

Vessel changes in selected naturally grown Dipterocarpaceae and Non-Dipterocarpaceae at Peninsular Malaysia

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1. Introduction

Wood anatomical features can be used as an indicator that records their physiological variations during changes in environmental conditions. That information can be obtained without difficulties for trees grown in seasonal climate and those which forms a clear annual and/or growth rings. This situation is different than trees grown in the tropics. In Malaysia, all trees are grown under the influence of tropical rainforest climate that receives much amount of precipitation throughout a year. Based on the geography, climate and diversity of tree species and traits, it is considered that cambial activities are always active since most of the tree species are evergreen. However, trees all over the world are now experiencing an abnormality in climate such as severe increment and decrement in surrounding temperature and alteration in precipitation. Based on mentioned scenario, it is considered that even trees grown under tropical rainforest climate might shows some responds towards the climate event. Therefore, changes in anatomical features, i.e. vessels were investigated in order to deepen the understanding of tropical trees.

2. Experiment

This study was conducted at secondary disturbed lowland dipterocarp forest, which is Ayer Hitam Forest Reserve, Malaysia (AHFR, 3°1'N, 101°39'E). The climate of AHFR is classified as tropical rainforest, but with a short dry period for 1–2 months, depend on the recorded climate. First study on anatomical changes of vessel traits was conducted with selected naturally grown *Dipterocarpus costulatus* and *D. verrucosus* in duration of 16 weeks from July to October 2015. Based on the record of climate events in Malaysia from January 2015 until March 2017, this study was again conducted with *Shorea acuminata*, *S. hypochra*, *Azadirachta excelsa*, and *Cinnamomum iners* for 22 weeks from April to September 2017. Cambial marking with electrical stimulation, cambial monitoring by impedance measurement and phenological observation were conducted during field experiment. Vessel changes, specifically on mean vessel lumen area (MVLA) and vessel frequency (VF) from pith to cambium were macroscopically and microscopically analyzed. Seasonality of MVLA and VF for each studied species was analyzed with the changes in cambial activities, phenology and meteorological conditions.

3. Results and discussion

All studied samples showed the characteristics of diffuse porous, which leads to the difficulties in detecting the growth ring boundaries. However, anatomical investigation of a pith-cambium radial strip of all studied species showed some cyclic variations in MVLA and VF. In the first study, *Dipterocarpus costulatus* and *D. verrucosus* showed weak cyclic variations of MVLA and VF (Fig. 1a and b). In the second study, *Shorea hypochra* and *Azadirachta excelsa* showed slightly clear cyclic variations of MVLA and VF (Fig. 1c and d) while *S. acuminata* and *Cinnamomum iners* showed weaker variations

(Fig. 1e and f). Based on the synchronicity of MVLA-VF for all studied species, *D. costulatus*, *D. verrucosus*, *S. hypochra*, and *A. excelsa* showed that variation of MVLA-VF can be related to the changes in cambial activity, phenology and precipitation. This study confirms that evergreen tropical species especially those belonging under Dipterocarpaceae do show some changes in vessel traits even it is faint.

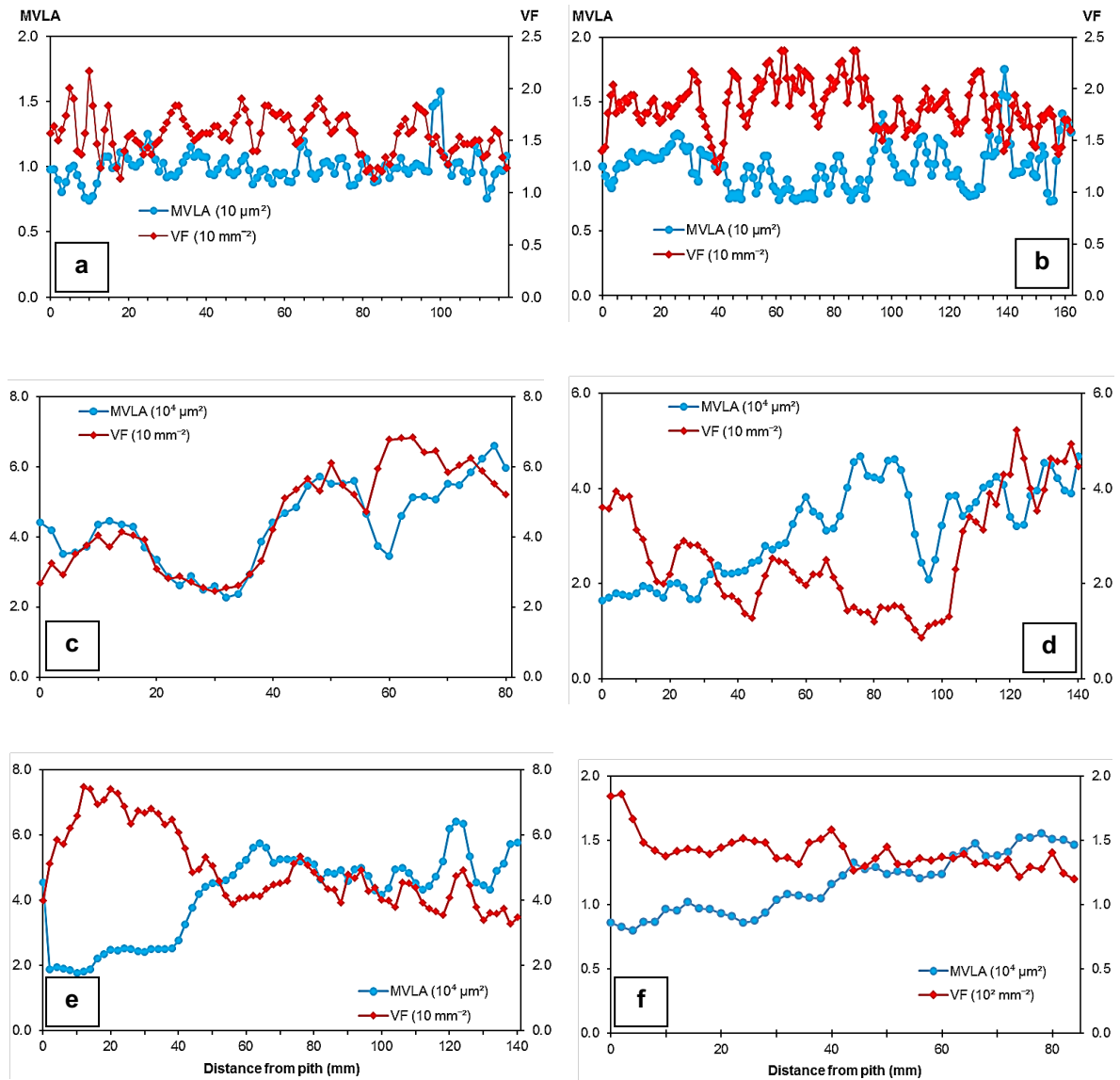


Fig. 1. Variation of mean vessel lumen area (MVLA) and vessel frequency (VF). (a) *Dipterocarpus costulatus*, (b) *Dipterocarpus verrucosus*, (c) *Shorea acuminata*, (d) *Shorea hypochra*, (e) *Azadirachta excelsa*, and (f) *Cinnamomum iners*.