

## ABSTRACT

### CADMIUM (Cd) REMEDIATION CAPACITY AND GROWTH RESPONSE OF CITRONELLA (*Cymbopogon nardus* (L.) Rendle) IN POST-TIN MINING SOILS AMENDED WITH BIOCHAR

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Oil palm empty fruit bunch (EFB) biochar has potential to improve the physicochemical properties of cadmium (Cd)-contaminated post-mining soils while enhancing the effectiveness of phytoremediation using citronella grass. This study aimed to evaluate the effects of EFB biochar application rates on Cd reduction in post-tin-mining soil, as well as on the growth response and phytoremediation potential of citronella grass (*Cymbopogon nardus* (L.) Rendle). The experiment was conducted by planting citronella grass seedlings in pots containing Cd-contaminated post-mining soil amended with EFB biochar. A control treatment consisted of soil without plants. The experiment employed a  $4 \times 2$  factorial completely randomized design with five replications, comprising biochar application rates (0%, 5%, 10%, and 15%) and the presence or absence of citronella grass. Observed parameters included soil pH, Cd concentrations in soil and plant tissues, bioconcentration factor (BCF), bioaccumulation factor (BAF), translocation factor (TF), vegetative growth, biomass, and chlorophyll and carotenoid contents. Data were analyzed using independent t-tests, Kruskal–Wallis tests, and Mann–Whitney U tests according to data distribution and remaining treatment levels. The results showed that EFB biochar application at 5–15%, with or without citronella grass, increased soil pH to alkaline levels ( $>9.00$ ). Biochar rates of 5–15% without citronella grass reduced soil Cd concentrations, with the greatest reduction observed at the 15% rate. The highest Cd reduction under planted conditions occurred in the treatment without biochar but with citronella grass ( $22.94 \text{ mg kg}^{-1}$ ), indicating phytostabilization potential, as reflected by  $\text{BCF} > 1$ ,  $\text{TF} < 1$ , and  $\text{BAF} > 1$ . The addition of 5% biochar significantly reduced Cd concentrations in both roots and shoots and decreased BCF, BAF, and TF values to  $<1$ . The 5% biochar rate enhanced vegetative growth of citronella grass at 7 days after planting, although the effect declined by 14 days, while shoot biomass increased. Biochar rates of 10–15% resulted in plant mortality. Root biomass, chlorophyll content, and carotenoid content were not affected by biochar application. In conclusion, high rates of EFB biochar are effective in reducing soil Cd but do not support citronella grass growth, whereas a 5% biochar rate is optimal for promoting citronella grass growth.

**Keywords:** EFB biochar, phytoremediation, *Cymbopogon nardus*, cadmium, post-tin mining soil