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The potential of Vachellia kosiensis (Acacia kosiensis) as a dryland forestry species in terms of its water use, growth rates and resultant water-use efficiency

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ABSTRACT:

The potential of the country's numerous indigenous tree species to address challenges facing the commercial forestry industry in South Africa is under-explored. Relevant issues include the rising demand for timber and non-timber forest products due to population and economic growth, minimal available land for expanding traditional commercial forestry operations, and known streamflow reduction impacts associated with introduced plantation tree species. However, little is known about the water use and corresponding growth rates of indigenous tree species, and consequently their potential as an alternative form of forestry and sustainable resource use. In this study, the water use, growth rates and resultant water-use efficiency of Vachellia kosiensis (Acacia kosiensis) (dune sweet thorn) were quantified within a mature stand of these trees situated on rehabilitated dune mining land in the Richards Bay area of South Africa. Hourly sap flow rates were measured over a two-year period in five trees, and tree heights and stem circumferences were recorded periodically throughout the monitoring period, to derive biomass increments. Rates of growth and water use were used to calculate water-use efficiency, defined as mass of utilisable (stem) wood produced per unit of water transpired. Results were compared with similarly sampled data for introduced plantation species, including Eucalyptus, Pinus and Casuarina. Results showed that the indigenous V. kosiensis trees used less than half the water used by introduced plantation species. The growth rates of individual V. kosiensis trees were unable to compete with introduced species; however, their higher tree density nevertheless yielded a mean annual increment of 10.3 m^3 ha^{-1} y^{-1} (7.2 t ha^{-1} y^{-1}). Furthermore, their correspondingly low water-use rates indicated that the indigenous trees had similar biophysical water-use efficiency values compared with genetically improved introduced tree species and highlighted their potential as an attractive land-use option in appropriate locations within water-constrained or dryland areas.