A comparison of soil moisture relations between standing and clearfelled plots with burnt and unburnt harvest residue treatments of a clonal *eucalypt* plantation on the Zululand Coastal Plain, South Africa

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Abstract

The effects of clearfelling and subsequent residue retention or burning on water and nutrient balances needs to be understood and quantified on forest sites that are sensitive to loss, so that the long-term sustainable productivity of such sites can be maintained and promoted. An experimental site was established in a clonal eucalypt compartment on the Zululand Coastal Plain, to compare changes in water fluxes through the mature undisturbed eucalypt stand with those after felling and re-planting, under 2 conditions; burning, and retention of the harvesting residues. The study was located in an area of high rainfall and high stand productivity, with sandy soils and low soil carbon and nutrient status; chosen so that the effects of intensive demands on water and nutrient fluxes on a potentially sensitive site could be investigated. This paper presents only the hydrological component of the study. Data collection included weekly determination of rainfall, throughfall, stemflow and soil moisture fluxes from the surface to a depth of 1 m. Drainage rates through the profile were established using time domain reflectometry probes while water drainage volumes were assessed using shallow plate lysimeters. Despite slow growth in the unfelled crop during the monitoring period (attributed to a pest infestation), soil moisture depletion remained rapid and drainage below 1 m remained low. Soil moisture was recharged within a few months after clearfelling, but became rapidly depleted as the canopy of new crop developed and approached canopy closure. A decreased wetting-front velocity and a marginally higher field capacity were proposed as evidence of pore clogging that appeared to occur during the inter-rotation period. The soil profile under the unburnt residue maintained a marginally higher soil moisture status and lower drainage than the soil profile under the burnt residue. Although soil moisture and drainage in the burnt and unburnt residue treatments became similar to the unfelled crop from canopy closure onwards, rainfall additions to soil moisture were depleted faster under the new crop during the first few months after canopy closure. Small differences in soil moisture status between the burnt and unburnt residue treatments presented here may not be sufficient to influence residue management decisions. The length of the inter-rotation period and practice of residue burning may, however, need consideration where soil carbon and nutrient loss or displacement may negatively affect the sustainability of the site.

Keywords: Soil moisture drainage, residue burning, post felling, inter-rotation