

PHYTOCAPPING OF LANDFILLS: OPTIMISING TREE CHARACTERISTICS AND SOIL DEPTH

SUMMARY

Managing percolation of water into landfill, to reduce leachate and methane generation, is the key function of landfill covers. Amongst a few techniques used, "phytocapping" is considered more effective and environmentally-friendly. In this capping system, trees are established over a layer of soil, where trees act as 'bio-pumps & interceptors' and soil as "sponge" respectively. Trees used in phytocapping play a significant role in minimising entry of water into the refuse, via canopy evaporation and transpiration. The degree to which each species contributes to each of these processes, however differ between species. This project evaluates the attributes of 21 tree species that have been established on a landfill using two depths of soil. The site water balance will be modelled using STOMP (Subsurface Transport over Multiple Phases) software.

At two years of establishment, 19 tree species grown on two capping depths (700 mm and 1400 mm) attained an average height of 4 m, and produced an average biomass of 6 kg/plant. The overall growth response was better in the thick (1400 mm) cap than in thin (700 mm).

Water uptake: Sap flow rate (average of 12 species monitored over 12 months) varied markedly between species, with an average of $2.4 \text{ mm m}^{-2(\text{land})} \text{ d}^{-1}$. The highest sap flow was observed in *Melaleuca leucadendra* ($6.26 \text{ mm m}^{-2} \text{ d}^{-1}$) and the lowest in *Syzygium australis* ($0.6 \text{ mm m}^{-2} \text{ d}^{-1}$) (Figure 1).

Soil moisture measurements are being taken at regular intervals to check the soil moisture levels at different times and between seasons. This also acts as an indicator as to how much moisture has been depleted by the trees and up to what depth over different seasons.

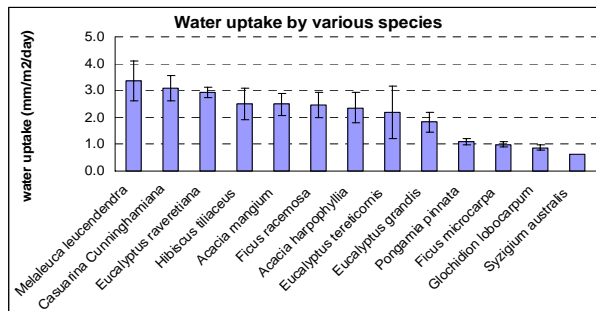


Figure 1: Different species and their capacity to take up water (mm/m²/day) after 2 years of planting (Measurements During 2005 - 2006)

Similar studies are being conducted seasonally for various species grown on thick and thin capping systems. These data will help identify plant species suitable for specific sites. Morphological characteristics, root depth and biomass production of the established trees will be studied in detail to assess their suitability for phytocapping.

PROJECT STAFF

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\$56,000

Rainfall Interception: Average interception of species after two year of planting was 29%. The results show significant variation between species (18% to 40%), with *Ficus microcarpa* recording the highest and *Acacia harpophylla* the lowest (Figure 2). The preliminary data clearly demonstrate the need to consider plant canopy interception values to reliably model water balance for sensitive sites such as landfills. Further studies are currently under way to identify salient features of the trees, and the weather conditions that will allow plants to maximise canopy interception.

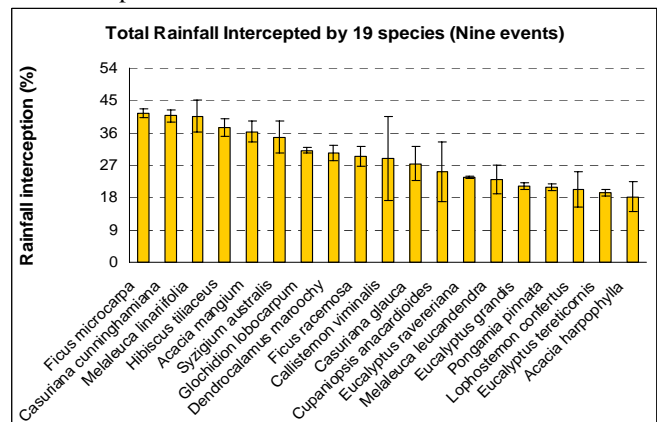


Figure 2: Rainfall intercepted by 19 species (Average of nine rainfall events)

The causes for differences between species (eg canopy density, leaf size, leaf angle, hairiness) and their relative contribution to canopy interception are being studied. The climate data as well as the sap flow, canopy interception and soil data (eg water holding capacity, hydraulic conductivity) will be entered into STOMP to determine site water balance, with the overall aim of demonstrating if the phytocapping technique can serve as an alternative to clay capping for landfill remediation.