Abstract of thesis presented to the Professor Committee of Graduate School of Agriculture, Kyoto University in fulfillment for the Doctoral Degree

Growth ring formation of selected tropical rainforest trees in Peninsular Malaysia

By

Amir Affan Abdul Azim

January 2014

Formation of growth rings was investigated in tropical trees in Peninsular Malaysia. The sample trees included five species from each of two plantations, in a tropical monsoon and tropical rainforest climate, and 26 species from a natural forest in a tropical rainforest climate. Cambial marking with electrical stimulation, dendrometer measurement, phenological observation, and cambial monitoring by impedance measurement were conducted during field experiment from July 2011 to December 2012. Anatomical observation and stable carbon isotope analysis were performed. Observed growth rings were classified as fiber zones, radially flattened fibers, marginal parenchyma, thick-walled fibers, or variations in vessel size and density. Distinctiveness of growth rings in each species was classified as well-defined, poorly-defined and absent. Anatomically, the ring-porous *Peronema canescens* and diffuse-porous *Intsia palembanica* showed well-defined growth rings. Poorly-defined growth rings were found in 17 species and 10 species had no growth rings. *P. canescens* and *I. palembanica* showed seasonal radial growth and cambial activity when they slowed down radial growth during the period of leaf shedding and low precipitation. Through the synchronicity of cyclic variation of $\delta^{13}C$ values, anatomical changes, rhythm of radial growth, leaf phenology, and precipitation in a known period, it was clarified that *P. canescens* grown in tropical monsoon do form annual ring. In tropical rainforest sites, *P. canescens* was considered to have absent growth ring and *I. palembanica* was judged as having poorly-defined growth rings. Present study confirms some tropical trees form anatomically distinct tree rings, which enhance the tree ring research in tropical region.

Keywords: Tropical trees; growth ring; tropical monsoon; tropical rainforest; Peninsular Malaysia