

Paper for New Frontiers in Soil fertility, etc

In mature soils plant available K is only the exchangeable-K: can ground silicate minerals increase the K-store?

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For mature soils in tropical areas dominated by kaolin and sesquioxides it is possible to carry out K-exhaustion experiments in the glasshouse that demonstrate that the available K is exactly equal to the exchangeable K. When this K is exhausted plants are unable to make use of the K contained in micas and feldspars present in the silt and sand fractions of these soils. These K-bearing silicate minerals generally contain most(>90%) of the K present in the soil but clearly do not contribute significantly to plant available K. As exchangeable K represents a finite reserve which is progressively depleted by removal of plant and animal products it is commonly concluded that the soil K reserves are being 'mined' and must be renewed by fertilization. Unfortunately many farmers in the tropics can not afford K-fertilizers and local supplies of plant residues and manures are insufficient to renew soil K reserves. K-silicate minerals such as feldspar and mica are significant constituents of several common rock types and might constitute alternative K-fertilizers if they can be made more soluble. This can be achieved by high energy milling which greatly reduces particle size (increases specific surface area) and induces crystalline disorder. These changes greatly increase the solubility of the K silicates and in suitable soils (acid, wet) sufficient dissolution occurs to release substantial amounts of K to plants. However the fertilizer effectiveness of high energy milled K-silicate minerals is less to much less than the effectiveness of the soluble K salts (KCl, K₂SO₄) in chemical fertilizers. This limitation can be overcome to some extent by applying more silicate rock fertilizer but the liming effect of ground silicates results in smaller proportions of rock being dissolved at very high application rates. Silicate rock fertilizers are suitable for use in 'organic agriculture' where chemical fertilizers are proscribed, they may be superior for very sandy soils where water soluble K fertilizer is rapidly leached and they may be suitable for use for plants with a relatively low external K demand(cassava) and a long growing period (fruit trees, forests).