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Managing *Eucalyptus* plantations under global changes

Abstracts Book

Potassium fertilization mitigates the negative effect of reduced water availability on hydraulic lift and growth in Eucalyptus grandis plantations

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A passive phenomenon called hydraulic lift (HL) allows some plant species to take up water from deep moist soil layers and redistribute it in the upper dry soil layers. Soil fertilization, particularly K, can also alleviate water shortage and increase plant water use efficiency (WUE) on poor and acidic tropical soils. The present study aimed gaining insight on the role of HL and K fertilization in increasing both wood productivity and WUE for stemwood production (WUEp) of eucalyptus plantations under undisturbed and 37% throughfall exclusion. Tree transpiration was measured over 21 months in a large-scale throughfall exclusion plantation of *E. grandis* in Brazil. HL was estimated by measuring the density and direction of water in shallow roots over 18 months. Tree biomass, leaf and whole tree hydraulic conductance (Kleaf and Ktree), soil water storage from surface to the water table, at a depth of 17 m, and photosynthetic activity through A-Ci curves measurement were also assessed. The monthly density of water redistributed by roots was significantly increased by K-fertilization. This density decreased with throughfall exclusion, probably due to a lower tree transpiration under that condition. Potassium increased WUEp by about 200% through an increase in the partitioning of dry matter to produce stemwood. That change in the partitioning of carbon between tree organs was possible because: K-fertilization increase leaf longevity and decreased limitations in the use of light through an increase in the photosynthetic efficiency, so trees with +K did not need to allocate much C in leaves; and potassium decreased limitations on water supply through an increase in stem hydraulic conductance and HL, so trees did not need to allocate much C in roots. The results

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indicate that fertilizing *E. grandis* plantations with potassium is beneficial to increase both wood biomass production and WUEp, even with a 37% decrease in rainfall. However, K fertilization also increase the water demand and therefore could pose a risk of plant hydraulic failure under very extreme drought.

Keywords: forest plantation, soil fertilization, tree transpiration, tropical soil, water use.