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Competitive dominance in a secondary successional rain-forest community in Borneo

Stuart J. Davies*†[1] and Hardy Semui†

* Center for Tropical Forest Science-Arnold Arboretum Asia Program, Harvard University, Cambridge, MA, USA
† Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia
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Abstract: Competitive interactions among pioneer species may have a significant impact on the course of secondary succession in tropical rain forests. We predicted that the outcome of competitive interactions in early succession would vary with soil nutrient availability. To test this hypothesis we grew seven pioneer tree species alone and in dense competitive mixtures, with four nutrient treatments: no nutrient addition, and N, P, and N plus P addition. Performance of plants grown alone and in mixtures was strongly nutrient limited. However, contrary to expectation, the competitive hierarchy among the seven species was almost identical among the four nutrient treatments. The dominant species, *Melastoma malabathricum*, accounted for > 70% of total stand biomass in all nutrient treatments. Seedlings of this species had higher rates of gas exchange and initial growth, and lower root allocation than the other species. Profiles of light availability within the competitive stands indicated that light levels at ground level were well above levels at which pioneer species can successfully survive and grow, yet seedlings of species other than *Melastoma* remained stunted. Leaf N concentrations in all stands were 25–55% reduced by competitive interactions, and N addition increased relative competitive performance in only *Melastoma* suggesting that *Melastoma* was particularly effective at N acquisition, limiting nutrient uptake by the other species. Toward the end of the experiment individuals of *Melastoma* began to reproduce, suggesting that the competitive hierarchy would have changed in a longer-duration experiment.

Key Words: competition, *Dillenia suffruticosa*, *Duabanga moluccana*, *Ficus grossularioides*, *Melastoma malabathricum*, *Nauclea maingayi*, nutrient limitation, pioneer trees, succession, tree seedlings, *Trema cannabina*, tropical forest, *Vitex pubescens*

INTRODUCTION

The dynamics of secondary succession vary across tropical rain-forest landscapes. Rates of species and biomass accumulation, as well as the composition of successional communities vary. This variation results from a range of interacting factors including the availability of plant propagules, local climatic and edaphic conditions, and biotic interactions, all of which are affected by the nature of the disturbances that initiate successional dynamics (Brown & Lugo 1990, Guariguata & Ostertag 2001). Understanding factors constraining successional dynamics is an important objective of tropical forest ecology, and is of practical significance for managing the extensive areas of cleared tropical forests (Holl & Kappelle 1999).

The composition and dynamics of successional communities are strongly affected by edaphic conditions (Ewel *et al.* 1984, Mesquita *et al.* 2001, Sim *et al.* 1992, Uhl *et al.* 1988). Within Malaysian forests it has long been recognized that the floristic composition of secondary succession varies significantly across edaphic gradients (Holttum 1954). Wyatt-Smith (1963) recognized communities regenerating on land deforested and cultivated for less than 2 y to be dominated by species of *Trema*, *Mallotus* and *Macaranga* (Kochummen 1966), whereas communities regenerating on deforested and severely degraded land were initially dominated by species of *Melastoma*, *Chromolaena* and *Dicranopteris* (Kochummen & Ng 1977). This latter community, in extremely degraded conditions, develops into a vegetation type locally referred to as *Adinandra*-belukar which is

[1]Address for correspondence: Center for Tropical Forest Science, Smithsonian Tropical Research Institute, Unit 0948, APO AA 34002-0948, USA. Email: sdavies@oeb.harvard.edu