

Prof. dr. sc. Božidar Petrić, mr. sc. Jelena Trajković, mr. sc. Radovan Despot
Šumarski fakultet, Zagreb

Some structural characteristics of ashwood (*Fraxinus angustifolia*, Vahl.) from the Lipovljani region in Croatia

Neke strukturne karakteristike jasenovine (*Fraxinus angustifolia*, Vahl.) iz područja Lipovljana u Hrvatskoj

Izvorni znanstveni rad

Prispjelo: 04. 02. '95. • Prihvaćeno: 30. 03. '95 • UDK 630*0.811

SUMMARY • Among various problems concerning rational processing of thin logs, this work discusses the structure of juvenile and adult ashwood. Variations in fiber lengths and diameters, thicknesses of their membranes, diameters of late wood and early wood vessels, and volume percentage of vessel members, width and height of rays and ray volume percentage have all been researched. Necessary measurements in annual rings (age 5, 10, 20, 40, 70 and 100) have been made. It has been established that juvenile ashwood spreads from the pith up to approximately 40th annual ring.

Key words: variations of structural elements, juvenile wood, adult wood, ashwood.

SAŽETAK • U sklopu racionalne preradbe tanke oblovine, u ovom je radu ispitana struktura juvenilnog i zrelog drva jasena iz područja NPŠO Lipovljani. Istražene su varijacije duljine i promjera libriformskih vlakana, debljine njihovih stijenki, promjeri članaka traheja ranog i kasnog drva i njihov udio, te udio drvnih trakova, njihove visine i širine. Potrebna mjerenja obavljena su u godovima starosti od 5, 10, 20, 40, 70 i 100 godina. Duljina, promjer i debljina stijenki libriformskih vlakana, promjer članaka traheja, te visina i širina drvnih trakova rastu od srčike do približno 40-og goda, a dalje prema kori ostaju jednake veličine ili rastu znatno sporije. Volumni udjel članaka traheja ranog i kasnog drva te drvnih trakova raste u istom smjeru, dok volumni udjel vlakana ranog i kasnog drva opada (slika 1-8). Utvrđeno je da se juvenilno drvo jasena prostire od srčike do približno 40 godina starosti.

Ključne riječi: varijacije elemenata građe, juvenilno drvo, zrelo drvo, jasenovina.

1. INTRODUCTION

1. Uvod

Wood structure of each tree species is genetically determined. Nevertheless, there is a considerable variation in wood structure between and within each individual tree of the same species. Some of these variations are influenced by ecological, others by ontogenetical factors of growth. The most significant variations in wood structure dependent on the ontogenetical factors are the appearance of juvenile and adult wood. Juvenile wood is formed by cambium in the first several years of growth. It is thus a central cylinder, built of a certain number of growth rings from the pith along the whole trunk, that forms juvenile wood, and on its outside cambium forms adult wood. Differences in the structure of juvenile and adult wood are affected by abrupt enlargement of wood cells, change in structure and thickness of their cell walls and change in their volume percentage in wood. In the zone where these changes cease or rapidly decrease, juvenile wood transforms into adult wood. Besides the tree species and number of growth rings, the volume of juvenile wood depends on growth ring widths. These structural variations affect alterations in physical, chemical, and mechanical properties and quality of wood.

2. AIM OF RESEARCH

2. Cilj istraživanja

Today the openness of forests is being increased in the Republic of Croatia through the construction of new forest roads. In such forests additional thinning is required. Consequently, the presence of thinner logs in wood processing mills is constantly increasing. The proportion of juvenile wood in such logs enlarges and becomes more significant. Among various problems of rational processing of these logs, this work investigates variations in ash wood structure and determines the boundary between juvenile and adult wood.

3. RESEARCH MATERIAL

3. Materijal za istraživanje

The material for this research originates from the Lipovljani educational and experimental forest site Faculty of Forestry, University of Zagreb, a typical domain of ash trees (*Fraxinus angustifolia*, Vahl.). Four regular, healthy, dominant trees were selected by random samples method and then fallen. 10 cm thick disks were cut from breast heights of each tree, marked on the north and south sides, and then transported to laboratory.

4. LABORATORY WORK

4. Laboratorijski rad

Samples for histological section and the macerated material were taken from each 5th, 10th, 20th, 40th, 70th and 100th growth ring, both from the north and the south side of each disk. Diameters and cell wall thicknesses of wood fibres, diameters and volume percentage of vessel elements in wood structure were all measured on cross sections. Width, height and volume percentage of wood rays were measured on tangential sections. Libriform fibre lengths were measured on macerated material. There were 20 to 30 measurements done on each sample.

5. RESEARCH RESULTS

5. Rezultati

The measurement results of the mentioned wood characteristics, their variations, minimum, average and maximum values are shown in figures 1 to 8.

The diagram in Figure 1 represents variations of wood fibre lengths. It can be seen from the diagram that wood fibre length varies from 0.48 mm to 1.45 mm. Moreover, it can be seen that wood fibre length abruptly increases from the pith to approximately 40th growth ring, while further increase is much slower toward the bark. The average length of all wood fibres is 1.01 mm.

The diagrams in Figure 2 represent variations of wood fiber diameters and their cell wall thicknesses. In the upper diagram it can be seen that wood fiber diameter varies from 8.6 μm to 27.52 μm . The diameter of wood fibres increases to approximately 40th growth ring while further on it remains more or less constant. The average diameter of all wood fibers is 18.20 μm . The lower diagram shows that the cell wall thickness of wood fibers varies from 1.72 μm to 6.88 μm . Cell wall thickness increases slightly to approximately 40th growth ring and then it also remains more or less constant. The average cell wall thickness of all wood fibres is 3.70 μm .

Figures 3 and 4 represent diagrams of variations of early and late wood vessel element diameters. The diagram in Figure 3 shows that the diameter of early wood vessel elements varies from 0.07 to 0.35 mm. It increases to approximately 40th growth ring and then on, but much more slowly toward the bark. The average diameter of all early wood vessel elements is 0.22 mm. The diagram in Figure 4 shows that the diameter of late wood vessel elements varies from 0.04 to 0.21 mm. It also increases to approximately 40th growth ring and then remains

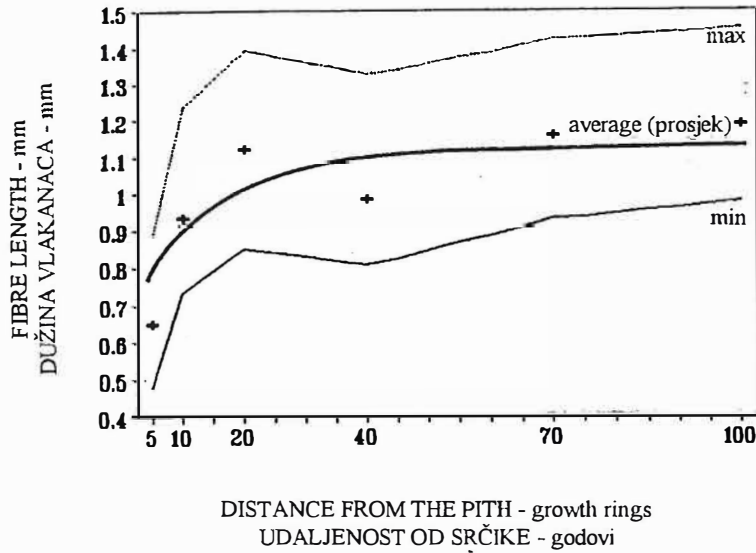


Figure 1
Variation in wood fiber lengths. •
Varijacije dužine libriformskih vlakana

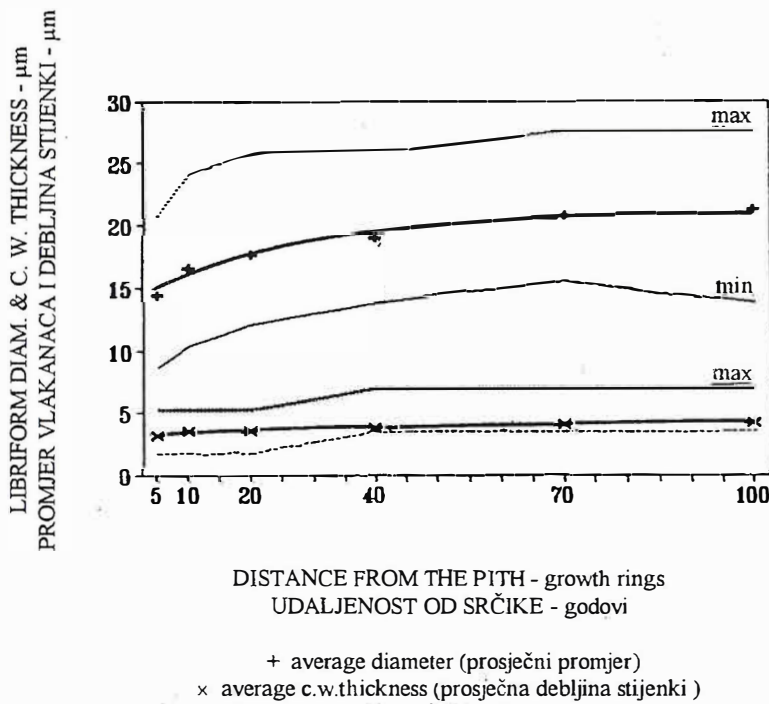


Figure 2
Variation in wood fiber diameter and cell wall thickness. •
Varijacije promjera drvnih vlakana i debljine staničnih stijenki.

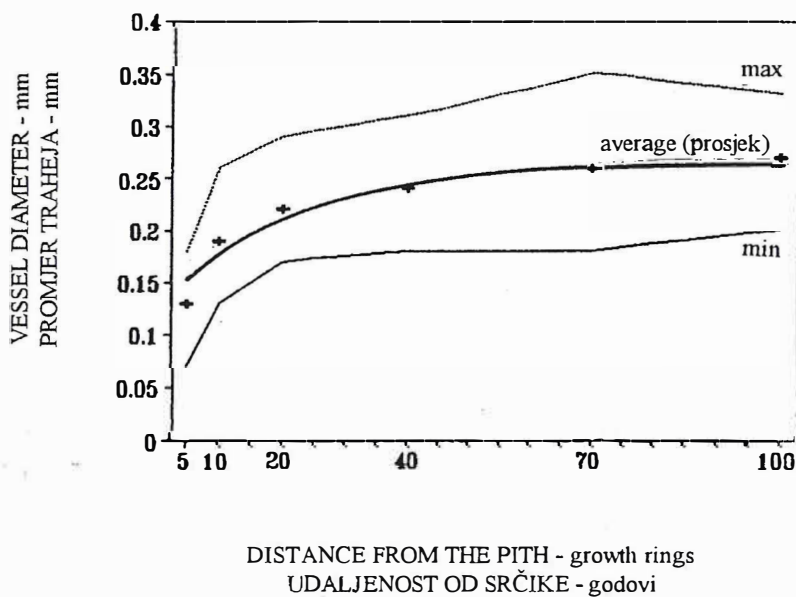


Figure 3
Variation in early wood vessel element diameters. •
Varijacije promjera traheja ranog drva.

Figure 4

Variation in late wood vessel element diameters. • Varijacije promjera traheja kasnog drva.

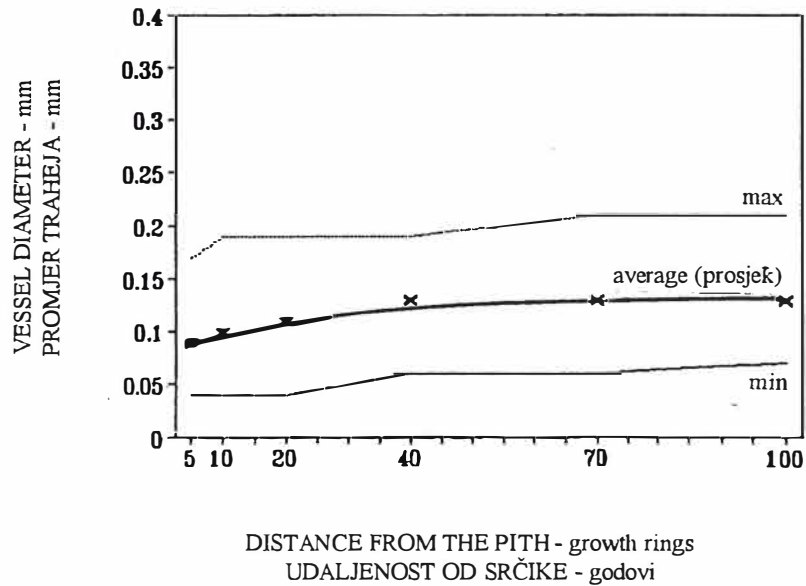


Figure 5

Variation in volume percentage of early and late wood vessel elements. • Varijacije volumnog udjela traheja ranog i kasnog drva.

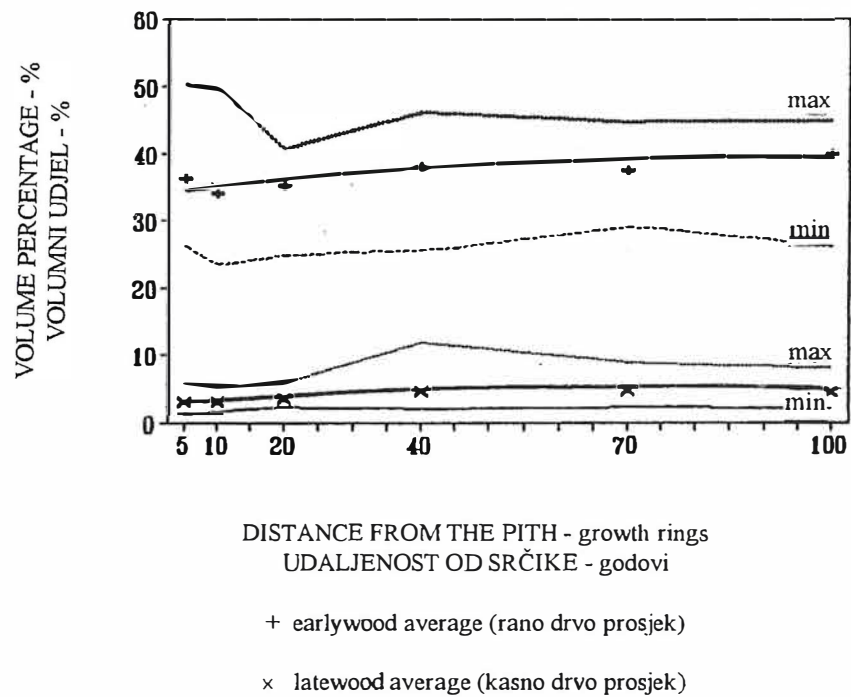
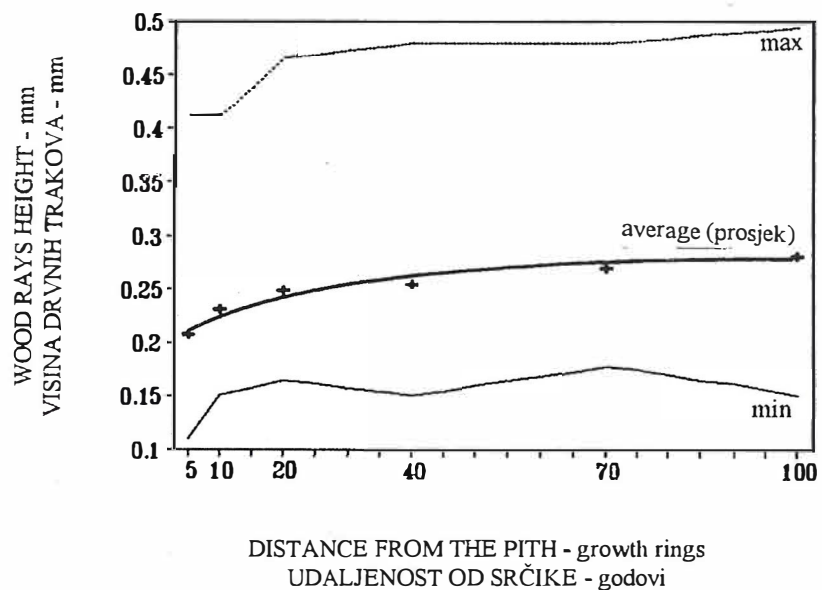


Figure 6

Variation in wood ray height. • Varijacije visine drvnih trakova.



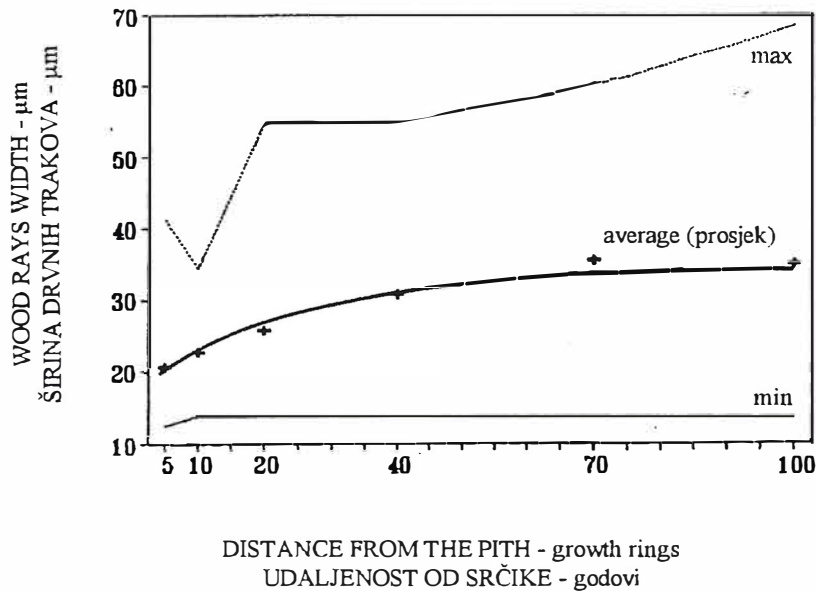


Figure 7
Variation in wood ray width. • Varijacije širine drvnih trakova.

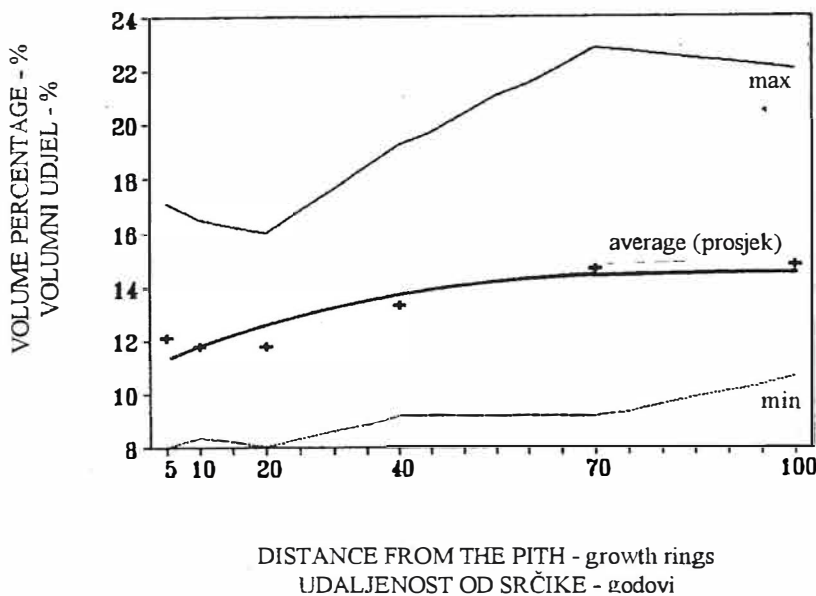


Figure 8
Variation in volume percentage of wood rays. • Varijacije volumnog udjela drvnih trakova.

more or less constant. The average diameter of all late wood vessel elements is 0.115 mm.

The diagrams in Figure 5 represent variations of volume percentage of early and late wood vessel elements. In the upper diagram one can see that volume percentage of early wood vessel elements varies from 23.3 to 50.2 %. The volume percentage of early wood vessel elements slowly increases to approximately 40th growth ring and further on it remains more or less constant. The average volume percentage of all early wood vessel elements is 36.74 %. The lower diagram shows that the volume percentage of late wood vessel elements varies from 1.15 to 11.8 %. It also slowly increases to approximately 40th growth ring and then remains constant. The average volume percentage of all late wood vessel elements is 3.87 %.

Figures 6 and 7 represent variation dia-

grams of wood ray height and width. The diagram in Figure 6 shows that the height of wood rays varies from 0.11 to 0.49 mm. Wood ray height increases slowly from the pith to approximately 40th growth ring and further on remains constant. The average height of all wood rays is 0.25 mm. The diagram in Figure 7 shows that the width of wood rays varies from 12.3 μm to 58.5 μm. It increases slowly to approximately 70th growth ring and from then on remains constant. The average width of all wood rays is 28.4 μm.

The diagram in Figure 8 represents variations of volume percentage of wood rays. It can be seen from the diagram that the volume percentage of wood rays varies from 8.0 % to 22.8 %. Volume percentage of wood rays increases slowly to approximately 70th growth ring and then remains constant. The

average volume percentage of all wood rays is 13.5 %.

It is possible to determine the volume percentage variation of wood fibers on the basis of the volume percentage variation of vessel elements and wood rays. Regardless of axial parenchyma percentage and its variation, the procedure indicates that the volume percentage of wood fibers in early and late wood decreases from pith to approximately 40th growth ring and from then on remains constant. The average volume percentage of all libriform fibers in early wood is 50.2 %, and in late wood 83.31 %.

6. CONCLUSIONS

6. Zaključak

On the basis of the research on the variation of structural characteristics of ashwood from Lipovljani, Croatia the following conclusions can be made:

- wood fiber length, diameter and their cell wall thickness, diameter of early and late wood vessel elements, as well as height and width of wood rays increase from pith to approximately 40th growth ring. Further on toward the bark, they remain constant or increase much more slowly.

- the volume percentage of early and late wood vessel elements and wood rays increases in the same direction while the volume percentage of early and late wood fibers

decreases.

- juvenile ashwood spreads out from the pith to approximately 40th growth ring.

REFERENCES

Literatura

1. Dadswell, H.E. 1958: Wood structure variations occurring during tree growth and their influence on wood properties. *J. Inst. Wood Sci.*, No. 1, p. 1-24.
2. Dinwoodie, J.M. 1961: Tracheid and fibre length in timber. *Forestry*, 34, p. 124-144.
3. Heinowicz, Z., Heinowicz, A. 1959: Variations of length of vessel members and fibres in the trunk of *Robinia pseudoacacia*. *Abstr. IX Intern. Bot. Congr.*, Montreal, p. 158-159.
4. Lewark, S. 1986.: anatomical and physical differences between juvenile and adult wood. *IUFRO 18th World Congress, Yugoslavia, Proceedings, Division 5:272-281*
5. Petrić, B., Šćukanec, V. 1980: Some structural characteristics of juvenile and mature oakwood (*Quercus robur*, L.). *Drvna industrija*, 31(3-4):81-86
6. Petrić, B., Trajković, J., Despot, R., Krstinić, A. 1991: Varijacije dužine vlakana drva breze (*Betula pendula*, Roth) iz prirodne populacije na području Hrvatske. *Šumarski list*, 6-9:273- 284
7. Rendle, B.J. 1960: Juvenile and adult wood. *J. Inst. Wood Sci.*, No. 5, p. 58-61.
8. Senft, J. 1986: Practical significance of juvenile wood for the user. *IUFRO 18th World Congress, Yugoslavia, Proceedings, Division 5:261-271*