Potassium availability in soils – splitting plant and soil factor effects

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Potassium availability in soils depends on its quantity and intensity indices. At a given moment, the directly available K, i.e., the soluble K, in the root zone amounts to few percent of the amount needed by crops. Thus, plants rely on the solid phase potassium, mostly in the form of adsorbed cations. The energy for K-extraction from the soil is ultimately derived from metabolic energy and is assumed to equal the energy of the cation exchange between the most prevailed cations, usually Ca^{2+} and Mg^{2+}. This energy was suggested by Woodruff [1] to equal $RT \cdot \ln(AR)$ (termed ΔF), where $AR=(K/(Ca+Mg)^{0.5}$, and K, Ca, and Mg are the activities of the free cations in the soil solution at equilibrium with the cation exchange complex of the soil. The ΔF is thus considered to be a measure of K intensity in soils, while extractable K (by 1-*M* ammonium acetate, 10-*mM* $CaCl_2$, or other extractants) is a common index for available K quantity in soils. The ratio of K to the major cations in the soil solution has also a direct effect on the uptake of potassium by the roots. The relations between the cations in the soil exchangeable complex, in the soil solution, and in tomato plants were studied in order to separate the effects of the soil from those of the uptake system of the plants. The results suggest an improved method to assess K availability in soils and an improved interpretation for soil tests for potassium.

[1] Woodruff, C.M. 1955. *Soil Sci. Soc. Am. J.* 19: 167–171.