

# **Co-Application of Inorganic Fertilizers with Charcoal and Sago Bark Ash to Improve Soil Nitrogen Availability, Uptake, Use Efficiency, and Dry Matter Production of Sorghum Cultivated on Acid Soils**

## **ABSTRACT**

Efficient management of N fertilizers enhances crop yields and contributes to sustainable food security. Tropical acidic soils with high Al and Fe are prone to easy loss of basic cations, such as  $\text{NH}_4^+$ , via leaching and erosion. Appropriate soil amendments and agronomic practices minimize the loss of fertilizer nutrients, improve soil nutrient retention, and maximize their uptake by plants. This study aimed to evaluate the effects of co-applying charcoal and sago bark ash with inorganic fertilizers on N availability, uptake, use efficiency, and dry matter production of sorghum in a tropical acid soil. The results revealed that the co-application of inorganic fertilizers with charcoal and sago bark ash increased sorghum plant height, dry matter production, N uptake and N use efficiency. The soil treated with a combination of 100% of the recommended rate of charcoal and sago bark ash (C1A1) resulted in significantly higher sorghum dry matter production, N uptake, and use efficiency compared with normal fertilization (U1). The C1A1 treatment resulted in significantly lower soil available N compared with U1. The C1A1 treatment enhanced the uptake of N by the sorghum plants, resulting in less available N in the soil after the experiment. Although the effects of co-applying charcoal and sago bark ash on soil total N were not glaring, this practice increased soil pH and total C, and reduced exchangeable acidity and  $\text{Al}^{3+}$ . A long-term field study is recommended to confirm the effects of co-applying inorganic fertilizers with charcoal and sago bark ash on sorghum productivity, economic viability, and soil nutrient residual effects.