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Variation of Carbon Isotope Ratio (δ13C) and Leaf-Productivity Traits in Aquilaria Species (Thymelaeceae)

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Abstract : Aquilaria genus produces a highly valuable fragrant oleoresin known as agarwood. Agarwood forms in a few trees in the wild as a response to injure or pathogen attack. The resin is used in perfume and incense industry and medicine. Cultivation of Aquilaria species as a sustainable source of the resin is now a common strategy. Physiological traits are frequently used as a proxy of crop and tree productivity. Aquilaria species growing in Queensland, Australia were studied to investigate relationship between leaf-productivity traits with tree growth. Specifically, 28 trees, representing 12 plus trees and 16 trees from yield plots, were selected to conduct carbon isotope analysis (δ13C) and monitor six leaf attributes. Trees were grouped on four diametric classes (diameter at 150 mm above ground level) ensuring the variability in growth of the whole population was sampled. Model averaging technique based on the Akaike's information criterion (AIC) was computed to identify whether leaf traits could assist in diameter prediction. Carbon isotope values were correlated with height classes and leaf traits to determine any relationship. In average four leaves per shoot were recorded. Approximately one new leaf per week is produced by a shoot. Rate of leaf expansion was estimated in 1.45 mm day-1. There were no statistical differences between diametric classes and leaf expansion rate and number of new leaves per week ($p > 0.05$). Range of δ13C values in leaves of Aquilaria species was from -25.5 ‰ to -31 ‰ with an average of -28.4 ‰ (± 1.5 ‰). Only 39% of the variability in height can be explained by δ13C in leaf. Leaf δ13C and nitrogen content values were positively correlated. This relationship implies that leaves with higher photosynthetic capacities also had lower intercellular carbon dioxide concentrations (ci/ca) and less depleted values of 13C. Most of the predictor variables have a weak correlation with diameter (D). However, analysis of the 95% confidence of best-ranked regression models indicated that the predictors that could likely explain growth in Aquilaria species are petiole length (PeLen), values of δ13C (true13C) and δ15N (true15N), leaf area (LA), specific leaf area (SLA) and number of new leaf produced per week (NL.week). The model constructed with PeLen, true13C, true15N, LA, SLA and NL.week could explain 45% (R2 0.4573) of the variability in D. The leaf traits studied gave a better understanding of the leaf attributes that could assist in the selection of high-productivity trees in Aquilaria.

Keywords : 13C, petiole length, specific leaf area, tree growth
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