Leaf chlorophyll content is an indicator of growth rate of tropical teak tree

Teak (*Tectona grandis*) is an important timber resource in tropical forests and has a high market value, so a stable supply is required. However, there are large differences in growth rates between individual trees even within the same teak plantation. This difference limits accurate prediction of future timber yields. Various leaf traits such as leaf size, nutrient, and pigment contents affect photosynthesis; thus, they are likely to be related to the tree growth rate. For example, chlorophyll is a pigment that absorbs the energy of sunlight for photosynthesis, and if it is lacking, the photosynthetic rate decreases and growth becomes restricted. If the difference in growth rates between individuals can be easily estimated from leaf traits, it will lead to improved accuracy in predicting yields and rapid identification of areas of poor growth. This study examines the relationship between growth rate and leaf traits related to photosynthesis in teak trees.

We measured the height and diameter of teak trees in four plantation forests aged 14 to 46 years old in Malaysia and found a large variation in diameter and height within plantations (Fig. 1). Canopy leaves were collected and compared for leaf area, chlorophyll content indexed by SPAD value (hereafter referred to as chlorophyll content), nitrogen content, and leaf mass per area. Leaf traits vary greatly among individuals even within the same plantation, and they also differ in appearance (Fig. 2). Leaf chlorophyll content positively correlates with diameter and height growth rates, suggesting that individuals with high chlorophyll content also have high growth rates (Fig. 3). In contrast, there is no correlation between other leaf traits and tree growth (Table 1).

Using leaf chlorophyll content as an indicator of growth, this approach can be used to improve the accuracy of timber production across large plantation areas using remote sensing technology such as drones and satellites, and also contribute to identifying areas of poor growth in the plantation. Although these results were obtained from teak plantations in Malaysia, confirming whether similar results can be obtained from teak plantations in other regions with significantly different climates and soil traits, as well as to teak varieties that differ genetically, could make these findings useful for forest tree breeding.

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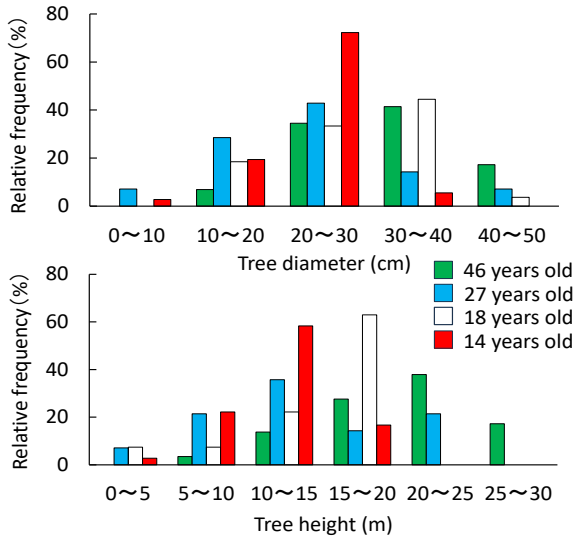

Fig. 1. Frequency distribution of tree height and diameter

Bar colors indicate plantation age.

Fig. 2. Leaves taken from same plantation

Each leaf is from a different individual. Dark green leaves contain a high amount of chlorophyll.

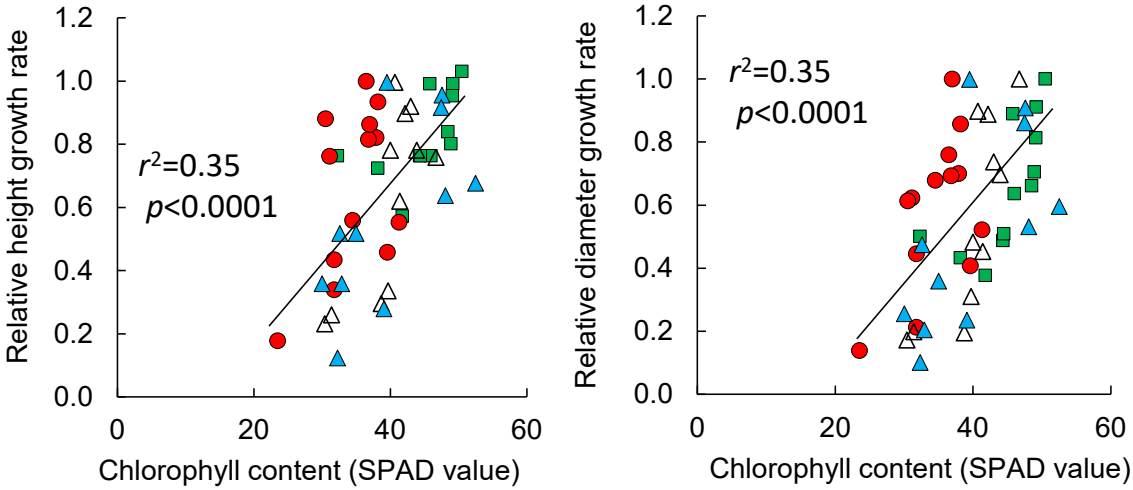

Fig. 3. Relationship between chlorophyll content and tree height (left) and diameter (right) growth

The symbol colors indicate stand age as in Fig.1, and the solid line represents the regression line.

Table 1. Results of multiple regression analysis of leaf traits and height and diameter growth rates in teak trees

Explanatory variables for growth rate	Relative height growth rate	Relative diameter growth rate
Nitrogen content	0.177	0.184
Chlorophyll content (SPAD value)	0.475**	0.561**
Leaf area	0.249	0.174
Leaf mass per area	−0.044	−0.001
Stand age	0.057	−0.153

The values are standardized coefficients, and ** indicates a significance level of p<0.01.

Reference: Kenzo et al. (2024) *Tropics* 33: 73–85.