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Light Spectral Regimes under a Closed and Dense Canopy: Evidence from *Mesua ferrea* Trees for Human Comfort in Urban Landscape Planning

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Abstract

Trees play an important role in urban landscape planning due to their multi-faceted functions including the provision of human comfort through shade and cooling and air pollution abatement. Mesua ferrea is the national tree of Sri Lanka with multi-colored leaves and pyramidal dense canopy architecture, which can be promoted to grow in roadside gardens and parks to gain more attraction and attention. It is important to know how different trees provide human comfort under the canopy. In the present study, we measured the transmittance spectra in the 318-885 nm range using a high-resolution spectroradiometer under the canopy of selected Mesua ferrea trees on bright sunny days. The change in shade casting on the ground during the day was modeled. In addition, the temperature, CO_2, and relative humidity were also measured. The light transmittance through the canopy is reduced when moving from the outer edge of the canopy (1,142 $\mu W.cm^{-2}.nm^{1}$) to the trunk-base (0.82 $\mu W.cm^{-2}.nm^{-1}$) on the horizontal plane. It was obvious that the irradiance received closer to the base of the tree is not sufficient to support the understory plant growth. The irradiance levels of blue (B: 400-500 nm), red (R: 650-680 nm), and far-red (FR: 700-885 nm) components of the transmittance spectra under the canopy were also found significantly low compared to sunlight, with significantly altered R:B, R:FR and B:FR ratios. Importantly, a 14 fold cut down in the UV radiation (318-400 nm) under the canopy beyond half of the canopy diameter towards the trunk was also observed. Under the canopy, there was a temperature reduction of about 1° C on bright sunny days perhaps due to the reduced irradiance and the altered spectrum, and the reduced CO_2 concentration (by 5%). We identified that the Mesua trees are suitable for human comfort, and thus can be recommended for roadside planting and for public parks in urban landscape planning.

Keywords: Shade caste, Radiation spectrum, Mesua ferrea, Landscape planning, Urban planning