SPECIES DISTRIBUTION IN THE HILL DIPTEROCARP FOREST IN PENINSULAR MALAYSIA AS AFFECTED BY SOIL NUTRIENTS

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Introduction

Shorea curtisii (Seraya) is the major timber species in Peninsular Malaysia and is also the indicator tree species in the hill dipterocarp forest. The latter forest is the major resource base for the wood-based industry with sawn logs placed third behind petroleum and oil palm in the 1998 export of primary commodities. Post-harvest regeneration in the fragile hill dipterocarp forest stand is increasingly of concern in its management. Knowledge on Seraya's response to the influence of soil nutrients, as reflected in its topographic distribution, is limited. Such information should be useful in assisting its regeneration since a major portion of disturbance in the post-F hill dipterocarp forest stand concerns the mineral soil. In this study Seraya's responses to soil nutrients were compared with that of *S. leprosula* (Tembaga) which represents the normative lowland dipterocarp timber species. Both species have overlapping distribution at the lower elevation of the hill forest.

Materials and Methods

The study was carried out in an inland hill dipterocarp forest in Berembun Forest Reserve, Negri Sembilan State. The study area is a normative hill dipterocarp forest with Seraya ridge forest. The climate is typically moist equatorial. A stratified random design was used in locating plots where 60 10x10m quadrats were established covering three strata chosen on the basis of occurrence and dominance of Seraya relative to Tembaga. For each plot all trees (dbh >=10cm) were identified and diameter measured. Seedlings were identified and enumerated. Soil samples were augured (0-30cm depth) and analysed for pH, available and total phosphorous, total potassium, magnesium nitrogen and CEC. Paired vegetation and soil data were analysed using Canonical Correspondence Analysis (Ter Braak, 1986).

Results and Discussion

Generally strong canonical correlation ($r^2 \geq |0.7|$) were shown between species and environmental axes ranging from 0.74 to 0.88. P_{av}, K_{tot} and CEC_{tot} were influential in determining the distribution for both trees and regeneration. The latter was also sensitive to N_{tot}, P_{tot} and pH. only Mg_{tot} was not influential. Correlation values for P_{av} were 0.79 (tree basal area), 0.84 (tree frequency) and 0.89 (seedling); for K_{tot}, 0.76 (tree basal area) and 0.75 (seedling); CEC_{tot}, 0.77 (tree basal area), 0.96 (tree frequency) and 0.91 (seedling); N_{tot}, 0.7 (seedling); P_{tot}, 0.76 (seedling) and pH, 0.76 (seedling). CEC_{tot} and P_{av} showed very strong correlation with respective $|r^2|$ values ranging from 0.77 to 0.96 and 0.79 to 0.89.The ordination diagrams for both trees and regeneration consistently showed Seraya's adaptation to lower nutrient status relative to that of Tembaga. Thus Seraya trees and seedlings were shown to tolerate topographic sites with lower P, K and CEC. In addition, Seraya regeneration was also adapted to lower N status and more acidic soil. To some extent the distribution pattern of Seraya observed in the hill dipterocarp forest of inland mountain massif in Peninsula Malaysia, as with the Berembun site, may be attributed to its ability to adapt to low nutrient status and acidic soil. The aggregation of Seraya on ridge and upper slope positions, and its possible association with nutrient stress is well reported in the literature (Lim, 1979; Wan Yusuf, 1979). A topographic ridge-valley catena exists with nutrient fertility gradually increasing towards the valley and soil acidity in reverse, the long-term effect of gravitational soil erosion and leaching. In a coastal hill dipterocarp forest in Pasir Panjang Forest Reserve, Negri Sembilan State, Zahari (1994) showed the significant influence of soil nutrient and acidity in effecting Seraya's dominance. The species' dominance pattern however did not show strong topographic association but tends to be more 'mosaic' in nature. Seraya was strongly correlated with sites low in P and CEC levels and more acidic soils relative to Tembaga. Regeneration was however unaffected by soil nutrient. The possibility of limiting P and N levels exerting influence on the growth and distribution of trees has also been suggested by Raaimakers (1994) for acid sandy soils in tropical rain forests of Guyana. For the hill dipterocarp forest in Peninsular Malaysia, results from Zahari (1994) and this study showed evidence of the strong influence of soil nutrient and acidity on the distribution of tree species. The two study areas represent contrasting ecosystems. Pasir Panjang is coastal, isolated and marginal while Berembun is far inland and is part of the normative hill dipterocarp forest of the Main Range. Despite the wide variations to be expected from disjunct distributions the influence of P and CEC on the tree vegetation is however common to both sites although the influence of nutrients and acidity on regeneration was only evident in the inland Berembun site.

Conclusions

The study in the inland hill dipterocarp forest in Berembun Forest Reserve has shown the importance of CEC_{tot}, P_{tot}, P_{av}, K_{tot} and soil pH in influencing tree distribution. Seraya trees appear more tolerant of lower P_{tot}, K_{tot} and CEC_{tot} than Tembaga. Similar tolerance pattern was also shown by Seraya regeneration. In addition Seraya seedlings were also better adapted to more acidic soils.

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