Optimizing the formulation of engineering slag using modified organic materials and microbial inoculants

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Abstract

As China's urbanization grows by leaps and bounds, engineering slag has turn into one of the broadest forms of solid wastes. The purpose of this research was to utilize engineering slag as a new planting substrate component to improve the soil environment in mine sites and address the growing shortage of land resources. The substrate optimal formulation was filtrated utilizing an orthogonal experiment involving four factors: slow-release fertilizer (SRF), microbial inoculants (MI), water-retaining polymer (WRP), and soil-to-slag ratio (SS). The results presented that SRF significantly increased the nutrients availability of the slag substrate. The addition of MI induced changes in the physicochemical properties of the substrate, ultimately affecting plant germination. Furthermore, at a concentration of 0.8% WRP had a significant effect on the physical properties and soil dehydrogenase (S-DH). However, 1% WRP was most favorable for plant growth. Exogenous soil significantly improved SOC content and Soil alkaline phosphatase (S-ALP) activity when applied at a dosage of 500 g. There existed significant correlations between soil properties and plant indicators. Afterwards we comprehensively analyzed the effects of 20 parameters, and from an economic perspective, the optimal parameters were as follows: SRF content of 1 g kg $^{-1}$, MI content of 90 mL kg $^{-1}$, WRP concentration of 1.0%, and SS of 30:70. Additionally, amplicon sequencing showed a positive impact on soil microbial community diversity due to the treatment. The results of this research will establish a theoretical foundation on combining microbial inoculants with external soil spray seeding techniques in mine sites reclamation.

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