RESEARCH CONCERNING THE SETTING AND DEVELOPMENT OF ROT WITHIN WOUNDS AT BEECH TREES

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Abstract: *The wounds inflicted on standing trees are lesions constituted by tissue damage and dislocations of wood anatomical elements, caused by striking, frost and blazes. Their cicatrisation is the result of cambium activity which generates callus tissues under the form of healing waves. Callus tissues on the brink of the wound develop rapidly on a tangential and then radial direction, which allows the wound to close with the increase of the tree circumference. The cicatrisation time, the infestation of wounds and the spreading of pathogen agents inside the tree depend on the influence of the following factors: location, size, age, depth and form of wounds.*

Key words: *tree wound, dead wood, rot, European beech.*

1. Introduction

Wounds are lesions inflicted on trees constituted by tissue damage and dislocations of wood anatomical elements, caused by striking, frost, blazes, etc. Many of them are inflicted as a result of logging, when standing trees are damaged both during the felling and the collecting process.

Mechanic damage noticed at standing trees as a result of logging are important not only for their frequency and size but also for their consequences. Thus, open wounds leave the wood directly exposed and they can become, on the one hand, gates for the entering of xylophagous fungi or other pathogen agents, and, on the other hand, growth decrease and modifications of physical and mechanical wood properties. Moreover, trunk deformations at wounds level and qualitative losses accentuate as the trees live longer [7].

Dead wood appears as a result of wounds inflicted on standing trees, in the areas in which the tree bark has come off due to wounds or it has been burnt by the sun or fire. As an example, Figure 1 presents a beech tree with a wound and dead wood. This appears as a necrosis area, with sound wood, of a darker colour and numerous cracks, surrounded by cicatrisation tissues with round edges, which do not cover completely the affected portion. In time, dead wood is accompanied by chromatic or physical modifications of wood. Sometimes the exposure of wood to the contact with the atmosphere only leads to the drying of superficial tissues and, as a result, the development of fungi cannot take place or is delayed [7].

The infestation of wounds and the spreading of pathogen agents inside the tree depend on the influence of certain factors among which the following can be mentioned:

The localization of wounds on the tree trunk influences the frequency of fungi

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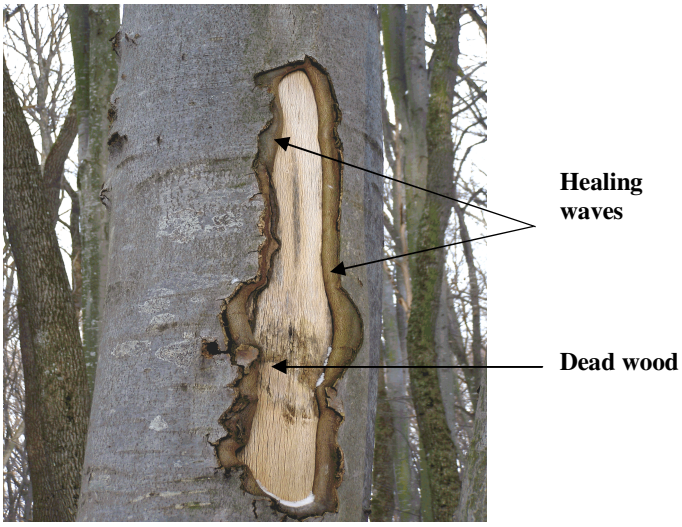

Fig. 1. *Dead wood wound*

infestations and the rot content. Generally wounds located below 1.3 meters are more liable to fungi infestations than those located in an upper position on the tree trunk [5]. Also, the wounds located on the roots and those which come into contact with the soil are infected in most cases [4]. In this case the rot develops more rapidly than in the case of wounds located on the upper part of the trunk. It is also the case of wounds inflicted on trees during the collecting process, which are normally located no higher than 1.5 meters. Although the frequency of wounds with rot decreases with height, more than 80% of the wounds situated higher than the chest level will be infested [2]. Nevill (1997) states that wounds situated at upper heights on the tree trunk can be infested but the frequency of rot is diminished, this being valid both for bigger and smaller wounds.

The wounds size is one of the most important characteristics of the defect in relation with the infection and the subsequent content of rot. The research conducted by Petrescu (1974) in spruce and fir tree stands has demonstrated a direct connection between the size of the wound and the occurrence and extension of infections determined by rot agents. Thus, more severe rot was noticed in the case of wounds with a bigger sapwood surface exposed. Wallis *et al*. (1971) have shown that about 60 to 85% of wounds with surfaces bigger than 90 dm^2 have approximately twice more rot than smaller wounds. According to OMNR (2004), wounds are considered important defects when they exceed 25% of the tree circumference, in the case of trees with diameters between 10 and 31 cm. Also, all wounds bigger than 1000 cm^2 are considered severe irrespective of the tree diameter. Petrescu (1974) noticed that open wounds with a surface bigger than 0.50 dm^2 do not cicatrize or they cicatrize after more than 10 years. During this time the rotting process begins.

The bigger depth of the wound is conducive to the appearance of more severe attacks than when the wounds are superficial. The appearance of rot is more frequently associated with wounds at which woody tissues are affected (depth wounds) than with wounds caused by the removal of the bark (surface wounds) [8].

It is the case of wounds inflicted on trees during the logging process when the blade of the chainsaw penetrates the trunk of coalesced trees. These wounds are not important because of their size but because of their depth and orientation [7]. Generally wounds with a depth smaller than 5 cm or with a surface smaller than 930 cm^2 have coloured spots and low rot content. After 20 years wounds have significant rot content.

The form of the wound is important because of the way in which cicatrisation takes place and because of the rot content. Thus wide wounds lead to higher rot content than the narrow ones [5]. The rot content is at least two times bigger in the case of wide wounds because of the longer period during which the wound cicatrisation takes place.

The age of the wound together with its size represent the characteristics which are best associated with the rot content. In the case of most forest species the wounds whose age is smaller than 10 years are not important in point of the rot content because this had no time to develop. After 10 years the wounds rot content increases irrespective of the size of the wound [1].

The thinner the bark the bigger the damage caused to trees. Therefore, the thicker the bark and the harder the wood, the lower the risk of producing mechanical damage to the trunk and roots [6]. In this respect, the beech tree is part of the species with thinner bark and harder wood where semi-deep wounds are predominant and in which the bark is removed up to the wood without the latter being damaged. Severe damage is caused only in the case of abrasion or repeated striking. As far as the evolution of wounds is concerned and the consequences that these might have on the quality of beech wood, Decei (1975) and Petrescu (1984) reached the following conclusions:

- in the area without bark dead wood is produced on all the wound surface;
- in the first 5 up to 10 years since the wound infliction, dead wood extends in depth between 2 and 10 cm, according to the size of the wound and is accompanied by chromatic modifications;
- at beech trees after 10 years and in some cases after 8 years, the rotting process begins;
- the speed of longitudinal spreading of the rot inside the wood and its lateral spreading are correlated with the age of the wound;
- the spreading of rot upwards and downwards takes place slower and only after the whole wounded area has been infested;
- in the case of taller and older trees the rot length is bigger but it does not exceed 8 m at beech trees.

2. Research Method

Within the present paper the characteristics of 15 wounds with dead wood and rot have been analysed and measured (Table 1) with the purpose of completing the already existing information and identifying certain new aspects concerning the development of dead wood and of rot.

To this end beech logs with wounds, dead wood and rot in different stages of development have been cross-cut and cleft. The age of the wound has been established by counting the annual rings from the healing waves.

3. Results and Discussions

The analysis of the cleft wood, the study of wood in section and the measurement of wound characteristics from the table above allowed the following observations to be made:

- in the time between 5 and 10 years from wound infliction the depth of dead wood varies between 0.5 and 2.5 cm (Figure 2a);

Characteristics of wounds with dead wood and rot Table 1

The age of the wound [years]	The length of the wound [cm]	The width of the wound [cm]	The depth of dead wood [cm]	The depth of colorations [cm]	The depth of rot [cm]
8	80	30	1.5	-	-
10	32	12	2.5	10	-
14	60	20	-	24	16
6	20	15	1.0	-	-
5	35	16	0.5	-	-
15	25	13	-	21	15
12	30	10	-	19	13
9	15	10	1.6	5	-
16	18	9	-	24	15
20	54	26	-	32	19
18	26	15	-	26	17
7	62	36	1.5	5	-
9	25	10	2.0	7	-
11	36	16	3.0	10	-
10	42	26	-	15	5

- the development of dead wood is preceded by a brown coloration of the wood in the direction of medullary radii (Figure 2b);
- the coloration proceeds in the shape of a triangle with the vertex oriented towards the centre of the section and the base towards the exterior equal with the width of the wound;
- at ages older than 10 years dead wood loses its properties as a result of the initiation of the rotting process;
- once the rotting process has started its three stages (the incipient stage, the second stage and the rot proper) take place simultaneously; each stage can be observed separately in transversal section (Figure 2c);
- rot penetrates the wood in the shape of a triangle with the vertex oriented towards the centre and the base oriented towards the exterior; afterwards it extends in radial form (Figure 2c);
- the smaller the trunk diameter at the wound place, the shorter the time it takes the rot to get to the trunk centre;
- wide wounds take a longer time to close, a fact which is conducive to the setting and subsequent development of rot.

4. Conclusions

Considering the information mentioned above it could be said that wound cicatrisation is the result of cambium activity, which generates cicatrisation tissues under the form of healing waves. The cambium activity around wounds is much more intense which leads to the production of more wood in this area than in any other part of the trunk at the same level. The cicatrisation tissues from the brink of the wound develop rapidly in a tangential and then radial direction, which allows the wound to close with the increase in tree circumference. After the cicatrisation of the wound by the merging of healing waves, the deterioration and the rotting of wood decrease. As a result, the cicatrisation time and the development of rot inside the wood mainly depend on the size and age of the wound.

Due to the overwhelming importance of an objective evaluation of wood quality,

the above observations serve the purpose of completing the already existing information from scientific literature. Some observations are entirely new; therefore, for the establishment of their validity further research is required.

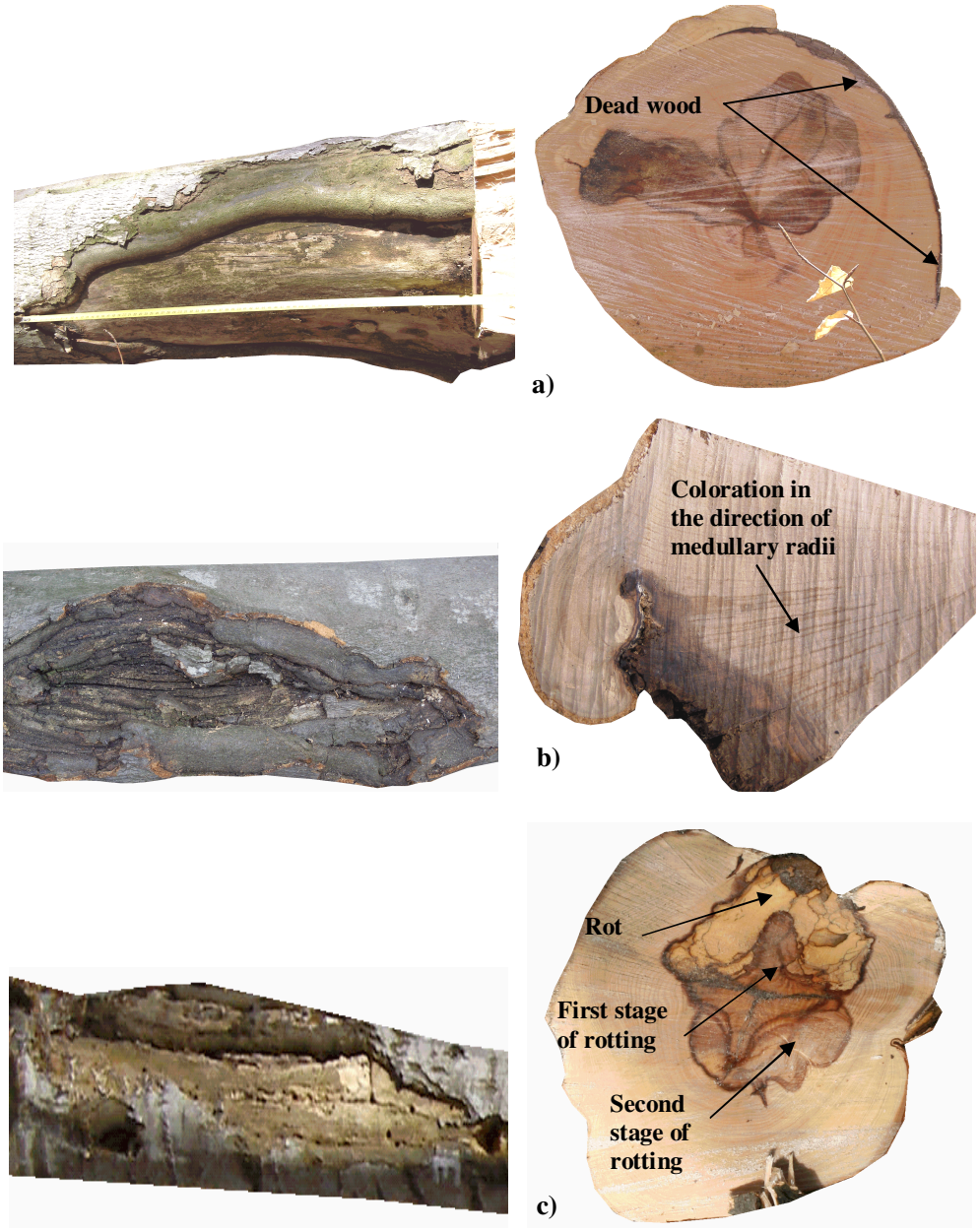

Fig. 2. *Rotting dynamics:*
a) 8 year old wound with dead wood; b) 10 year old wound with dead wood;
c) 15 year old wound with rot

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