Understanding the microbiology behind transformation of coal mine spoils to soils, in the Bowen Basin

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Summary

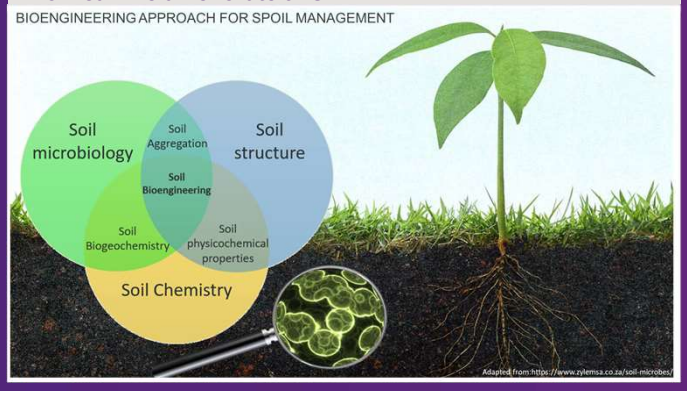
Sustainable management of Australian coal mines after closure is one of the most difficult challenges faced by the mining industry, especially because of the presence of low quality spoil material. Microorganisms are recognized as being an important tool for successful soil reclamation because of their vital role in carbon cycling and soil formation. The aim of this project is to identify, and understand the mechanisms by which, microorganisms can improve spoil fertility for post-mining restoration purposes. The overarching objective is development of a biofertilizer that can be applied to coal mine spoil to improve remediation outcomes. In this poster we present the results of the first year of work (Phase 1), in which the focus was on identifying microbial gaps that affect spoil fertility after mining and comparing the effect of topsoil addition during site rehabilitation.

Why is it a challenge?

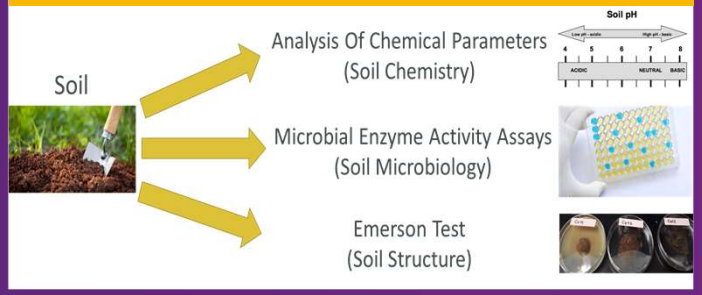
Presence of spoil material and poor quality of the soil

- Weathered soil
- Sodic and dispersive condition
- Low infiltration rates
- High pH and salinity
- High levels of erosion
- Weak aggregate stability

How can we ameliorate this?



Materials & Methods



Field Site

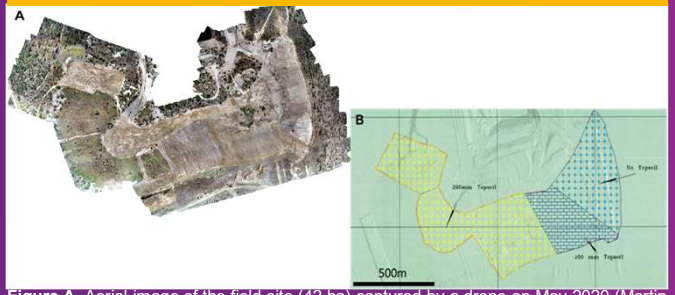
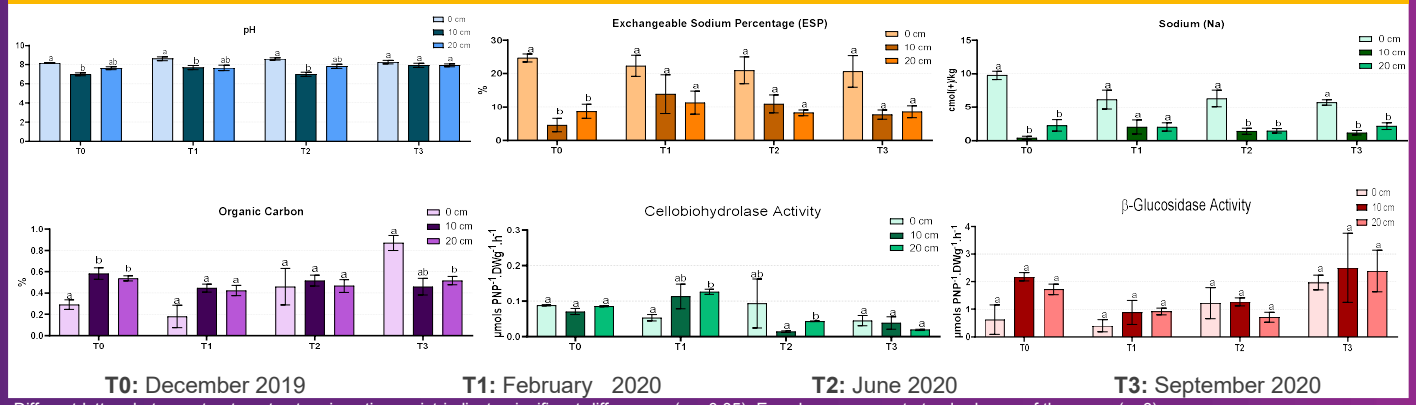


Figure A. Aerial image of the field site (42 ha) captured by a drone on May 2020 (Martin Keilbach, BMA); **Figure B.** Field setup divided into different topsoil layers (0, 10 and 20 cm of topsoil).

Preliminary Results (Phase 1)



T0: December 2019 **T1:** February 2020 **T2:** June 2020 **T3:** September 2020

Different letters between treatments at a given time point indicate significant differences ($p < 0.05$). Error bars represent standard error of the mean (n=3).

Remarks from Phase 1

- High salinity and high pH limit soil and spoil fertility.
- The addition of topsoil is a valuable strategy for reducing the spoil's sodic-saline condition.
- The indicative of phase 1 is that the addition of 10 cm of topsoil may have a better cost-benefit than 20 cm (standard method).
- Carbon cycling was efficient only in the first 6 months with the addition of topsoil.
- The soil dispersion index showed no significant difference between topsoil and spoil, most likely due to the heterogeneous character of the soil.

Next Steps

- Identification and quantification of soil microorganisms through DNA amplification.
- Proteomics Analysis: Selection of samples to investigate present and absent microbial functions.
- Development of biofertilizer composed of microorganisms identified and enriched in the laboratory and ongoing monitoring of chemical parameters.

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