Calibrating QUEFTS model for Improved Fertilizer Use Efficiency in Cassava based Farming System in West Africa

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ABSTRACT

Soil nutrient depletion and inefficient use are major constraints to crop production in Sub-Saharan Africa, decreasing crop yields and farm economic returns. The use of computer models like QUEFTS, a model for the quantitative evaluation of the fertility of tropical soils, was successfully to manage soil nutrient and formulate site specific fertilizer recommendations for maize and rice production. Its calibration for cassava, major staple food and source of calories for many people in West Africa, which has a longer crop life cycle in the field with greater nutrient uptake potential, is required to sustain food production in cassava based farming systems in this sub-region.

The objective was to calibrate QUEFTS model in order to optimize fertilizer use, crop yield and economic returns in cassava based farming systems in West Africa. A fertilizer trial was conducted on station in a randomized block design with 4 replicates for 2 years in 4 locations of different soil organic carbon content ranging relatively from high in Kumasi (South Ghana), medium in Davié (South Togo), and low in Tamale (North Ghana). The trial was composed of 10 treatments: T0 (0-0-0), T1 (0-40-130), T2 (40-40-130), T3 (80-0-130), T4 (80-20-130), T5 (80-40-0), T6 (80-40-65), T7 (80-40-130), T8 (40-20-65) and T9 (150-50-170) for two cropping systems: sole cassava (all sites) and maize-cassava intercropping (only Davié). The inherent soil fertility and internal use efficiency parameters were estimated from treatments T1 for N, T3 for P, T5 for K. The performance of the model to assess cassava response to increasing rates of N, P and K per cropping system was measured by comparing simulated and observed yields from treatments T1, T2 and T7 for N (0, 40 and 80 kg/ha), treatments T3, T4 and T7 for P (0, 20 and 40 kg/ha), and treatments T5, T6 and T7 for K (0, 65 and 130 kg/ha). After successful evaluation, the model was used to formulate optimal rates of N, P and K with high yield and economic returns potential.

The inherent soil fertility values varied from site to site. The internal use efficiency also varied for each cassava cultivar. Their use for QUEFTS calibration for cassava was successful for the simulation of cassava root yields and response to increasing rates of N, P and K. The resulting site specific fertilizer rates formulated gave higher yields and value cost ratio compared to traditional nutrient management practices.

Therefore, the calibration of QUEFTS model for cassava production helped improve the efficiency of fertilizer use within the system and farmers revenues.

Keywords: Cassava, QUEFTS, cropping system, inherent soil fertility, nutrient use efficiency.