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Degradation of rotenone in soils and influence of temperature fluctuation on its persistence

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Nowadays, a broad-spectrum pesticide, rotenone, is used with strong restriction because of its environmental hazards. It is a heterocyclic organic compound, practically insoluble in water, and its environmental pathways and behaviour are rather unknown. The persistence and degradation of rotenone and its primary degradation product in soils were performed under standardized laboratory conditions in dark at 20˚C or 10˚C and at 40 % of maximum water holding capacity. Degradation experiments were carried out on two types of soil collected in southern Italy, silt clay loam (SCL) and loam (L). Soils were spiked with 10 mg/kg of rotenone and degradation was investigated during aerobic incubation of 5-mounths. A kinetic model was developed to describe degradation rates of rotenone, taking into account the production, retention, and degradation of the main metabolites. We also observed the formation of nonextractable residues.

The DT50 values of rotenone, 12aβhydroxyrotenone, the time for 50% decline of the initial pesticide concentration, were 8 and 52 d, in SCL soil at 20˚C and 5 and 23 d, in L soil, respectively. On the other hand at 10˚C there was a tendency for slower degradation of rotenone and 12aβhydroxyrotenone in SCL of 21 and 118 d, and in L soil of 25 and 35 d, respectively. The differences were significant for most datasets. Temperature had a strong effect on degradation. An increase in temperature by 10˚C resulted in a decrease in the DT50 value by a factor of 2.6 and 2.2 in SCL and of 5.0 and 1.4 in L soils for both rotenone and 12aβhydroxyrotenone, respectively. The results show that the degradation rates of both rotenone and 12aβ hydroxyrotenone were greatly

affected by temperature changes and soil physico-chemical properties. In experimental studies, changes in temperature and/or soil properties affected the degradation rate and caused deviations from first-order kinetics; the degradation reaction fits the two compartment or the multiple compartment model pathways better, which clearly indicates the rather complex chemical process of rotenone degradation in soils. Results provide additional insights on the rates and the mechanisms of rotenone degradation, aiming to describe more clearly the degradation performance of chemical residues in the environment.