I. The antecedents and objective of research

With respect to the wood supply of Hungary it is particularly important to improve the wood quality of the plantation of the tree species that grow quickly. My paper was written the intention to give information to professionals working in the field of forest management and wood processing about the characteristics of wood material coming from plantation forests and to point out the differences between certain species (clones) with the help of comparative studies. The study of the relations between the anatomic and technical characteristics of plantation wood material can significantly increase the efficiency of wood utilization in the future.

The tissue structure of the tree planted in a network differs from the structure of trees growing in natural or natural-like forests. The choice of the planting distance, that is to say the size of network enables the change of the growth circumstances of the tree. The problem of the first narrow networks justified the growth of planting distances and the study of the wood material resulting from these network experiments. In my paper I intend to give information to professional in the field of forest planting on the topic of which networks produce wood materials that have the best characteristics with respect to wood processing.

Out of the coniferous trees in our country Scotch pine, black pine and spruce have economic significance. The strength grading of Scotch pine grown under domestic circumstances differs from the data given in the literature. Therefore the Scotch pine growing in Hungary has a structure of looser tissue. Nevertheless, spruce has advantageous features, its quality matches or sometimes even surpasses the quality of imported spruce. While in our country there has been significant research done on the poplar and locust (clones), there is a gap in the study of tissue, structural and physical characteristics of coniferous trees. The studies on clones done so far with respect to coniferous trees examined the problem from the viewpoint of forest economy. In my paper I give information to professionals in wood utilization about the wood characteristics of Scotch pine and spruce trees.

The objectives of research:

- To study of some macroscopic tissue, microscopic structural, fiber morphological and physical characteristics out of the features that determine the quality of wood material of trees grown in plantation forests.

- To show the differences in the wood material characteristics of the species of vegetative propagation (clones) introduced by the breeders.

- To study the trunks planted in various networks to gain information which plantation method is the most favorable with respect to industrial utilization.

- For the saturation and hydrothermal treatment of wood materials it is essential to know their permeability features. One objective of the research is to study the permeability features of wood out of its physical features, and to work out a new method with respect to coniferous trees.

- To use the method determining the decurrent direction of micro fibers that constitute the secondary cell wall of tracheids building up the largest part of the wood material of coniferous trees. This method is based on measuring the direction of the pit opening of the intersecting field. One objective is to apply this method under domestic conditions and study the efficiency of measuring.

II. The method of research

Within the framework of research I have studied 157 trunks of 41 clones in case of spruce and the wood material characteristics of 23 trunks of 3 clones in case of Scotch pine. In case of the latter the three clones came from four different networks (2x2; 8x2; 8x6; 8x16).

On the material of both trees, that is to say the sample trunks of spruce and Scotch pine, the macroscopic, microscopic tissue and physical features were examined. When planning the inquiries, I had to take into account the moisture condition of wood and the fact that for each trunk I had at my disposal a disc with a thickness of 2,5-3 cm. My primary goal was to secure the measure of as many wood features as it is possible on the discs for the sake of complexity. For this I established a scheme, in which I divided the discs into parts. On the wood material divided into parts, test bodies of 2x2 cm were created along two axes vertical to each other. With this method it was possible to trace wood characteristics on a radial direction.

The following examinations were conducted on the discs:

- To determine the diameter of trunk
- To determine external precision
- To measure annual ring width
- To measure the length of tracheids
- To determine the cell wall-lumen ratio
- To measure the angle of micro fibers
- To measure basic density
- To measure the shrinking of volume
- Permeability examination
- To determine compressive strength

Out of the examinations the measure of the angle of micro fibers constituting secondary cell the wall and in case of coniferous trees, permeability examinations have been firs determined in Hungary in this research.

III. Methodological, measurement technical results

In practice, the preservative saturation of spruce has a very important role. Saturation is closely related to permeability. For the latter examinations, I created the first measuring system in Hungary.

According to the result of permeability examinations, the 80 % diluted solution of ethyl alcohol (C_2H_6O) proved to be the best permeable liquid. The reason for this is the fact that it hardly swell the wood, and it damages wood structure to lesser degree than other dissolvent. On the basic of measures I concluded that the average permeability grade of spruce is $7{,}61 \cdot 10^{-6}$ darcy ($0{,}776 \cdot 10^{-10}$ $m^3/m \cdot Pa \cdot s$), which is very low, and proves the heavy saturation of spruce. Furthermore, the result of examinations between clones have shown, that the scale of aspiration of pits can change even within one trunk, which largely influences the results of measurement.

The measurement of micro fiber angel done in the framework of the project, which was also pioneering in Hungary, where previously no such research was conducted, proved that because of the differences resulting from the tissue variability of the trees, it is almost impossible to determine the differences between the clones. The changes in the tissue of the wood, e.g. the creation of compression wood, greatly alter the decurrent direction of micro fibers, and therefore we can experience great variability also within the clones. I measures the decurrent direction of micro fibers located in the cell wall of the tracheids with the "method based on the direction of the pit opening of the intersecting field", which is familiar to foreign researchers. I concluded that this method is very suitable for the determination of the compression wood in coniferous wood material, which is sometimes difficult to locate because it can happen that the wood containing compression wood shows no change of color. For the wood industry the wood containing compression wood is less interesting since their technical features are largely determined by its presence.

IV. Thesis – like summary of new academic results

1. As a result of the examinations conducted in the framework of the project I verified that out of the examined Scotch pine networks (2x2; 8x2; 8x6; 8x16) the individuals growing in the network of 2x2 have the best wood material features.

2. I stated that the genetic improvement of spruce significantly influences wood quality, and out of the 41 spruce clones I chose the ones that have advantageous features with respect to wood processing and paper industry. Therefore I recommend the plantation of the following 6 clones: '2454', '25177', '25194', '27140', '28114', '28396'.

3. I stated that the quality of Scotch pine wood body is less influenced by improvement because I found no significant differences between the 3 Scotch pine clones examined in the project with respect to their anatomic, physical and mechanical features.

4. To increase the natural protection of wood material during the various saturation processes and to use hydrothermal treatment we have to know the permeability features of the wood. Under domestic conditions I was the firs to determine the permeability features of spruce. As the result of the investigations, I got the average of $7{,}61 \cdot 10^{-6}$ darcy for the whole population, which proves the difficult saturation of spruce.

5.1. I was the first in Hungary to determine the decurrent direction of micro fibers located in the cell wall of the tracheids of spruce and Scotch pine wood with the "method based on the direction of the pit opening of the intersecting field". I stated that the examined Scotch pine wood had 80 % compression wood.

5.2. I recommend the use of the "method based on the direction of the pit opening of the intersecting field" that determine the decurrent direction of micro fibers to trace the presence of compression wood because according to my examination results it is reliably suitable to determine compression wood.

6. I stated that in case of the examined Scotch pine of domestic origin the "juvenile tree" encompasses 15-17 annual rings and the "juvenile effect" can be markedly demonstrated in the physical and mechanical features. Therefore the thinner roundwood versions of Scotch pine have weaker mechanical features. Spruce investigations justified that the juvenile tree encompasses only 10-12 annual rings. Because of the thin-walled, early tracheid stock the "juvenile effect" was not yet expressed in the technical features.

IV: Publications connected to the subject

Book chapter

1. PAUKÓ, A. 2000: Hazai és egzóta haszonfák. Faipari Kézikönyv I. Szerk. Molnár, S. Faipari Tudományos Alapítvány, Sopron, pp. 89-110

Presentations pudlished in proceedings of international conferences

1. PESZLEN I.- SZOJÁKNÉ TÖRÖK K. -PAUKÓ A. 1999: Wood properties in *Pinus silvestris* clones, 2nd International Conference of PhD Students, University of Miskolc, Aug 8-14, pp. 55-61.

2. PESZLEN I.- SZOJÁKNÉ TÖRÖK K. -PAUKÓ A. 2001: Comparison of Anatomical and Physical Characteristics of Norway Spruce Clones, 3nd International Conference of PhD Students, University of Miskolc, 2001 Aug 13-19, pp. 215-218.

Posters

1. PESZLEN I.- SZOJÁKNÉ TÖRÖK K. - NÉMETH R.- PAUKÓ A. 2000, Wood properties in *Picea abies* clones, Technical Forum Presentation, Forest Products Society 54th Annual Meeting, South Lake Tahoe, USA, Jun 18-21.

2. PESZLEN I.- SZOJÁKNÉ TÖRÖK K. -PAUKÓ A. 2001: Comparison of Anatomical and Physical Characteristics of Norway Spruce Clones, 3nd International Conference of PhD Students, University of Miskolc, 2001 Aug 13-19.

Papers in Hungarian language

1. PAUKÓ A. 1997: Az akác folyadékáteresztő képességének vizsgálata, Bútor és Faipar 3-4. pp. 24

2. PAUKÓ A. 1997: Miért előnyös az akác felhasználása a hordógyártásban, Magyar Asztalos és Faipar 09. pp. 142-143

3. PESZLEN I.- PAUKÓ A. 2001: A reakciófa kialakulása és tulajdonságai I., Magyar Asztalos és Faipar 11 pp. 134-135

4. PESZLEN I.- PAUKÓ A. 2001: A reakciófa kialakulása és tulajdonságai II., Magyar Asztalos és Faipar, 12 pp. 152-153

5. PESZLEN I.- PAUKÓ A. 2002: A reakciófa kialakulása és tulajdonságai III., Magyar Asztalos és Faipar, 01 pp. 134-135

6. MOLNÁR S.- NÉMETH R.- PAUKÓ A.- GÖBÖLÖS P. 2002: Fehérnyár hibridek faanyagminőségének javítási lehetőségei, Faipar 02 pp. 24-26

Presentations in Hungarian language

1. PAUKÓ A. (2001): Fenyő klónok faanyagának morfológiai és fizikai összefüggései, Új eredmények a fa és rosttechnológiai tudományokban konferencia, Nyugat-Magyarországi Egyetem, 2001. November 7.

Oral presentations

1. PAUKÓ A. 2002: The reaction wood, North Carolina State University, USA North Carolina, Raleigh, 2002.11.21.

Final report not placed in a library

1. Fehérnyár hibridek faanyagminőségének változékonysága és javítási lehetőségei – OTKA, NYME, Faanyagtudományi Intézet 1999

2. A juvenilisfa jellemzőit és a reakciófa előfordulását befolyásoló tényezők elemzése ültetvények faanyagában – OTKA, NYME, Faanyagtudományi Intézet 1999

3. A faanyagminőség genetikai javítása – OMFB-PHARE, NYME, Faanyagtudományi Intézet 2000