

DETERMINATION OF TREE SPECIES IN QUANTITATIVE INDICATORS OF THEIR VASCULAR CELLS

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ABSTRACT

The wood of deciduous species are characterized by complex structure and greater specialization of cells. Besides the different diameter and density for each type trachea may be more or less similar in size. The work examines the differences of the trachea in several mestnorastyashti several tropical tree species.

Measured are the dimensions of cells and their variation within the annual ring. Certain cells are area variances and their diameter. Comparison is made between anatomical characteristics of individual species.

Key words: wood, deciduous trees, tracheas

INTRODUCTION

Wood is made up of different tissues whose cells vary in size, proportion and position. These parameters depend both on the wood species and the conditions of the habitat, location in the tree, etc. In the recognition of tree species are currently used mainly qualitative characteristics of the building – location and shape of the early and late tracheas, the rays etc.

Diagnostic information can also be obtained by using the quantitative characteristics of cells. For example, when the „trachea are similar in diameter“, this will mean that the size of the diameter there is a small dispersion, and when they are „different“ – great. Moreover, this indicator can be examined within the ring. So we will have some value for the dispersion of early tracheas, others for later. This would be particularly useful in species of diffuse-porous wood and one with a transitional structure that claims to have an uniform distribution of the trachea in the ring, and many authors do not accept these terms of early and late wood. Such methods may be useful only when dealing with archaeological wood, i.e. they

can not be produced by preparations with light passing through. For successful implementation, however, a large amount of measurements and preparation of reference tables is required. This work aims to determine the statistical characteristics of the main groups of hardwood construction, and the minimum number of measurements.

METHODS AND MATERIALS

Persistent microscopic chemicals from the wood of the main representatives of different groups of construction were examined. Light microscope was used with „Laboval“ type transmitting light. The used magnifications are 32x and 100x are. At 32x the density of the trachea is determined, and at 100x the size of the cell gap (L) in the tangential direction. Using them there are calculated the variance of the diameter and area of the cell gap. Tested species were 15 species of wood ring-porous, 29 species of wood diffuse-porous, 28 species of tropical and 9 types of transient timber. To reduce the influence of the width of the annual ring, rings studied were selected close in width. Tangential diameter is measured in the cross section of trachea from both sides of the

border between the rings. In tropical species measured tracheas were selected in a radial line, marked by several core beam. There are measured respectively 20 early and 20 late tracheas. An analysis of the values of the mean and variance is made. To determine the minimum number of measurements oak is selected as a species with high dispersion both at the early and late tracheas. At cross-section of six oak species there were measured 40 early and 40 late tracheas. From these measurements there were chosen two samples of randomly selected values of the trachea, respectively 30, 20 and 15 pieces early and late tracheas. An analysis of the values of the mean and variance was made. Density is determined both of the early and late tracheas. The variance and the surface were estimated. The obtained values for diameter, density and area of the trachea

were analyzed in order to extract diagnostic information.

RESULTS AND DISCUSSION

Variation of the trachea in groups structure

In ring-porous wood the diameter of early tracheas vary from about 140 μm to 290 μm (Figure 1). Rates are low at the wood of acacia, mulberry and elm, while at the oaks are high. The diameter of the late tracheas varies from about 30 μm to 104 μm . The low rates are at the wood of oak, elm, mulberry and Polish, while high is at *Acacia* and *Maclura*. The obtained average results of about 200 μm the early tracheas and 55 μm of late are expected since the species are collected in this group because of the large difference between these values.

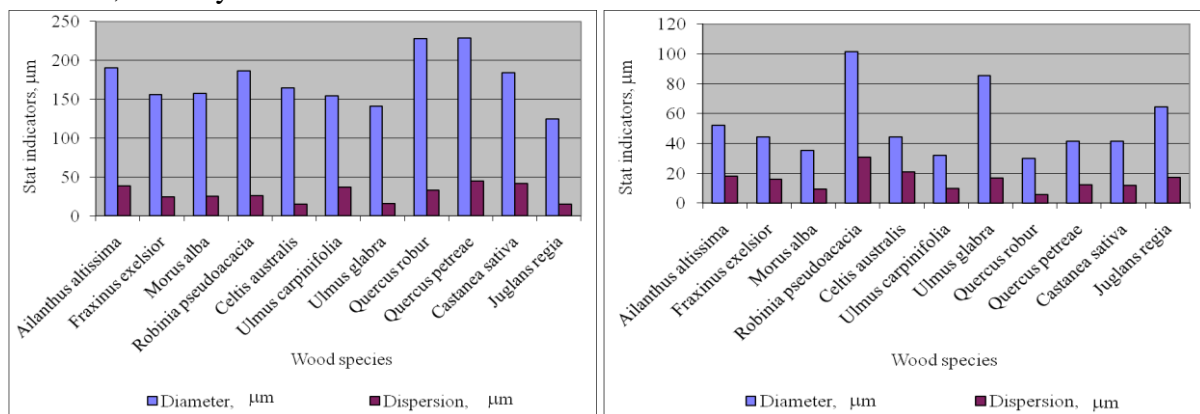


Figure 1: Values of diameter and variance in early (left) and late (right) tracheas of species of wood ring-porous.

In diffuse-porous timber the values of the diameter and dispersion vary little (Figure 2). Concerning the trachea in the early wood they are at about 30 μm up to 80 μm . The low values are at the wood species of the fifth subgroup (birch, pear, etc.) while the high ones are at sycamore tree and *Liriodendron*. The diameter of the trachea in

late wood ranges from about 20 μm up to about 55 μm the representatives are the same. The received average results of about 50 μm for the early trachea and 37 μm for the trachea in the late wood are relatively close, which is a characteristic of diffuse-porous wood.

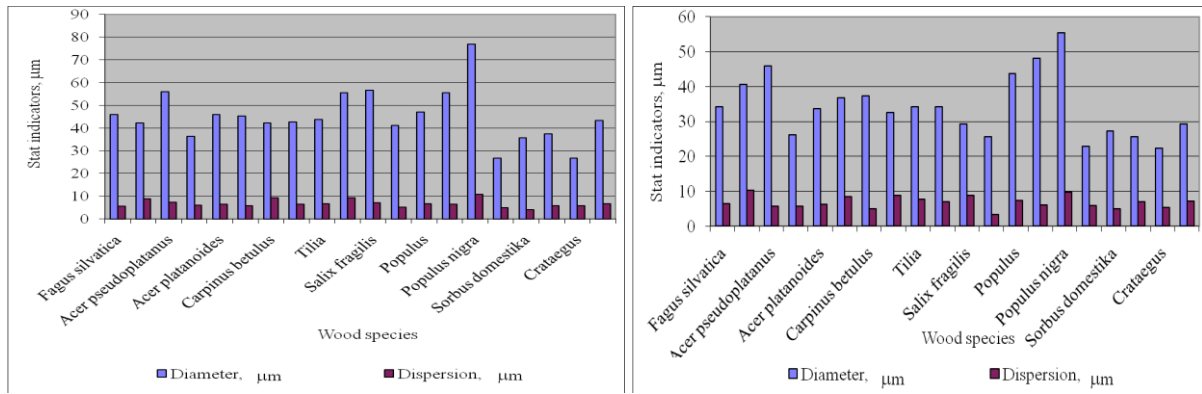


Figure 2: Mean diameter and variance in early (left) and late (right) tracheas of species of wood diffuse-porous.

In tropical timber the variation is divided in groups. There is no difference in the diameter and density of the trachea in the ring. The diameter varies from about 72 μm to about 260 μm. The low values are in the wood species of the fifth subgroup (rosewood, ebony, etc.), while high types are in the fourth subgroup (balsa, limbs, etc.). Splitting wood with transient device into two subgroups – half ring-porous i and half diffuse-porous is precisely according to the value of the diameter of the earliest tracheas. Values of the early wood here are at about 227 μm for the first group to at about 73 μm for the second. In the late wood material difference – at about 38 μm for the first group and 40 μm for the second.

The dispersion of the diameter of the trachea as a diagnostic feature

The analysis of the values of timber ring-porous shows that if the diameter is used only there can be detected acacia wood, field elm, oak and walnut (Figure 1). When the analysis of variance is included, however, the differences of the others can be detected. For example, the wood of ash and coleus are roughly similar in early and late diameter tracheas. The difference in variances between the two as well as between the early and late wood of each of them allows them to be identified successful. Similar is the picture with diffuse-porous (Figure 2). Using only the trachea there can be determined belonging to the fourth or fifth subgroup. By using dispersion there can be recognized beech, canvas, some poplars.

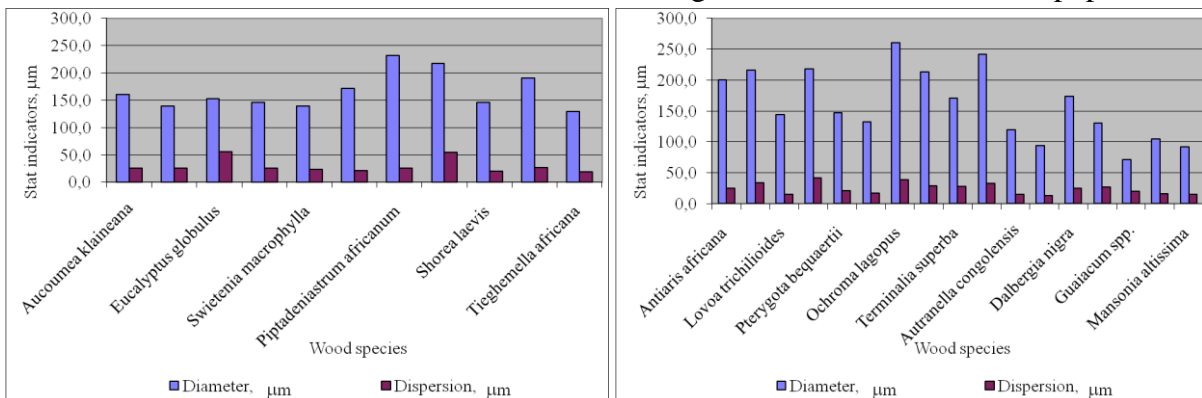


Figure 3: Mean diameter of the trachea and dispersion of species of tropical timber

In tropical timber even through the diameter of the trachea alone the subgroups can be separated from each other (Figure 3). By using the values of the variance the wood of Eucalyptus, Paducah, Iroko, can be easily identified. When using the values of the diameter and dispersion, however, it must be taken into account not only the average value, but the range defined by at least five representatives of each species. This is because some types have values that are similar and overlapping. These include rep-

representatives from the heel of each major sub-group structure.

The area of the trachea as a diagnostic feature

Knowing the diameter and density of the trachea, it is also easy to calculate the area they occupy in the early and late wood. The area of the trachea and the upstream speed is individual for each species and depends on their physiological characteristics (Figure 4). In analysis of the obtained values it should be considered when a certain tree is peeled off, when it blooms etc.



Figure 4: Distribution of early and late wood in the tracheas of *Kalopanax*, *Castanea* and *Phellodendron*

Upon careful consideration of the anatomical structure of both species it is observed that the values, obtained for the early and late wood only, will not be enough. Even with close values for diameter and dispersion of early and late tracheas, the amount of the transition zone is very different. On the other hand diffuse-porous timber first tracheas often have a smaller diameter than those located in the entire area of the early wood. This distribution was observed in *Phellodendron*. That is why you should include a measurement of the diameter and density of the transition zone in the trachea.

Using a graphical method of detection

Obviously the presented methods for identification of tree species by quantitative indicators of their conductive elements are not accurate and can not be used alone to diagnose. However, if you identify as key indicators the diameter and density of the trachea and the dispersion of the diameter and the area of the trachea as a function of them you would have another option for a species comparison method (Figure 5).

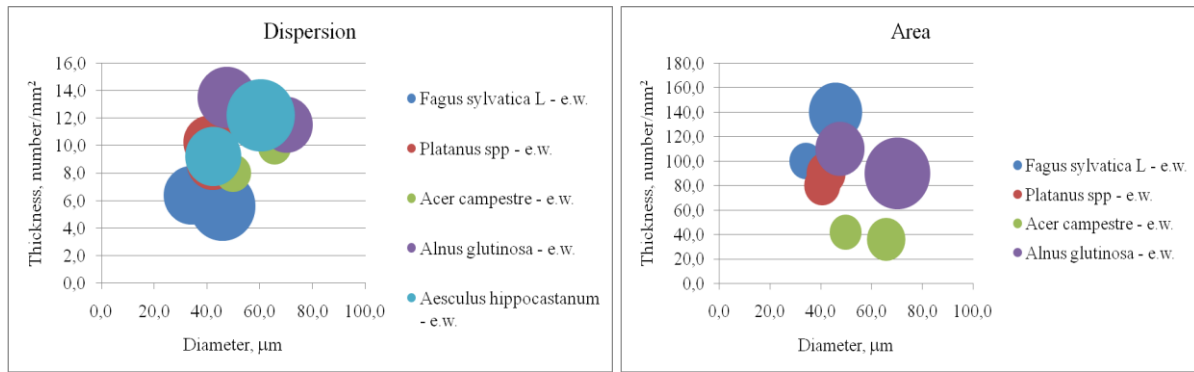


Figure 5: Distribution of certain tree species, depending on the diameter and dispersion area of the trachea.

The tree species shown in the picture are the most prominent representatives of diffuse-porous in the first three subgroups. The figure clearly shows the differences between the different types. Similar comparison between the values of a particular species tested would be far easier and comfortable than the classic study of the anatomical structure of timber for identification.

Required measurements of the trachea

To increase the efficiency of the work it is necessary to determine the minimum

number of tracheas measured without seriously compromising the accuracy of the work. On one hand, according to the methods of statistics this number is different for each species. On the other in order to use dispersion as a diagnostic value, this number must be the same for all types. Therefore, to determine this number measurements of oak timber were conducted, because it has one of the largest variances in diameter of the trachea (Table 1).

Table 1. Values of the difference of diameter and dispersions of the tracheas at certain number of experiments.

Type of wood	Early wood		Late wood	
	Sample average	Standard	Sample average	Standard
<i>Q. robur</i> , number 30	1,51	0,59	2,35	0,72
20	13,82	8,76	5,92	0,44
10	17,73	7,97	8,66	4,35
<i>Q. petraea</i> , number 30	1,89	3,69	1,90	1,09
20	6,65	6,40	3,07	0,89
10	11,90	3,84	4,03	1,62
<i>Q. frainetto</i> , number 30	1,32	0,18	0,38	1,17
20	13,31	8,65	2,04	3,36
10	20,19	15,51	4,22	4,69
<i>Q. ilex</i> , number 30	3,77	0,28	1,13	0,46
20	6,07	1,26	2,83	2,04
10	7,20	4,17	4,60	2,44
<i>Q. rubra</i> , number 30	1,89	0,53	0,38	1,68

Type of wood	Early wood		Late wood	
Statistic indicators	Sample average	Standard	Sample average	Standard
20	2,51	5,66	0,33	4,03
10	0,94	5,90	1,03	4,50
<i>Q. suber</i> , number 30	1,78	7,49	1,83	0,80
20	3,74	0,73	2,85	2,22
10	8,67	2,21	2,20	3,70

The obtained differences in a different number of measurements for early tracheas at 30 measurements vary from 1,32 μm to 1.89 μm . An exception is the wood of *Quercus ilex* with very different tracheas of 3,77 μm . In late tracheas values range from 0.38 μm to 2.35 μm .

In general, closest to the average are the values of the early tracheas in *Q. ilex*, while furthest - in *Q. frainetto*. In late tracheas the

closest values are in *Q. petraea*, and furthest – *Q. rubra*.

The obtained values of the differences between the average values of diameter and dispersions after 15, 20 and 32 measurements respectively, show that much more precise are the values after 30 measurements (Table 2).

Table 2. Average of the diameter of the trachea and variances for different number of attempts.

Type of timber	Early timber		Late wood	
Statistical indicators	Sample average	Standard	Sample average	Standard
30 measurements	2,03	2,13	1,33	0,99
20 measurements	7,68	5,24	2,84	2,16
10 measurements	11,11	6,60	4,12	3,55

The differences of 20 measurements are about 2 times larger than those of 30 measurements. Differences in values of 10 measurements are about 3 to 5 times larger.

CONCLUSIONS

After analyzing the size of the cells and their variation within the annual ring of the modes, the following important conclusions can be inferred:

- In analysing the values obtained for the diameter and density of the trachea, the physiological characteristics of the species should also be considered.
- For a more accurate description of the pattern of trachea change within the

annual ring, measurement of their diameter and density should also be included both in the area of early and late timber and in the transient area.

To determine the diameter and dispersion of species and to compare them with the reference table, 30 measurements in early and late wood are sufficient.

- Successful identification of tree species by quantitative indicators of their tracheas can only be obtained by combining all methods.

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