CHEMODYNAMIC STUDIES AND ASSESSMENT OF PESTICIDE RESIDUES IN LAKE VICTORIA CATCHMENT AREA FOR RIVERS SIO AND NZOIA

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any University.

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This thesis has been submitted for examination with our approval as University Supervisors.

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ABSTRACT

This study covered monitoring of transport and persistence of pesticides in tropical soils through modeling studies, and environmental assessment of pesticide residues. Major processes influencing persistence and transport of pesticides, comprising of degradation, mineralization, photolysis, sorption, and leaching were investigated using labeled and unlabeled 2,4-D amine and metribuzin (4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one) on acidic and basic soils. Bioremediation of pesticides by organic compost amendment was included in experimental designs involving sterile-, unsterile- and unsterile amended-soils, whereas data analyses were performed using established models for persistence and transport processes.

Single-phase and biphasic kinetic rates described mineralization processes of 2,4-D and metribuzin in soils under incubation and sunlight experiments. Rapid first phase mineralization rates were observed for 2,4-D and metribuzin breakdown in unsterile-unamended soils, and unsterile soils amended with organic compost, giving half-lives between 1222.12-14.35 days and 95.15-78.46 days for 2,4-D in Chemelili and Mwea soils respectively, whereas half-lives between 13482-2046 days and 619.32-477.21 days were recorded for metribuzin in the same soils respectively. 2,4-D and metribuzin photolysis gave half-lives ranging of 369-544 days and 6004-486 days for 2,4-D in Chemelili and Mwea soils; and between 1733-770 days and 2310-1386 days for metribuzin in Chemelili and Mwea soils respectively.

Shorter degradation half-lives were observed for 2,4-D and metribuzin, ranging from 10-12 days and 9-14 days for 2,4-D in Chemelili and Mwea soils respectively; whereas 28-37 and 29-34 days were observed for metribuzin in the same soils and order. Sorption

experiments of metribuzin showed higher adsorption desorption coefficients in both soils compared to 2,4-D, partly accounting for the trend observed in mineralization, degradation and sunlight experiments. K_{ad} values of 1.38 and 1.25 were observed for metribuzin in Chemelili and Mwea soils, whereas 1.10 and 1.04 were observed for 2,4-D in the same soils in the same order. Similarly high retardation factors of 4.95 and 3.4265 were obtained for metribuzin in Chemelili and Mwea soils, whereas 4.165 and 3.0273 were obtained for 2,4-D in the same soils, in soil column leaching experiments.

Assessment of pesticide residues in the environment was conducted in December 2002, March and April 2003, and covered water, soil, weeds and fish samples that constituted 127 samples screened for 20 residues comprising of organochlorine and organophosphorus pesticides. Some of the investigated pesticides included POP pesticides banned under the Stockholm Convention, and green pesticides. Residues of p.p'-DDT, o,p'-DDE, and p,p'-DDD, α-, β-, γ-HCH, dieldrin, endrin, aldrin, α-, β-endosulfan, endosulfan sulfate, heptachlor, heptachlor epoxide, ethyl parathion, dimethoate, malathion, fenitrothion, and diazinon were detected at varying frequencies and concentrations. In general, the residue levels ranged from BDL-0.44 µg/l in water, BDL-65.48 µg/kg in soils, BDL-10.07 µg/kg in weeds and BDL-481.18 µg/kg in fish samples, whereas dieldrin, p,p'-DDD, aldrin, p,p'-DDT, heptachlor, heptachlor epoxide, endosulfan sulfate and lindane constituted the highest residues detected.