Geophysical Research Abstracts
Vol. 18, EGU2016-5557, 2016
EGU General Assembly 2016

The limitations of seedling growth and drought tolerance to novel soil substrates in arid systems: Implications for restoration success

Amber Bateman (1,2), Wolfgang Lewandrowski (1,2), Jason Stevens (2), Miriam Muñoz-Rojas (1,2,3)

(1) The University of Western Australia, School of Plant Biology, Crawley, 6009, WA, (2) Kings Park and Botanic Garden, Kings Park, Perth 6005, WA, (3) Curtin University, Department of Environment and Agriculture, 6845 Perth, WA, Australia

Introduction

With the limited knowledge available regarding the impact of drought on seedling growth, an understanding of seedling tolerance to arid conditions is crucial for restoration success (James et al., 2013; Muñoz-Rojas et al., 2014). However, restoration in semi-arid areas faces the challenge of re-establishing plant communities on altered soil substrates (Muñoz-Rojas et al., 2015). These substrates are a result of anthropogenic disturbances such as mining which have altered the plant-soil-water dynamics of the ecosystem (Machado et al., 2013). The aim of this study was to assess the impact of mining on the plant-soil-water dynamics of an arid ecosystem of Western Australia (Pilbara region, North Western Australia) and the implications these altered relationships have on seedling growth and their responses to drought.

Methods

Drought responses of native plant species were assessed through a series of glasshouse experiments. Firstly, 21 species dominant to the Pilbara region were subjected to drought in a topsoil growth media to assess variation in responses (leaf water potential at the time of stomatal closure) across species and identify traits associated with drought tolerance. Secondly, four species ranging in their drought tolerance identified previously, were grown to two leaf stages (second and fourth leaf stage) in three mining substrates (topsoil, a topsoil and waste mix and waste) to assess seedling drought responses to various potential restoration substrates and how that varied with plant development stage.

Results and discussion

Four morphological traits were found to be significantly associated with drought indicators (leaf mass ratio, stem area, stem length, stem weight), however, these were weak correlations. Waste substrate and its addition to topsoil reduced plant total biomass but did not alter species responses to drought. However, the soil physical properties of the waste reduced water retention and water availability for plant uptake resulting in seedling mortality at less negative soil water potential. Finally, no significant differences in drought tolerance were observed between the two leaf stages across the four species tested. Analysis of plant desiccation curves found the advanced leaf stage to be less tolerant of drought as shown by a decrease in soil water potential at the time of stomatal closure. Species possess a range of morphological traits, some of which are associated with drought tolerance. However, these traits on their own may not be main drivers for drought resilience and other factors play a role, for example soil nutrient availability. Materials tested in this study that may be available to create novel restoration substrates hinder plant growth but not necessarily plant responses to drought. These findings go a long way to defining some of the limitations of seedling growth and the degree of drought tolerance which will assist in the management of post-mining restoration.

References

James, J.J., Sheley, R.L., Erickson,T., Rollins, K.S., Taylor, M.H., Dixon, K.W. (2013) A systems approach to restoring degraded drylands. Journal of Applied Ecology 50:730-739.

Machado, N. A. M., Leite, M. G. P., Figueiredo, M. A., Kozovits, A. R. (2013) Growing Ereman-thus erythropappus in crushed laterite: A promising alternative to topsoil for baux¬ite-mine revegetation. Journal of

Environmental Management 129: 149–156.

Muñoz-Rojas, M., Erickson, T., Merritt, D., Dixon, K. (2014) Optimising post-mining soil conditions to maximise restoration success in a biodiverse semiarid environment. Geophysical Research. Abstracts Vol. 16, EGU2014-2069-1, EGU General Assembly.

Muñoz-Rojas, M., Erickson, T., Merritt, D., Dixon, K. (2015) Applying soil science for restoration of post mining degraded landscapes in semi-arid Australia: challenges and opportunities. Geophysical Research. Abstracts Vol. 17, EGU2015-3967-1, EGU General Assembly.