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Growth Rate Effects on Wood Density and Ring Characteristics of Over-mature *Pinus caribaea* in Sri Lankan Plantations

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Abstract

The current oversupply of mature and over-mature *Pinus caribaea* (Pine) plantations in Sri Lanka necessitates optimal resource utilization, particularly for private furniture manufacturing and export industries. This study investigated the relationship between growth rate and wood quality parameters by examining radial relative density and ring width variations within and between trees, focusing on slow, medium, and fast-grown trees, with particular emphasis on over-mature specimens. Wood quality assessment employed the maximum moisture content method to determine relative density, with measurements standardized at 12% moisture content to facilitate comparative analysis. The experimental design incorporated Boron treatment on selected samples to evaluate its impact on wood quality parameters. Data analysis utilized descriptive statistics and one-way ANOVA with Tukey's post-hoc comparisons using Minitab 16 software. Results revealed that fast-grown trees exhibited significantly higher relative density than slow and medium-grown counterparts, while no significant differences were observed between slow and medium growth rates. This suggests that Pinewood relative density may be largely independent of growth rate within the slow to medium growth range. Ring width analysis demonstrated a consistent pattern across all growth rates, characterized by an initial decrease in juvenile wood and stabilization in mature wood, attributed to cambial ageing or canopy closure. Relative density variations from pith to bark displayed distinct patterns according to growth rates: slow-grown trees exhibited an initial decline followed by a slight increase towards the bark; medium-grown trees maintained a relatively constant density after an initial decline, and fast-grown trees showed an initial decrease followed by irregular slight increases. The transition from juvenile to mature wood formation occurred consistently at approximately ten years, independent of growth rate. The findings suggest that implementing silvicultural practices promoting faster growth rates could yield high-quality mature Pine wood without compromising wood properties. Moreover, Boron treatment showed no statistically significant effect on wood quality, indicating its potential as a preservative treatment option to enhance durability and rot resistance while maintaining wood properties. These results are important for optimizing Pine plantation management and wood utilization strategies in Sri Lanka.

Keywords: *Pinus caribaea, Relative density, Ring width, Growth rate, Wood quality*