



## CORRELATION BETWEEN WOOD DENSITY AND FIBER LENGTH WITH ESSENTIAL MACRO-NUTRIENTS ON BASE OF STEM OF *Shorea leprosula* and *Shorea parvifolia*

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### ABSTRACT

*S. leprosula* and *S. parvifolia* are widely developed as source of high quality wood. The quality of wood could be affected by nutrient elements. It is important to measure the nutrients contained in tree stem including wood density and fiber length due to their influence in tree growth. This research aims to know correlation between wood density and fiber length with distribution of essential macro-nutrients; N, P and K on stem base of *S. leprosula* and *S. parvifolia* trees. Wood density measurement followed DIN 2135 standard method, fiber length measurement followed FPL method, and nutrient measurement used AAS method. Further, the observation data was analyzed using SPSS 16 software. Wood density and fiber length on stem bases of both of tree species tended to increase radially from section nearby the pith to section nearby the bark respectively. Wood density of *S. leprosula* ranged from 0.333-0.362 with 1.279-1.343  $\mu\text{m}$  in fiber length, while wood density of *S. parvifolia* ranged from 0.285-0.346 with 1.497-1.805  $\mu\text{m}$  in fiber length. Distribution of nutrient N, P and K of stem base from pith to bark also tended to increase. On *S. leprosula*, nutrient elements N, P, K had significant correlation with wood density and fiber length. On *S. parvifolia*, nutrient elements N, P, K had a significant correlation with wood density. Meanwhile, nutrient elements N, P, K had a non significant correlation with fiber length.

Keywords : *Shorea leprosula*, *Shorea parvifolia*, base of the stem, wood quality distribution, nutrient distribution.

### INTRODUCTION

Dipterocarpaceae is dominant tree family in lowland tropical rain forest of Southeast Asia. These trees have larger size than the others, so that it becomes one of high-value sawn timber (Breulmann *et al.*, 1998). Some species of Dipterocarpaceae that have been developed are *Shorea leprosula* and *Shorea parvifolia*.

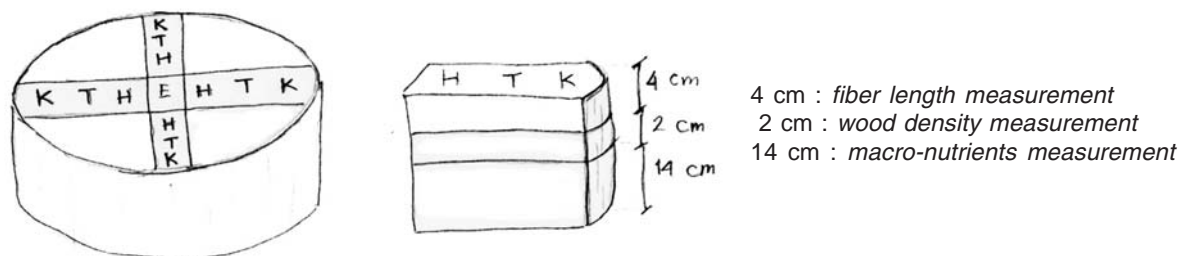
Tree growth is strongly influenced by the environment and nutrition. Richards (1992) explained that it is important to measure the nutrients contained in the tree based on age, size, fertilization and soil fertility. Tree nutrition information is mostly gained from leaves nutrition, while the nutritional content of stem is very rarely observed.

Wimmer (2002) explained that in each individual tree, encompass cells structure, tissues and organs are closely related to tree physiology and provide lots of information about its past life and environment. Some wood properties that can be analyzed are cell anatomy, cell dimension, micro fibril angle and wood density (Lasserre *et al.*, 2009).

The aim of this research is to determine the distribution of wood density and fiber length and its correlation with the distribution of essential macro-nutrients (nitrogen, phosphorus and potassium) contained in the base of stem of *S. leprosula* and *S. parvifolia*.

## MATERIALS AND METHODS

Disc samples of stem base of *S. leprosula* and *S. parvifolia* have 40 cm of diameter and 20 cm of cutting thickness. These samples were taken from the area of RKT 2011 IUPHHK PT. Gunung Gajah Abadi, Muara Wahau, East Kutai, East Kalimantan. Each disc was made into X axis as shown below.



Caption : E : empulur/pith  
T : tengah/mid  
H : dekat hati/near of pith  
K : dekat kulit/near of bark

Figure 1. Sampling test on stem base of *S. leprosula* and *S. parvifolia*.

Measurement of wood density and fiber length was held in Laboratory of Forest Products Technology, Dipterocarps Research Center, Samarinda, East Kalimantan. The air-dried wood density measurement followed DIN 2135 Standard Method (DIN, 1975). Maceration and fiber length measurements followed the method of Forest Products Laboratory (1960). Measurement of macro-nutrients in stem base was conducted at the Laboratory of Soil, Pusreht, Unmul, Samarinda, East Kalimantan, with spectrophotometric method. Further, the data was analyzed using SPSS 16 software.

## RESULT AND DISCUSSION

Distribution of wood density, fiber length and macro-nutrients on stem base of *S. leprosula* and *S. parvifolia* can be seen in this following table.

Tabel 1. Distribution of wood density, fiber length and macro-nutrients on stem base of of *S. leprosula*

	Wood density	Fiber length ( $\mu\text{m}$ )	Macro-nutrients		
			N (%)	P (%)	K (%)
<i>Pith</i>	0.333	1.279	0.115	0.0015	0.050
<i>Mid</i>	0.339	1.303	0.160	0.0055	0.111
<i>Bark</i>	0.362	1.343	0.180	0.0085	0.471

Tabel 2. Distribution of wood density, fiber length and macro-nutrients on stem base of *S. parvifolia*.

	Wood density	Fiber length ( $\mu\text{m}$ )	Macro-nutrients		
			N (%)	P (%)	K (%)
<i>Pith</i>	0.285	1.497	0.120	0.005	0.083
<i>Mid</i>	0.312	1.679	0.130	0.005	0.103
<i>Bark</i>	0.346	1.805	0.210	0.011	0.613



Beets *et al.* (2001) explained that wood density is influenced by genetic factors, climate and soil. The increasing of nitrogen although in small amounts has a significant effect on wood density. The increasing of wood density can increase the number and length of fiber.

Table 4 showed that the fiber length of *S. parvifolia* had a non significant correlation to the macro-nutrients (nitrogen, phosphorus and potassium). This was consistent with the results of Ikonen *et al.* (2008) which stated that the relationship model of fiber length distribution is not significantly due to changes in nutrients on *Pinus sylvestris* and *Picea abies*, but it was caused by the cambium growth. Cambium growth in forming cell dimensions of the stem is likely influenced by hormonal activity in plants (Elo *et al.*, 2009).

## CONCLUSION

Distribution of macro-nutrients radially contained on stem base gave a positive correlation to the wood quality, wood density and fiber length. In general, nutrient distribution had an increasing tendency radially from the pith, mid and bark respectively. Further analysis showed that the nutrient distribution had a significant positive correlation to the wood density from both of test samples. Meanwhile, the nutrient distribution of fiber length indicated different analysis results from both of test samples. Significant positive correlations obtained from the test sample of *S. leprosula*, while the results were non-significant positive correlation obtained from the test sample of *S. parvifolia*. However, the tested parameters can be considered in the observation of wood quality, although it is still in limited number of test parameters. Some other parameters, such as the cambium growth and hormonal activity are worth considering as the parameter for further testing.

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