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Contrasting water use patterns of two drought adapted native fruit tree species growing on nutrient poor sandy soils in northern KwaZulu-Natal

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Abstract

Natural forests are an important source of livelihood for various communities. Yet economically important fruit tree species endemic to sub Saharan Africa e.g. Sclerocaryea birrea (Marula) are critically endangered due to over-exploitation and climate change. Effective conservation, management and utilization of native fruit trees require accurate quantitative information on how the trees interact with their environment. In this study we investigated the water use patterns and fruit yield dynamics of S. birrea, and another widely used species Strychnos spinosa (Monkey orange) growing on nutrient poor sandy soils in northern KwaZulu-Natal Province, South Africa. The study aimed to understand how the water use and yield of these species are influenced by climate and soils. These data are essential to support biodiversity conservation and management, and agroforestry programs. Transpiration was measured on co-occurring trees of each species over two years using the heat ratio sap flow method. The sap flow and environmental data were used to develop and test a simple Penman-Monteith transpiration model. The model provided insights on how environmental factors affected water use and yield in the trees' natural habitats. The two species had similar diurnal transpiration trends characterized by midday stomatal closure. Peak transpiration per unit leaf area was higher for S. spinosa (2.3 L/m2/d) than S. birrea (1.4 L/m2/d). S. birrea transpiration responded strongly to rainfall pulses with the soil water deficit explaining 65% of the variation in tree water use. S. spinosa transpiration, on the other hand, was largely driven by the atmospheric evaporative demand rather than by soil water availability ($R2 < 0.10$), suggesting that the two species had different mechanisms to cope with drought stress. Despite the contrasting water relations, transpiration could be determined accurately using the combination model. The model has potential applications in agroforestry and species-specific conservation programs by providing accurate information on their water requirements.