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RESEARCH ARTICLE

Potassium supplying capacity of some tropical alfisols in southwest Nigeria as measured by intensity, quantity and capacity factors

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Abstract Experiments were conducted in the laboratory, greenhouse and on farmers' fields to determine, the potassium (K) supplying capacity of some soils in Ogun State, Nigeria, using equilibrium parameters as measured by quantity, intensity and activity indices. The result showed that the potassium status of the soils varied widely. Total K varied from 14.2 to 104 cmol kg^{-1} in the green house soils and 46.05 to 89.1 cmol kg^{-1} in the field soils. On the average, exchangeable and solution K constituted 0.39 and 0.09% of the total K, respectively in the greenhouse soils. The potential buffer capacity (PBC), which measures the ability of the soil to maintain the intensity of K in the soil solution, varied from 12.24 to 39.25 ($ML^{-1/2}$). About 50% of the soils studied in the green house and in the field have high PBC indicating slow release of K to the soil solution. The specifically bonded K which constituted the bulk of the labile K (K_L) that is immediately available is generally low. It ranged from 0.10 to 0.29 cmol kg^{-1} with a mean of 0.18 cmol kg^{-1} in the greenhouse soils, and mean of 0.16 cmol kg^{-1} in the field soils. These low values accounted for the appreciable responses to K application by soybean in most of the soils studied. The change in Gibb's free energy (ΔG) values, which measures the intensity of exchangeable K relative to other cations, is moderate in most of the soils. Correlation analysis showed that all the forms of K correlated positively and significantly with soybean dry matter yield at the first cropping harvest. However, soybean K concentration in the first harvest was only positively correlated with available K, exchangeable K, solution K and fixed K ($P < 0.01$). The clay content of the soil is also positively and significantly correlated with K forms. The prediction equation showed that the soil's clay content is a major determinant of labile K, equilibrium activity ration (EAR) and the potential buffering capacity. The EAR is also strongly determined by the ECEC and the K saturation ($R^2 = 0.990$, 0.996, $P < 0.01$). The critical level of soil labile K, available K and specifically bonded K are 0.21, 0.35, and 0.19 cmol kg^{-1}, respectively. Thus, with the use of available K as the index of K fertility, about 50% of the soils are K deficient. Hence potassium fertilization is necessary for enhanced production of soybean in these sites.

Keywords Potassium status · Quantity-intensity-capacity indices · Southwest Nigeria

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