RESPONSE OF SELECTED FOREST TREE SPECIES IN SRI LANKA TO INCREASING AIR TEMPERATURE

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Increasing air temperature is an important aspect of long-term global climate change. It has been brought about by increased emissions of greenhouse gases such as carbon dioxide, methane, nitrous oxides and chlorofluourocarbons into the atmosphere and the consequent retention of outgoing thermal radiation in the earth's atmosphere. Global climatic models have predicted that the mean air temperature of the earth will increase by 1.4 – 5.8°C in the next 100 years and this will be the most rapid episode of warming in the earth's history.

Temperature is a key environmental variable that determines the physiology and growth of forests. Therefore, it is important to know how different forest tree species would respond to the expected increase in air temperature. This is especially relevant in view of the long life cycle durations of many forest tree species which will force them to experience the phenomenon of global warming. The primary objective of this study was to determine the response of some key physiological processes and growth parameters of selected forest tree species to increasing air temperature at the seedling stage.

The experiment was carried out in the controlled environmental growth chambers at the Faculty of Agriculture of the University of Peradeniya, Sri Lanka during a 100-day period from August to November, 2003. Seedlings of five tree species, i.e. Teak (*Tectona grandis*), Jak (*Artocarpus heterophyllus*), Satinwood (*Chloroxylon swietenia*), and two varieties of Mahogany (*Swietenia macrophylla* and *Swietenia mahogany*) were grown at two daily mean temperatures, i.e. 28°C (day/night regime of 30°/26°C) and 32° (day/night regime of 34°/30°C).

The majority of tree species tested showed lower leaf net photosynthetic rates at the higher temperature. *Swietenia mahogany* was a consistent exception to this trend. The leaf chlorophyll content was lower at the higher temperature in all species except *Swietenia macrophylla*. All species showed decreases in stomatal conductance and increases in leaf temperature when air temperature increased from 28° to 32°C. Despite reduced stomatal conductance, transpiration rate per unit leaf area increased in all species in response to the temperature increase. This was because of the greater leaf-air water vapour concentration gradients brought about by the higher leaf temperatures at 32°C. As a result of increased transpiration rates, the leaf water potential of all tree species except teak, showed decreases when temperature increased from 28°C to 32°C.

While both mahogany species and satinwood showed greater plant heights at the higher temperature, jak and teak showed the opposite trend. On the other hand, higher stem girths were observed at the higher temperature in *S. macrophylla*, satinwood and teak while the opposite was observed in the rest. Number of leaves and leaf area per plant were greater at the higher temperature in all species tested except jak. Jak, *S. mahogany* and teak showed decreases in total biomass (W), absolute growth rate (AGR) and relative growth rate (RGR) in response to the temperature increase from 28°C to 32°C. In contrast, *S. macrophylla* and satinwood showed greater W, AGR and RGR at the higher temperature. The leaf weight ratio (fraction of leaf dry weight in total biomass) increased while the root weight ratio (fraction of root dry weight in total biomass) decreased in response to increasing temperature in all species.

Based on the above results, we conclude that the response of forest tree species to increasing air temperature is species-specific and that the direction of response depends on the optimum temperature (i.e. the temperature at which a given physiological or growth parameter is maximum), which varies from tree species to species. If the air temperature increase due to global warming does not exceed the optimum for a given species, it would show a positive response to warming. On the other hand, if the temperature increase goes beyond the optimum of a given species, its response would be negative. Accordingly, the temperature increase from 28°C to 32°C in the present study probably went beyond the optimum for biomass production of jak, *S. mahogany* and teak, but stayed under the optimum for satinwood and *S. macrophylla*. These results have important implications on the selection of tree species for future plantation forestry and on the future productivity of existing plantation forests.