The Mechanism by which Bacteria Inhibit Acidification of Variable Charge Soils (A): Effect of *Pseudomonas fluorescens* on Chemical Forms of Al

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The associated low pH and cation exchange capacity of variable charge soils make them prone to depleted base cations and increased levels of Al^{3+}. Consequently, Al toxicity to plants and soil infertility decrease crop yield. Bacteria aggregates found in plant rhizosphere promote plant growth by enhancing nutrient acquisition and inhibiting the adverse effects of plant pathogens. This study was designed to investigate the effect of *Pseudomonas fluorescens* on the acidification of two variable charge Ultisols derived from different parent materials. The study was extended to analyze soluble Al and the pool of potentially active Al (exchangeable Al^{3+}, organically bound Al, and sorbed hydroxyl Al) in the solid phases of the soils. The simulated acidification studies demonstrated that the pH of the bacteria-treated soil was higher than that for the control under similar conditions, with the effect related to the amount of bacteria adhered to each soil. This observation was attributed to the ability of negatively charged functional groups ($RCOO^-$ or RO^-) on the bacteria surface to bind H^+ thereby forming neutral molecules (RCOOH or ROH) and reducing the activity of H^+ in solution. The proportion of toxic Al^{3+} (soluble + exchangeable Al^{3+}) was reduced by the bacteria as it was converted to the non-toxic organically bound and sorbed hydroxyl Al. Thus, the organically bound Al dominated the soil solution when the soils were treated with bacteria as opposed to the control where the toxic Al^{3+} dominated the soil solution. Zeta potential measurements and ATR-FTIR spectroscopic analysis, helped us to arrive at the conclusion that *P. fluorescens* reduced the quantity of potentially toxic Al^{3+} by (1) inhibiting acidification in variable charge soils by reducing the activity of protons in solution, (2) increasing the organic matter content of the soils and providing multiple oxygen-rich bonding sites on the soil surface to bond H^+ and Al^{3+}, and (3) enhancing the overall surface negative charge of the soils.