A MATHEMATICAL MODEL TO ESTIMATE THE VOLUME OF GREY WATER OF PESTICIDE MIXTURES

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This paper presents a mathematical model to estimate the volume of grey water of crops by calculating the volume of water necessary to dilute pesticides mixture in water bodies. The model was developed for crop production systems that use a set of pesticides that may reach the freshwater (surface or groundwater) sources. In this approach, the volume of grey water is calculated from the toxicological end point of each pesticide component of the mixture, rather than their maximum acceptable concentration in freshwater and considers concentrations of the pesticides which provokes 50% effects (EC50) on organisms used as indicators of water quality, with first order kinetics soil degradation and linear soil sorption. The model requires short-term toxicity data from algae, daphnids, fish and aquatic plant (aquatic ecotoxicity EC50 values) pesticide half-life in soil and the pesticide soil sorption coefficient, instead thresholds concentrations or maximum residue limits as established for water quality. Lixiviation rates of each component of pesticide mixture were estimated by retardation and attenuation factors. The usefulness of the proposed model was illustrated by estimating the volume of grey water required to dilute the seventeen most widely used herbicides in the agricultural system of sugarcane crops in Brazil. The volume of grey water corresponding to each herbicide considered in this study varied between $1{,}69\times10^{2}m^{3}ha^{-1}$ (glyphosate) and $4{,}64\times10^{8}m^{3}ha^{-1}$ (trifloxysulfuron) and the total of grey water volume to the mixture of herbicides was $5{,}09\times10^{8}m^{3}ha^{-1}$. These results establish the relative weight of each herbicide in the composition of the total volume of grey water of a mixture of herbicides.

Keywords: water footprint, sugarcane, herbicide