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Do plant-based amendments improve soil physiochemical and microbiological properties and plant growth in dryland ecosystems?

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Background

Land intensive practices including mining have contributed to the degradation of landscapes globally. Current challenges in post-mine restoration revolve around the use of substrates poor in organic materials (e.g. overburden and waste rock) and lack of original topsoil which may result in poor seedling recruitment and in later stages in soil nutrient deficiency, metal toxicity, decreased microbial activity and high salinity (Bateman et al., 2016; Muñoz-Rojas et al., 2016). Despite continuous efforts and advances we have not proportionally advanced our capability to successfully restore these landscapes following mining. Recent attempts to improve plant establishment in arid zone restoration programs have included the application of plant based amendments to soil profiles. This approach usually aims to accelerate soil reconstruction via improvement of soil aggregate stability and increase of soil organic carbon, and water holding capacity. Whilst a significant amount of recent research has focused on the application of such amendments, studies on the potential application of plant based materials to recover soil functionality and re-establish plant communities in post-mined landscapes in arid regions are limited. Here we will discuss our work investigating the application of a plant based amendment on soil substrates commonly used in post mining restoration in the Pilbara region, Western Australia.

Methodology

The study was conducted in a glasshouse facility where environmental conditions were continuously monitored. Using two growth materials (topsoil and waste rock) and a plant based amendment (dry biomass of the most common grass in the Pilbara, Triodia wiseana) five different treatments were tested. Treatments consisted of control soil treatments (topsoil, waste and a mixture of the former soil types (mixture)) and two amended soil treatments (waste amended and mixture amended). Additionally, three different vegetation communities were studies, these include Triodia wiseana, Triodia wiseana and Acacia ancistrocarpa and a combination of the former species with Grevillia wickhamii. Pots were filled with soil materials and allocated plant community treatments. Plant growth and morphology, soil physiochemical (pH, electrical conductivity, N and organic C) and biological (microbial activity) properties were measured after 12 months to assess the suitability of the amendments.

Results

Our results have demonstrated a general decline in plant survival over the duration of 12 months, where pots with amended mine soils displaying the lowest survival rates compared to the topsoil. However, soil microbial activity of pots containing amendments was greater than those without, although there was no significant difference in microbial activity across vegetation communities ($p < 0.05$).

References

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