報告番号	※　　　第　　　号

主　論　文　の　要　旨

論文題目　Growth stress and wood property assessment of different provenances of big-leaf mahogany (*Swietenia macrophylla* King) landrace in the Philippines
（フィリピンに導入された big-leaf mahogany (*Swietenia macrophylla* King) の成長応力および材質に及ぼす地域品種間差に関する実証試験）

氏　　名　GILBERO Dennis Morgia

論　文　内　容　の　要　旨

The scarcity of timber to supply the wood-based industries is one of the prevailing problems worldwide. Tree plantations are the remaining solutions to subdue the shortage of raw materials, at the same time sequester atmospheric CO_2 in its biomass to reduce global warming. Planting Big-Leaf mahogany (*Swietenia macrophylla* King) contributes valuable economic inputs to small tree farmers in the Philippines. However, the occurrence of lumber defects during processing due to growth stresses reduces the potential value of timber.　The first part of this study was aimed at examining the differences of surface growth stresses and wood properties of 8-year old BL mahogany from six landrace provenances in two progeny trial sites, Butuan and Cagayan de Oro in the Philippines. The longitudinal released strains of the surface growth stress (SRS) were not significantly different among six landrace provenances and between two trial sites. The SRS were not significantly related to diameter at breast height (DBH) in both trial sites.　The high level of negative SRS was observed in some tested trees with small diameter in both trial sites, which was attributed to the tension wood formation in an irregular shaped stem. The xylem density (XD), average microfibril angle in the secondary cell wall (MFA), vessel element length (VL) and vessel element width (VW) have no significant differences among six landrace provenances. In terms of trial sites, Butuan trial site gave high lateral growth (DBH), high XD, longer FL with a narrow FW and smaller MFA as compared to the Cagayan de Oro trial site. It was observed that an 8-year old BL mahogany plantation with small diameter trees exhibited high SRS, low XD, small FL, wide FW and large MFA, which are passively considered as properties of juvenile wood.

The increasing global population with a commensurate increase in demand for forest products such as timber becomes a worldwide challenge on how to balance forest regulations in response to environmental concerns and utilization of timber resources. Sustainable tree plantations of fast-growing species are the best option to meet the increasing demand for timber. However, planting of the fast growing trees has an issue in the utilization of juvenile wood. This is a concern that is also partly addressed in this study.

The area of juvenile wood zone of an 8-year old planted BL mahogany *(Swietenia macrophylla* King*)* was uniform regardless of diameter, hence, assumed that xylem maturation is dependent on diameter.

The radial distribution patterns of FL, VL, VW and XD exhibit shorter FL and VL, narrow VW and low-density XD from the pith, then suddenly increases outward and become more or less stable near the bark. However, the radial distribution pattern of FW and MOE overlaps and becomes scattered regardless of tree diameter sizes. The Juvenile wood zone of FL is significantly different from the transition wood zone and to the mature wood zone, and vice versa. The Juvenile wood zone of VL, VW and XD is significantly different in transition wood zone and mature wood zone, but there is no difference between transition wood zone and mature wood zone. Same trends were observed in FL, VL, VW and XD in terms of its relationship between DBH and the *b*-value, and the diameter boundaries of three wood zones. Using selected xylem maturation properties, BL mahogany starts to mature when it reached the diameter of 18.08cm for FL, 17.36cm for VL and 16.23cm for VW.

Tree girdling is one of the convenient methods to disrupt translocation of water and nutrients in the trunk from the soil that causes death of trees in certain period of time depending on the species, site and size of trunk. Part of the study aimed to determine the effect of girdling in different periods (0, 1 year, and 2 years) on the growth stress reduction and basic wood properties of 8-year old planted Big leaf Mahogany (*Swietenia macrophylla* King*)*. Result shows that after 2 years of girdling, all test trees with small sizes in two trial sites did not survive. However, test trees with large sizes have 100% and 83% survival, and medium sizes have 83% and 50% survival in Butuan and Cagayan de Oro trial sites, respectively. Longitudinal released strain of surface growth stresses (SRS) of test trees with large size and medium size have highly significant differences between the non-girdled and 2-year girdled, but no significant variation between the non-girdled and 1-year girdled test trees. The small size test trees have the same SRS in three treatment periods. Using the difference of residual released strain of growth stresses (RRS), the diameter class and treatment periods revealed no significant differences both in longitudinal and tangential releases. Moisture content (MC) of test trees showed significant differences between girdled and non-girdled treatment. Small size test trees that died after 2 years of girdling have almost the same MC that ranges from 11.93% to 14.87% from pith to the bark, as compared to the non girdled test trees that gradually increases from 37.39% to 64.68% from pith to the bark.

The lightness, redness and yellowish parameters have high significant differences between non-girdled and girdled test trees. The wood color of non-girdled test trees averages are; 70.95 in L* (lightness), 10.64 in a* (redness) and 22.14 in b*(yellowness) and the wood color of girdled test trees averages are; 67.80, 13.60 and 24.57, respectively. A significant correlation were found between a* and L*, b* and L*, and a* and b* parameters. These results showed that the variation in wood color of non-girdled and the girdled test trees of BL mahogany produced an inverse variation between a* and L*, b* and L*, but not with a^* and b^*. The color difference ΔE^*_{ab} = 10.09 between the girdled and non girdled test trees.

Heat water treatment has been proven to reduce the residual release strain inside the log in some other tree species. In BL mahogany, heat water treatment drastically reduced the average residual release strains in three diameter classes: small, medium and large tree sizes to 167%, 90% and 50%, respectively. Significant reduction in residual released strain were observed in small and medium size trees, but not with the large size trees. The effect of heat water treatment on wood color averages as: 55.38 in (lightness), 16.79 in a* (redness) and 26.30 in (yellowness) while the control wood color averages: 62.83, 15.80 and 28.78, respectively. The effect of heat water treatment in L*(lightness) and b*(yellowish) parameters have high significant differences between control and water heated wood samples, but not with the a* (redness). A significant correlation was found only between a* and L*, and not with b* and L*, and a* and b* parameters. The color difference is ΔE^*_{ab} = 8.66 between the water heated and control wood samples. This color variation is detectable by the human eye. Therefore, BL mahogany lumber applied with heat water treatment will reduce the residual release strain and enhances the wood redness.