Promoting seedling physiological performance and early establishment in degraded Mediterranean-type ecosystems

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Mediterranean climate ecosystems (MCEs) are amongst the most heavily degraded ecosystems worldwide. Restoration efforts are challenged by high vulnerability to extreme drought, which is projected to become more frequent with future climate change. The aim of our study was to determine whether restoration efforts could be enhanced through the individual and combined effects of the site preparation technique of soil ripping and the addition of fertilisers. We tested the effects of ripping and fertiliser (±surfactant) on survival, shoot height, crown health, root biomass and leaf physiology of Eucalyptus gomphocephala seedlings in degraded MCEs in Western Australia. Restoration treatments had a much stronger impact under closed canopy (forest) compared to open canopy (woodland) conditions. In the forest, soil ripping doubled seedling survival and together with fertiliser application enhanced shoot height 2.35-fold relative to control seedlings. Ripping resulted in more favourable leaf water potentials and enhanced stomatal conductance suggesting increased water availability compared to unripped soil. In the woodland, fertilisation improved seedling survival and stimulated shoot height (+45 %) and root biomass (>2-fold). Our results demonstrate that restoration techniques targeting the co-limitation by water and nutrients can greatly increase chances of successful restoration in these types of ecosystems. However, whether enhanced seedling establishment translates into canopy recovery largely depends on fire regimes since tree survival to maturity in these systems decreases from nearly 40% in areas with low burn frequency (8 years) to less than 1% in regions experiencing high fire frequencies.