

☐ Talk ☒ Poster

Field-Relevant Soil Stabilization Using Bacterial EPS to Improve Erosion Resistance and Vegetation Growth

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Improving soil stability is critical for mitigating sediment transport, turbidity in surface waters, eutrophication, and the loss of arable land through erosion and desertification. Biologically derived polymers offer a sustainable alternative to conventional chemical stabilizers. Extracellular polymeric substances (EPS) produced by *Rhizobium tropici* are particularly promising due to their low cost, biodegradability, and soil-binding properties. The ethanol-precipitable material (EPM) fraction of RT-EPS retains moisture and nutrients while enhancing soil structure, making it a potential tool for erosion control and soil rehabilitation under variable field conditions. This study evaluated the capacity of EPM to improve mechanical stability of sandy substrates and its influence on plant establishment and nutrient dynamics.

Mechanical stability was assessed by measuring the angle of repose of sand amended with 0, 12.5, 50, and 125 mg kg⁻¹ EPM. Treated sand was shaped into conical piles and monitored over time. Samples with 125 mg kg⁻¹ EPM maintained a significantly higher and more persistent angle of repose compared to the untreated control, indicating improved cohesion and resistance to slumping. Unconfined compressive strength (UCS) was measured as well for 0.5 and 1.0 biopolymer, where more than an order of magnitude increase was observed in samples dried for periods from one week to several months.

Vegetation trials demonstrated that soil stabilization benefits translated into enhanced plant performance. Bermuda grass grown for two months in EPM-amended sand exhibited increased shoot density and root biomass at 25 and 125 mg kg⁻¹, suggesting improved water and nutrient retention in the substrate. Bush beans grown in 25 mg kg⁻¹ EPM produced the greatest bean pod yield and root-to-shoot ratio. X-ray fluorescence (XRF) analysis of harvested pods revealed elevated potassium and chlorine levels in EPM-treated plants. However, pod yield at 125 mg kg⁻¹ declined to control levels despite further increases in mineral content, indicating a potential threshold effect. Increased lateral root formation, was also found using *Arabidopsis* plants, which RNA-seq analysis indicated as due to upregulation of the Auxin stem cell pathway and suppression of Cytosin pathway. the Micro-CT measurements were performed to determine the sand porosity and localization of the biopolymer within the pores and coating the sand grains. These findings demonstrate that EPM enhances soil cohesion and supports early plant establishment, key factors for erosion mitigation in field settings.

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