined by the duraminisation of parenchymatic cells and by the oxidation of substances contained within them.



Fig. 1. *Beech red heartwood*

Irrespective of the causes which determine the appearance of red heartwood its presence at beech logs considerably reduces the value of round wood.

This paper is aimed at finding the proportion of red heartwood from the total volume of beech round wood of Valea Teslei felling area, its influence in the sorting process as well as its development on a radial and longitudinal direction at beech tree trunks of different ages.

2. Research Method

In order to achieve the stated aims the research took place in Valea Teslei felling area, forest compartment 65 A from U.P. V Tesla, on the territory of the Experimental Forest District of Săcele, on the right bank of Târlung River. In order to determine the percentage of red heartwood from the volume of beech round wood, a volume of round wood of 65.638 m³ (44 logs of

different lengths and diameters) has been studied. At each log the end diameters have been measured as well as the diameters of the areas with red heartwood. In order to find the dynamics of red heartwood development nine trees have been studied the age of which has been determined by counting the annual rings at the stump level. Three trees have been included in each age class of 120, 140 and 160 years. In order to determine the size of the red heartwood portion within the section and the height up to which red heartwood appears measurements have been done at these trees on increment cores extracted with the help of Pressler's borer, at a one meter distance from one another as well as at the sectioning areas.

3. Results Obtained

3.1. The Proportion of Red Heartwood and Its Influence in the Sorting Process

The Romanian standard concerning the qualitative classification of beech round wood SR EN 1316 - 1:2001, corresponding to European standard EN 1316 - 1:1997, stipulates that the maximum accepted proportion of red heartwood in the diameter of an A quality class log is 20% and it increases to 30% in the case of a B quality class log. The Romanian standard SR 2024 - 1993, round beech wood for industrialization, stipulates that 40% is the maximum limit of the diameter of the log for decorative veneer and 60% for structural veneer.

Considering the admission limits of red heartwood stipulated by the existing standards and with a view to observing its influence on the quality of beech round wood Table 1 presents two sorting schemes (qualitative and industrial) according to the percentage of the red heartwood from the log diameter.

Industrial and qualitative sorting of beech logs

Table 1

Log length [m]	Log average diameter [cm]	Red heartwood average diameter [cm]	Percentage of the red heartwood from the diameter [%]	Log volume [m ³]	Red heartwood volume [m ³]	Percentage of the red heartwood from the volume [%]	Industrial Sorting SR 2024 - 1993 [m ³]			Qualitative Sorting SR EN 1316 - 1: 2001 [m ³]		
							Fe	Ft	C	A	B	C+D
3.18	73	45	62	1.313	0.506	39			1.313			1.313
4.37	73	46	63	1.829	0.726	40			1.829			1.829
4.25	69	40	58	1.589	0.534	34		1.589				1.589
6.5	56	13	23	1.601	0.086	5	1.601				1.601	
4.56	66	43	65	1.537	0.647	42			1.537			1.537
6.75	49	28	57	1.273	0.416	33		1.273				1.273
5.15	65	33	50	1.709	0.427	25		1.709				1.709
7.5	44	22	49	1.141	0.272	24		1.141				1.141
5.75	52	28	53	1.198	0.342	29		1.198				1.198
6.1	56	25	45	1.476	0.299	20		1.476				1.476
3.1	83	45	54	1.657	0.482	29		1.657				1.657
3.5	74	48	64	1.505	0.620	41			1.505			1.505
3.05	79	49	62	1.495	0.575	38			1.495			1.495
4.25	76	49	64	1.928	0.802	42			1.928			1.928
4.48	69	40	58	1.651	0.563	34		1.651				1.651
4.1	68	42	62	1.467	0.568	39			1.467			1.467
4.28	62	41	66	1.292	0.565	44			1.292			1.292
3.18	84	48	57	1.742	0.576	33		1.742				1.742
4.24	59	39	66	1.159	0.507	44			1.159			1.159
4.28	65	47	72	1.420	0.727	51			1.420			1.420
4.13	67	45	67	1.456	0.657	45			1.456			1.456
3.18	68	45	66	1.138	0.495	43			1.138			1.138
3.24	68	44	65	1.177	0.493	42			1.177			1.177
3.24	86	52	60	1.882	0.688	37			1.882			1.882
4.5	75	42	56	1.988	0.624	31		1.988				1.988
4.43	75	45	59	1.957	0.689	35		1.957				1.957
5.25	61	35	58	1.509	0.505	33		1.509				1.509
5.25	53	33	62	1.137	0.436	38			1.137			1.137
6.36	45	23	52	0.989	0.264	27		0.989				0.989
4.17	63	40	63	1.280	0.511	40			1.280			1.280
4.21	65	016	24	1.397	0.079	6	1.397				1.397	
5.42	49	27	56	1.001	0.310	31		1.001				1.001
3.5	76	47	62	1.567	0.594	38			1.567			1.567
5.6	62	38	60	1.691	0.619	37			1.691			1.691
3.53	74	39	53	1.498	0.422	28		1.498				1.498
4.35	66	38	57	1.466	0.481	33		1.466				1.466
4.43	51	29	57	0.905	0.293	32		0.905				0.905
3.4	93	53	56	2.310	0.736	32		2.310				2.310
5.75	52	26	50	1.221	0.305	25		1.221				1.221
4.46	68	39	58	1.596	0.533	33		1.596				1.596
4.24	64	45	70	1.364	0.660	48			1.364			1.364
3.26	80	41	51	1.639	0.430	26		1.639				1.639
3.2	87	54	62	1.903	0.733	39			1.903			1.903
4.3	69	43	63	1.585	0.625	39			1.585			1.585
TOTAL	-	-	-	65.638	22.421	34	2.998	31.515	31.125	-	2.998	62.640

It has been noticed that in the case of the industrial classification of round beech wood, red heartwood determines the downgrading of a volume of 31.129 m³ representing 47% this being admitted only in the C quality class (timber) and of 31.515 m³ representing 48% leading to its being admitted only in the Ft class (structural veneer). If we consider the prices from the beech wood market this means a decrease of the revenue coming from the valuing of round beech wood between 40% and 50%. Likewise, it can be noticed that in the case of qualitative sorting wood is not admitted in the A qualitative class because of the red heartwood. In the B quality class a volume of 2.998 m³ is admitted representing 5%, the rest being only admitted in the C and D quality classes where there are no admission limits concerning red heartwood.

Regarding the volume of red heartwood occupied by red heartwood it has been noticed that this represents 34% of the volume of round wood and that it varies in the case of the studied logs between 5% and 48%. Also, it has been observed that at 9% of the analyzed logs inner decay has developed, this occupying between 20% and 70% of the logs' diameter. When compared to the total volume of round wood, the volume occupied by inner decay represents 2%. As the tree stands grow older and they get over 100 years old under favourable site conditions, red heartwood is more and more frequently associated with the inner decay of wood, that is red heartwood can turn into decay [2].

3.2. Red Heartwood Development

Throughout the years more hypotheses have been suggested concerning the development of red heartwood, some even contradictory. Thus, Predescu (1941) cited by Vintilă (1946) established that red heartwood grows from the lower part to

the upper part reaching the maximum value at the height of 3 meters, the maximum proportion of red heartwood of about 30% is maintained between 3 and 10 m after which it drops suddenly. Zycha (1948) cited by Vintilă (1946) localizes the maximum percentage of red heartwood at heights between 8 and 10 m. In these areas red heartwood may occupy 50% of the surface of the transversal section of the trunk. Vintilă (1946) claims that the proportion of red heartwood is 30 to 50% and, that it spreads all through the length of the trunk up to the crown. According to Georgescu (1957) cited by Milescu et al. (1967) beech red heartwood affects 15 to 50% of the number of trees from a tree stand, and with respect to its proportion within the trees volume it is situated between 20 and 70%. Drăghiciu (2007) estimates that ever since the age of 100 years red heartwood affects a considerable number of trees from tree stands irrespective of their age, vegetation layer, productivity, structure or even silvicultural interventions.

In order to observe the dynamics of red heartwood development along the stem of beech trees, the latter have been sectioned at a one meter distance. They belonged to the age classes of 120, 140 and 160 years, their average being represented by the graph from Figure 2.

An accentuate increase of the red heartwood on a radial direction is noticed from the base of the tree up to the height of 3-4 m where the percentage of red heartwood from the tree diameter reaches the maximum value. This increases from 10 to 39% in the case of the age class of 120 years, maintains between 39 and 29% up to the height of 10 m and then suddenly decreases on the last 5 m.

In the case of the age class of 140 years the percentage of red heartwood increases from 16 to 38% up to the height of 15 m, after which it decreases suddenly and

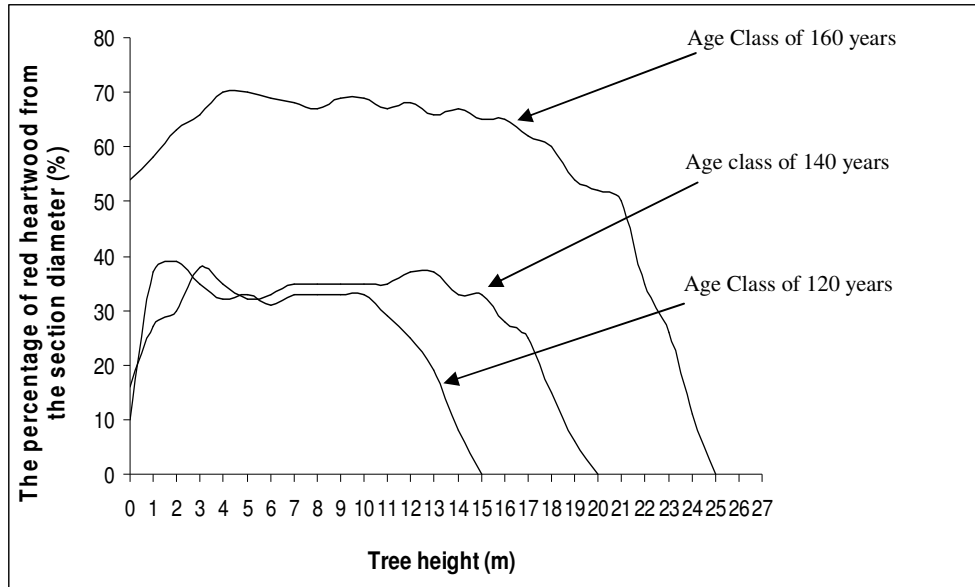


Fig. 2. Dynamics of red heartwood along the stem of beech trees, on age classes

disappears at the height of 20 m. At the age class of 160 years the percentage of red heartwood increases from 54 to 70%, maintains between 50 and 70% up to the height of 21 m, after which it decreases suddenly and disappears at the height of 25 m. Therefore, red heartwood has an accentuated development on a radial direction between the height of 3 m and up to about 67% from its height at the age of 120 years, between 3 m and up to 75% from its height at the age of 140 years and, between 3 m and up to 84% of its height at the age of 160 years.

As the tree grows older red heartwood develops more and on a longitudinal direction, reaching the height of 15 m at the age of 120 years and representing approximately 50% from the tree height. At the age of 140 years red heartwood reaches the height of 20 m, representing approximately 62% of the tree height and, at the age of 160 years it reaches the height of 25 m and represents approximately 73% of the tree height. At trees older than 160

years it may reach the tree crown and being detected even in the thick branches at the base of the crown.

4. Conclusions

Concerning the influence of red heartwood on beech wood sorting and its economic impact the following conclusions can be drawn:

- the downgrading occurring as a result of the presence of red heartwood may cause the decrease of revenues coming from the valuing of round beech wood amounting to 40 to 50% irrespective of the sorting system used;
- in the present case it has been established that the volume of round wood occupied by red heartwood represents approximately 34% of the wood volume studied;
- inside red heartwood inner decay may develop. 9% of the analyzed logs presented this defect, the volume of round wood affected by inner decay representing

approximately 2% of the volume of round wood.

With respect to the development of red heartwood on a radial and longitudinal direction the following conclusions can be drawn:

- on a radial direction the percentage of red heartwood grows steadily from the base up to the height of 3-4 m where it reaches the maximum value irrespective of the age class of the tree. It maintains at considerable values up to the height of 10, 15 and 20 m corresponding to the age classes of 120, 140 and 160 years after which it decreases suddenly and disappears in the course of the following 5 m;

- along the trunk of beech trees red heartwood appears up to approximately 50, 62 and 73% of the tree height corresponding to the age classes of 120, 140 and 160 years, being able to reach the crown at older ages.

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