

Synthesis

Challenges in Regulating Pesticide Mixtures

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ABSTRACT. This paper introduces the field of mixture toxicity and the challenges in regulating pesticide mixtures. Even though pesticides are unique chemical stressors designed to have biological activity that can affect a number of nontarget species, they are intentionally placed into the environment in large quantities. Currently, methods and terminology for evaluating mixture toxicity are poorly established. The most common approach used is the assumption of additive concentration, with the concentrations adjusted for potency to a reference toxicant. Using this approach, the joint action of pesticides that have similar chemical structures and modes of toxic action can be predicted. However, this approach and other modeling techniques often provide little insight into the observed toxicity produced by mixtures of pesticides from different classes. Particularly difficult to model are mixtures that involve a secondary toxicant that changes the toxicokinetics of a primary toxicant. This may result in increased activation or a change in the persistence of the primary toxicant within the organism and may be responsible for a several-fold increase or decrease in toxicity. At present, the ecological effects caused by mixtures of pesticides are given little consideration in the regulatory process. However, mixtures are being considered in relation to human health in the pesticide registration process, setting a precedent that could be followed for ecological protection. Additionally, pesticide mixtures may be regulated through toxicity testing of surface water under the *Clean Water Act*. The limits of our basic knowledge of how mixtures interact are compromising both these avenues for regulating mixtures. We face many challenges to adequately protecting the environment from mixture toxicity; these challenges include understanding the interactions of toxicants within an organism, identifying the mixtures that most commonly occur and cause adverse effects, and developing a regulatory structure capable of minimizing environmental impacts.