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## 主論文の要旨

論文題目 Influence of Site Conditions on Teak Growth and Traits in the Lao PDR (ラオスにおけるチークの成長と形質に及ぼす立地条件の影響)

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## 論文内容の要旨

Teak (*Tectona grandis* Linn. f) is a globally valuable hardwood tree species whose growth performance and tree quality characteristics are controlled by various factors. High timber quality of teak is mainly obtained from tree quality, tree growth performance, and heartwood quality. This study is aimed to investigate the suitable site conditions of teak plantations in Luang Prabang province, Lao PDR.

In Luang Prabang, the 61 target teak plantations ranged from 287 to 1057 m.a.s.l. and from 10 to 31 years in stand age were selected in various modes of topography. Then, in each target plantation, a temporary sample plot with 20m x 20 m was established. Among 61 temporary sample plots, 53 plots, 27 plots and 49 plots were selected for assessing tree quality, tree growth performance and heartwood quality, respectively. The tree qualities of all trees within a plot were assessed using a scoring system. The growth performance was assessed by parameters of growth curve of the Mitscherlich function obtained by applying it to stem analysis data of three trees felled within a plot. In addition, several methods were applied to assess the teak heartwood quality, such as heartwood content and color, using geometric formula and CIELab color system, respectively. The spearman's partial rank correlation analysis was used for investigating the influences of stand and site characteristics using R version 4.0.3 with ppcor and qgraph packages.

For tree quality, the elevation was negatively correlated with poor tree quality characteristics such as epicormic shoots, mode of branching, and branch size. The stand density was also negatively correlated with poor tree quality such as stem

form and axis persistence. However, the stand age was positively correlated with poor tree quality such as protuberant buds and buttressing. Therefore, it was suggested that higher-density plantations at the higher elevation sites might be suitable for teak plantations, but a longer rotation in forest management might degrade tree quality in this area.

For teak growth performance, the upper limit of DBH and height growth curve had a significant negative correlation with slope positions, while the intrinsic speed of DBH and height growth had a significant positive correlation with slope forms. Moreover, the slope gradient showed a significant negative correlation with the upper limit and subsequent speed of height growth. However, the initial DBH growth had a significant negative correlation with slope position, while the slope gradient was positive to initial height growth. Therefore, it was suggested that the planted teak grows faster in the lower slope position interaction with a gentle concave slope in this area.

For teak heartwood quality, the heartwood content of basal area had larger proportion at lower slope position whereas higher elevation. In contrast, the heartwood content of commercial volume increased with tree age, having a greater proportion in the middle to upper slope. Lower shrinkage with higher basic density means better wood properties. Therefore, it was suggested that teak's heartwood properties, basic density, and tangential shrinkage had an increasing quality with tree age, medium to high gradient, and middle to upper slope. In contrast, radial shrinkage had a greater quality at gentle concave slope might be affected by soil condition factors. On the other hand, teak heartwood color;  $L^*$  has a darker associated with the southwestern lower elevation slope. The redder ( $a^*$ ) showed a relationship with southeastern straight slope, while yellowish ( $b^*$ ) had associated with lower elevation and younger tree age.

In conclusion, it was found that teak timber has the best quality with high productivity at lower, middle gentle slope interaction with straight concave slope at higher elevations in this area.