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RESEARCH CONCERNING THE FREQUENCY OF THE EXTERNAL DEFECTS FOR POPLAR (*POPULUS NIGRA L.*) FROM ALIGNMENTS

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Abstract: *The paper analyzes the external defects detected on poplar specimens from Vadul Roşu alignment, Braşov County. To better highlight the variation of the defects, they were grouped by defect type, cardinal directions and sections of tree height. For example, for damages (wounds) three portions in the tree height were considered: portion between the ground and 1 m height, portion between 1 and 2 m and the portion higher than 2 m.*

Key words: *defect, curvature, ovality, knot, wounds.*

1. Introduction

The external defects of the trees are indicators of the internal quality of wood, therefore their careful analysis is required. Many authors have studied the external defects of trees but most of them have focused on studying the defects of the species founded in forests and less of those from alignments and public places.

According to Romanian Standard SR 3302 [16], the poplar wood may be used for technical veneer, as a raw material for matches, in the timber industry and paper pulp processing. Each area of use has some dimensional and qualitative limits, which makes the assortment fit into a category or not.

Curvature, a defect of shape which consists in the deviation of trunk axis from the straight line [6] and [14], was analyzed according to place of occurrence (on the trunk or branches) and type (single or multiple).

The bifurcation of the trunk consists in its separation at a certain height in two or more main branches, due to the growth of the lateral bud instead of the terminal bud [9] and [14].

The defect characterized by the deformation of the cross section of the trunk from circular to elliptical or ovoid is called ovality and this defect limits the usage of the wood. According to the Romanian Standard SR 3302 [16], the ovality of poplar wood for technical veneers and matches should not exceed 10%.

Frost cracks appear at standing trees, manifesting itself along the trunk, sometimes on helical direction, from the periphery and gradually narrowing to the wood marrow.

Knots are inevitable wood characteristics, which are resulting from the incorporation of branches in wood as a result of growth in thickness. They are classified differently according to each author as follows: [1],

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[2] and [11] classifies the knots taking into account the degree of health (healthy knots, vicious knots and rotten knots), and [7-8], [15] classifies the knots according to the manner in which they appear on the surface of wood (hidden knots, covered knots and apparent knots).

Defects due to injuries, a much debated topic, has encountered different approaches in terms of defects that are included in this category [2-5], [10], [12], [15]. By injury it is meant any wood damage caused by hitting, by the falling trees or by other cutting or logging tools.

2. Materials and Methods

The studied alignment is located in the Feldioara village, Vadul Roşu area, and the studied species is represented by black poplar (*Populus nigra* L. - Figure 1). On the alignment 163 trees with heights between 9.9 and 27.4 m and diameters between 30 and 74 cm were analyzed.

For each tree both the height (in meters) and the maximum and minimum diameter at 1.30 m height of the ground (expressed in centimetres) were measured.

Among the defects, some were only detected visually (curvature, bifurcation and excrescences), most were measured (knots, hollows and flaws of injury) and ovality was determined in the office, based on the two diameters measured in the field. The items measured for knots, hollows and flaws of injury were the height where the defect occurs, the width and height of the defect; the depth of the hollow. The devices used were TruPulse 200 for distances and heights, Criterion 1000 and clup diameter for diameters and, for length and width of the defects from accessible areas the measuring tape was used.

For this paper, the knots were classified into five categories taking into account the degree of health and whether they appear at trunk surface or not. Thus, the knots were divided into: hidden knots (which do not appear at the surface and whose presence is betrayed by the cracks of bark, called the eyebrows), covered knots (which do not appear at the wood surface, but are betrayed by swelling occurred in the area of the knot), healthy knots (which appear at the wood surface and do not show signs of decay), vicious knots (knots whose surface is

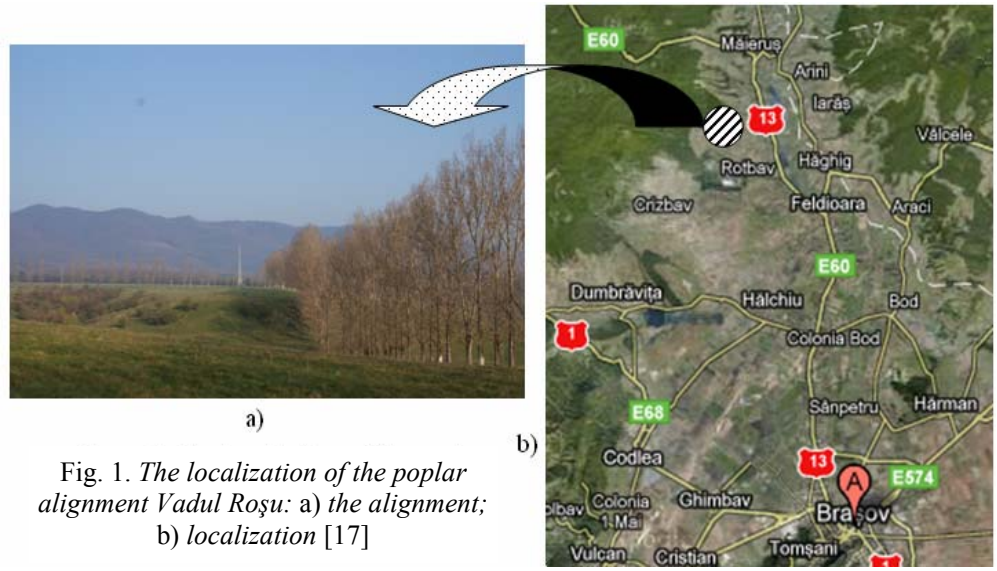


Fig. 1. *The localization of the poplar alignment Vadul Roşu:* a) *the alignment;* b) *localization* [17]

decayed less than one third) and decayed knots (whose decayed surface is greater than a third of the total area of the knot).

In this paper, the wounds were classified into: open wounds - that are newly formed, wounds being healed (in that case the trees could not cover completely the wound by its system of defence and the wounds having scar tissue around them), healed wounds (wounds closed by the tree), decayed wounds (rotten wounds) and dead wood (in that case the cellular elements of wood are dead, the area is payment?, often surrounded by scar tissue with rounded edges which do not cover the entire affected portion [2-3] and [13]).

3. Results and Discussions

To better highlight the frequency of the defects which are present on the studied trees, the necessity of separate analysis of each defect was considered.

From all 163 examined trees, 41 specimens are affected by curvature of the trunk and eight trees present curvatures of the ramifications. From all the curvatures occurring on the trunk, 38 are simple and the remaining 3 are multiple. In order to talk about the curvatures occurring on ramifications, the trees should have ramifications, so the trees must be forked. In our case, the ramifications' curvature affects 8 of 9 forked trees, four trees being affected by simple curvature and four trees presenting multiple curvatures.

From the total forked trees, 7 presented two ramifications and two individual trees presented three ramifications after bifurcation point.

Following an evaluation of data obtained for ovality (Table 1) a very small percentage of specimens with values greater than 10% for this defect was found, a situation encountered at 13 poplars (equivalent to 8%). The remaining trees were divided into trees without ovality (14%) and trees with ovality between 0.1 and 10%.

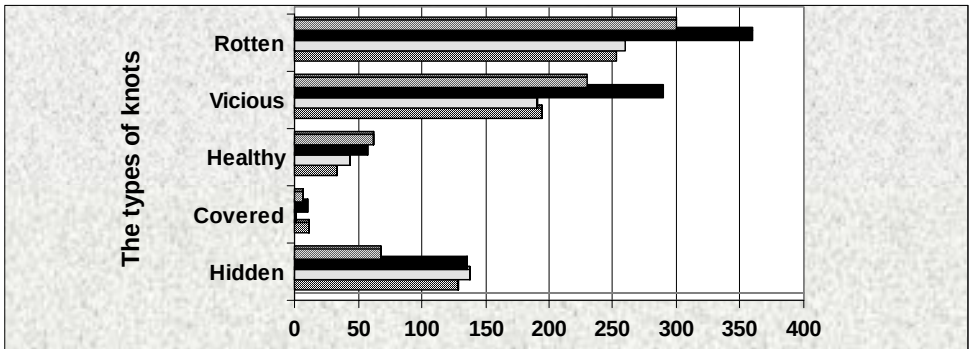
From the 163 poplar specimens that were analyzed, only six present frost cracks, each being affected by a single closed frost crack. The distribution according to the cardinal directions indicates a single frost crack in North and South sides, and two in the East and West side. Analyzing the occurring height, there can be observed that 5 frost cracks affect the first third of tree height and a single frost crack affects the middle section of tree height.

In the poplar alignment from Vadul Roşu 2773 knots were detected, the afferent data being centralized in Figure 2. Following data analysis there can be observed that the distribution of knots on the cardinal directions: North, East and West varies from 620 knots (appeared in the North side) to 667 knots (detected in the West side). The highest number of knots appears in the South side where were found 852 knots were found. If we analyze the distribution of knots according to the five previously set categories, we can easily see that the fewest knots are the covered knots, accounting for approximately 1% of all knots detected at the studied trees, followed by healthy knots with a percentage of 7%, equivalent to 196 knots from the total of 2773. The largest share corresponds to the rotten knots with 42% of the total (equivalent with 1173 knots), seconded by the vicious knots with 33% of the total (905 knots).

To better reflect the knots' variation according to their position on the tree, the tree height was divided into three equal portions, each representing one third of its height. Following this distribution it was discovered that the highest number of knots appears in the first third of the tree height (74.5% representing 2063 knots), followed by the middle part of the trees with 24% (696 knots). The lowest proportion of knots was founded in the third portion which represents the crown (only 0.5% - 14 knots).

The distribution of the trees depending of the ovality values Table 1

Total number of trees	Number of trees without ovality	Number of trees with ovality between…		
		0.1-10 [%]	10.1-15 [%]	> 15 [%]
163	23	127	10	3



	Hidden	Covered	Healthy	Vicious	Rotten
West	68	7	62	230	300
South	135	10	57	290	360
East	138	1	44	191	260
North	129	11	33	194	253

Fig. 2. *The distribution of the types of knots on cardinal directions*

The data analysis from Table 2 shows that at the base of the trunk the highest proportion is detained by the decayed knots (853 knots - 41%), followed by the vicious knots (600 knots - 29%) and hidden knots (440 - 21%). The lowest percentage is represented by covered knots (1% - equivalent to 27 knots).

In the second third of the tree height (Table 2), predominance is maintained by the vicious and rotten knots, this time with very close values (312 rotten knots - 45% and 301 vicious knots, equaling 43%). The third and fourth places were changed compared with the portion from the base of trunk, meaning that third place corresponds to the healthy knots (7% - 49 knots), while on the fourth place ranks the hidden knots with a rate of 5%, equivalent to 32 knots. The covered knots appear in a very small proportion, representing less than 1% of the total.

The knots distribution according to the cardinal directions shows a relatively small oscillation between North (618 knots, or 22%), East (632 knots - 23%) and West (663 knots - 24%) and a higher proportion of knots in the Southern direction (31%, which equals 846 knots).

The features from the upper third are irrelevant for the quality of wood, this section corresponding to the crown.

However, there can be observed a predominance of knots in the Southern side (6 knots), followed by 4 knots detected in the Western side and by Northern and Eastern sides, with two knots each.

According to the previously established knot categories, it is noted that knots from this part of trunk are grouped only into three categories namely healthy knots (2), vicious knots (3 knots) and decayed knots (9 knots).

The knots distribution on the poplar specimens (Populus nigra L.) Table 2

Cardinal direction		Knots distribution in the first, second and third tree height portion										Total	
		Hidden		Covered		Healthy		Vicious		Rotten		No.	%
		I	II	I	II	I	II	I	II	I	II		
North		119	10	10	1	25	8	137	56	200	52	618	22
East		125	15	1	0	32	9	122	68	188	72	632	23
South		131	4	9	1	40	16	194	95	250	106	846	31
West		65	3	7	0	46	16	147	82	215	82	663	24
Total	**No.**	**440**	**32**	**27**	**2**	**143**	**49**	**600**	**301**	**853**	**312**	**2759**	**100**
	%	**21**	**5**	**1**	**0**	**7**	**7**	**29**	**43**	**41**	**45**	**100**	-

Data regarding the wounds was grouped according to the cardinal direction, the stage of development of the wound (Figures 3-6), and the height of occurrance. It was found that most wounds appear in the first category - one meter from the soil level, and a few above two meters.

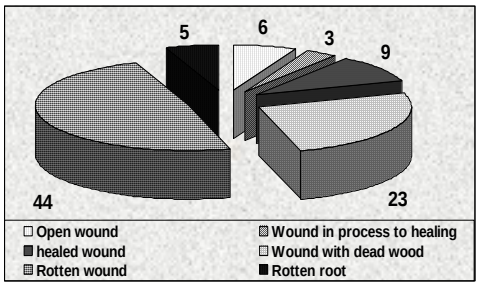


Fig. 3. *The distribution of the wounds from the North side*

From the total analyzed number of wounds in the case of Vadul Roşu poplar alignment (324), in Figure 3 the distribution of the 90 wounds founded in the Northern side is presented. There can easily be observed that the rotten wounds represent the highest proportion (49%), followed by dead wood with 26%. The wounds in process of healing have the lowest percentage (3%), followed by open wounds (7%) and healed wounds (10%). On the Northern side five rotten wounds that affect the roots from surface appear. To highlight the most injury affected area, three sections have been taken into account: the portion between the ground level and one meter from the tree height, the portion between one and two meters, and the rest of the tree, between 2 m and the top of the tree. Following this division it was concluded that 88% of detected wounds in the Northern side occur up to a height of 1 m (equivalent to 79 wounds), 11% affect the portion between 1 and 2 m (10 wounds) and only one wound was discovered above the height of 2 m. There can be also noted that this rule is a general one. Most wounds were detected in the first portion and a very small proportion in the portion between 1-2 meters. Exceptions are represented by the healed wounds which are present with a proportion of 44% in the first section (four wounds healed) and 46% in the second section (5 wounds).

Figure 4 shows the distribution of wounds on the Eastern side where 88 defects were detected.

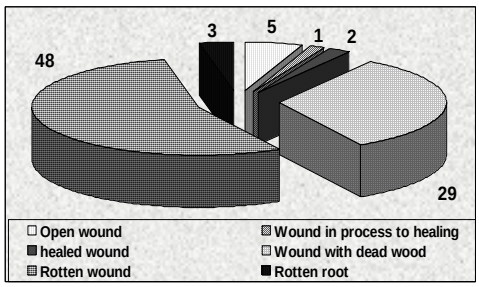


Fig. 4. *The distribution of the wounds from the East side*

Dominant are rotten wounds (55%) followed by dead wood with 33%. Participation rates fall gradually as follows: open wounds - 6%, rotten wounds on roots (3%), healed wounds (2%) and wounds in process of healing - 1%.

According to the repartition of the wounds depending on the height of occurrence, the situation stands as follows: 93% of wounds were detected below one meter from the soil level (respectively 82 wounds), 6% - 5 injuries appeared between 1 and 2 meters, and only one wound appeared above 2 m. The open wounds, the wounds in healing process, the decayed wounds and dead wood were detected exclusively under 1 m height.

Figure 5 presents the distribution of the wounds detected in the South on the analyzed poplar trees. From the 82 wounds developed on this cardinal direction more than half are wounds with dead wood (51%). Second place is held by the rotten wounds with 39%, and the last place is held by the open wounds, represented only by a single wound. Except a single rotten wound which was found at a height greater than 2 m and a wound with dead wood lying between 1 and 2 m, all the other 80 wounds were found within the first meter from the ground.

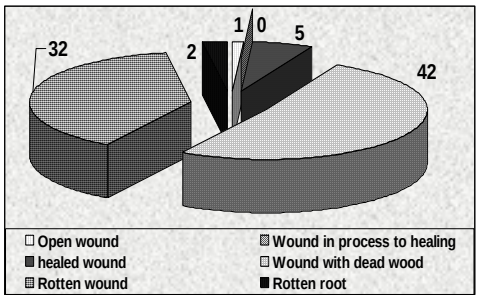


Fig. 5. *The distribution of wounds from the South side*

The western part is characterized by the fewest wounds, compared with the other cardinal directions, respectively with 64 injuries, representing 20% of all wounds detected in the studied poplars. In Figure 6 the wound type distribution and the predominance of wounds with dead wood (45%) and the rotten ones (33%) can be seen.

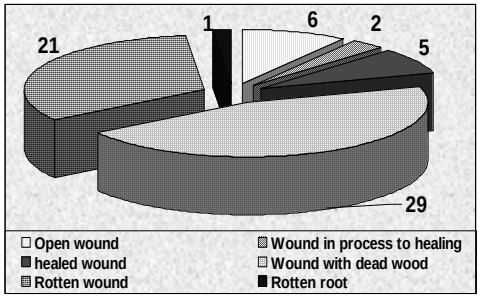


Fig. 6. *The distribution of wounds from the West side*

The open wounds rank the third place with 9% followed by the healed wounds (8%) and by the wounds in process of healing and those that affect the roots, totaling 5%. The majority of the wounds were detected in the first portion (between the ground level and 1 meter), only three wounds appearing between 1 and 2 m, while over 2 m height a single open wound was detected.

Hollows are defects caused by fungi and consist in the total local destruction of the tissue and formation of the cavities. From the 163 studied poplars corresponding to Vadul Roşu alignment, only six trees presented this defect (equivalent to 4%). On this trees seven hollow, distributed as follows were detected: on five trees only one hollow was found, while a single tree presented two hollows. If the studied item is the height on which the defect occurs, it was found that 6 of the hollows occur in the first third of the tree height (three in the Northern side and three in the Southern side), and only a hallow affects the middle of the trunk in the Eastern side.

4. Conclusions

From the data presented in this paper some conclusions can be drawn as follows:

- The proportion of black poplar trees (*Populus nigra* L.) affected by the curvature is relatively high, about a quarter of all examined trees, respectively 41 specimens. Out of these, 38 specimens are affected by simple curvature and 3 are affected by multiple curvature;
- Only 8% of the examined trees present an ovality bigger than 10%, value indicated in the standards for the use of poplar wood (13 pieces);
- Forking affects 6% of studied trees (9 specimens) and, in all cases, it is located in the first third of the tree height;
- The frost cracks are not frequent, the percentage of affected specimens is relatively small (4% equivalent to 6 trees). In all cases, frost cracks are closed;
- The number of knots identified in the Vadul Roşu poplar alignment is very large (2773 knots), which represents about 17 knots on each tree;
- The rotten knots have the highest proportion (42% - 1173 nodes), followed by the vicious ones with 33% (905 knots). The dominance of these two types of knots is kept on the cardinal directions too;
- The section with the biggest number of knots is located at the base of trees, where 74% of the total number of knots (2063) were identified;
- The total number of analyzed wounds in the Vadul Roşu alignment was 324, equivalent with an average of two wounds on each tree. Naturally, there are situations in which some trees have no wound, while others are affected by more than two wounds;
- Regarding the dominance of certain types of wounds on cardinal directions, there was highlighted that decayed wounds in the Northern and Eastern sides (North - 49% and East - 55%) predominate, while in the South and West wounds with dead wood predominate (South - 51% and West 45%);
- Hollows affect about 4% of the total number of examined trees, respectively 6 poplars.

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References

1. Balleux, P.: *Les défauts du bois* (*Wood Defects*). In: Silva Belgia, Bruxelles, no. 5/2004, september - october, bisemestrial, A de Jambline de Meux Publishing House, p. 23-28 (I-VI).
2. Beldeanu, C.E.: *Produse forestiere şi studiul lemnului, vol. I* (*Forest Products and Wood Study, Vol. I*). *Transilvania* University of Braşov Publishing House, 1999.
3. Beldeanu, C.E.: *Produse forestiere şi studiul lemnului* (*Forest Products and Wood Study*). *Transilvania* University of Braşov Publishing House, 2001.
4. Beldeanu, C.E.: *Produse forestiere* (*Forest Products*). *Transilvania* University of Braşov Publishing House, 2008.
5. Ciubotaru, A.: *Exploatarea pădurilor* (*Forest Exploatation*). Braşov. Lux Libris Publishing House, 1998.
6. Câmpu, R.: *Cercetări privind posibilităţile de evaluare a calităţii*

lemnului pe picior, în arborete pure de fag (*Fagus sylvatica L.*)*, din Bazinul Târlungului* (*Research Concerning the Possibilities for Evaluating the Quality of Standing Trees, in Pure Stands of Beech* (*Fagus sylvatica L.*) *from Tarlung Basin*). In: Ph.D. Thesis, *Transilvania* University of Braşov, Romania, 2008.

7. Corlăţeanu, S.: *Produse forestiere. Partea I: Lemnul* (*Forest Products. First Part: The Wood*)*. Transilvania* University of Braşov, 1978.
8. Dincă, M.: *Cartarea calitativă a arboretelor de fag din Ocolul Silvic Experimental Săcele - Referat ştiinţific final* (*Qualitative Mapping of Beech Stands from Săcele Experimental Forest District - Final Scientific Report*). Bucharest. Forestry Research Institute Publishing House, 2002.
9. Drénou, C.: *Prunning Trees: The Problem of Forks*. In: Journal of Arboriculture **26** (2000) No. 5, p. 264-269.
10. Filipovici, J.: *Studiul lemnului. Vol. I* (*Wood Study. Vol. I*)*.* Bucharest. Didactica and Pedagogical Publishing House, 1964.
11. Lunguleasa, A.: *Ştiinţa lemnului* (*Wood Science*)*. Transilvania* University of Braşov, 2001.
12. Morocico, V.: *Produse forestiere.* (*Forest Products*). *Ştefan cel Mare* University of Suceava Publishing House, 1994.
13. Nimară, D., Voiculescu, P., et al.: *Cartea sortatorului de produse lemnoase de pădure* (*Sorter's Book for Wood Products*). Bucharest. Agro-forestry Publishing House, 1964.
14. Pescăruş, P.: *Studiul lemnului, Vol. I* (*Wood Study, Vol. I)*. *Transilvania* University of Braşov, 1982.
15. Vanin, S.I.: *Studiul lemnului* (*Wood Study - translated from Russian*). Bucharest, Technical Publishing House, 1953.
16. *** *Standardul românesc SR 3002 cu privire la defectele lemnului rotund de diverse specii tari şi moi* (*Romanian Standard SR 3002 Regarding Wood Defects for Various Hardwood and Softwood*)*.* 2000.
17. http://maps.google.com/. Accessed: 03. 23.2011.