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Aluminum Phytotoxicity in Sorghum Grown in High-Activity Clay Soils

Daíza Ellen da Silva Borges*[1], Ronielton Coelho[2], Witória Maria Cavalcante Lins[3], Marcelo Metri Corrêa[4], Alexandre Tavares da Rocha[5]
[1]Universidade Federal do Agreste de Pernambuco (UFAPE), Garanhuns/PE, Brasil; [2]Universidade Federal Rural de Pernambuco (UFRPE), Recife/PE, Brasil; [3]Universidade Federal do Agreste de Pernambuco (UFAPE), Garanhuns/PE, Brasil; [4]Universidade Federal do Agreste de Pernambuco (UFAPE), Garanhuns/PE, Brasil; [5]Universidade Federal do Agreste de Pernambuco (UFAPE), Garanhuns/PE, Brasil. * daiza.e@gmail.com

The sugarcane-growing region of Pernambuco is characterized by soils with high levels of aluminum, extracted by potassium chloride, often associated with 2:1 clay minerals. This extraction method can overestimate aluminum levels, resulting in inaccurate assessments of soil toxicity. Excessive aluminum in the soil can be highly phytotoxic, negatively impacting plant growth. This study aims to determine the phytotoxicity of sorghum to aluminum in high-activity clay soils, with the goal of improving agricultural practices in the region. The research involved collecting samples from the A and B horizons in soils from the municipality of Cabo de Santo Agostinho, Pernambuco. These samples were subjected to chemical, granulometric, and mineralogical analyses for detailed characterization. Subsequently, a greenhouse experiment was conducted to evaluate the response of two sorghum varieties, BRS-332 (sensitive) and BRS-373 (tolerant) to aluminum, with and without the application of lime ($CaCO_3$). The experiment aimed to compare the growth and dry mass of the plants under different soil pH correction conditions. The need for lime to adjust the soil pH was determined by incubating the samples. Results indicated that to reach the ideal pH, doses of (4 t ha^{-1}) for the A horizon and (12.5 t ha^{-1}) for the B horizon were required. These values reflect the different chemical and physical characteristics of the horizons, with the B horizon requiring a significantly higher amount of lime due to its greater acidity and cation exchange capacity. The experiment's results showed that the sensitive cultivar BRS-332 exhibited a significant reduction in the dry mass of shoots and roots when grown in uncorrected soils. Conversely, the tolerant cultivar BRS-373 demonstrated superior performance in terms of growth and development in both horizons, especially when the soil was treated with lime. The results indicate that with proper soil correction, it is possible to significantly improve sorghum productivity in regions affected by high aluminum toxicity. The application of $CaCO_3$ resulted in a significant reduction in aluminum levels in the soil, creating a more favorable environment for plant development. The cultivar BRS-373 with lime application in the A horizon showed an increase in the dry mass of shoots to (1.516 g pot^{-1}) and roots to (1.069 g pot^{-1}). Soil correction with lime proved to be essential in mitigating aluminum phytotoxicity in sorghum, particularly in the high-activity clay soils of the sugarcane-growing region of Pernambuco. Reducing aluminum levels in the soil through liming not only promoted better plant development but also highlighted the importance of selecting aluminum-tolerant cultivars.

Keywords: Toxic aluminum, pH correction, clay soils, Sorghum.