Worker Exposure and Risk

Mixer-Loader and Applicator Exposure

Risk is a function of hazard potential and exposure (Risk = ∫(Hazard, Exposure). The model for conducting worker exposure Risk Assessments was developed jointly by the U.S. Environmental Protection Agency (EPA), the Pesticide Management Regulatory Authority (PMRA) of Canada and Crop Life America (CLA).

Exposure estimates for mixing, loading, and applying EBDC fungicides during outdoor agricultural applications would be conducted using the Pesticide Handlers Exposure Database (PHED) as the source of surrogate exposure data. The database contains exposure data for mixing, loading and application of pesticides obtained from a large number of field trials conducted using various kinds of equipment in a variety of agricultural scenarios. Mixing and loading scenarios available in PHED include but are not limited to the following; Dry Flowable: Open Mixing, Liquid Formulations: Open Mixing, Wettable Powders: Open Bag, and Wettable Powders: Water Soluble Packets. Similarly application scenarios available in PHED include but are not limited to: Aerial-Fixed Wing: Liquid Formulations; Enclosed Cockpits, Aerial-Fixed Wing: Granular Formulations; Enclosed Cab, Airblast: Open Cab, Airblast; Enclosed Cab, Groundboom; Open Cab, and Groundboom; Enclosed Cab. Values in PHED are normalized by pounds handled per day and are presented as micrograms per pound of active ingredient handled (ug/lb. ai). The formula for calculating exposure (dermal and inhalation) and dose for mixer-loaders and for applicators is:

Exposure = PHED value x Pounds Handled (Application rate [lb/A] x Acres [A] treated)
Dose = Exposure x % Absorption ÷ Body Weight

Re-entry Exposure and Re-entry Intervals

Exposure estimates for entry into crops previously treated with EBDCs would be conducted according to the algorithm used by the U.S. EPA and presented in various Registration Eligibility Documents (REDs). This algorithm presents exposure as a function of dislodgeable foliar residues (DFRs) for the crop of interest and an appropriate transfer coefficient (TC) for a specific work function within that crop. DFRs are a measure of the amount of pesticide present (ug/cm2) on a crop leaf or stem surface that is available for transference to the worker, and the TC is a measure of the amount of surface area that a worker would be exposed to in a specific time frame (cm2/hour). DFRs can be estimated as a % of application rate (20%) or can be measured through direct sampling using accepted methodology. The work function being carried out by the worker is the determinant factor in assigning the appropriate TC. The formula for calculation of re-entry exposure and dose is as follows.

Exposure = (TC (cm2/hr)X DFR) x Hours worked
Dose = Exposure x % Dermal Absorption ÷ Body Weight

Calculation of Risk

Risk is represented by the value known as Margin of Exposure (MOE). While not a true measure of risk it is a representation of the ratio between calculated exposure and the appropriate No Observed Effect Level <link to NOEL in glossary> (NOEL). A NOEL is used that is appropriate to the pathway and duration of exposure, if available. In other words, since exposure to mixer-loaders, applicators and re-entry workers is expected to occur to the skin, or as dermal exposure, a dermal NOEL from a study of a length that would represent the time frame a worker would be exposed would be appropriate. If no dermal NOEL is available it would be appropriate to use an oral NOEL of appropriate duration and then correct the exposure value calculated for dermal absorption to give the resultant dose. This dose is then compared to the NOEL to calculate a MOE. For worker risk calculations when a NOEL or NOAEL is established the uncertainty factors are usually limited to 10X for intra-species variability and 10X for inter-species variability for a total of 100. Thus an acceptable MOE would be 100.

MOE = NOEL (mg/kg/day) ÷ Dose (mg/kg/day)

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