

1,3-Dichloropropene: Hazard Identification and Risk Assessment for Occupational and Bystander Inhalation Exposures

Human Health Assessment Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA, USA

Andrew L. Rubin, Ph.D., D.A.B.T., Charles N. Aldous, Ph.D., D.A.B.T., Svetlana E. Koshlukova, Ph.D., Carolyn M. Lewis, MS., D.A.B.T., Peter N. Lohstroh, Ph.D., Steven Rinkus, Ph.D., Ian Reeve, Ph.D.

Overview

1,3-Dichloropropene (1,3-D) is a fumigant used to control diverse, soil dwelling pests. 1,3-D is used to protect many economically important food and non-food crops in California. 1,3-D is applied to soil by injection or drip irrigation and can volatilize to air leading to exposures for people working and living in the near and far from the sites of use.

Hazard Identification

1,3-D was absorbed in the lower and upper respiratory tracts leading to systemic toxicity. The acute, inhalation end-point was reduced bodyweight in rats on day 3 of a 13-week inhalation study (Benchmark Concentration (BMC) = 49 ppm). A Regional Gas Dose Ratio (RGDR) approach was used to calculate a Human Equivalent Concentrations (HEC) for occupation (occ) and non-occupation (nocc) exposures ($HEC_{occ/nocc} = 11/33$ ppm). The subchronic, inhalation end-point was based on incidences of nasal, epithelial hyperplasia in rats in a 13-week inhalation study (No Effects Level (NOEL) = 10 ppm; $HEC_{occ/nocc} = 0.19/0.56$ ppm). The chronic, inhalation end-point was based on incidences of nasal, epithelial hyperplasia, transitional epithelial hypertrophy and roughened, irregular opaque surface of the urinary bladder of mice in a 2-year inhalation study (NOEL = 5 ppm; $HEC_{occ/nocc} = 0.16/0.49$ ppm). There was evidence of genotoxicity and oncogenicity for 1,3-D. Oncogenic risk was estimated using the incidences of bronchoalveolar adenomas in mice from a 2-year inhalation study. RGDR and BMC approaches were used to generate potency factors as Air Units of Concentration (AUC) ($AUC_{occ/nocc} = 0.018/0.0059$ ppm⁻¹).

Exposure Assessment

Exposure estimates for agricultural workers and residential bystanders were calculated using 1,3-D specific data, surrogate data and probability based models. These values were used with the toxicologic end-points to characterize the inhalation risk of 1,3-D. The estimated short-term [8-hrs time-weighted-average (TWA) per day for up to 1 week], breathing-zone air concentrations (STACs) for agricultural workers range from 0.04 to 38 ppm. Estimated lifetime breathing-zone air concentrations (LACs) (8-hr TWA/day) range from 0.0009 to 2.2 ppm. For the residential bystanders, the LACs (24-hr TWA) range from 0.0693 to 0.6697 ppb.

Conclusions

While short-term public exposures to 1,3-D did not exceed DPR's level of concern, seasonal and annual ambient exposures to children, exposures to adults and children adjacent to applications, and exposures to some workers involved in 1,3-D applications did.