The use of feldspars as potassium fertilizers in the savannah of Colombia

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Abstract. Finely ground sanidine feldspar from the Huila area of Colombia (< 100 mesh, largely sanidine, 7% K) and KCl were used as fertilizers in a pasture experiment at Carimagua on an oxisol containing 1 mg total K and 23 μg exchangeable K per g (0.6 μeq per g). The association of Brachiaria dyctioneura and Pueraria phaseoloides clearly responded to K taken up from the KCl with a small though non-significant response to the feldspar. During 14 months the crop took up between 25 and 68% of the KCl-K or about 10% of the feldspar-K. Much of the applied KCl became non-exchangeable, but was released as required by the crop: the soil contained an Al chlorite-vermiculite which held the native K and fixed and released K during the experiment. The feldspar may be valuable as a slow release fertilizer in low input agricultural systems particularly on leached soils of low ECEC.

Introduction

Tropical savannah produces a low output of dry matter which can be grazed by cattle. Improved productivity can result from high inputs to arable crops, or low inputs to improved pastures. There are 16 million hectares of savannah in Colombia and low input technology is being studied in the Tropical Pastures Programme of CIAT. Inputs can be through the use of (a) legumes to fix nitrogen, (b) rock phosphate as a slowly soluble source of phosphorus and calcium, and (c) lime to reduce the soluble aluminium and to supply calcium. If acid tolerant species are used, small amounts of rock phosphate may be the only input required [13]. Potassium availability is often low in these soil which normally have a variable charge, and a small effective cation exchange capacity at the low pH values produced by leaching. Application of KCl may be of limited use because being soluble, the potassium may initially be taken up in luxury amounts and is also readily leached. In Colombia, KCl has to be imported which causes a drain on foreign ex-

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change. Feldspar rocks, widespread in the Andes and in other parts of South America, may be useful as potassium fertilizers because of their slow-release characteristics.

The rate of release of K from feldspars has been explained by (a) a surface controlled reaction with constant rate of dissolution and (b) incongruent weathering with the formation of a protective residual coating and a parabolic rate of release of ions [6]. Holden and Berner [7] found no evidence of protective coatings: the parabolic release rate was explained by a surface controlled mechanism with very fine particles dissolving more quickly than larger ones [4]. Dissolution occurs with the etching of the surface by $H^+$ to produce pits [16]. However the reaction appears to be incongruent with the formation of an Al-rich silicate as a secondary mineral, and the interpretation of the kinetics is complex. The rate of release is pH dependent: increased solubility at low pH is also predicted from consideration of thermodynamic equilibrium between feldspar and solution [10] although theoretical $K^+$ concentrations are much higher than those found in practice. This implies that secondary reactions may be important in controlling rates of release [8] or that equilibrium is not reached.

There are early reports of the use of feldspars as K fertilizers [1] [3] but they have been little use subsequently. Interest has been renewed [9] [5, 1983] but we do not know whether K can became available in soils at rates significant for crop use. Apart from expecting that K would be more readily released into acid soils with low concentrations of K in soil solution it is not known if other soil chemical properties influence availability, although solubility considerations suggest that a low concentration of Al and Si in soil solution would also increase the rate of release.

A field experiment using cassava carried out by CIAT (unpublished) suggested that useful responses could be obtained with ground feldspar, and in 1984 a pasture experiment was established at the Carimagua Research Station in the eastern savannah of Colombia to study the availability of K under low input conditions. This paper gives the results: further information is available [5, 15].

**Methods**

The site for the field experiment was in the area La Reserva of the Carimagua Research Station, run jointly by Instituto Colombiano Agropecuario