EFFECT OF SMALL QUANTITIES OF 2/1 INTERSTRATIFIED CLAY MINERALS ON THE FATE OF POTASSIUM IN FERRALSOLS OF SOUTHERN TOGO

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This work was conducted on rhodic Ferralsols of Southern Togo (typic Eustrustox), so-called terres de Barre, where clay minerals are mainly kaolinite and hematite. The aim of this study was to determine the fate of potassium, in order to propose a fertilization in agreement with the mechanisms involved in these soils. Potassium leaching, exchange properties of K^+ ions and clay minerals were analysed. This study was carried out on two plots, continuously cropped with maize twice a year for 13 years; one plot received NPK fertilizers each year, and the other received only NP fertilizers. In the latter, severe potassium deficiencies appeared after two or three years of cropping, decreasing drastically maize yield (10 q.ha^{-1} versus 35 q.ha^{-1}).

Potassium leaching was determined for two consecutive years by measuring the water movement, using tensiometric and neutronic methods, as well as the potassium concentration in soil solution, using porous ceramic cups placed at a depth of 180 cm. Annual potassium leaching was 7.5 kg K.ha^{-1} in treatment with K fertilizer applied each year at 100 kg K.ha^{-1} rate for 13 years and 5.8 kg K.ha^{-1} in treatment without K.

Exchange properties of K^+ ions were analysed on 2 soil horizons from 0 to 100 cm depth by using not only M NH_4-acetate, but also $^{42}K^+$ labelled potassium ions. Amounts of NH_4-exchangeable potassium and of isotopically exchangeable potassium (slightly higher than the previous) were higher, within the upper 50 cm, for the treatment with K fertilizer than for the treatment without K. The amounts of exchangeable K did not significantly differ in deeper soil horizons. The K concentration in the soil solution increased for two months after a K input, due to the buffering capacity for potassium of the soil, but only in the first 50 cm. Measurements by isotopic exchange showed that 15 % of an input of K became non isotopically exchangeable in the upper soil layers and 30 % in the deeper ones. These data were somewhat surprising for Ferralsols.

Clay minerals were determined by coupling chemical analysis, T.E.M. and X-ray diffraction. One weak band at 1.4 nm, moving to 1.0 nm after heating (500°C), proved that the soils contained a few interstratified 10-14 Sm clay minerals. Their amount was estimated, by chemical analysis, to be about 2 %. T.E.M. showed that they derived from small particles of micas. The interstratified clay minerals, although in small quantities, are responsible for K fixation.

In these soils, low in exchangeable potassium, where no more than 5 to 10 kg K.ha^{-1} are annually leached to a depth of 180 cm, and where a significant fraction of the K inputs can occupy non exchangeable sites, K fertilizers should be applied every year to cover plant needs and the K outputs of the crops.