Aluminium speciation of amended acid tropical soil and its effects on plant root growth

ABSTRACT

Exchangeable and soluble soil aluminum (Al) is limiting plant growth in many soils worldwide. This study evaluated the effects of increasing rates of dolomite and magnesium carbonate (MgCO3) on Al3+, pH, dissolved organic carbon, cations, anions, and Al speciation on oil palm Deli dura × AVROS pisifera root growth. Dolomite and MgCO3 additions significantly raised linearly soil solution pH, magnesium (Mg2+), nitrate (NO_3^-) and chlorine (Cl^-) concentrations; exponentially decreased the activity of phytotoxic Al species [aluminum (Al3+), aluminum sulfate (Al2SO4), and aluminum fluoride (AlF3)]; and reduced manganese (Mn) concentration and activity. High activity of those species exponentially reduced root dry weight. Optimum oil palm growth was achieved at: <50 µM monomeric Al, < 30 µM Mn, and <0.20 unit of the ratio Al+Mn to calcium (Ca)+Mg. High activity of Al species and Mn in acidic soil solution cause significant reduction of the root growth. Soil acidity alleviation either with dolomite or MgCO3 mitigates the toxic effect of Al and Mn.

Keyword: Soil acidity; Oil palm; Amendment; Soil solution; Aluminum; Manganese; Ultisol