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# The combination of restoration strategies to overcome topsoil deficit and enhance quality of reconstructed soils in semi-arid lands

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The scarcity of topsoil in post-mined arid landscapes is a challenge for future restoration efforts. With 20% of these regions degraded, and a predicted degradation rate of 12 million ha per year, restoration of these disturbed regions has become of international priority to maintain ecosystem function, biodiversity and resilience to globalchange (Menz et al., 2013). Topsoil contains essential soil characteristics which support the development and survival of seedlings. Thus, we investigated the use of alternative soil materials such as mine waste to enhance soil functions and alleviate the topsoil deficit (Bateman et al., 2016; Muñoz-Rojas et al., 2016). Reconstructed soils using alternative mine substrates often lack essential soil properties and thus, the additional of exogenous organic matter was used to investigate its effects on enhancing plant survival and overall soil function (Hueso-Gonzalez et al. 2018). This study was conducted in a 12-month multifactorial microcosms setting under controlled conditions that mimicked those in the mining-intensive semi-arid Pilbara region in NW Western Australia The effects of different restoration techniques were investigated, including: soil reconstruction by blending available soil materials; the addition of a native abundant plant-based amendment (Triodia pungens biomass); and sowing different compositions of native plant species. The different compositions were (i) T. wiseana in monoculture, (ii) a mixture of T. wiseana and Acacia ancistrocarpa and (iii) a combination of the former species with Grevillia wickhamii).We analysed the effects of these techniques on (i) seedling recruitment and growth of Triodia wiseana, an abundant native spinifex in Australian arid regions, and (ii) soil physical, biological and chemical characteristics (e.g. microbial activity, total organic C, total N, and C and N mineralisation) of reconstructed soils. Overall, our results indicated that the addition of Triodia pungens biomass increased the C and N contents of re-made soils; however these values were still lower than those found in the topsoil. Furthermore, microbial activity and C mineralization rates significantly increased in the amended waste, which contrasted the low N mineralisation, however this did not improve the overall emergence and survival of T. wiseana. These findings indicate a short-to-medium term soil N immobilization caused by negative priming effects of the un-composted amendments of microbial communities. Similar growth and survival of the T. wiseana in topsoil, and a blend of topsoil and waste (50:50) highlighted the importance of topsoil for plant establishment in arid restoration, even in small amounts.

References

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