Geophysical Research Abstracts
Vol. 12, EGU2010-7823, 2010
EGU General Assembly 2010

Effect of humic substances on P sorption capacity of three different soils

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Organic matter decreases P sorption by soils. It has been demonstrated the effect of low molecular weight compounds decreasing P adsorption on active surfaces and the effect of humic and fulvic acids inhibiting the precipitation of hydroxyapatite and favouring the formation of more soluble phosphates. This contributes to increase the recovery of applied P fertilizer. The objective of this work was to study the effect of 4 different humic substances (commercially available and provided by Tradecorp Internacional S.A.) on the sorption capacity of three soils differing widely in chemical properties (two calcareous from south Spain, pH 8 and 8.5, and other acidic from Brazil, pH 5.9 and 50 % of exchangeable basic cations). To this end, sorption isotherms were performed at a soil:0.01 M CaCl2 ratio of 1:10 at 6, 30 and 90 days. 2.5 mg of humic substances per g of soil were added to the solution. Data were fitted to the best model and linearized sorption curves for each humic substance were compared with the linearized sorption curve for the control without humic substances application (intersection point and slopes).
Soil from Brazil showed a much higher sorption capacity (400 mg P kg-1 soil sorbed at 1 mg L-1 of P in the solution at 1 day) than the other two soils (50 and 100 mg P kg-1). Slow reactions significantly contributed to P sorption in the three soils, amounts sorbed at 90 days being twice than those sorbed at 1 day. Two of the products increased P sorption in the soil from Brazil at 1 day. At 90 days all the products increased P sorption significantly. This increased P sorption can be only explained by metal complexation by the substances applied, which may result in organo-metallic compounds with a high P sorption capacity. This effect was independent of the proportion of humic and fulvic acids in the applied products because the amounts of metal complexed by these compouds depend on the amount of functional groups to coordinate with metals. In the Spanish calcareous soils, the most effective product decreasing P sortion was one constituted by 8 % humic acids + 2 % fulvic acids. In general terms, this product promoted a lower intercept point and a higher slope than the control without application of humic substances. This indicates that the decrease in P sorption was more evident at low P concentrations in the solution, perhaps indicating a significant effect decreasing adsorption process, more than precipitation of Ca phosphates which are assumed to be the dominant process involved in P sorption above 10-4 M P in the solution. Other products only decreased the intercept point at 1 or 30 days in these calcareous soils, less evidently than the first product, indicating an interaction with adsorption and precipitation processes. In calcareous soils, fulvic based products were, in general terms, less efficient decreasing P sorption than those based on acid + fulvic acids mixtures. However, products with a similar content of humic and fulvic acids did not necessarily promote similar effects, thus revealing that other factors related to these organic compounds, such as type and amount of functional groups, may affect the interaction with P sorption processes. These results reveal that the application of mixtures of P fertilizer with humic + fulvic acids could be effective in increasing the efficiency of P fertilizers applied thus revealing the potential interest of the knowledge of the effect of organic matter on the P cycle in soil.