A STUDY OF THE DISTRIBUTION OF THE VESSELS AS A DIAGNOSTIC SIGN

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ABSTRACT

The distributi on of the vessels in wood is largely genetically staked for each species. Many of the features available are permanent and unique to each species. The size and density of the vessels depend to a large extent by the site conditions and the location in stem.

The article examines the distribution of the vessels of some tropical tree species. The vessels were examined in cross-section. From the next few cells are formed the figures such as loops. Attitude lap / area (V/S) of these figures is discussed.

Key words: vessels, wood, distribution of the vessels, tropical tree species.

INTRODUCTION

The examination of the trachea as abstract structures involves the study of their quantitative characteristics - diameter, density and location. The size and density of the vessels, however, depend largely on the conditions of habitat, their location in the stem and others. It is therefore necessary to find such a characteristic that has remained relatively constant at changing the factors that affects plant development. The location of vessels can be assumed for such characteristic. Moreover, in many species it is so characteristic that it defines the membership of tree species to the respective structure –ring-porous, diffuse-porous and others.

Whether this is true in tropical tree species in which this feature seems very close to most of them? To identify these species anatomical signs of their wood there are two ways:

- the signs are qualitative categories (previously used in the identifying of wood);
- the signs are quantitative categories (which can be measured and processed statistically);

The analytical description of the vessels as a diagnostic feature can include the study of the following sets of characteristics:

- Diameter and density of the vessels;
- The location of the vessels in the radial and tangential direction;
- Relative positions to one another vessels.

If, for example, we look at two types (*Afzelia* and *Antiaris*), which have similar quantitative characteristics of the diameter and density of the trachea becomes very clear the need to describe the location of these vessels (Fig. 1).

Figure 1: Location of the vessels in Afzelia (left) and Antiaris (right), which have similar quantitative characteristics of vessels.(Afzeliaafricana – diameter100–180–270 µm, density 3–5 piece/mm^2), (Antiarisafricana – diameter155–200–245 µm, density 3-5 piece/mm^2.)

The aim of this work is to examine species that are very close in structure of the wood to look for those quantitative characteristics that can successfully be used as diagnostic signs.

METHODS AND MATERIALS

The tree species that a reused for research in this work were selected from the collection of H. G. Richter и M. J. Dallwitz – „Commercial Timbers: Descriptions, Illustrations, Identification, and Information Retrieval“. The species included in the collection are among the most popular industrial-used tree species. From this collection are analyzed more than 220 tropical tree species.

The purpose of the analysis is to select these representatives that the structure of the cross section is very difficult to distinguish from each other. The species are introduced into the table with their tabulated values for the diameter of the vessels, the density of vessels and the wood density. Of these were selected only 46 species whose vessels diameter is 120 to 150 µm. Of these were selected 22 species with density vessels from 8 to 14 pieces/mm^2.

Of selected species has been studied only cross section. The diameter and density of the vessels were measured. Section itself (picture) is divided into 9 equal portions. The schemes for location in radial and tangential direction have been composed. Same repetitive structures have been sought.

To measure is used the program SketchUp, running Windows 10. Linear sizes are determined precisely to the third sign of the particular scale and are converted into µm.

In the first inspection are spent lines close to parallel to the core rays connecting a series of consecutive cells. The distances between the cells have been measured. The average value, which in this case indicates the average distance between the vessels in the radial direction and the standard deviation are defined (Fig. 2).

In the second measurement are spent lines close to perpendicular to the core rays also linking a series of consecutive cells. The distances between the cells have been measured. The average value and standard deviation also have been defined.

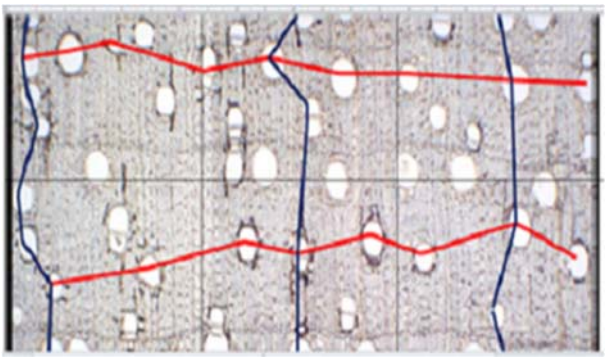

Figure 2: Measuring the distribution of vessels in radial (vertical lines) and tangential (horizontal lines) direction

In the third measurement are formed loops forming approximately the same and characteristic of each type of placement. The purpose of these figures is the determination of the relative position of vessels. The distances between the cells have been measured. The average value (i.e. the average distance between the vessels), standard deviation and the number of the measurements are defined (Fig. 3). The circumference and face shapes have been determined. The relationship between the circumference and the face has been formed.

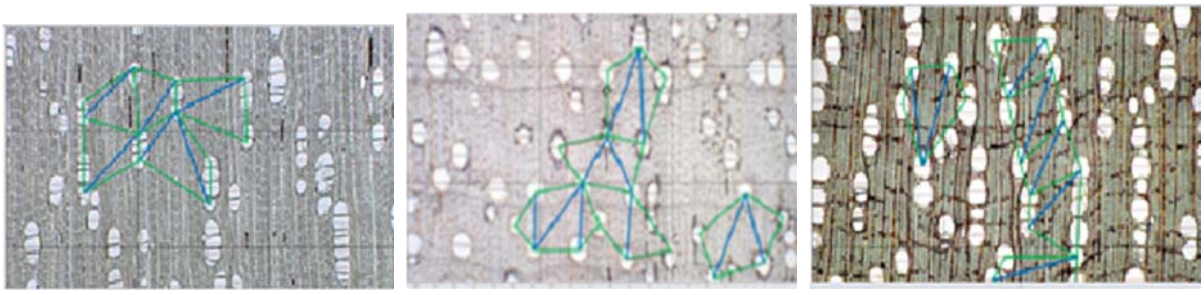

Figure 3: Small, approximately the same and repetitive figures in *Diospyrosvirginiana*, *Gambeyabeguei* and *Palaquiumhexandrum*.

In preliminary studies proved that this indicator is more useful as a category rather than individual code. It is important to define what, how many and how are selected vessels. The problems in this setting can be combined into two groups:

- Technical – how many and which vessels to choose how to connect (with center or without center) etc.;
- Factual– how to select these vessels so that there is repetition in the same tree species, how to define this group, etc.;

After determining the figures of vessels could be examined the area of the group with the circumference of the whole group. Variants of these groups are few and they will not be able to describe solutions of the problems in one article. Therefore, here are selected pieces of the same type (quadrangles and pentagons) and the same number of vessels. The area of the figures is determined once they are broken down into triangles and then used the formula of Heron. The circumference is defined as the sum of the segments.

RESULTS AND DISCUSSION

The diameter of the vessels is one of the most easily measured parameter. Enough to have a quality microscope slide and a good starting line. The tree species chosen for study had close table values for this indicator. However, for accurate measurement of the tangential diameter, they are divided into three groups (Table 1). This means that despite the relatively high variation of this indicator in species with very different diameters (not only studied in this article) the division would be very effective in the indicator that carries diagnostic information.

Furthermore, there are separations depending on the size of the standard deviation i.e. even species caught in one group and three indicators can be divided depending on it. In this measurement, the high value of standard deviation means many different vessels according to their diameter (for example as *Afzelia* and *Antiaris*) and vice versa – a small standard deviation means almost the same size as vessels (for example as *Gambeya* and *Palaquium*). It should be noted that the separation of the groups here is relatively a selected step of separating about 30 μm. However, the step size may be determined only after having examined the variation of the diameter, depending on the site conditions and the location in the stem. It is possible to choose the standard five categories (Wagenfur, R. 1996, Bardarov, N. 2014).

The location of the vessels in the radial direction is relatively varied. Here species are divided in to three groups, with an average location of the vessels, respectively, in 450 μm, 370 μm and 280 μm. Even these small differences in more precise measurement are a sufficient indicator of difference in construction. There is also a splitting and depending on the size of the standard deviation. In this measurement, high standard deviation means spilled as much available and vice versa – a small standard deviation means many evenly spaced one from another. This means that even species fall into one group can be separated depending on the uniformity of the location of the vessels each from other.

The location in the tangential direction is also very diverse. These species also are divided into three groups, with an average location of the vessels, respectively, in 680 μm, 530 μm and 400 μm. Immediately impressed is the difference in value compared to the radial location. Differences in location here are larger, which necessitated the selection of these ranges. Furthermore, the combination of the values of the standard deviation emphasizes the differences between the species. While differences in the values of this index for the top group are about 150–200 μm, then here they are from 100–300 μm.

Table 1: Anatomical indicators of the studied species

Tree species	Diameter of vessels	Location in radial direction	Location in tangential direction	Location in closed loops	Relation V / S
Leucaenaglauca	124	635	812	559	0,008
Diospyrosvirginiana	158	397	538	484	0,007
Palaquiumhexandrum	189	310	677	548	0,008
Gambeyabeguei	145	254	583	518	0,008
Grevillearobusta	145	450	543	565	0,008
Virolamultinervia	121	342	545	613	0,008
Lovoatrichilioides	175	347	407	346	0,011
Turraeanthusafricanus	184	347	522	434	0,008
Astroniumurundeuva	144	350	456	318	0,014
Gossweilerodendronbalsamiferum	171	404	530	509	0,007
Guareacedrata	144	317	386	406	0,010
Guareathompsonii	128	427	496	428	0,008
Gonystylusmacrophyllus	140	382	509	547	0,008
Payenaobscura	112	263	364	339	0,010
Manilkarabidentata	118	301	442	666	0,008

Tree species	Diameter of vessels	Location in radial direction	Location in tangential direction	Location in closed loops	Relation V / S
Terminaliaamazonia	132	413	473	421	0,009
Chlorocardiumrodiei	119	412	472	373	0,009
Piptadeniarigida	114	447	457	379	0,010
Cinnamomumcassia	106	363	405	276	0,010
Entandrophragmacilindricum	166	488	760	501	0,008
Mezilaurusitauba	156	451	535	428	0,008
Vitexcofassus	129	371	334	247	0,011

Due to the closeness in values of the position of the vessels in the radial and tangential direction of some of the types have to look for another feature of the layout of the vessels. Upon closer inspection in cross-section of each species are observed characteristic and repetitive figures. The measurement of these figures can be differentiated species still more from each other. Here also has been selected separating the types into three groups.

The first group is evenly distributed and collected vessels from one another by an average distance between the vessels about 500 μm. In the second group there are some types that are very evenly and closely spaced vessels one from each other with a distance between 400 μm. In the third group has the closer spacing of the trachea from each other with a distance between vessels 300 μm.

In the study of the resulting pieces of vessels is formed between the circumference ratio (V) and their face (S). For larger pieces this relation is relatively stable and ranged from 0.006 to 0.008. The smaller figure leads to bigger increase of the ratio. Shown in the table values are obtained as are formed arithmetical average of the tour and the face of all formed in the section pieces. Even if it is not used as an accurate code, this indicator can be used to separate the types of groups. To fully exploited, however, like other characteristics of the location, we must first study the variability in this indicator.

CONCLUSIONS

After analyzing the results can be drawn the following conclusions and recommendations:

Using the diameter of the trachea remains the leading in the identification of species. Because of the wide variation of this indicator is well, species can be divided into categories;

Using the standard deviation of diameter is very useful in the identification of species whose average is very similar, but their wood is (or not) vessels of different categories according to their diameter;

The breakdown in tangential and radial direction gives a very definite diagnostic information and facilitates the even identification of species of one genus;

If possible, it would be better separation of the categories to be carried out with the same step size. The categorization of the types according to the position to be used and the standard deviation – for example large groups regular or irregular large groups;

The minimum size of the cross-sectional studies, which is sufficient to identify the tree species of the order of several millimeters. In the division of this area of the parts are compared results for different parts of our ensure accuracy of the study;

To conduct studies to determine the variability in each of these anatomical indicators. To examine how they depend on each other;

When working with more and different types it is well the categorization to be presented schematically.

In order to determine the effectiveness of the method while working with many trees with identical structure it is needed to determine the approximate number of species in one category.

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UNIVERSITY OF FORESTRY
FACULTY OF FOREST INDUSTRY

INNOVATION IN WOODWORKING INDUSTRY AND ENGINEERING DESIGN

1/2018

INNO vol. VII Sofia

ISSN 1314-6149
e-ISSN 2367-6663

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