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Effects of light quantity and quality on the seedling development of *Dalbergia latifolia*

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SUMMARY

The effect of different irradiances (Photon flux density, 400-700 nm) and different spectral qualities (red to far-red ratio, R:FR) on the growth of *Dalbergia latifolia* (Roxb.), seedling morphology, plant architecture and physiology were studied. Seedlings were grown in six replicated treatments: (1) direct sunlight and 1.25 R:FR, (2) 45% solar PPFD and 1.25 R:FR, (3) 12% PPFD and 1.25 R:FR, (4) 12% PPFD and 0.25 R:FR, (5) 3% PPFD and 1.25 R:FR, (6) 3% PPFD and 0.25 R:FR. Medium light favors for better seedling growth in terms of height growth, volume increment, dry weight and architecture. It was also noted that seedlings' net photosynthetic rate was also found higher at this light condition. Little influence to low and medium PPFD environment was observed. Spectral quality did not influence growth and development very much but low R:FR reduced leaf area and eventually less biomass allocation. These results are consistent with an observation of *Dalbergia latifolia* seedlings which are naturally slow growing, shade tolerant, performs poor in direct sunlight and dramatically different to their behavior in later developmental stages.

Key words : *Dalbergia latifolia*, Light quality, Light quantity, Seedling development, R:FR.

Light is the most important environmental factor influencing the growth and normal development of plants in natural environments. Plants vary in their capacities to tolerate different degrees of shading, or in taking full advantage of high light intensities. In many plants there are profound morphological differences between juvenile and adult stages (Allsopp, 1967). These developmental stages have important bearing on the survival of individuals as they develop and most have been interrupted as adaptations to changes in light climates plants where grown. Although the types of developmental responses among seedlings that constitute adaptations to shade are somewhat controversial, it is clear that species at their seedlings as well as later stages of growth vary in their tolerance to shade conditions (Turner, 2001).

In tropical forest, pioneer trees typically occur in large gaps, are light demanding, plastic in response to light conditions, photosynthesis occurs rapidly, and relatively short lived (Bazzaz and Pickett, 1979). Their growth and physiology have been contrasted with those of more shade-tolerant mature phase trees (Bazzaz and Pickett, 1979; Fetchar *et al.*, 1983; Turner *et al.*, 1992; Whitmore, 1996). However, in tropical rain forest some pioneers are not short-lived trees, but are long lived and eventually attain the canopy in mature forest (Whitmore, 1984). *Dalbergia latifolia* is such a tree, occurring in tropical rain forest of India.

Seedlings growing in the gradient of shade microclimate within the forest experience dramatic changes in irradiance as well as spectral quality (Smith, 1994; Whitmore, 1996). Foliage density and canopy gaps alter PPFD and R:FR in a parallel manner (Lee, 1987; Chazdon *et al.*, 1996). Reduced R:FR influences phytochrome equilibrium in plant tissues, and induces a variety of developmental responses (Smith, 1994; Chazdon *et al.*, 1996) such as inhibition of branching and the promotion of extension growth (Lee *et al.*, 1996). Until recently virtually all research on plant shade responses has manipulated PPFD without altering R:FR, thus exposing seedlings to the very low PPFD of rain forest shade and the spectral quality of sunlight. Such research underestimates shade responses in the natural environments (Schmitt and Wulff, 1993). Most of the research on the influence of PPFD and R:FR on seedling function has examined photosynthetic characteristics, finding relatively little influence of R:FR (Turnbull, 1991; Kitajima, 1994; Tinoco-Ojanguren and pearcy, 1995).

Learning respond to two aspects of PPFD and spectral quality, which will help us to understand how individual species are adapted to condition in the rain forest. This study reveals how these rain forest species respond to changes in light quality and quantity as they grow in the rain forest environment. The purpose of this research was to answer the following questions. First, what aspects

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